Producing a better estimate of variance when systematic samplers are used

Systematic samples

Problem:
Systematic designs give the best variance, but the worst variance estimation!

Estimates of encounter rate variance assume random lines

But it is better (lower variance) to use systematic lines

Systematic designs are best, but we might overestimate the variance. Use stratification to improve variance estimation for systematic designs

No unbiased estimator exists for estimating variance from a single systematic sample
Systematic samples advice

Usually, do nothing!

Variance estimation based on random lines will not be perfect, but adequate

\[
\left\{ CV \left( \frac{n}{L} \right) \right\}^2 = \frac{k}{n^2 (k - 1)} \sum_{i=1}^{k} \lambda_i^2 \left( \frac{n_i}{\lambda_i} - \frac{n}{L} \right)^2
\]
If there are strong trends, variance might be significantly overestimated.
Post-stratification can give much better variance estimates.

Group lines into small strata

Two lines per stratum, or at most three
Post-stratification can give much better estimates of variance.

Trends within strata are minor;
Estimate encounter rate variance separately for each stratum.

\[
\text{vâr}\left(\frac{n}{L}\right) = \frac{1}{L^2} \sum_{h=1}^{H} L_h^2 \text{vâr}_h\left(\frac{n_h}{L_h}\right)
\]
In Distance 7:

Click on the “Advanced…” tab

Choose this option

Successive pairs of lines will be grouped together, according to their ID in the sample layer (1 & 2, 3 & 4, etc). (If there are an odd number of lines, the last 3 will be grouped.)
Overlapping strata are even better, as you get a larger sample size of post-strata
Systematic point transect surveys

Less of an issue (no problem of different line lengths), but can similarly group into strata of two or three adjacent points for encounter rate variance if required.
However, it is harder to do in Distance – need to manually post-stratify.

Can only do non-overlapping post-stratification this way.

Add new field VarGroup into the Point transect layer (i.e., the sample layer)
Enter values into VarGroup so that it groups together points 1 and 2, 3 and 4, etc
Post-stratify on VarGroup

Encounter rate estimated at Stratum level, everything else Global. Global density is Mean weighted by Effort.