

## INDEX

Subjects are indexed as Book chapter: book pages (pdf file pages). For instance, AIC is indexed as 2:44 (16), which means it is on page 44 in the book, which is the 16<sup>th</sup> page in Chapter 2. Likewise, the index reference 3:75-6 (24-5) is to pages 75-76 in the book, which is in Chapter 3, on the 24-25<sup>th</sup> pages. 6A refers to the first part of Chapter 6, and 6B the second part, which are stored as separate files.

- Akaike's Information Criterion (AIC) 2:44 (16), 3:75-6 (24-5), 4:113-4 (10-1), 5:151-2 (11-2)
- Arapaho point transect songbird surveys 8:402-9 (53-60)
- Assumptions
  - accurate measurements 1:18 (18), 2:34-6 (6-8), 4:137 (34), 5:170-1 (30-1), 7:317-35 (23-41)
  - cue counting 6B:270-4 (46-50)
  - failure of
    - double counting of objects 2:37 (9), 5:171 (31), 7:314 (20), 7:336 (42)
    - movement in response to observer 1:18 (18), 2:31-4 (3-6), 4:136 (33), 5:168-70 (28-30), 7:314 (20), 7:336 (42)
    - random object movement 1:19 (19), 2:32 (4), 4:136 (33), 5:168 (28), 7:336 (42)
  - $g(0)=1$  1:18 (18), 2:30-1 (2-3), 4:136 (33), 5:167 (27)
  - independence between detections 2:36 (8), 4:135-6 (32-3)
  - line transect sampling 4:135-7 (32-4)
  - migration counts 6B:284 (60), 6B:286-7 (62-3)
  - point transect sampling 5:166-71 (26-31)
  - random distribution of objects 1:18 (18), 2:29 (1), 4:135 (32), 5:166-7 (26-7)
  - shoulder to the detection function 2:36-7 (8-9), 5:167-8 (27-8)
  - trapping webs 6B:278-80 (54-6)
- Audio-detectability function 6A:184 (12)
- Bayesian approach to distance sampling 6B:260 (36), 6B:263 (39)
- Bias
  - due to double counting 2:32 (4)
  - due to  $g(0)<1$  2:30 (2), 4:138 (35)
  - due to measurement error 2:34-5 (6-7), 4:137 (34), 5:170-1 (30-1)
  - due to movement in response to observer 2:32-4 (4-6), 4:136 (33), 5:168-70 (28-30)
  - due to random object movement 4:136 (33), 5:168 (28)
    - in estimates of  $g(0)$  6A:205-8 (33-6)
  - model mis-specification 3:96 (45), 4:120 (17), 5:158 (18)
  - size-biased sampling of clusters 1:13 (13), 3:77-87 (26-36), 4:125-35 (22-32), 5:158-66 (18-26)
- Binomial models 6A:173-8 (1-6), 8:409-14 (60-5)
- Bivariate detection function 3:81-7 (30-6), 3:102-3 (51-2), 4:134-5 (31-2), 6B:235-44 (11-20)
- Bootstrap 3:94-6 (43-5), 4:119-20 (16-7), 5:155-8 (15-8)
- Clusters
  - as ancillary data 1:16 (16)
  - definition 1:12 (12)
  - line transects 4:122-35 (19-32)
  - point transects 5:158-66 (18-26)
  - size-biased detection 3:77-87 (26-36)
- Clustered populations
  - estimation in line transect surveys
    - bivariate approach 3:102-3 (51-2), 4:134-5 (31-2)
    - cluster size independent of detection distance 4:122-5 (19-22)
    - covariate approach 3:80 (29), 3:102-3 (51-2)
    - regression estimator 3:79-80 (28-9), 4:132-4 (29-31)

