Comparing invertebrate biodiversity in 2 different oak species

WALT

- describe a method to sample invertebrate biodiversity
- collect valid data
- assess the strength of any conclusion using statistics

Quercus robur

Native oak

Quercus palustris

Pin oak

Null hypothesis:

There is no difference in the invertebrate biodiversity found in pin oaks and native oaks

The method: tree-bashing!

How do we collect valid data?

- Only change the independent variable
- What variables must be kept constant?

Arthropods

Chelicerates

- mites
- scorpions
- spiders

Myriapods

- centipedes
- millipedes

Insects

(29 groups in total)

- Lepidoptera: butterflies & moths
- Odonata: dragonflies
- Hymenoptera: ants, wasps, bees
- Diptera: flies
- Dermaptera: earwigs
- Hemiptera: leafhoppers, shield bugs,
- Coleoptera: ladybirds, weevils, beetles

Crustacea

- crabs
- shrimps
- woodlice

Results

	Observed numbers	Expected numbers	(O-E)	$(O-E)^2$	$\frac{(O-E)^2}{E}$
Pin oak					
Native oak					

Why use the chi-squared test?

- find out if differences from the expected numbers are due to chance or are biologically important

- **categoric** data

Step 1:

Write a null hypothesis

Step 2:
Draw a table for your analysis

	Observed numbers	Expected numbers	(O-E)	$(O-E)^2$	$\frac{(O-E)^2}{E}$
Pin oak					
Native oak					

Step 3:
Calculate expected numbers under the null hypothesis

	Observed numbers	Expected numbers	(O-E)	$(O-E)^2$	$\frac{(O-E)^2}{E}$
Pin oak					
Native oak					

Step 4:
Do the calculations

	Observed numbers	Expected numbers	(O-E)	$(O-E)^2$	$\frac{(O-E)^2}{E}$
Pin oak					
Native oak					

Step 5:
Calculate the chi-squared statistic

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

$= 5.2$

Step 6: Look up the critical value for your data (depends on number of categories)

X_2 must be larger than the critical value for your null hypothesis to be rejected.

Figures bigger than the critical value are what you would expect to get by chance only 5% of the time, if the null hypothesis were true.

Critical values for Chi-squared

A table showing the critical values of χ^2 for different degrees of freedom.

Degrees of freedom	Critical value
1	3.84
2	5.99
3	7.82
4	9.49
5	11.07
6	12.59
7	14.07
8	15.51
9	16.92
10	18.31

You need to look at the relevant degrees of freedom, which is one fewer than the number of categories

Critical values for Chi-squared

A table showing the critical values of χ^2 for different degrees of freedom.

The oak tree study has 2 categories:

- pin oak
- native oak

There is 1 degree of freedom

Degrees of freedom	Critical value
1	3.84
2	5.99
3	7.82
4	9.49
5	11.07
6	12.59
7	14.07
8	15.51
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Step 6: Compare the critical value with your chi-squared value

- Critical X_2 -squared value = 3.84
- Experimental X_2 -squared = ?

If our value is greater than the chi squared value we reject the null hypothesis.

There is a significant difference between observed and expected values.

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$$D = \frac{\sum n(n-1)}{N(N-1)}$$

The most common formula for working out Species Diversity is the Simpson's diversity index, which uses this formula.

Where:

- D = diversity index
- N = Total number of organisms of all species found
- n = number of individuals of a particular species