STAT402 HW 9

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Problem One

A common approach to estimating the total number of animals, nests, etc. is to (1) fly or walk a transect (2) mark down each sighted object (3) record characteristics such as experience of observer, weather, vegetation type, size of object and especially distance from object to the transect (4) use a model to assign detection probabilities to each object. Here is some example data:

animal	dist	terrain	probability
1	12m	A	0.3
2	10m	A	0.5
3	5m	B	0.1
4	10m	B	0.4
5	8m	B	0.6
6	16m	A	0.2
7	20m	B	0.4
8	10m	B	0.5

a. To estimate total number of animals, we will set $y_i = 1$ for all animals sighted. Why will this give us an estimate of N, the number of animals?

b. The chance that an animal is sighted is π_i, the Detection Probability. Note the the detection probability is the chance of seeing the animal the one time we pass it. Why is this the inclusion probability only if we walk the transect exactly one time?

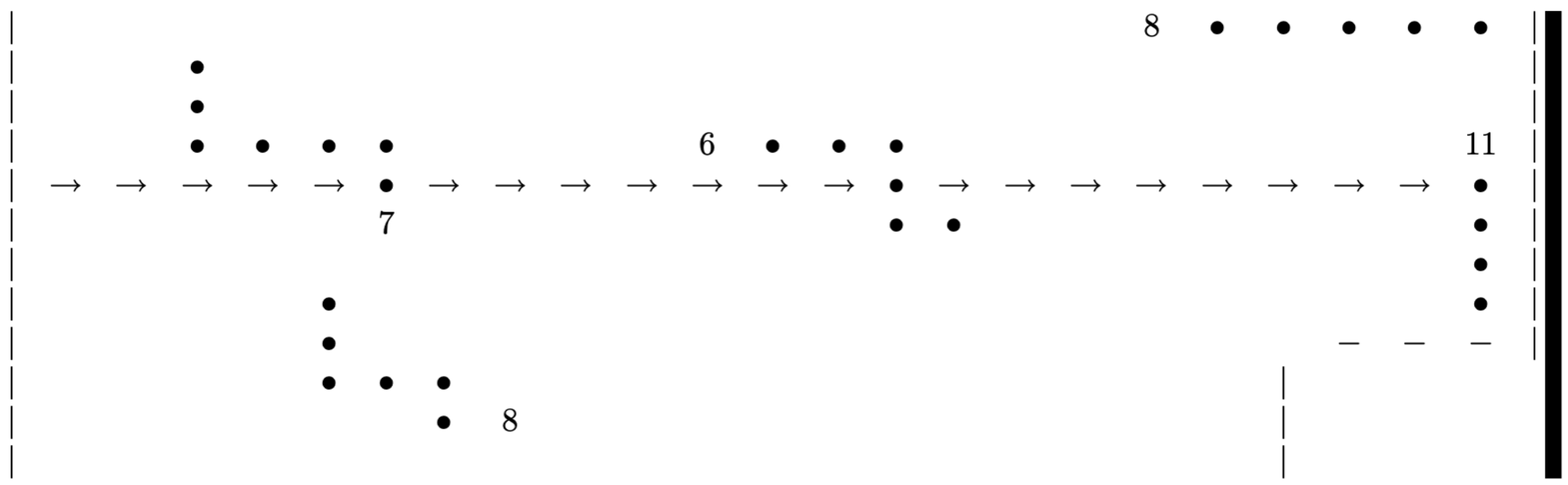
c. We assume that sighting one animal does not change the chance of seeing another one, so that $\pi_{ij} = \pi_i \pi_j$. Can you think of a situation where that would not be reasonable?

d. Why would the Hansen-Hurvitz estimator be wrong, wrong, wrong for this data?

e. Assuming independent detection as in (c), use the Horvitz-Thompson estimator (actually Hajek) to get an estimate of the total number of animals and find its standard error.

Problem Two

We fly a transect and 'sample' a wolf track if it intersects out flight path. The probability of sampling a track is the fraction of possible transect that intersect the path (πi) while πij is the fraction of possible transects that cross both paths. The transects are rows of the table below and each transect is equally-likely to be selected as out path. The marked path is the one we actually flew (so only consider paths that cross this). The number of wolves yi is at the end of the path. Compute an estimator of the number of wolves and its standard error. [NOTE: In reality we would likely fly several independent transects, compute the estimated total wolves (based on Horvitz-Thompson) for each one, then treat the transects as units of a SRS and perform the simple SRS analysis.]



NOTE:

It's not part of the HW, but you might want to look over the paper "Adaptive Cluster Sampling for Estimation of Abundances within Local Populations of Low- Abundance

Plants" (Philippi 2005, Ecology 86 (5)) for a good, in depth discussion of the use of Adaptive Cluster Sampling.

Problem Three

We have divided a region into $N = 1000$ plots, each with area 0.1 Ha. We only observed whether a fox has been in the area or not. From a SRS of size $n = 20$, we get the following presence/absence data: absent in 8 of the 20 locations.

a. We assume complete spatial randomness. What does this tell us about foxes?

b. Use the stocked quadrats method to get a 95 percent confidence interval for the density of foxes (per square Ha).

Problem Four

We want to estimate the number of ants in a large colony. Each day we will capture 20 ants, count the number that are unmarked, then mark all of them with a small colored dot. We get the following data:

Effort: 20, 20, 20, 20 20 20, 20, 20

Catch (unmarked ants): 20, 18, 18, 16, 15, 15, 13, 15.

a. Compute CPUE and CC at each time period. Plot them against each other. Does CPUE seem to decrease over time?

b. Get a 95 percent confidence interval for the total number of ants.