replacement of cluster by individual objects 4:131 (28)  
 stratification 4:132 (29)  
 truncation 4:130-1 (27-28)  
 estimation in point transect surveys  
   cluster size independent of detection distance 5:159 (19)  
   covariate approach 3:80 (29), 3:102 (51)  
   regression estimator 3:79-80 (28-9), 5:165-6 (25-6)  
   replacement of cluster by individual objects 5:164 (24)  
   stratification 5:164-5 (24-5)  
   truncation 5:161-4 (21-4)  
 estimation theory 3:77-87 (26-36)  
 modeling variation in cluster size 6A:199 (27)  
 simulation of 6B:235-44 (11-20)  
 Coefficient of detectability 6A:179 (7)  
 Complementary log-log model 3:61 (10), 6A:184 (12)  
 Confidence intervals  
   bootstrap 3:94-5 (43-4), 5:155-8 (15-8)  
   jackknife 3: 93 (42)  
   log-based 3:88-9 (37-8), 4:118 (15), 5:154 (14)  
   numerical comparisons 6B:254-60 (30-6)  
   profile likelihood intervals 6B:247 (23)  
   Satterthwaite degrees of freedom for 3:89-90 (38-9), 4:120-1 (17-8)  
   standard method 3:88 (37), 4:118 (15), 5:154 (14)  
 Covariates 3:80 (29), 3:99-100 (48-9), 3:102-3 (51-2), 6A:193-8 (21-6), 6A:200 (28), 6B:287-9 (63-5)  
 Cox method 6A:177-8 (5-6)  
 Cue counting 1:8-9 (8-9), 6B:270-5 (46-51)  
 `CumD' estimator 6A:180-1 (8-9)  
 Cutpoints 1:15 (15)  
  
 Darkling beetle trapping web surveys 6B:282-4 (58-60)  
 Data  
   analysis of grouped or ungrouped 4:110-1 (7-8), 5:149-50 (9-10)  
   ancillary 1:16-7 (16-7)  
   grouped 1:14-5 (14-5), 3:67-9 (16-8), 4:116 (13), 5:152-3 (12-3), 7:322 (28), 7:326-33 (32-39)  
   recording form 7:317-8 (23-4)  
   spiked 4:127 (24)  
   truncation 1:15 (15), 2:50 (22), 4:106-9 (3-6), 5:146-8 (6-8)  
   ungrouped 1:13-4 (13-4), 3:65-7 (14-6), 7:323-6 (29-32)  
   units of measurement 1:16 (16)  
 Density estimation 1:1 (1), 2:37-41 (9-13), 3:87-8 (36-7), 4:116-7 (13-4), 5:153-5 (13-5)  
 Density function 3:54-7 (3-6)  
 Design 7:298-313 (4-19)  
 Detection function  
   bivariate 3:81-7 (30-6), 3:102-3 (51-2), 4:134-5 (31-2), 6B:235-44 (11-20)  
   models for, see Estimators and Models  
   relationship with pdf  
     line transect sampling 3:54-5 (3-4)  
     point transect sampling 3:56 (5)  
   shape criterion 2:37 (9), 2:42-4 (14-6), 3:74 (23)  
   with covariates 3:80 (29), 3:99-100 (48-9), 3:102-3 (51-2)  
 Dispersion parameter 3:102 (51), 6A:187-93 (15-21), 6A:199 (27)  
 DISTANCE  
   computer program 1:27-8 (27-8)  
   constrained MLE 3:73 (22), 4:137 (34)

cue count option 6B:271 (47)  
 GOF 8:396 (47)  
 LOOKAHEAD 4:113 (10), 5:151 (11), 8:399 (50)  
 OBJECT 8:404 (55)  
 PVALUE 8:401 (52)  
 SAMPLE, use with replicate lines or points 3:91 (40)  
 Satterthwaite procedure 4:125 (22)  
 SELECT 4:113 (10), 5:151 (11), 8:400 (51)

Distances

density function of 3:54-7 (3-6)  
 measurement of 2:34-6 (6-8), 4:137 (34), 5:170-1 (30-1), 7:317-35 (23-41)  
 simulation of 6B:235-44 (11-20)  
 truncation 1:15 (15), 2:50 (22), 4:106-9 (3-6), 5:146-8 (6-8)

Dolphin relative abundance estimates 8:390-6 (41-7)  
 Doughnut or Donut 5:170 (30)  
 Duck nest surveys 1:19-21 (19-21), 8:359-80 (10-31)

Effective area 3:56 (5)

Effective strip half-width 3:56 (5)

Effective strip width 1:23 (23), 3:56 (5)

Efficiency

estimator 2:44 (16), 3:74 (23)  
 of binomial point transect model 6A:175 (3)

Empirical estimators 6A:178-81 (6-9)

