MT5751Projects

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Chapter 1

Distance Sampling

Submit via MMS before midnight on Monday the 16th February[1]

The file `bw.csv` in folder "`Exercises and Projects`" on MMS contains the survey data from the bowhead whale survey described in the first lecture, and in the paper

Rekdal, S.L., Hansen, R.G., Borchers, D.L., Bachmann, L., Laidre, K.L., Wiig, O., Nielsen, N.H., Fossette, S., Tervo, O. and Heide-Jørgensen, M.P. 2014. Trends in bowhead whales in West Greenland: Aerial surveys vs. genetic capture-recapture analyses. *Marine Mammal Science.* **31**: 133-154

which is on MMS in the folder "`Literature`".

Read these data into `R` with the command `read.csv`. (Use `?read.csv` to find out about this command.) Having done that, use the `R` package `Distance` to obtain the best estimate you can of bowhead whale and group abundance in this survey region from these data, together with a 95% confidence intervals.

By considering the CV of the group abundance and individual abundance estimates for stratum 2 (as an example), verify that `Distance` has not used the Delta method to calculate the CV of individual abundance, given the CVs of group abundance and mean group size. (Give brief details of your calculations in your report.) Look at the help for the function `dht` (which `Distance` uses to estimate abundance from fitted models) to see how the CVs and confidence intervals were calculated.

Wite up your analysis in the form of a *short* scientific paper (you could use Rekdal, *et al.* (2014) as a rough guide to the structure of your paper). Your paper should be no more than two A4 pages and include a brief abstract. You can restrict yourself to a very brief summary of the survey (a few sentences), directing the reader to Rekdal, *et al.* (2014) for details.

You should describe the estimation methods used for point and interval estimation, the key aspects of your results, and what you conclude about bowhead whale abundance in the survey area from your analysis. Do not include any code in your paper. You can include it as an appendix if you would like to do so.

[1]The School lateness penalty policy is as follows: A late piece of work is penalised with an initial penalty of 15% of the maximum available mark (or 3 marks if anyone is marking on the University's 20-point scale), and then a further 5% (1 mark on the 20-point scale) per 8-hour period, of part thereof.

Chapter 2

Capture-Recapture

Submit via MMS before midnight on Monday the 2nd March[1]

The Datasets

The file `mrds.rda` in folder "`Exercises and Projects`" on MMS contains data from the survey of numbers that we did in class when dealing with mark-recapture distance sampling. It is an `R` data frame that has four columns: `ch` is capture histories (two different students are the two "occasions"), `x` is perpendicular distance (rounded to the nearest integer), `big` is a binary variable indicating whether the number ("animal") was big (=1) or not (=0), and `fog` is a binary variable indicating whether the number was detected from the transect that had "fog" (=1) or not (=0).

The file `skink.rda` in folder "`Exercises and Projects`" on MMS contains the data from the survey of skinks on North Brother Island, New Zealand, which we looked at in class. It is an `R` data frame that contains a single column `ch` with the capture histories from 7 capture occasions.

After downloading these datasets onto your computer, load them into `R` using the command `load`.

Your Analysis and Report

Having loaded these dataframes into `R`, use the `R` package `RMark` to obtain the best estimates you can of the number of numbers ("animals") in the strips that we surveyed in class, and separately the number of skinks on North Brother Island, together with 95% confidence intervals.

Write up your analysis in the form of a short scientific paper. Your paper should be no more than three A4 pages and must include a brief abstract. You should describe clearly (using equations as appropriate) the estimation methods that you used for point and interval estimation.

In the case of the mark-recapture distance sampling data from the in-class survey, you must also explain clearly the difference between a capture-recapture estimator in which the variable `x` is an explanatory variable, and a mark-recapture distance sampling Horvitz-Thompson-like estimator. (For this purpose assume that `x` has not been rounded to the nearest integer.)

Your report should summarise the key aspects of your results for both surveys, including an interpretation of the estimated parameters, as well as the conclusions you draw from these analyses.

Do not include any code in your paper, but DO include the code you used to obtain the estimates in an appendix.

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Chapter 3

SECR

Submit via MMS before midnight on Monday the 30th March[1]

The Data

These data are from an ongoing camera-trap study in the Boland mountains of South Africa. This particular dataset is from 2010. Cameras were placed in pairs along routes that leopards are believed to use, with cameras facing each other so as to get photos of both sides of the animals passing them. Although leopards are believed to prefer the chosen routes, the habitat is quite open and it is easy for leopards to move through it off these routes. The surveyors believe that male leopards tend to dominate the routes, while females tend to avoid them. The vast majority of captures are of male leopards (it is possible to distinguish males from female in photographs) and the data presented here are for males only.

