

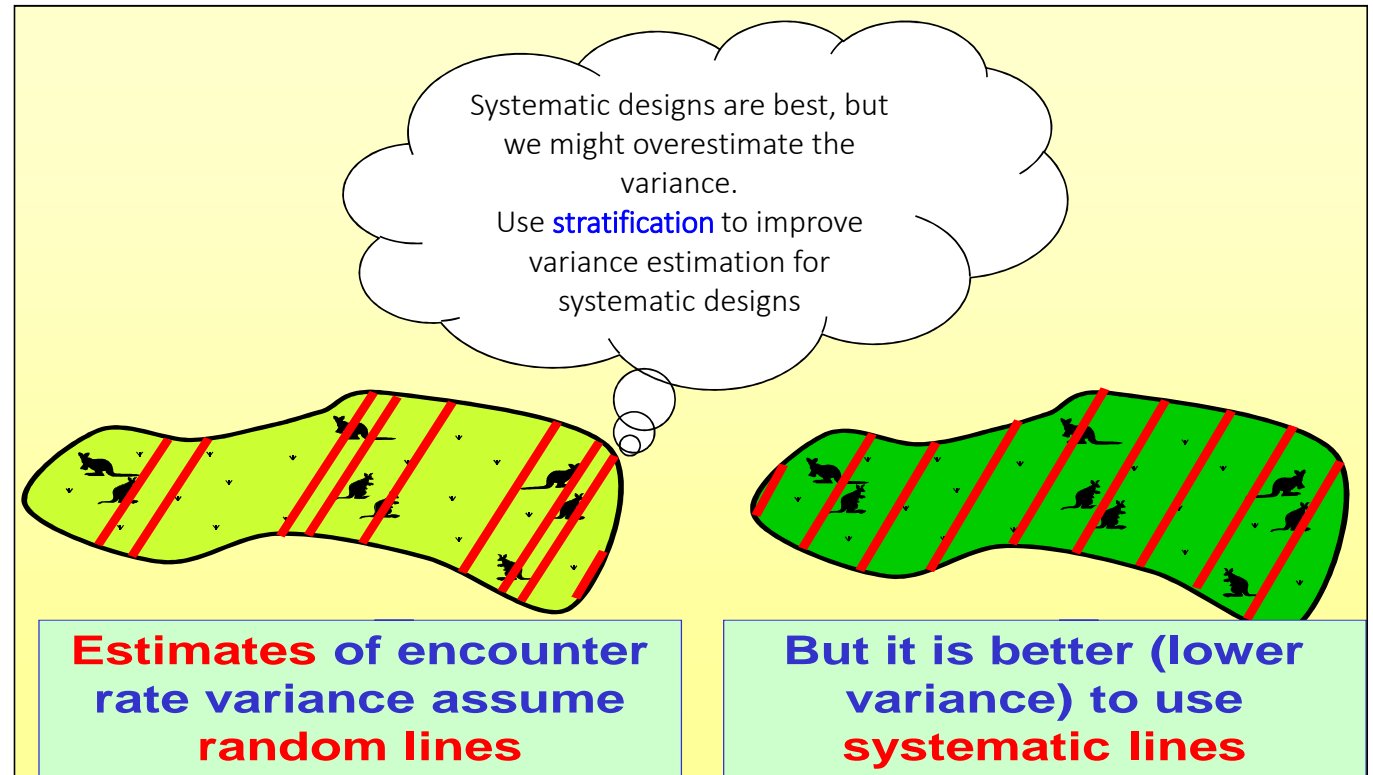
Producing a better estimate of variance when systematic samplers are used

- Fewster, RM, Buckland, ST, Burnham, KP, Borchers, DL, Jupp, PE, Laake, JL, and Thomas, L. 2009. Estimating the encounter rate in distance sampling. Biometrics 65: 225-236.