Encounter rate 6A:186-98 (14-26)

Estimation

of line length to be surveyed 7:301-6 (7-12), 7:308-12 (14-8)  
 of number of points to be surveyed 7:307-8 (13-4)  
 of object density

cue counting 6B:271 (47)  
 line transects 2:37-9 (9-11), 2:41 (13), 3:87 (36), 4:116-7 (13-4)  
 nearest neighbour methods 6B:292-3 (68-9)  
 point-to-object methods 6B:292-3 (68-9)  
 point transects 2:40-1 (12-3), 3:87-8 (36-7), 5:153-5 (13-5)  
 trapping webs 6B:280 (56)

when objects are in clusters 3:77-87 (26-36), 4:122-35 (19-32), 5:158-66 (18-26)

Estimator efficiency 2:44 (16), 3:74 (23)

Estimators

Cox 6A:177-8 (5-6)  
 `CumD' 6A:180-1 (8-9)  
 empirical 6A:178-81 (6-9)  
 isotonic regression 6A:180 (8)  
 kernel 6A:182-3 (10-1)  
 maximum likelihood 3:65-73 (14-22)  
 shape restricted 6A:181-2 (9-10)  
 see also Models

Examples

cue counting

Antarctic minke whale surveys 6B:272-7 (48-53)

line transect sampling

dolphins 8:390-6 (41-7)  
 duck nests 8:359-80 (10-31)  
 fin whales 8:380-90 (31-41)  
 Lake Huron brick data 8:351-3 (2-4)

wooden stakes 8:353-8 (4-9)  
migration counts  
California grey whales 6B:285-93 (61-9)  
point transect sampling  
Arapaho NWR songbird surveys 8:402-9 (53-60)  
house wrens 8:396-401 (47-52)  
songbird surveys of Welsh conifer plantations 8:409-14 (60-5)  
trapping webs  
darkling beetle surveys, Wyoming 6B:282-4 (58-60)  
mouse surveys, New Mexico 6B:282 (58)  
Exponential power series model 1:26 (26)  
Exponential quadratic model 1:26 (26)

#### Field methods

for mobile objects 7:337-8 (43-4)  
when detection on centreline is not certain 7:338-9 (44-5)  
Finite population correction factor 3:96-8 (45-7)  
Fin whale line transect surveys 8:380-90 (31-41)  
Fisher information matrix 3:66 (15), 3:68 (17)  
Fourier series model 2:48 (20), 3:63-4 (12-3)

Generalized exponential model 4:134 (31)  
Genstat 6B:288 (64)  
Goodness of fit tests 2:44-6 (16-8), 3:76-7 (25-6), 4:114-6 (11-3), 5:152-3 (12-3)  
Grey whale migration count surveys 6B:285-93 (61-9)

#### Half-normal model

as a key function 2:46-8 (18-20), 3:63-4 (12-3)  
binomial 6A:174-6 (2-4)  
bivariate 3:102-3 (51-2), 4:126-7 (23-4), 4:134 (31), 5:154-5 (14-5)  
line transect sampling 3:70-71 (19-20), 6B:238-40 (14-6), 6B:245-8 (21-4), 6B:257-9 (33-5)  
point transect sampling 3:71-72 (20-21), 6B:240-3 (16-9), 6B:252-4 (28-30)

#### Hazard-rate analysis

continuous 3:58-62 (7-11)  
discrete 6A:183-5 (11-3)

#### Hazard-rate model

as a key function 2:46-8 (18-20)  
definition 3:60 (9)  
derivation 3:58-62 (7-11)  
discrete 6A:184 (12)  
Heaping 2:35 (7), 4:110-1 (7-8), 5:149 (9)  
Hermite polynomial model 2:46-8 (18-20), 3:63-4 (12-3)  
Hessian matrix 3:66 (15)

#### Heterogeneity

behaviour of animals 6A:207-8 (35-6)  
covariates 3:99 (48), 6A:205 (33)  
environmental 6A:207 (35)  
observer 6A:206-8 (34-6)  
platform 6A:206-8 (34-6)  
stratification 3:99-102 (48-51), 6A:205 (33)  
House wren point transect surveys 8:396-401 (47-52)

Information matrix 3:66 (15), 3:68 (17)  
Innate detectability 6A:217-25 (45-53)