The data span a 13-week period, during which cameras were checked weekly and a record kept for each pair of cameras of each individual that was detected each week. Leopards were identified by visual inspection of photos and individual identification is believed to be reliable. We assume no leopards were lost or recruited over the study period.

The capture history data are in the `R` object `BolandCH.rda` on the Exercises and Projects folder on MMS and a mask with some geographic variables in its attributes is in the `R` object `BolandMask.rda` on the Exercises and Projects folder on MMS. You can load them into `R` as follows:

```
load(BolandCH.rda)
load(BolandMask.rda)
```

The following produces a readable plot for these data:

```
plot(BolandCH,border=0,rad=500,tracks=TRUE,
  icolour=colors()[seq(2,202,10)],gridlines=FALSE)
```

It is convenient to extract the traps from the capture history object, which you can do by `cameras=traps(BolandCH)`. There are a number of covariates attached to the mask, which may be useful in modelling leopard distribution in space. See `summary(BolandMask)` for a summary of them. The covariates are as follows:

alt altitude.

Landuse Landuse category (1=Natural, 2=Cultivated, 3=Degraded, 4=Plantation).

Natural binary variable: 1=Natural land use category, 0=not.

dist2.Urban distance to closest Urban land use category cell.

dist2.Water distance to closest Water land use category cell.

dist2.Natural distance to closest Natural land use category cell.

LUfactor Landuse category as a factor variable.

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Plotting Mask Covariates

You can plot the covariates using commands like those below (which does an image plot of altitudes in the mask and overlays to trap locations on this).

```
plot(Boland.mask1,covariate="alt",axes=TRUE,plottype="shaded",legend=FALSE,
     add=FALSE,breaks=15,col=terrain.colors(20),mesh=NA)
plot(cameras,add=TRUE)
```

You will notice from this plot that there are "holes" in the mask. These are pixels corresponding to urban areas and water bodies - both of which are unsuitable habitat for leopards. You can get an idea of where the urban areas and water bodies are by plotting `dist2Urban` and `dist2.Water` instead of `alt`, using commands similar to those above.

Model Fitting and Comparison

Obtain the best estimate that you can of the number of male leopards within the area covered by `BolandMask`. You should consider models that allow density to vary in space as well as models that assume it is constant. Restrict yourself to consideration of `alt` and `dist2.Water` as variables that might affect leopard density. You should consider regression spline smooths of these variables, and to this end, read the vignette `secr-densitysurfaces.pdf`, and the section **Regression splines** in particular. The `secr` command `region.N` is useful for estimating abundance from a density surface.

Your Report

Write up your analysis in the form of a short scientific paper. Your paper should be no more than three A4 pages and must include a brief abstract. You should describe clearly (using equations as appropriate) the estimation methods that you used for point and interval estimation.

Your report should summarise the key aspects of your results and the conclusions that you draw from these analyses.

Do not include any code in your paper, but DO include the code you used to obtain the estimates in an appendix.

Chapter 4

Occupancy

Submit via MMS before midnight on Monday the 13th April [1]

The Datasets

The file `swtdat.rda` in folder "`Exercises and Projects`" on MMS contains presence/absence data on Swiss willow tits from the Swiss Survey of Common Breeding Birds. This is an annual survey conducted during the breeding season. Sample units are 1km^2, and these are sampled 2 or 3 times by each volunteer observer. The observers survey on foot a route of variable length between quadrats, but the same length on different occasions within each quadrat. Observers choose the intensity of sampling themselves, i.e., the duration of their survey along the route. Surveys of each quadrat typically happened on different days and the data include the day on which each quadrat was surveyed on each occasion.

Two covariates believed to be of biological relevance are elevation and forest cover. These are thought to be important determinants of distribution and abundance. Elevation gradient is severe in Switzerland and this substantially affects climate, weather and vegetation. Elevation and forest cover are illustrated in Figures 4.1 and 4.2.

The variables in `swtdat.rda` are as follows:

ch Capture history in `Rmark` format ("." means no survey of that quadrat on the occasion).

elev Elevation difference from mean elevation (1182.574 m), in metres.

elevsq Square of elev.

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Figure 4.1: Elevation of Switzerland in metres above sea level.

