

# Index

## A

Abundance, estimation, [17](#)  
Acoustic sampling, [7](#), [275](#)  
    BUGS implementation, [278](#)  
    ~~other types, 279~~  
    *secr* implementation, [278](#)  
    signal strength model, [276](#)  
Activity center  
    binomial point process model, [130](#)  
    in BUGS, [146](#)  
    concept, [16](#)  
    conditional intensity and, [135](#)  
    ~~defined, 41, 128~~  
    direct linkage to density, [17](#)  
    in distance sampling, [133](#)  
    individual location, [429](#)  
    initial values of, [143](#)  
    location of, [161](#), [163](#), [169](#)  
    in MCMC, [164](#)  
    ~~in probability mass function, 135~~  
    in SCR model, [134](#)  
    in space usage, [135](#)  
    in state space, [131](#), [140](#), [160](#)  
    ~~multi-color spatial plot, 163~~  
    non-uniformity of, [160](#)  
    two-dimensional spatial coordinate, [127](#)  
    uniform distribution, [165](#)  
    unobserved random variable, [128–129](#)  
    in WinBUGS, [159](#), [161](#)  
    ~~of wolverine map, 166~~  
Adaptive rejection sampling, [450](#)  
ArcGIS, [465–466](#)  
Akaike Information Criterion (AIC), [55](#), [184](#)  
    ~~Bayesian model, 228~~  
    likelihood methods, [223](#)  
    model selection in, [202](#), [218](#), [224](#)  
    *secr* package, [206](#), [220](#), [226](#)  
    ~~sex-specific density, 227~~  
Alternative movement model, [396](#)  
American shad  
    Cormack-Jolly-Seber (CJS) models, [419](#), [423](#)  
    SCR issues, [426](#)  
    stream flow, [430](#)  
Animal movement, [287](#)  
    see also Trap spacing  
    ~~1-A protocol, 392~~  
Area search, [385](#), [390](#), [392](#)  
Avian mist-netting example, [264](#)

## B

Basic capture-recapture method, [532](#)  
Bayesian analyses, [33](#), [50](#), [436](#), [511](#), [534–535](#)  
    ~~Akaike Information Criterion (AIC), 228~~  
    Bayes' rule, [50](#)  
    BUGS language for, [60](#)  
    ~~checking, 80~~  
    confidence intervals, [68](#)  
    indicator variable, [231](#)  
    inference principles, [52](#)  
    in JAGS, [204](#)  
    MCMC methods, [63](#)  
    posterior inference, [54](#)  
    prior distributions, [53](#)  
    selection, [80](#)  
    small sample inference, [55](#)  
Bayesian inference, [436](#)  
    sampling variance, [149](#)  
Behavioral response  
    in animal studies, [102](#)  
    BUGS code for, [212](#)  
    ~~contamination of, 139~~  
    covariate effect, [207](#)  
    encounter probability, [209–210](#)  
    local or global, [212](#), [220](#)  
    ~~probability changes in, 102~~  
    to trapping, [102](#), [211](#)  
Bernoulli distributions, [29](#), [452](#)  
    encounter probability, [249](#)  
     $M_0$  model, [105](#)  
    observation model, [254](#)  
    ~~Poisson model, 252~~  
    prior distribution, [83](#)  
    probability distributions, [29](#)  
    Probability mass function (PMF), [29](#)  
    SCR0, [169](#)  
Binomial distributions, [452](#)  
     $M_0$  model, [103](#)  
    notation, [27](#)  
    ~~Poisson integrated likelihood, 196~~  
    probability mass function (PMF), [23](#), [28–29](#), [37](#)  
    ~~R code, 25~~  
Binomial GLMs  
    parameter estimation, [77](#)  
Binomial integrated likelihood, [196](#)  
Binomial observation model, [127](#)  
    ~~data augmentation, 145~~  
Binomial point process model, [130](#)

