Analytical Methods for Ecologists - Exercises in analysing data - part 3

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20/11/2021

1. Males of many species of dung beetle dig tunnels for females which they can then defend against rival males by defending the entrance. However, some rival males dig diagonal tunnels into the original tunnel in order to secretly gain access to the female, whilst the original male is defending the original tunnel entrance. It is likely that the depth of the original tunnel will be affected by the level of competition amongst males for females (stronger competition leading to deeper tunnels) and the consistency of the soil. A research team has produced a mathematical model which takes a number of variables describing competition levels and soil characteristics, and makes a prediction of the depth of tunnels that you would expect in that area.

Some field workers have just returned from taking measurements of tunnel depths (in the tab-delimited text file ‘dung\_beetle\_tunnel\_depths.txt’) from a particular area near the field station. This area has relatively homogeneous soil characteristics, and the researchers also measured the level of competition between males. The mathematical modellers have taken the soil and competition data and produced a prediction for the depth of tunnels expected in that area. Their prediction is 20.23 cm. Use the tunnel depth data to assess how good the prediction is. You can assume that the data are independent due to the sampling design.

1. Bovine tuberculosis is a serious concern in Great Britain as it can infect cattle, impacting on animal welfare and casuses millions of pounds of losses every year. One of the complexities of the epidemiology of the disease is that it has a number of wildlife host species including the badger (*Meles meles*). As part of recent work to understand disease dynamics in badger populations, researchers have developed a computer model that takes a number of variables describing the habitat in an area and makes a prediction of the badger density (number per km) in that area.

This model has been undergoing a validation process where predictions from the model are tested against field measurements. This has resulted in a dataset of of predictions and their corresponding field measurements. As part of the validation team, you have been given the data (tab-delimited file ‘badger\_density\_validation\_data.txt’) and asked to provide your assessment of the utility of the model.

1. The basic linear regression framework can be described using

Think of an example dataset where this equation may apply, assuming that the independent variable is a continuous variable. Explain what the and coefficients represent, and how you would interpret them in relation to your example.

1. The basic linear regression framework can be expanded to include the effect of a second independent variable

Think of an example dataset where this equation may apply, assuming that both independent variables are nominal or ordinal. Explain what the and coefficients represent, and how you would interpret them in relation to your example.

1. The tab-delimited text file ‘mammal\_size\_brain\_size\_data.txt’ contains measurements of the mean body size (weight in kg) and brain size (weight in kg) from a wide range of land mammals.

Plot body size on the x-axis and brain size on the y-axis.

Note how the more extreme large values make the plot very awkward to interpret. When there are large ranges in values, we often log the values in order to ‘shrink’ the scale. Log-log plots are commonly used in biologically related data as extreme ranges in values are common. Generate two new variables that hold the log of the body size and the log of the brain size, respectively. Use the **log(…)** function to do this. Now plot the log of the body size on the x-axis and log of the brain size on the y-axis.

Use linear regression to investigate the relationship between these two logged variables.

1. A research team are interested in the constraints of environmental conditions on evolutionary dynamics. Reptiles are particularly sensitive to differences in the environment and the researchers have collected data on adders (*Vipera berus*) from three different regions in Britain varying in latitude. The evolutionary constraints are likely to also vary between male and female adders, and the team have collected data from both. They are interested in how region and/or sex can affect the mass of individuals. The data are in the tab-delimited file ‘adder\_by\_region.txt’. Analyse these data to determine if region and/or sex affect the masses of individual adders.