Interval estimation 3:88-96 (37-45), 4:118-21 (15-8), 5:154-8 (14-8)

Jackknife 3:92-4 (41-3)

Kelker strip 1:23 (23), 3:54 (3)

Kernel estimation methods 6A:182-3 (10-1)

Key function

definition 2:46 (18), 3:62-3 (11-2)

exponential 2:49 (21)

formulation for distance data 3:62-5 (11-4)

half-normal 2:46-8 (18-20), 3:63-4 (12-3)

hazard-rate 2:46-8 (18-20)

uniform 2:46-8 (18-20), 3:64 (13)

Lake Huron brick data 8:351-3 (2-4)

Likelihood function

full likelihood approach 6B:244-63 (20-39)

grouped data 3:67 (16)

half-normal 3:70-2 (19-21)

ungrouped data 3:65 (14)

Likelihood ratio test (LRT) 3:74-5 (23-4), 4:112-3 (9-10), 5:150-1 (10-1)

LINETRAN 1:26 (26)

Line transect sampling

analysis guidelines 2:49-51 (21-3), 4:137-40 (34-7)

assumptions 1:18-9 (18-9), 2:29-37 (1-9), 4:135-7 (32-4)

examples 8:351-96 (2-7)

field comparisons with point transect sampling and mapping censuses 7:339-48 (45-54)

field methods 7:295-349 (1-55)

full likelihood approach 6B:245-51 (21-7), 6B:257-9 (33-5)

hazard-rate modeling of detection process 3:58-61 (7-10), 6A:183-4 (11-2)

history 1:23-7 (23-7)

method and analysis 4:104-40 (1-37)

strengths and weaknesses 5:141-2 (1-2), 7:296-7 (2-3)

survey design 7:298-306 (4-12), 7:308-12 (14-8)

three-dimensional 6B:263-6 (39-42)

Mark-recapture

double counting in  $g(0)$  estimation 6A:206-7 (34-5), 6A:210 (38), 6A:216 (44)

double counting in migration counts 6B:287-9 (63-5)

likelihood models 6B:262 (38)

trapping webs 6B:275 (51), 6B:281 (57)

Maximum likelihood estimators (MLE)

Maximum likelihood methods

full likelihood approach 6B:244-63 (20-39)

grouped data 3:67-9 (16-8)

theory 3:65-73 (14-22)

ungrouped data 3:65-7 (14-6)

Measurements 1:16 (16), 2:34-6 (6-8), 7:317-35 (23-41)

Migration counts 6B:284-93 (60-9)

Minke whale cue counting surveys 6B:272-7 (48-53)

Modeling

$g(y)$  3:58-64 (7-13)

philosophy and strategy 2:41-6 (13-8)

$\text{var}(n)$  3:90-1 (39-40), 4:109-10 (6-7), 5:148-9 (8-9), 6A:186-98 (14-26)

variation in encounter rate 6A:186-98 (14-26)  
variation in cluster size 6A:199 (27)  
Model robustness 2:42 (14), 3:73 (22)  
Model selection  
AIC 3:75-6 (24-5), 4:113-4 (10-1), 5:151-2 (11-2)  
criteria 3:73-4 (22-3)  
goodness of fit 3:76-7 (25-6), 4:114-6 (11-3), 5:152-3 (12-3)  
guidelines for 2:50-1 (22-3)  
likelihood ratio test 3:74-5 (23-4), 4:112-3 (9-10), 5:150-1 (10-1)  
line transects 4:111-6 (8-13)  
point transects 5:150-3 (10-3)  
Models  
binomial 6A:173-8 (1-6), 8:409-14 (60-5)  
bivariate 3:81-7 (30-6), 3:102-3 (51-2), 4:134-5 (31-2), 6B:235-44 (11-20)  
complementary log-log 3:61 (10), 6A:184 (12)  
exponential power series 1:26 (26)  
exponential quadratic 1:26 (26)  
Fourier series 2:48 (20), 3:63-4 (12-3)  
generalized exponential 4:134 (31)  
half-normal  
as a key function 2:46-8 (18-20), 3:63-4 (12-3)  
binomial 6A:174-6 (2-4)  
bivariate 3:102-3 (51-2), 4:126-7 (23-4), 4:134 (31), 5:154-5 (14-5)  
line transect sampling 3:70-1 (19-20), 6B:238-40 (14-6), 6B:245-8 (21-4), 6B:257-9 (33-5)  
point transect sampling 3:71-2 (20-1), 6B:240-3 (16-9), 6B:252-4 (28-30)  
hazard-rate 2:46-8 (18-20), 3:58-62 (7-11), 6A:184 (12)  
Hermite polynomial 2:46-8 (18-20), 3:63-4 (12-3)  
multinomial 3:67-9 (16-8)  
negative exponential 1:24 (24), 4:134 (31), 6B:248-52 (24-28)  
reversed logistic 4:134 (31)  
see also Estimators  
Monte Carlo simulation 6B:235-44 (11-20)  
Mouse trapping web surveys 6B:282 (58)  
Multinomial model 3:67-9 (16-8)  
  