Binomial probability mass function, 23  
 Binomial regression  
   waterfowl banding data, 79  
 Bivariate normal distribution, 33, 136  
 Black bears  
   SCR + RSF model, study on, 360  
   space usage, 362  
   convex hull, 9  
   standard approach, 12  
   BUGS implementation  
   Stratified populations, 373  
 Buffering, 9

## C

Camera trapping, 5  
   historical overview, 5  
   ~~drum bear study, 8~~  
   encounter probability, 8  
   ~~non-spatial, inadequacy, 11~~  
   ~~population studies in, 4~~  
   for sampling methods, 13  
   ~~Canada goose resightings, 511~~  
 Capture-recapture methods, 529  
 Categorical distributions, 30  
 Closed population models, 14  
   data augmentation (DA), 92–93  
 Closed capture-recapture model  $M_h$ , 451  
 Collared individuals, 521  
 C++, ~~computational speed using, 470~~  
 Conditional distribution, 37, 455, 457  
   constructing rules, 59  
    $M_0$  model, 91  
   Markov chain Monte Carlo (MCMC), 59  
   Metropolis-Hastings algorithm, 59  
 Conditional likelihood, 183  
   in closed population model, 91  
   full likelihood, 183  
   SCR model, 300  
 Convex hull  
   buffering, 9  
   density estimation, 9  
   trapping array, 13  
 Cormack-Jolly-Seber (CJS) models, 418  
 Cost-weighted paths  
   calculation, 338  
   computation, 337–338  
   defined, 335, 340  
   R code, 338  
   in SCR model, 336  
 Counter detector, in *secr* package, 258  
 Covariate effects

in density, 311  
 in encounter probability models, 207, 250  
 landscape structure, 353  
 in standard GLM or GLMM, 207  
*see also* Individual covariate model

## D

Data augmentation, (DA)  
   ~~in all-zero rows, 94~~  
   in closed population models, 92–93  
   formal development, 97  
   heuristic motivation, 94  
   joint likelihood using, 110  
   model-based analysis, 110  
    $M_h$  model, 105  
   in  $M_0$  model, 95  
   occupancy parameter, 94  
   posterior mass of, 120  
   remarks on, 97  
   sampling model, 118  
   ~~under a Uniform(0,  $M$ ), 121~~  
   unknown  $N$ , 144  
   in **WinBugs**, 146  
   zero-inflated model, 95, 110  
 Data format  
   ~~for number of traps, 155~~  
   three-dimensional, 155  
   two-dimensional, 141  
 Data structure  
   formatting, 141  
   manipulating, 141  
   sampling design and, 126  
~~Demographic composition, 500~~  
   ~~survival, 413~~  
 Density estimation  
   ~~Argentina jaguar study, 326~~  
   ~~canopy height, 324–325, 327~~  
   covariate, using, 303, 311  
   data simulation, 318  
   intensity parameter, 327  
   ~~of invariance, 116, 122~~  
   in  $M_0$  model, 102  
   parameter estimation, 321  
   posterior mean, 329  
   probability function, 316  
   ~~R code, 328~~  
   SCR definition of, 312  
   sex specificity, 329  
   ~~value expectation, 316~~  
 Density maps  
   effective sample area, 181

