Analytical Methods for Ecologists - 1-way Analysis of Variance

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1. Explain why the ‘within’ and ‘between’ group sums of squares are used in ANOVA as measures of different components of variation.
2. In a 1-way ANOVA, the F-statistic is calculated. If the null hypothesis is true, we expect the valule of the F-statistic to be 1. Explain why, as the F-statistic increases in value we will get a decline in the corresponding p-value.
3. Explain what a type 1 error is.
4. Explain what a type 2 error is.
5. Explain how the ANOVA framework tries to mitigate the increased risk of type 1 errors when making multiple comparisons.
6. The use of environmental DNA (eDNA) in conservation research and monitoring is currently increasing dramatically. However, there is still a lot that is unknown about the sensitivity of the method and how environmental factors can affect its performance.

Water samples can be taken from the environment, the eDNA (DNA from mucous, sloughed skin etc) in the sample can then be amplified and sequenced. These sequences can then be read to identify the species from which the DNA came. One of the major problems with DNA is false negatives, where the species of interest is present but it is not detected due to the eDNA not being present in the samples. Little is known about how the density of the species in the area where the sample is taken affects the probability of detecting the eDNA from that species. To investigate this in relation to the detection of the European eel (Anguilla anguilla), an experiment was conducted.

Tanks with different densities of eel were set up and kept for one month. There were three treatments (density = 2, 4, 8). At the end of the month, water samples were taken from each tank and the amount of eDNA recovered in the sample was determined. Each treatment had five replicates, and the measurement of the amount of eDNA is a unitless standardised quantity (to allow direct comparison) on a continuous scale. Analyse the data (eDNA\_European\_eel\_density\_effect.txt, in tab-delimited format) to determine if the density of eels had an effect on the amount of eDNA recovered in the samples.

Note that, for this particular exercise, you do not need to test the underlying assumptions of your analysis.