Nearest neighbour methods 1:9 (9), 6B:292-4 (68-70)  
Negative exponential model 1:24 (24), 4:134 (31), 6B:248-52 (24-8)  
Newton-Raphson 3:66 (15)  
Non-parametric estimators 6A:177-83 (5-11)  
  
Outliers 2:35-6 (7-8)  
  
Parsimony 2:44 (16), 3:76 (25), 3:102 (51), 6A:188 (16), 6A:200 (28)  
Pilot study 7:295 (1), 7:303-8 (9-14), 7:349 (55)  
Point process model 6A:183 (11), 6A:193-200 (21-28)  
Point-to-object methods 1:9 (9), 6B:292-4 (68-70)  
Point transect sampling  
analysis guidelines 2:49-51 (21-3), 5:171-2 (31-2)  
assumptions 1:18-9 (18-9), 2:29-37 (1-9), 5:166-71 (26-31)  
examples 8:396-414 (47-65)  
field comparisons with line transect sampling and mapping censuses 7:339-48 (45-54)  
field methods 7:295-349 (1-55)  
full likelihood approach 6B:251-4 (27-30)  
hazard-rate modelling of detection process 3:61-2 (10-1), 6A:184-5 (12-3)

history 1:27 (27)  
 method and analysis 5:141-72 (1-32)  
 strengths and weaknesses 5:141-2 (1-2), 7:296-7 (2-3)  
 survey design 7:298-303 (4-9), 7:307-8 (13-4)  
 three-dimensional 6B:266-70 (42-6)

**Poisson**  
 distribution of objects 1:18 (18), 2:29 (1), 2:36 (8)  
 variance of n 2:50 (22), 3:88 (37), 4:109-10 (6-7), 4:119 (16), 5:148-9 (8-9), 6A:188 (16)

**Polynomials**  
 Hermite 2:46-8 (18-20), 3:63-4 (12-3)  
 simple 2:46-8 (18-20), 3:62-4 (11-3)

Pooling robustness 2:42 (14), 3:74 (23)

Post-stratification 3:77-9 (26-8), 3:99 (48), 7:308 (14), 8:392 (43)

Precision, measures of, see Variance

Probability density function (pdf) 3:54-7 (3-6)

**Profile likelihood**  
 definition 6B:247 (23)  
 line transects 6B:247-51 (23-7), 6B:254-60 (30-6)  
 point transects 6B:251-6 (27-32), 6B:259-60 (35-6)

Quasi-likelihood 6A:189 (17), 6A:192-3 (20-1)

**Regression**  
 isotonic 6A:180 (8)  
 linear 3:79-80 (28-9)  
 logistic 6B:288-9 (64-5)  
 weighted linear 8:363 (14)

Regression estimator of mean cluster size 3:79-80 (28-9), 4:132-4 (29-31), 5:165-6 (25-6)

**Replicate lines or points**  
 bootstrap 3:95-6 (44-5)  
 in survey design 1:6-7 (6-7), 7:298-301 (4-7)  
 jackknife 3:92-4 (41-3)  
 variance estimation 3:90-2 (39-41), 4:109-10 (6-7), 5:148-9 (8-9)

Reversed logistic model 4:134 (31)

**Robust estimation**  
 criteria for 2:41-2 (13-4), 3:73-4 (22-3)  
 models for 2:46-9 (18-21)  
 variance 3:94-6 (43-5), 4:119-20 (16-7), 5:155-8 (15-8)