- individual prediction, 169
    - Wolverine analysis, 166
  - DENSITY-Program, 173, 189
  - Detection function
    - behavioral response, 254
    - conditional probability, 251
    - in covariate influence, 109
    - data collection, 279
    - in distance sampling, 117–118
    - in indicator variable, 235
    - individual, 110
    - models, 191
    - non-, 276
    - probability, 276
    - proximity in, 275
    - signal strength, 277
    - time trend, 269
  - Detector dogs, 400
  - DIC model selection, 229
    - wolverian data, 229
  - Discrete habitat mask, 160
    - coarseness, evaluation, 161
  - Dispersal dynamics
    - individual location, 428
    - in population ecology, 430
  - Distance sampling, 30, 41, 44, 383, 386, 392
    - desert tortoise example, 120
    - in hierarchical model, 119–120
    - latent variability, 129
    - in SCR model, 117, 119, 122
  - DNA sampling, 6
  - Distribution of individuals, 531
- ## E
- Ecological distance
    - Bayesian analysis, 343
    - density covariate, 349
    - likelihood analysis, 342
    - SCR simulation, 339
    - stochastic, 22
  - Effective sample area, 199
    - density mapping, 181
  - Effective sample size, 460
  - Efford's formulation, 15
  - Efford's possum trapping data, 272
  - Encounter data file, 153
  - Encounter device types, 191
  - Encounter modeling
    - fisher study, 394
    - mountain lions, 393
  - Encounter probability
    - Bayesian analysis, 204
    - Bernoulli process, 249
    - binary observation, 252
    - cautionary note, 254
    - covariate model, 207, 250
    - date, impact on, 208
    - Gaussian model, 202, 253, 260
    - individual covariate, 213
    - multinomial model, 271
    - signal strength model, 276
    - space usage, 252
    - time, impact on, 208
    - trapping interval, 271
    - trap-specific covariate, 210
  - Envelope function, 450
  - Euclidean distance
    - in activity centers, 333
    - cost-weight distance, 338
    - encounter probability and, 334
    - estimate parameter, 347
    - in MLE model, 343
    - least-cost path model, 336, 342
    - mis-specified model, 343, 345, 349
    - in SCR model, 340
    - shortcomings, 334
  - Explicit movement models, 536
- ## F
- Fitness model
    - components, 237
    - in encounter probability, 219
    - individual trap frequencies, 241–242
    - occupancy dynamics, 245
  - Fixed search path
    - alternative movement models, 396
    - design 1, 384
    - encounter probability, 385
    - intensity model, 395
- ## G
- Gaussian kernel, 519
    - G bins, defined, 30
  - Gelman-Rubin diagnostics, 463
  - Generalized linear (mixed) models (GL(M)Ms)
    - binomial, 84
    - in applied statistics, 48
    - in Bayesian framework, 63
  - Generalized linear models (GLMs)
    - binomial, 49, 77, 79
    - components, 48

- in exponential family, 48
- in SCR, 48
- Poisson, 69, 71, 75
- random effects, 49
- [Geographical analysis, 336, 345](#)
- Gibbs sampling, 57, 59, [438](#)
- in MCMC methods, 57
- MH sampling vs., [445](#)
- [R-code, 440](#)
- [Goodness-of fit, 55, 80, 82](#)
- evaluation, 236
- in SCR, 184
- wolverine data, 243
- [Google Scholar citations, 532](#)
- [Google Scholar search, 529](#)
- Gregarious species, 535
- Group structure
  - in data augmentation, 376
  - mean model, 374
  - multi-catch model, 369–370
  - no encountered individuals, 373
  - single parameter, 374

## H

- Habitat mask, [187, 199–200](#)
- Habitat selection
  - space usage, 354
  - landscape simulation, 364, 367
  - non-uniform distribution, 311
  - spatial variation, 316
- Hard plot boundaries, 390
- [Heterogeneity model, 103, 106](#)
- [Hierarchical modeling](#)
  - defined, 40
  - examples of, 41
  - random variables, 21
  - statistical analysis, 37
  - statistical inference and, 40
- [Home range center](#)
  - definition, 128
  - [exhibit behavior, 16](#)
  - implied model, 149
  - space usage model, 135
  - see also* Activity center
- Homogeneous point process, 523
  - [spatial randomness, 312](#)