Systematic samples

Problem:

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

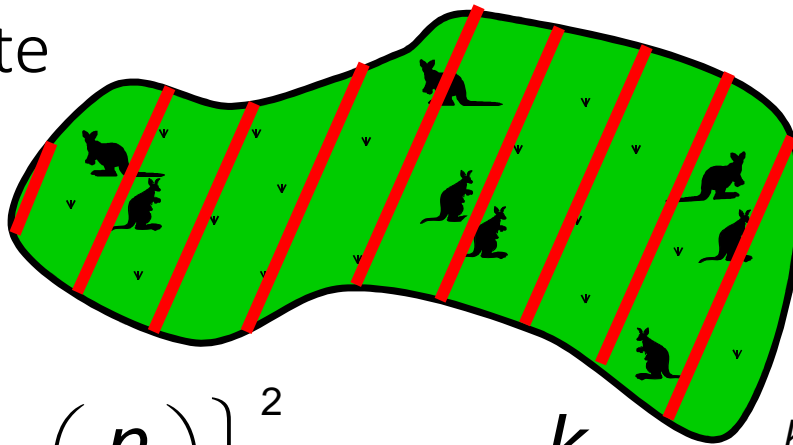


No unbiased estimator exists for estimating variance from a single systematic sample

Systematic samples advice

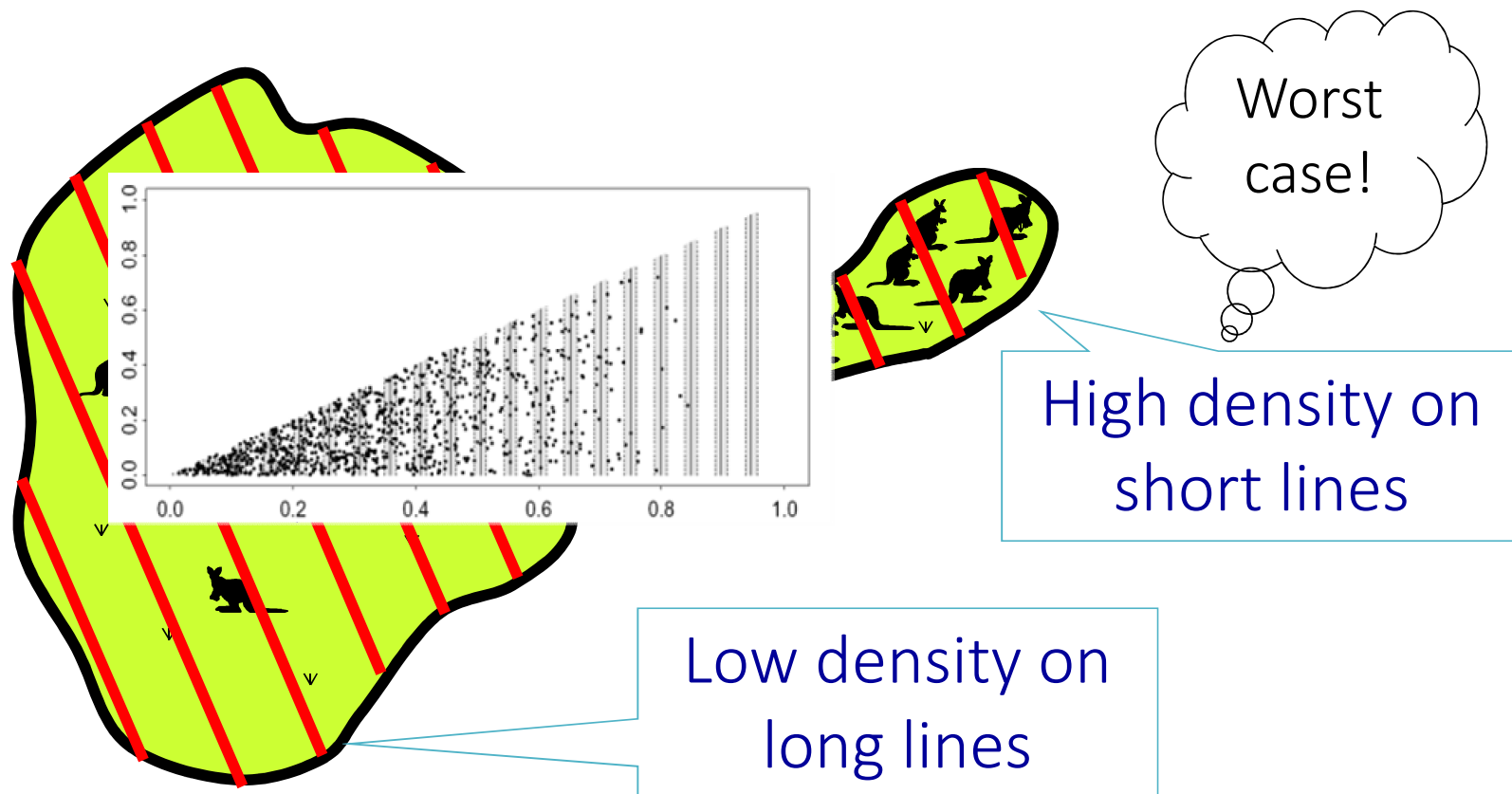
Usually, do nothing!