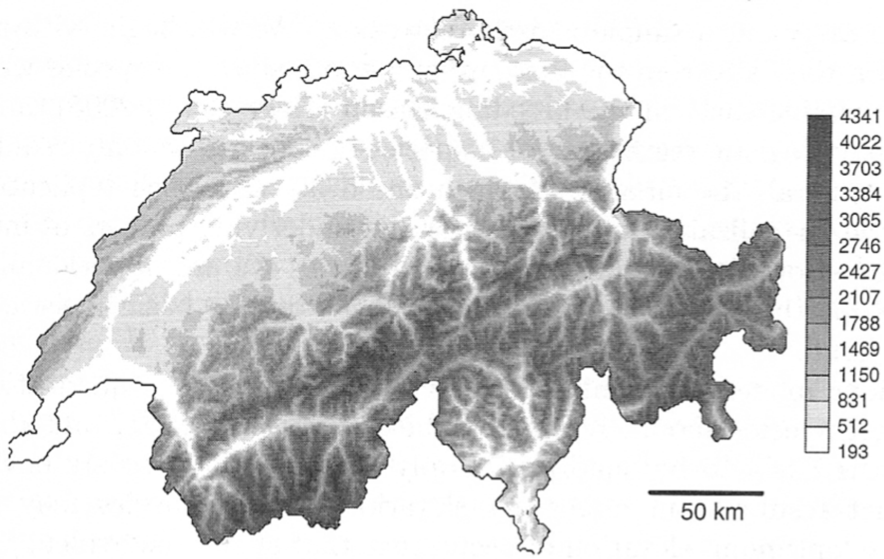
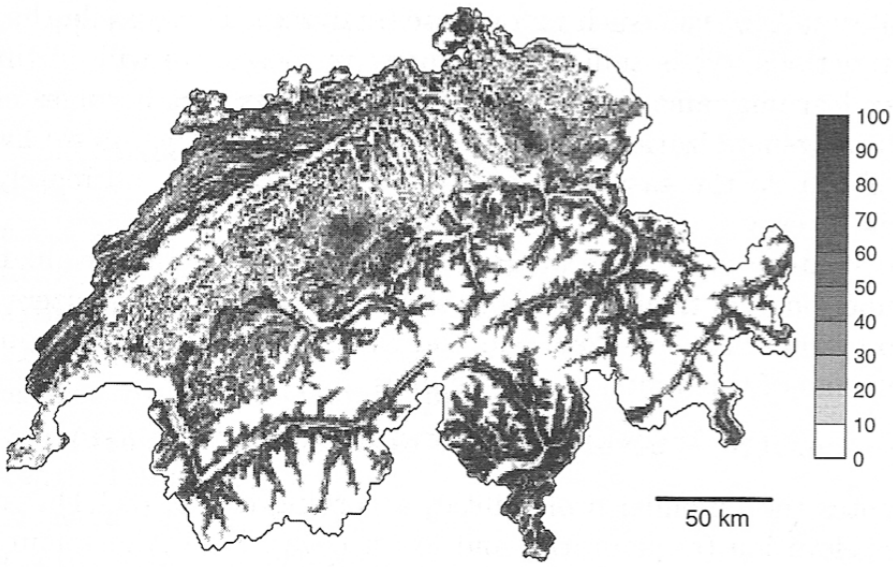


Figure 4.2: Forest cover of Switzerland (percent of quadrat that is forested).



forest Percentage of quadrat covered in forest.

dur1 Duration of search on occasion 1, in minutes.

dur2 Duration of search on occasion 2, in minutes.

dur3 Duration of search on occasion 3, in minutes.

length Length of route searched, in km.

intensity1 Intensity of search (duration/length) on occasion 1, in minutes per km.

intensity2 Intensity of search (duration/length) on occasion 2, in minutes per km.

intensity3 Intensity of search (duration/length) on occasion 3, in minutes per km.

day1 Day since start of year on which quadrat was searched on occasion 1.

day2 Day since start of year on which quadrat was searched on occasion 2.

day3 Day since start of year on which quadrat was searched on occasion 3.

Your Analysis and Report

Having loaded these data into `R`, use the `R` package `RMark` to obtain the best model you can for predicting occupancy of willow tits in Switzerland.

Use your best model(s) to produce results and a report that a wildlife manager who is interested in managing Swiss habitat to increase the presence of willow tits in Switzerland, would find useful for making management decisions.

In addition to results for Switzerland as a whole, the manager is interested in the probability of willow tit presence in four specific quadrats, namely those in rows 1, 10, 85 and 183. Include in your report your best estimates of occupancy in these quadrats.

Your report should be no more than three A4 pages and must include a brief abstract or executive summary that the manager can read to find out the key results of your analysis without having to read the whole report.

The body of your report should describe clearly (using equations as appropriate) the estimation methods that you used for point and interval estimation.

Do not include any code in your report, but do include the code you used to obtain the estimates in an appendix.