Chi-square test-Overview

Name _____
Date _____ Period __

This test makes a comparison among data obtained and data expected according to the rules of probability. The test is based on observed (O) and expected (E) frequencies of some event. On the basis of the chi-square test it is possible to determine whether the observed frequencies in a sample differ significantly from the expected frequencies. If chi-square (X^2) is small, the data fits the hypothesis well. A large X^2 value represents a large deviation and casts doubts on the hypothesis. This test is mainly used in research concerning genetics.

Use the following equation to calculate $\mathbf{X^2}$ for genetics experiments:

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

E = number expected in each class
O = number observed in each class

1) For each class of offspring, subtract the number expected in the class (E) from the number of observed in the class (O) to find (O-E).
2) Square the difference $(O-E)^2$.
3) Divide the result by the number expected in the class (E).
4) Repeat for all classes of offspring.
5) Add up ( ) all the results; the sum = $\mathbf{X^2}$
6) Determine the degrees of freedom (df) = # of classes - 1
7) Use table B-3 to find significance:

- if X^2 < table value at P=0.05 than do not reject H_o.
- if X^2 > table value at P=0.05 than reject H_o.

Table of Chi-Square Values

df/P	.001	.01	.025	.05	.10	.20
1	10.827	6.635	5.024	3.841	2.706	1.642
2	13.815	9.210	7.378	5.991	4.605	3.219
3	16.268	11.345	9.348	7.815	6.251	4.642
4	18.465	13.277	11.143	9.488	7.779	5.989
5	20.517	15.086	12.832	11.070	9.236	7.289
6	22.457	16.812	14.449	12.592	10.645	8.558
7	24.322	18.475	16.013	14.067	12.017	9.803
8	26.125	20.090	17.535	15.507	13.362	11.030
9	27.877	21.666	19.023	16.919	14.684	12.242
10	29.588	23.209	20.483	18.307	15.987	13.442
11	31.264	24.725	21.920	19.675	17.275	14.631
12	32.909	26.217	23.337	21.026	18.549	15.812
13	34.528	27.688	24.736	22.362	19.812	16.985
14	36.123	29.141	26.119	23.685	21.064	18.151
15	37.697	30.578	27.488	24.996	22.307	19.311

A computed chi-square value greater than or equal to a given table value will occur by chance less frequently than the indicated probability.

Chi-square Practice Problems

1) A biologist suspects that the temperature at which eggs of a certain lizard are incubated plays a role in determining the sex of the offspring. A preliminary study produced the following data. Does temperature play a role? Determine this at a 0.05 level of significance.

20^0C = 21 males; 29 females

24^0C = 35 males; 25 females

2) The birth records at a certain cattle ranch shows that in the last 233 live births in this herd only 96 have been male calves. The owner is alarmed by the statistic and feels that something is wrong with the male/female ratio in these births. Are his fears justified by this data?

3) An experiment involving the genetics of what is thought to be a lethal gene in cattle is carried out. The hypothesis is that the gene, when homozygous, causes the early death of the calf. In crossing cattle that were known to be heterozygous for the trait the following data was obtained. Does the data support the hypothesis?

Births = 19 Lived = 11 Died = 8

4) When Harry crossed red flowered plants and white flowered plants he obtained 705 plants with red flowers and 224 plants with white flowers. Harry expected 3 times as many red flowers as white. Complete a chi- square test to determine if his results were due to chance.

5) Sally crossed some smooth seed, yellow plants with some wrinkled seed, green plants and got the following results:

154 smooth, yellow
124 smooth, green
144 wrinkled, yellow
146 wrinkled, green

She expected a 1:1:1:1 ratio. Complete a chi square to see if her results were due to chance.