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

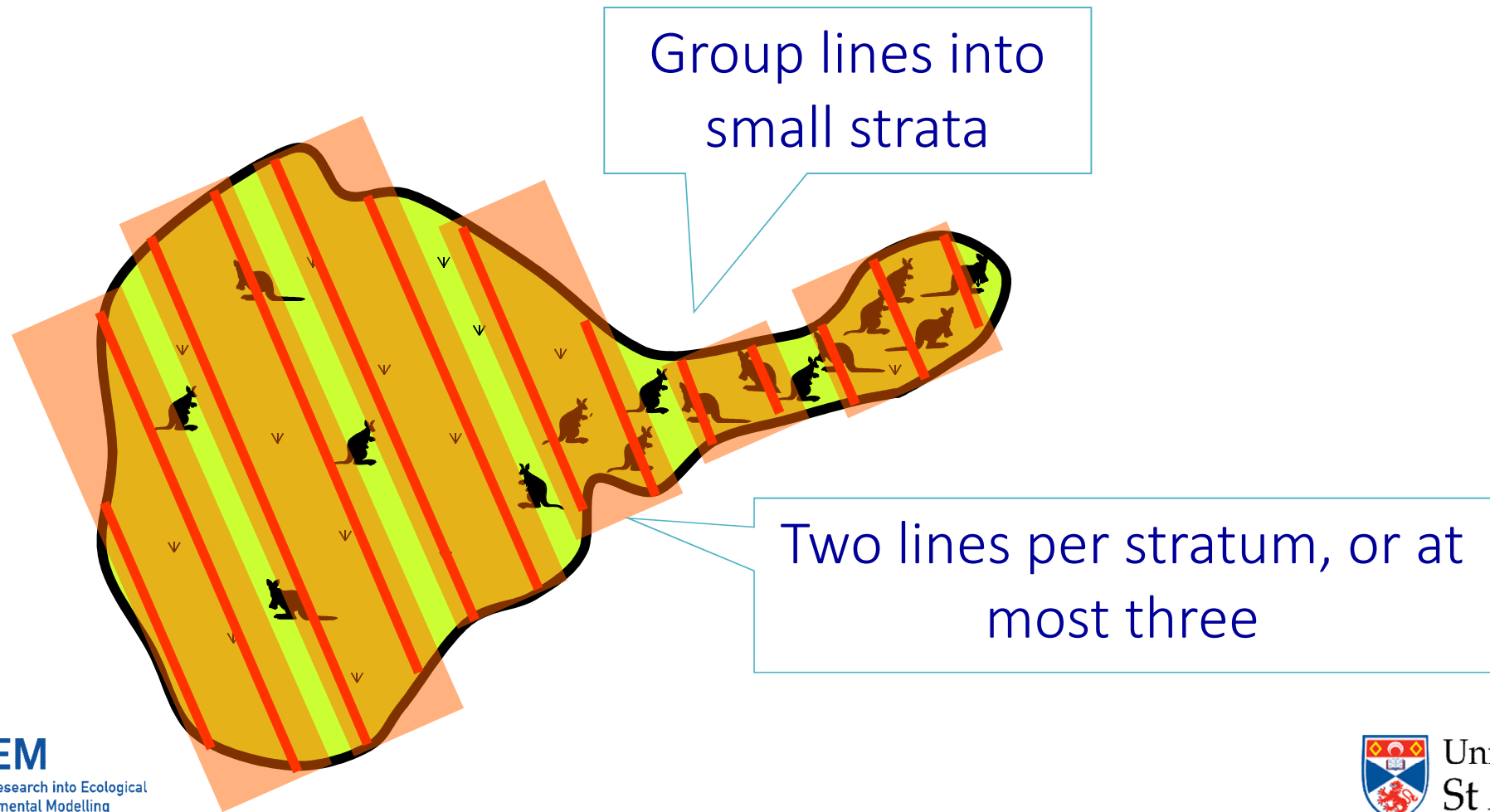


$$\left\{ cv \left(\frac{n}{L} \right) \right\}^2 = \frac{k}{n^2 (k - 1)} \sum_{i=1}^k \lambda_i^2 \left(\frac{n_i}{\lambda_i} - \frac{n}{L} \right)^2$$

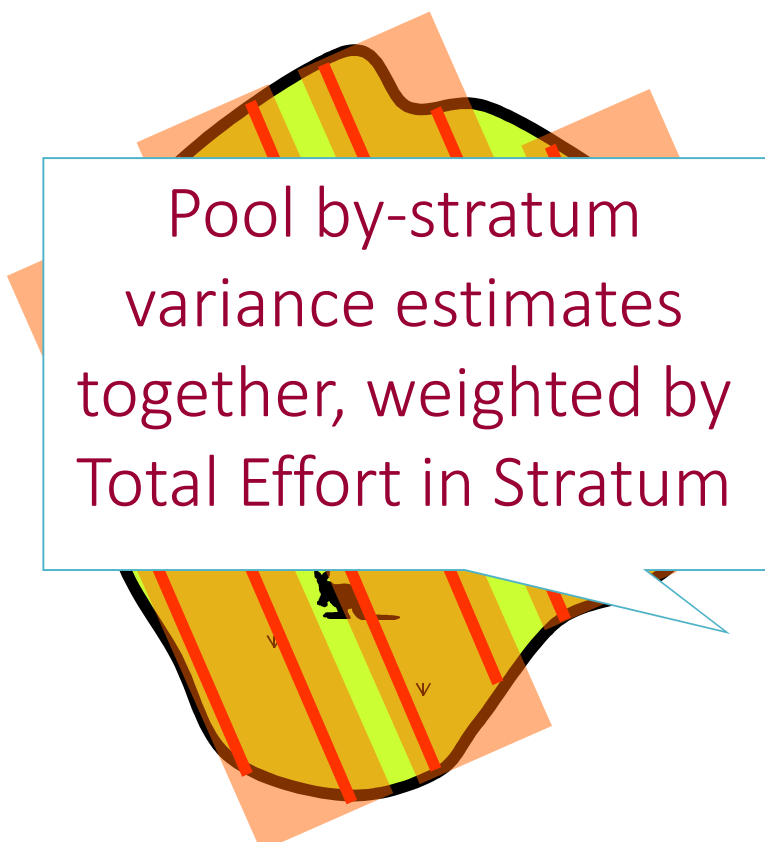
If there are strong trends, variance might be significantly overestimated



