

1. A conservation biologist is interested in the factors that affect seed set (N_{seed}) by an endangered plant. In addition to N_{seed} , the following variables were measured for individual plants.

Variable	Direction of effect	Reason
Soil nitrate (ppm)	or $\underline{+}$ $\underline{-}$	<u>nitrate increases seed set</u> <u>excess nitrate harms plant</u>
Crowding (distance in cm to nearest plant)	$\underline{-}$	<u>crowding slows growth</u>
Leaf area (cm^2)	$\underline{+}$ or $\underline{0}$	<u>seed set depends on</u> <u>plant size, as does leaf area</u> <u>seed set unrelated to leaf area</u>
Insect damage to seeds (scored from 0 to 3)	$\underline{-}$	<u>insect damage reduces</u> <u>seed set</u>

1a State the direction of effect (plus, minus, or zero) on N_{seed} for each of these 4 variables. Give a brief reason for each (if you use the other side of this sheet of paper to write out reasons, be sure to label each reason clearly).

1b. State three relations that you think might be important, within the set of 4 explanatory variables.

many possible relations among explanatory variables.

Examples:

insect damage increases with crowding,
 soil nitrate decreases with increased crowding
 leaf area decreases as nitrate decreases

1c Draw a box and arrow diagram that shows these three relations, in addition to the relation of N_{seed} to each of these 4 variables. Draw the arrows in the direction of effect. Place a plus or minus sign over each of your 7 arrows, to show whether the relation is positive or negative.

4 arrows pointing at response variable N_{seed} , (plus, minus, zero) as above
 3 arrows connecting response variables, consistent with 1b above

2. Ainley *et al.* (1995, *Marine Ecology Progress Series* 118:69-79) used a 21 year time series from the Farallon Islands to investigate productivity (number of chicks fledged per year) for 6 seabird species in relation to proximate and remote factors leading to variation in food supply to chicks. They obtained measurements of 3 measurements of upwelling intensity and 1 biological factor. How many pairwise correlations are there in the set of 4 environmental factors ?

For n objects the formula for number of pairs will be

$$Pairs = \frac{n(n-1)}{2}$$

$$Pairs = \frac{4 \cdot 3}{2} = 6$$