Title: M04D03-D: The effect of altitude on dung beetle community structure in a Honduran cloud forest.

Keywords: Biological indicators; biodiversity; climate change; data handling; deforestation; ecosystems; environmental monitoring; field techniques; human impact; rainforest; sampling; transects; species richness, species evenness, abundance

Skills: Spearman's correlation coefficient.

In tropical rainforests dung beetles are a conservation priority. As they move dung for feeding, nest building and the provision of nutrients to their larvae, the forest collaterally benefits as a result of soil fertilisation and aeration, nutrient recycling, seed dispersal, pollination, reduction in seed predation and the biological control of the eggs and larvae of mammalian parasites. As forest degradation continues apace, the survival of dung beetles, along with the important ecosystem services they fulfil, is threatened. The effects of global climate change are often first perceived when researchers notice alterations in the distributions of organisms. These distributional changes are most commonly associated with shifting latitudes as opposed to elevations. However, studies in dung beetle communities suggest that altitude affects species richness and diversity and therefore dung beetles can be useful biological indicators of disturbance and loss of biodiversity.

This study involves looking at the species richness of dung beetles within Cusuco National Park (CNP), Honduras. Species richness is calculated by simply adding up the number of different species of dung beetle found at each site. Seven areas were sampled across a range of altitudes (600-2200m) throughout the park and there are 127 sample points which have been continuously recorded for over many years.

Phanaeus endymion

The table below contains data pertaining to the relationship between species richness and altitude:

Altitude range (m)	Species richness
600 - 799	7.25
800 - 999	5.8
1000 - 1199	5.4
1200 - 1399	6.5
1400 - 1599	4.7
1600 - 1799	5.3
1800 - 1999	4.9
2000 - 2199	4.7

Tasks and questions:

Looking at the table and a graph the researchers suggest that there is a negative correlation between species richness and altitude, i.e. as altitude increase species richness decreases. They would like to know if this is a significant correlation and use the Spearman's Rank Correlation Coefficient to test the relationship based on the alternative hypothesis of "there is a significant negative correlation between the altitude of the sample site and the species richness of dung beetle species". Your task is to calculate the Spearman's R_s value and determine the degree of significance of the relationship.

1. Write down the hypothesis.
2. Work out the two sets of ranks. Make sure you are taking tied ranks into account; if there are two values that are identical and would therefore have the same rank take the average of the two places e.g. if both values are 4th each would get a rank of 3.5.

Altitude (m)	**600 - 799**	**800 - 999**	**1000 - 1199**	**1200 - 1399**	**1400 - 1599**	**1600 - 1799**	**1800 - 1999**	**2000 - 2199**
Rank								
Species richness	7.25	5.8	5.4	6.5	4.7	5.3	4.9	4.7
Rank								
D								
D^2								

3. No work out "D" and "D^2", where d stands for the difference between pairs of ranks. Fill in on the table above.
4. Now sum the values of D^2 to find ΣD^2.
5. Determine the value of n. This is the number of pairs of values in the sample.
6. Substitute the appropriate vales into the Spearman's formula and calculate R_s.

$$r_s = \left[1 - \frac{6\sum D^2}{N^3 - N} \right]$$

7. Look at the Spearman's table below and look up the critical value for the appropriate significance level. What is the critical value?
8. Make a decision. If your calculated value is bigger than the critical value you can accept your hypothesis.
9. Summarise the results of this research.

Degrees of freedom	α = 0.10	α = 0.05	α = 0.01
4	1.000		
5	0.900	1.000	
6	0.829	0.886	1.000
7	0.714	0.786	0.929
8	0.643	0.738	0.881
9	0.600	0.700	0.833
10	0.564	0.648	0.794
11	0.536	0.618	0.755
12	0.503	0.587	0.727