

# 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  
   ~~drumbeat 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
  - [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~~