Advanced distance sampling analysis methods

Available using Distance software
Analysis engines inside Distance

- Conventional distance sampling
  - Classical analysis
- Multiple covariate distance sampling
  - Covariates included in detection function modelling
- Mark-recapture distance sampling
  - Detection at distance 0 (on trackline or on point) is less than 1
- Density surface modelling
  - Encounter rate modelled by covariates
- Multi-analysis distance sampling
  - Incorporating uncertainty in cluster size or species identity
Simulation engine

- Evaluate precision and bias of proposed survey designs
- When assumptions are violated
- Contrast alternative survey designs
- Assess changes in precision associated with changing amounts of survey effort
Detection at distance 0 less than 1

“the g(0) problem”
Data requirements

Observation data must have:
  2 rows per object – one for Observer 1 and one for Observer 2

Fields for:
  \textit{object ID}
  \textit{observer (1 or 2)}
  \textit{detected (1=yes, 0=no)}

Additional covariate data can go in fields at the appropriate level

Example: (golf tee project)
Visual Mark-Recapture

Seen by 2
= “marked”

Obs 2
= “trapping occasion”

Obs 1
= “trapping occasion”
Visual Mark-Recapture

Obs 2 = "trapping occasion"
Obs 1 = "trapping occasion"

Seen by 2 = "marked"

Seen by 2 = "marked"

Seen by 1 = "success"

Passes unseen by 1 = "failure"
Visual Mark-Recapture

- We know 2 animals passed (because Obs 2 saw them)
- Of these, Obs 1 saw 1
- So estimate:
  \[ \hat{\Pr}(\text{Obs 1 sees}) = \frac{1}{2} = \frac{n_1}{n_2} = \frac{\text{number "duplicates"}}{\text{number seen by 2}} \]

Note: In this section, we use \( p \), not \( g \) for the detection function.
Main Topic 1: \( g(0) < 1 \): MRDS

\[
\hat{N} = \sum \frac{1}{\Pr(\text{animal } i \text{ included})}
\]

\( \Pr(\text{animal } i \text{ included}) \) depends on covariates of \textit{animal } i and \( g(0) \) can be \(<1\).

- Remove/reduce bias due to \( g(0) < 1 \)
- Can examine effects of covariates
Density surface modelling

Encounter rate varies spatially as a function of environmental covariates
After adjusting for imperfect detectability

Modelling of adjusted counts with generalised additive models (GAMs)
Multi-analysis engine

Include uncertainty in various phases of data collection into the analysis
Multi-analysis engine

Unidentified sightings
- Sightings cannot be identified to species
- Causes bias when there are unidentified sightings on the transect

Covariate uncertainty
- E.g. uncertainty in cluster size, distance, angle, multipliers
- If not included you may underestimate variability
ETP Data  Unidentified Sightings
Simulation of distance sampling
What does it do?

Survey Design
  → Survey Plan
  ↓ Observation Process
  ↓ Observations
  ↓ Analyse Data
  ↓ Estimates

Population Description
  → Population

Population Description
  • Population size or density
  • Density surface
  • Equal Spaced
  • Detectability
  • Spacing = 10km
  • Clusters?
  • Minus sampling
  • Covariates affecting?

Survey Design:
  • Zig zag design
  • Equal Spaced
  • Spacing = 10km
  • Clusters?

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Advanced topics are delivered in our St Andrews training workshops

Check the website for dates of next workshop
Workshops are available for persons attending in person or attending remotely (via internet)