## I

- Imperfect identification, [534](#)
- Indicators variable

- detection function, 235
- wolverine data, 233
- Individual covariate model [1](#)
  - capture location, 110
  - data augmentation, 92
  - distance sampling, 87
  - extension, 114
  - [Fort drum bear study, 111](#)
  - heterogeneity model, 103
  - [home range center, 115](#)
  - in SCR, 109, 117
- Individual heterogeneity
  - defined, 201
  - detection probability, 216
  - for home range size, 202
  - incorporation methods, 220
  - see also*  $M_h$  model
- Inhomogeneous point-process, [525](#)
  - density model, 326
  - discrete space, 324
  - [estimation parameters, 318](#)
  - fitting model, 322
  - in SCR model, 314
  - [intensity parameters, 315](#)
  - Poisson model, 312
  - spatial variation, 311, 319
- Integrated likelihood
  - construction, [177](#)
  - marginal distribution, 174
  - MLE estimators, 173–174
  - Poisson method, 195–197
  - in SCR models, 179–180
  - [simulated data, 175](#)
  - under data augmentation, 183
- [Irregular patches, 345](#)

## J

- JAGS, [467, 510](#)
  - Bayesian analysis in, 60
  - ecological introduction to, 60
  - [simulation analysis, 388](#)
  - summary command for, 68
- Joint distribution, [37](#)
- Jolly-Seber model, 406, 413
  - data augmentation, 409
  - spatial, 413

## L

- [Landscape connectivity](#)
  - geographical analysis, 345

- in SCR models, 333–334, 339
- Landscape structure
  - ~~‘A’ protocol, 354–355~~
  - covariate model, 353
  - ~~defined, 354~~
  - discrete model, 366
  - home range on, 361
  - resource selection, 364
  - simulated example, 356, 364
  - space configuration, 354, 367
- Langevin algorithm, 444
- Least-cost path
  - in BUGS, 343
  - computation, 347
  - covariate matrix, 340
  - ~~defined, 333, 335~~
  - encounter probability, 334
  - home range, 335
  - in MLE model, 342
  - ~~R code, 338~~
  - SCR example, 342
- Lincoln-Petersen estimator, 502–503
  - of abundance, 534–535
- Live-trapping study, 500

## M

- Marginal distribution, 37
- Marginal likelihood
  - binomial form, 195
  - calculation, 187
  - conditional elements, 178
  - ~~grid information on, 176~~
  - individual encounter and, 174
  - point process density, 196
- Markov chain Monte Carlo (MCMC)
  - algorithm, 60, 72, 82, 508
  - in Bayesian analysis, 60, 63
  - ~~binomial encounter process, 457~~
  - building own algorithm, 435
  - closed capture-recapture model  $M_h$ , 451
  - ~~in conditional distribution, 59~~
  - convergence analysis, 65
  - ~~ecology application, 47~~
  - manipulating state-space, 463
  - ~~parallel computing, 467~~
  - ~~parameter estimation, 68~~
  - posterior distributions, 56, 436
  - ~~R code, 65~~
  - in SCR models, 57, 454
  - ~~using C++, 470~~
  - in WinBUGS, 64, 67

- Marked individuals
  - homogeneous point process, 523
  - imperfect identification of, 514
  - ~~information, 516~~
  - inhomogeneous point processes, 525
  - known number of, 501
  - ~~known number of, 506~~
  - locations of home ranges of, 504
  - spatial distribution of, 505
  - unknown number of, 501–502
- Markov random fields, 533
- ~~MARK program, 503~~
- Mark-resight models, 499
- $M_b$  model
  - global trap response, 220
  - in non-spatial capture-recapture, 201
- Mean maximum distance moved (MMDM)
  - home range radius, 101
- Metropolis-Hastings algorithm
  - ~~conditional distributions and, 59, 520~~
- Metropolis-Hastings (MH) sampling, 443
  - vs. Gibbs sampling, 445
  - ~~R code to run, 445~~
  - ~~time series plots, 445~~
- Metropolis-within-Gibbs, 446
- $M_h$  model
  - analysis, 105
  - ~~Fort drum data, 106~~
  - ~~as non-spatial capture-recapture, 201~~
  - random effect, 216
  - SCR, relevance to, 216
- Misidentification, 534
- MLE with known  $N$ , 173
- MLE with unknown  $N$ , 179
- $M_0$  model
  - binomial observation, 103
  - in black bear study, 98
  - in Bernoulli, 105
  - in BUGS, 95
  - capture-recapture assumptions, 90
  - closed population model, 88
  - conditional distribution, 91
  - occupancy type, 98
- Modeling territoriality, 533
- Model selection
  - in AIC, 218, 220
  - in Bayesian, 83
  - issues, 80
  - ~~in prior distribution, 83~~
  - in SCR model, 84
  - statistical ecology, 55
  - ~~variable indicators, 65~~
- ~~Modeling movement~~