Post-stratification can give much better variance estimates



Post-stratification can give much better estimates of variance

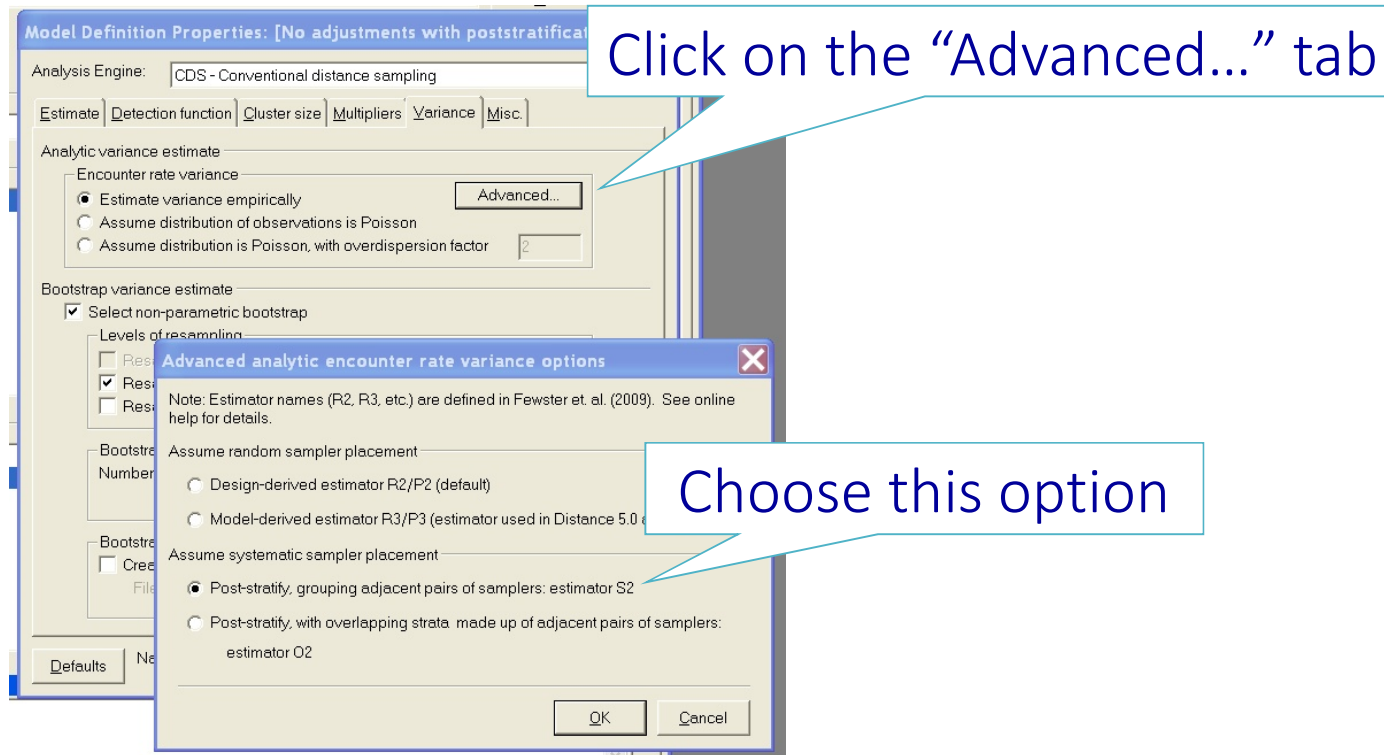


Pool by-stratum
variance estimates
together, weighted by
Total Effort in Stratum

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

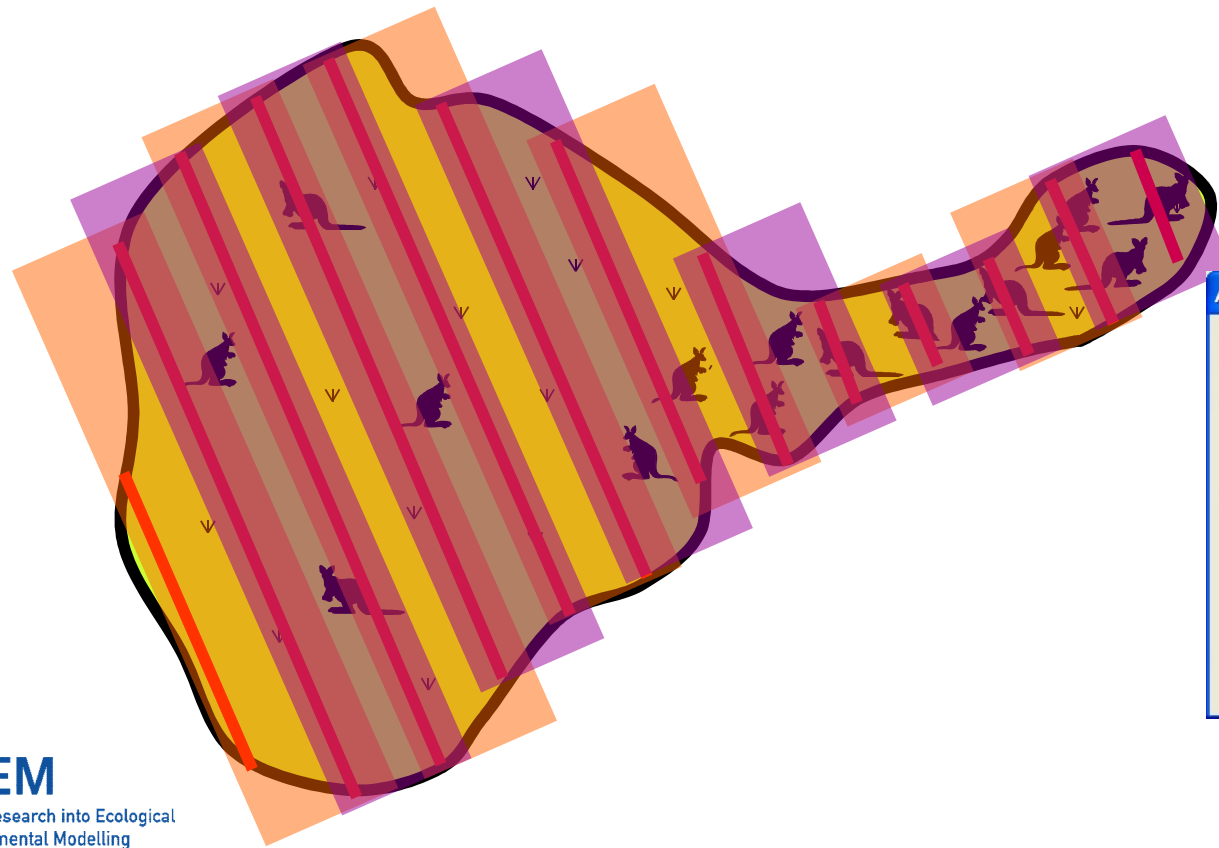
