3.2 Correlation

When a scatterplot takes a linear form, we use a numerical value called correlation (r) to discuss the direction and strength of the relationship between the two quantitative variables.

$$r = \frac{1}{n-1}\sum\left(\frac{x_i - \bar{x}}{s_x}\right)\left(\frac{y_i - \bar{y}}{s_y}\right)$$

Not as scary as it looks - each value in parenthesis is the z-score for the value in the data. You calculate a z-score for an x, a z-score for the corresponding y, multiply the pair, do that for each pair and then add them up and divide by n-1. So the correlation is the average of the products of the standardized values.

We will use our calculator to calculate correlation (r).

Interpreting Correlation (r):

r > 0 means positive linear association

r < 0 means negative linear association

r close to 0 means very weak linear association

$-1 \leq r \leq 1$

perfect correlation is when r = 1 or r = -1
*all points lie exactly on a straight line.

Good to know:

- r has no units (uses standardized values, doesn't change with conversions)
- r doesn't care which variable is x and which is y
- both variables must be quantitative to calculate r
- r is only used for measuring strength of linear relationships
- r is not resistant (if we take out an outlier, it strengthens the r score)
- r should be given with mean and std dev of x and y

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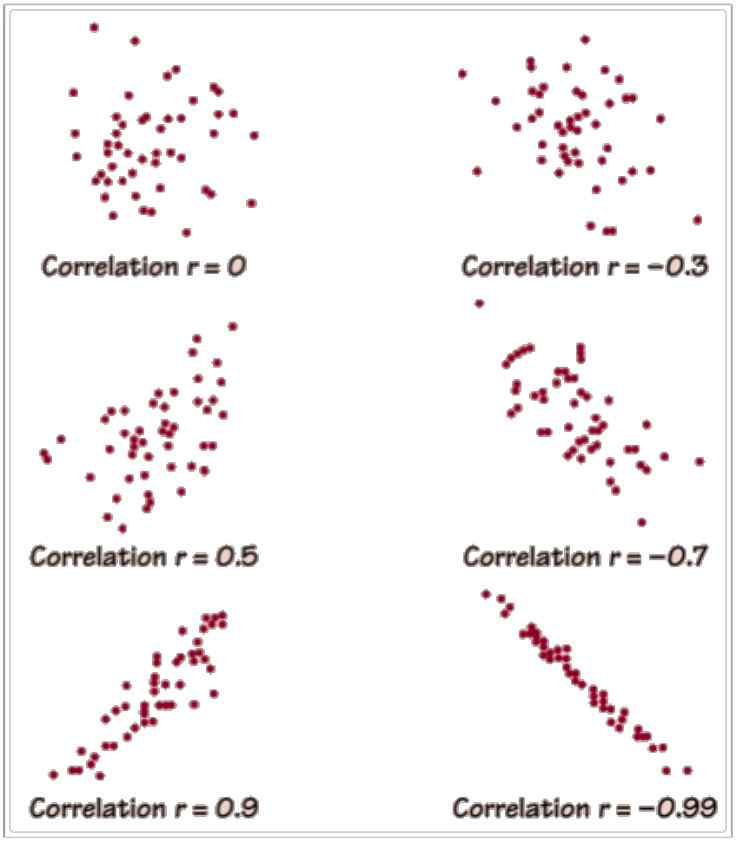
Correlation Applet



Using the Calculator:

From Ex. 3.19 on P138 Archaeopteryx femur & humerus lengths

Enter into L_1: 38 56 59 64 74
Enter into L_2: 41 63 70 72 84

Calculate 2-var stats:

STAT | CALC | 2 | L_1,L_2 | Enter

Now go to your list editor and in the header of L_3 type:

$$((L_1 - \overline{x}) / s_x)(L_2 - \overline{y}) / s_y)$$

VARS | 5 for mean & std dev

Now from your main screen, type:
(1/(n-1)*sum(L_3)

sum is in the 2nd | STAT | MATH menu