[population dynamics](#), 428  
 Model output  
   commands, 463  
   [Gibbs sampling](#), 438  
   [Metropolis-Hastings sampling](#), 443  
   [Metropolis-within-Gibbs](#), 446  
   posterior density plots, 459  
   rejection and slice sampling, 450  
   serial autocorrelation and effective  
     sample size, 460  
   summary results, 462  
   time series plots, 459  
[Movement model](#)  
   alternatives, 396  
   auto-regression, 397  
   data simulation, 395  
   [encounter frequency](#), 383  
   open population, 399  
   outcomes, 388  
 Moving activity centers, 526  
[Multi-catch device](#), 249, 258–259, 280  
 Multi-catch independent multinomial  
   model, 535–536  
 Multi-session models  
   BUGS language, 382  
   data augmentation, 369–370  
   landscape variation, 382  
   multi-catch observation, 377  
   other approaches, 376  
   [R code](#), 369–370  
   *secr* analysis, 377  
   sex effects on, 220, 369–370  
 Multi-state model  
   [apparent survival](#), 420  
   [issues](#), 423  
   [random parameters](#), 421  
   spatial states, 403, 423  
   [technical transition](#), 421  
 Multinomial abundance models  
   stratified populations, 371  
 Multinomial distributions, 30  
[Multinomial model](#)  
   density estimators, 271  
   encounter devices, 258  
   in Gaussian methods, 260  
   [JAGS using](#), 249  
   in single-catch trap, 271  
   resource selection, 260  
   in **WinBugs**, 260  
[Multiple](#)  
   [distinct sample group](#), 369  
   [space sample](#), 381

$M_x$  model  
   density invariance, 116

## N

[Non-spatial capture-recapture](#), 87, 534–535  
 Non-spatial mark-resight models, 503, 507 514–515  
 NOREMARK [program](#), 503  
 Normal distribution, 436  
[Notation](#)  
   [binomial distribution](#), 27  
   BUGS language, 23  
   [in hierarchical modeling](#), 21, 40  
   [issues](#), 22  
   [of R code](#), 21, 43  
   [uniform point process](#), 32  
 Numerical integration  
   fitting parameters, 195  
   integration grid spacing, 186  
   **R code**, 182

## O

[Observation model](#)  
   alternative methods, 249  
   in Bernoulli, 254  
   in Poisson, 250  
   **JAGS**, using, 249  
   multinomial distribution, 249, 271  
   single catch trap, 270  
 Observed point processes, 318  
[OpenBUGS](#), 435  
 Open populations  
   apparent survival, 405  
   [dispersal](#), 399  
   [issues](#), 409  
   [model](#), 511  
   movements, 399  
   recruitment, 408  
 Optima design  
   [calculation](#), 302  
   detector configuration, 293  
   [issues](#), 294  
   in SCR model, 287, 297  
   swapping algorithm, 300–301  
   trap spacing, 289, 303, 307  
 Ordinary capture-recapture models  
   Efford's formulation, 11, 15  
   encounter probability  
   *N*, estimation, 109, 292, 364  
   non-spatial, 12

- point process, 15
- technical problems, 17–18
- ~~Ovenbird data~~
- ~~reanalysis, 378~~
- ▲Ovenbird mist-netting study, 410, 414