$$\hat{v}\hat{a}r\left(\frac{n}{L}\right) = \frac{1}{L^2} \sum_{h=1}^H L_h^2 \hat{v}\hat{a}r_h\left(\frac{n_h}{L_h}\right)$$

In Distance 7:

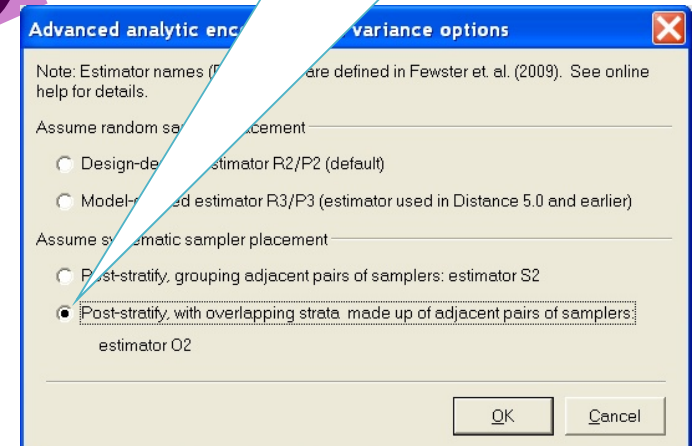


Successive pairs of lines will be grouped together, according to their ID in the sample layer (1 & 2, 3 & 4, etc). (If there are an odd number of lines, the last 3 will be grouped.)

