CHI^2

CHI^2 is a statistical test used to establish whether there is a statistically significant association between a number of variables. It is used when the data is in **Categories**, for example, age ranges, feeding levels, housing type, era of time (Victorian, Edwardian, etc..)

I have annotated the table which I used for the test below. It may look confusing but when it's broken down it's really simple.

Firstly we need to produce a hypothesis either based on data already which has already been collected or on the data you plan to collect. For the example below

The **Observed** values are the actual values which you recorded at you're site. I.e. using the example below, at the River there were **58 Herbivores, 36 Detritivores, and 75 carnivores** making up 168 organisms in total.

The **Expected** values are a mathematical value calculated which expresses what we would expect the number of organisms to be if there were **no association** at all.

Feeding level	River O	River E	River O-E	River $(O-E)^2$	River Chi Value	Pond O	Pond E	Pond O-E	Pond $(O-E)^2$	Pond Chi Value	Row Total
Herbivores	58	51.35	6.65	44.21	0.86	23	29.65	-6.65	44.21	1.49	81
Detritivores	35	57.69	-22.69	514.86	8.92	56	33.31	22.69	514.86	15.46	91
Carnivores	75	58.96	16.04	257.33	4.36	18	34.04	-16.04	257.33	7.56	93
Column Total	168				14.15	97				24.51	265
										Chi Value	38.66

Step 1: Enter observed values at both sites (Pond and River)

Step 2: Total them up in the 'column total' column.

Step 3: Work out row totals by adding together the observed values at both sites (58+23, 36+ 56, and 75 +18)

Step 4: Once you have the row totals add them up. The sum of your column totals should be the same as the sum of your row totals; in this case the answer is 265.

Step 5: Work out expected values (numbers in brackets relate to the example above)

Formula = <u>Row total (81) x Column Total (168)</u>

Grand total (265)

Step 6: Minus your expected values from your observed values.

Step 7: Square the number

Step 8: Work out your Chi^2 values.

Formula =   <u>(Observed – Expected)^2</u>

Expected

Step 9: Total these up

Step 10: Add your Chi^2 values together i.e. (14.15 + 79.47) = 93.62

Step 11: Work out your degrees of freedom.

Formula: (Number of columns -1) x (Number of Row's -1)

In the case above it is 3 rows, and two columns. The 3 rows are your **Categories** i.e. the feeding levels, and the 2 columns are your **locations** i.e. the pond and river. You **DO NOT** count the other columns or rows; it is purely your locations and categories.

Step 12: Compare your Chi Squared value to the critical value table below.

Significance level = How sure we are that the association hasn't happened by chance

Degree's of freedom

the 0.05 significance level means we are 95% the association didn't happen by chance.

the 0.01 significance level means we are 99% the association didn't happen by chance.

Level of Significance

df	0.05	0.025	0.01	0.005	0.001
1	3.84	5.02	6.63	7.88	10.83
2	5.99	7.38	9.21	10.60	13.82
3	7.81	9.35	11.34	12.84	16.27
4	9.49	11.14	13.28	14.86	18.47
5	11.07	12.83	15.09	16.75	20.51
6	12.59	14.45	16.81	18.55	22.46
7	14.07	16.01	18.48	20.28	24.32
8	15.51	17.53	20.09	21.95	26.12
9	16.92	19.02	21.67	23.59	27.88
10	18.31	20.48	23.21	25.19	29.59
11	19.68	21.92	24.73	26.76	31.26
12	21.03	23.34	26.22	28.30	32.91
13	22.36	24.74	27.69	29.82	34.53
14	23.68	26.12	29.14	31.32	36.12
15	25.00	27.49	30.58	32.80	37.70
16	26.30	28.85	32.00	34.27	39.25
17	27.59	30.19	33.41	35.72	40.79
18	28.87	31.53	34.81	37.16	42.31
19	30.14	32.85	36.19	38.58	43.82
20	31.41	34.17	37.57	40.00	45.31
21	32.67	35.48	38.93	41.40	46.80
22	33.92	36.78	40.29	42.80	48.27
23	35.17	38.08	41.64	44.18	49.73
24	36.42	39.36	42.98	45.56	51.18
25	37.65	40.65	44.31	46.93	52.62