## P

- Parallel computing, 467
- ▲Parameter estimation
  - in maximum likelihood estimates (MLEs), 36
  - statistical inference, 34
- Partial information designs, 399
- Photographic survey, 533–534
- Point process aggregation, 15
- Point process model
  - binomial, 130
  - state-space, 131
  - for homogeneous point process, 523
  - for inhomogeneous point processes, 525
  - ~~bin counts, 240~~
- ▲Poisson distribution, 31, 69
- Poisson GLMs, 69
  - ~~bird survey, example, 69~~
  - ~~PoisGLMM(), 449~~
  - in WinBUGs, 71
  - ▲random effects, 75
- Poisson integrated likelihood
  - binomial form of, 196
  - development, 195
- Poisson model
  - ~~in Bernoulli, 252~~
  - in BUGS, 254
  - data simulation, 255
  - encounter probability, 249, 507, 515
  - GLMM, 449
  - multinomial relationship, 263
  - regression, 452
  - in SCR, 250
  - in *secr*, 266
  - space usage, 251
  - ~~trap specific, 263~~
  - wolverine camera, 257
  - zero-inflated, 255
- ▲Population dynamics
  - animal movement, 405
  - ~~overview, 404~~
- ▲Posterior distribution, 438–439, 441
  - Bayesian inference, 52
  - ▲~~conditionality, 57~~
  - ~~defined, 52~~
  - ~~density plots, 459~~
  - discrepancy measures, 82
  - ~~inference of, 54, 55~~
  - ▲mass of, 75
  - MCMC simulation, 56, 65, 68, 436
  - ~~MH algorithm, 60~~
  - parameter estimation, 54, 83
  - ~~plots of, 441~~
- ▲Prior distribution
  - ~~Bayes' rule for, 52–53, 64, 83~~
  - choices, 63
  - conjugates, 58
  - ~~in Bernoulli, 83~~
  - ~~MCMC algorithm, 67~~
  - ~~parameter estimation, 54~~
  - ~~WinBUGS parameter, 73~~
- ▲Probability density function (PDF), 22
  - resource selection, 25
  - see also* Probability mass function (PMF)
- Probability distributions
  - Bernoulli, 29
  - binomial, 27
  - ~~commonly used, 27~~
  - different notations for, 22
  - hierarchical model, 40
  - properties, 24–25
  - random variable, 21, 22
- Probability mass function (PMF)
  - Bernoulli distribution and, 29
  - binomial ~~return~~, 23, 28–29, 37
  - ~~defined, 23~~
  - issues, 22
  - parameters, 22, 37
  - properties, 24
  - random variable values, 23
- Proposal distribution, 443
  - random walk, 443
- Proximity detector
  - density estimators, 249
  - in signal strength, 275

## R

- ~~Raccoons, 521~~
- ~~R-code~~
  - ~~beta distribution, 33~~
  - ~~binomial distribution, 25~~
  - ~~binomial pmf returns, 23~~
  - ~~data analysis, using, 21~~
  - ~~data simulation, 261~~
  - ~~dbinom function, 28~~