Overlapping strata are even better, as you get a larger sample size of post-strata

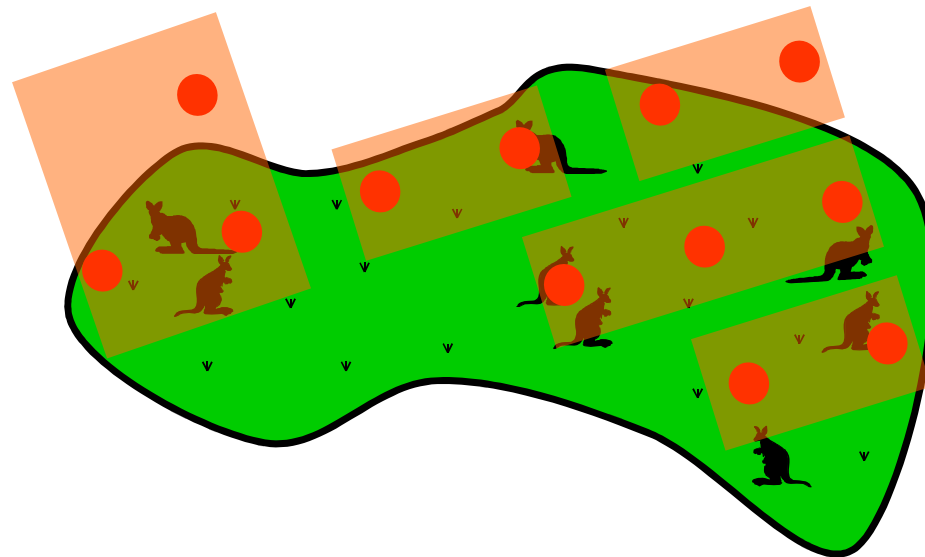


Choose this option



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)

The screenshot shows the 'Project Browser' window on the left and the 'Append Field to 'Point transect' ...' dialog box on the right. The 'Project Browser' displays a tree structure under 'Data layers' with 'Study area' expanded, showing 'Region', 'Point transect', and 'Observation'. The 'Contents of Sample layer 'Point transect' and all fields from higher layers' table is visible, showing columns for 'Study area', 'Region', and 'Point transect'. The 'Append Field' dialog box has 'Field name' set to 'VarGroup', 'Field type' set to 'Integer', 'Units' set to 'None', and 'Data table' set to 'Point transect'.

Study area			Region			Point transect		
ID	Label		ID	Label	Area	ID	Label	Survey effort
n/a	n/a		n/a	n/a	ha	n/a	n/a	[None]
Int	Int		Int	Int	Int	Int	Int	Int
1	Point transect project		1	Default	0	1	1	1
						2	2	1
						3	3	1
						4	4	1
						5	5	1
						6	6	1
						7	7	1
						8	8	1
						9	9	1
						10	10	1
						11	11	1

Enter values into VarGroup
so that it groups together
points 1 and 2, 3 and 4, etc

Project Browser

Data | Maps | Designs | Surveys | Analyse | Simulations

Data layers

- Study area
 - Region
 - Point transect
 - Observation

Contents of Sample layer 'Point transect' and all fields from higher layers

Study area			Region			Point transect			
ID	Label		ID	Label	Area	ID	Label	VarGroup	Survey effort
ID	Label		ID	Label	Decimal	ID	Label	Integer	Decimal
n/a	n/a		n/a	n/a	ha	n/a	n/a	[None]	[None]
Int	Int		Int	Int	Int	Int	Int	Int	Int
1	Point transect project		1	Default	0	1	1	1	1
						2	2	1	1
						3	3	2	1
						4	4	2	1
						5	5	3	1
						6	6	3	1
						7	7	4	1
						8	8	4	1
						9	9	5	1
						10	10	5	1
						11	11	5	1

Model Definition Properties: [Default Model Definition]

Analysis Engine: CDS - Conventional distance sampling

Estimate | Detection function | Cluster size | Multipliers | Variance | Misc.

Stratum definition

☐ No stratification Layer type: Field name:

☐ Use layer type: Stratum

☒ Post-stratify, using: Sample VarGroup

Sample definition (for encounter rate)

Use layer type: Sample

Quantities to estimate and level of resolution

	Level of resolution of estimates		
	Global	Stratum	Sample
Density	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Encounter rate	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Detection function	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cluster size (if required)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Global density estimate is Mean of stratum estimates

weighted by Total effort in stratum ☐ Strata are replicates

Defaults Name: Poststratification for variance estimati OK Cancel

Post-stratify on VarGroup

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