**Sample size**  
 fixed or random 6B:225-35 (1-11)  
 modeling variation in 6A:186-98 (14-26)

**Sampling in three dimensions**  
 line transects 6B:263-6 (39-42)  
 point transects 6B:266-70 (42-6)

Satterthwaite correction 3:89-90 (38-9), 4:120-1 (17-8), 4:125 (22)

Searching behaviour 7:313-6 (19-22)

Semiparametric model 2:42 (14), 3:73 (22)

**Series expansions**  
 cosine series 2:46-8 (18-20), 3:63-4 (12-3)  
 Fourier series 2:48 (20), 3:63-4 (12-3)  
 Hermite polynomials 2:46-8 (18-20), 3:63-4 (12-3)  
 simple polynomials 2:46-8 (18-20), 3:62-4 (11-3)

Shape criterion 2:36-7 (8-9), 2:42-4 (14-6), 3:54 (3), 3:74 (23), 5:167-8 (27-8)

Shape restriction estimator 6A:181-2 (9-10)  
 Shoulder 2:36-7 (8-9), 2:42-4 (14-6), 3:54 (3), 3:74 (23), 5:167-8 (27-8), 6A:217-25 (45-53)  
 Simple polynomials 2:46-8 (18-20), 3:62-4 (11-3)  
 Simplex procedure 3:66 (15)  
 Simulations 6B:235-44 (11-20)  
 Size-biased sampling 1:13 (13), 3:77-87 (26-36), 4:125-35 (22-32), 5:158-66 (18-26)  
 SIZETRAN 3:103 (52), 4:134 (31)  
 Smearing 7:319-22 (25-8)  
 Smoothing methods 8:392-6 (43-7)  
 Statistical theory 3:52-103 (1-52)  
 Stratification  
   by cluster size 3:77-9 (26-8), 4:132 (29), 5:164-5 (24-5)  
   post-stratification 3:77-9 (26-8), 3:99 (48), 7:308 (14), 8:392 (43)  
   to reduce heterogeneity 3:99-102 (48-51), 6A:205 (33)  
 Strip transect sampling 1:3-4 (3-4), 1:12 (12), 2:41 (13), 7:296 (2), 7:337 (43)  
 Survey design 7:298-313 (4-19)

Test power 2:44-6 (16-8)  
 Training 7:319 (25), 7:325 (31), 7:335-6 (41-2)  
 TRANSECT 1:26 (26), 3: 73 (22)  
 Trapping webs 1:7-8 (7-8), 6B:275-84 (51-60)  
 Truncation  
   for reducing bias in estimating mean cluster size 4:130-1 (27-8), 5:161-4 (21-4)  
   for robust estimation of detection function 1:15 (15), 2:50 (22), 4:106-9 (3-6)  
   left-truncation 1:15 (15), 6B:273-7 (49-53), 8:377-9 (28-30)  
   line transects 4:106-9 (3-6)  
   point transects 5:146-8 (6-8)

Units of measurement 1:16 (16)

Variable circular plots, see Point transect sampling  
 Variance  
   bootstrap 3:94-6 (43-5), 4:119-20 (16-7), 5:155-8 (15-8)  
   delta method 3:53 (2)  
   estimation 3:87-98 (36-47), 4:109-10 (6-7), 4:116-21 (13-8), 5:148-9 (8-9), 5:153-8 (13-8)  
   finite population correction factor 3:96-8 (45-7)  
   inflation factor 3:102 (51), 6A:187-93 (15-21), 6A:199 (27)  
   jackknife 3:92-4 (41-3)  
   of mean cluster size 3:77-81 (26-30), 4:123 (20), 5:159 (19), 6A:199 (27)  
   of sample size 3:90-1 (39-40), 4:109-10 (6-7), 5:148-9 (8-9), 6A:186-98 (14-26)  
   reduction using spatial models 6A:186-200 (14-28)  
   use of information matrix 3:66 (15), 3:68 (17)  
   use of replicate lines or points 3:90-2 (39-41), 4:109-10 (6-7), 5:148-9 (8-9)  
 Visual-detectability function 6A:184 (12)

Welsh point transect surveys in conifer plantations 8:409-14 (60-5)  
 Wooden stake data 8:353-8 (4-9)