- ~~declaration-deat~~, 31
- ~~dnorm function~~, 33
- ~~joint distribution~~, 37
- ~~marginal distribution~~, 38–39
- ~~non-negligible probabilities~~, 23
- ~~normal distribution~~, 24
- ~~Poisson outcomes~~, 35
- ~~resource selection~~, 25
- ~~in SCR model~~, 43
- ~~uniform distribution~~, 32
- ~~uniform search model~~, 397
- Radio-tagged individuals, 502–503
- Random effect
  - in Bayesian analysis, 84
  - ~~in GLM~~, 49
  - in GLMMs, 47, 49
  - in hierarchical models, 83
  - in MCMC, 47
  - in Poisson GLM, 75
  - in **WinBUGS** model, 61, 84
- Random sample assumption, 504
- Random variable
  - ~~defined~~, 21, 25
- Random walk proposal distribution, 443
- ~~readShapeSpatial()~~, 466
- ~~Recall Bayes' theorem~~, 436
- Recruitment
  - data augmentation, 409
  - ~~degenerate~~, 410
  - JS model, 406, 413, 416
  - ~~in open population~~, 408
  - ~~sampling perspectives~~, 404
  - time dependent, 412
- Regular capture-recapture models, 501–502
- Rejection sampling, 319, 450
- Resighting techniques, 501
- Resource selection
  - encounter probability, 354, 359
  - in Poisson model, 358
  - in SCR model, 353
  - mis-specification, 364
  - population estimate, 354
  - second-order scale, 361
  - telemetry data, 364, 366
- Resource selection function (RSF)
  - independence assumption, 365
- S**
- Sample size
  - encounter probability, 290
  - estimation parameters, 289, 307
  - generation techniques, 285
  - in conditional probability, 297
  - in SCR model, 292
  - spatial problems, 281
  - trap clusters, 302–303
- Sampling design, 126
  - focal population vs. state-space, 284
  - model based, 282
  - population closure, 304
  - ~~space vs individual~~, 283
- Sampling methods
  - ~~latent heterogeneity~~, 12
  - non-invasive, 13
- Sampling techniques, 529
- Scenario analysis, 281–282
- ~~SCR framework~~
  - ~~assumptions of~~, 535
  - ~~misidentification in~~, 535
- SCR0
  - Bayesian analysis of, 131
  - Bernoulli model, 169
  - BUGS** analysis, 125
  - fitting model, 156–157, 142
  - home range area, 149
  - ~~multiple detections~~, 126
  - ~~R function~~, 161
  - statistical assumptions, 151
  - ~~in WinBugs~~, 146
- SCR models
  - activity center, ~~character~~, 298
  - applications, 376
  - Bayesian analysis, 149
  - binomial encounter process, 457
  - characterization, 41
  - conditional likelihood, 300
  - construct full conditionals, 455
  - continued development of, 532
  - core assumption, 151
  - data simulation, 262–263
  - distance sampling, 133
  - effective sample area, 169
  - encounter probability, 296
  - ~~fixed array trap~~, 44
  - ~~identify~~, 454–455
  - independence assumption, 365
  - integration, 359
  - model  $M_h$ , 133
  - optimal criteria for, 297
  - Poisson observation model, 299
  - population closure, 305
  - sex-specific encounter, 290
  - ~~spacing aspect~~, 291
  - study design, 285
- Search-encounter designs



- fixed path, 384–385
- methods, 7
- total hazard, 386
- uniform intensity, 385
- [secr package, 189](#)
  - additional capabilities, 197
  - analysis, 192
  - covariate models, 199
  - density mapping, 199
  - encounter device, 191
  - in likelihood analysis, 195, 218
  - multi-session model, 196
  - ovenbird data, 266
  - population closure test, 199
  - sex specificity, 266
  - state-space buffer, 198
- Serial autocorrelation, 460
- Sex specificity
  - effects, 220
  - uncaptured individuals, 183
  - multi-session models, 369–370
  - [secr package, 266](#)
- [Single-catch trap, 535](#)
  - [inference system, 271](#)
  - multiple sample session, 265
  - observation model, 270
- Slice sampling, 450
- Small sample inference
  - Bayesian analysis, 55
- SMR model. *See* Spatial mark-resight model
- [Space usage model, 354](#)
  - empirical analysis, 137
  - home range center, 135
  - Poisson distribution, 358
  - [understanding, 139](#)
- Spatial capture-recapture (SCR) methods
  - in animal population, 5
  - [in bears, 5](#)
  - characterization, 9
  - construction of, 14
  - defined, 4
  - density estimation, 5
  - ecological theories and, 18
  - historical context, 12
  - inference formalization, 15
  - [in lions, 5](#)
  - non-spatial aspects, 8, 11
  - technical problems, resolving, 3–4
  - [in tigers, 5](#)
  - traditional, 18
- [Spatial Capture-Recapture Odyssey, 533](#)
  - [combining data from surveys, 533](#)
  - [explicit movement models, 536](#)
  - [gregarious species, 535](#)
  - [misidentification, 534](#)
  - [model fit and selection, 536](#)
  - [modeling territoriality, 533](#)
  - [single-catch traps, 535](#)
- [Spatial design](#)
  - construction, 307
  - formal analysis, 281
  - issues, 282, 294, 300
  - model-based, 293
  - optimization criteria, 300
  - temporal aspects, 303
- Spatial distribution, 500
- Spatial mark-resight (SMR) model, 500
  - [for Canada geese in North Carolina, 514](#)
  - hybrids of, 500
  - [homogeneous point process, 523](#)
  - [imperfect identification of marked individuals, 514](#)
  - [implementing, 507](#)
  - [individual capture histories, 503](#)
  - inhomogeneous point processes, 525
  - [information, marked and unmarked individuals, 516](#)
  - [known number of marked individuals posterior distributions from, 522](#)
  - [raccoons on outer banks of North Carolina, 521](#)
  - [random sample assumption, 504](#)
  - resighting techniques, 501
  - [short history, 502](#)
  - telemetry data, incorporating, 518
- Spatial randomness, 311–312
  - homogeneous point process and, 312
  - observation model, 241
  - uniform distribution, 238
- [Spatial sampling](#)
  - in SCR model, 283
  - issues, 281, 303
  - trap location, 283
- State-space [concept, 16](#)
  - [camera trapping, 302](#)
  - [manipulating, 463](#)
  - [size sensitivity, 240](#)
- State-space model
  - invariance, 132
  - point process, 131
  - prescribing, 132
- [Stationary distribution, 441](#)
- Statistical inference
  - fundamentals of, 21
  - hierarchical models and, 40
  - parameter estimation and, 34
  - role in probability laws, 22

## Stratified populations

- BUGS implementation, 373
- data simulation, 375
- hierarchical model, 371
- multinomial abundance models, 371
- ~~prototype, 370~~
- in SCR model, 369

## Strauss model, 532

## Survival

- affecting factors, 403
- American shad, 419, 426
- Cormack-Jolly-Seber (CJS) models, 418, 421
- ~~defined, 405~~
- demographic parameters, 413
- vs emigration, 405
- in spatial model, 404
- ~~JS model, 406~~
- ~~non-spatial version, 426~~
- in open population, 408
- ~~parameters, 408~~
- ~~posterior mean, 416~~
- ~~spatial multi-session model (S-MS), 410~~
- ~~week probability, 420~~

## T

## Telemetry data

- activity centers, 355
- ~~on black bear study, 360~~
- ~~estimation parameters, 362, 364~~
- ~~raccoons on outer banks of North Carolina, 521~~
- resource selection model, 353
- RSF model, 366
- SCR model, 354, 365
- space sampling, 356, 359

## Temporal dependence

- multi-session formulation, 379

## Temporary emigration, 13, 382

- ~~SCR models and, 13~~

## Time series plots, 459

## Total hazard,

- encounter model, 386–387, 392

## Trap arrangement, 293

## Trap spacing

- ~~array size, 287~~
- ~~home range factors, 285–286~~
- movement estimates, 286, 289
- ~~sensitivity analysis, 281~~
- study design, 285, 291

## Trap-specific covariate

- encounter probability models, 210, 515

## U

## Uniform distribution, 32

## Uniform intensity

- design 2, 395
- search-encounter designs, 385

## Unmarked individuals

- estimated number of, 507
- information, 516

## Unstructured spatial surveys, 392

## UTM polygon, 467

## W

## WinBUGS, 435–436, 462–463, 467

- fitting model, 156
- in linear regression, 61
- in markov chain Monte Carlo (MCMC)-, 64, 67
- ~~in prior distribution, 73~~
- in random effect, 61, 84

## Wolverine analysis

- camera trapping, 162, 184
- density map, 166
- space usage, 159
- ~~summary, 158~~

## Z

## Zero-inflated, Poisson model, 255

~~Zero-truncated distribution, 511~~