Topic: Chi-square Analysis (χ^2)

B.Sc. Botany (Sub.) I

Group:B

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Chi-square Analysis (χ^2)

One of the simplest statistical tests devised to assess the null hypothesis is chi-square analysis (χ^2). This test takes into account the observed deviation in each component of an expected ratio as well as the sample size and reduces them to a single numerical value. This value (χ^2) is then used to estimate how frequently the observed deviation can be expected to occur strictly as a result of chance.

The formula used in chi-square analysis is-

$$\chi^2 = \Sigma\, (o - e)/e$$

In this equation, o is the observed value for a given category and e is the expected value for that category. Σ (sigma) represents the sum of the calculated values for each category of the ration. Because (o – e) is the deviation (d) in each case, the equation can be reduced to

$$\chi^2 = \Sigma\, d^2/e$$

Objective:

In genetical studies, chi-square test is useful in trying to test goodness or fit for any observed data. The genetical experiments are useful in testing principles of heredity. A different ratio is accepted on the basis of specify principle. However, whenever any experiment is done under field condition deviations are accepted in the observed data. To confirm whether the deviation is genetically significant or non-significant chi-square analysis is essential. Any deviation in the data can be attributed either to the environmental factors or to genetical factors. Chi-square test is a definite to confirm the nature of deviation

Method:

Data.....> F2 population for monohybrid experiment
Tall plant = 295
Dwarf plant =105
.....
Total = 400

Problem:

1. Certain whether the data is fit for 3:1 or not?

Chi-square Analysis (χ^2)

Sr. no.	Phenotypic class	Observed (o)	Expected (e)	Deviation = (o-e)	d^2	d^2/e
1.	Tall	295	100x3=300	295-300=-5	25	25/300=0.083
2.	Dwarf	105	100x1=100	105-100=+5	25	25/100=0.25

Unit= size of population/Total numerals in the ratio (3:1) = 400/4 =100

(χ^2) = d^2/e =25/300+25/100 =0.33

Degree of freedom = (n-1), n = Number of phenotypic classes

= 2-1

= 1

If the Chi-square value is 0.33 and degree of freedom is 1.

The probability value will be 0.09.

Interpretation:

- P value of 0.05 or above- Suggest that the deviations in the data are negligible, the deviation can be attributed to chance and environmental factors. The provided data fits in the ratio 3:1. They also confirmed the principle of inheritance as proposed by Mendel that is dominance and segregation.
- The P value less than 0.05 through Chi-square analysis indicates that the deviations in the data are genetically significant. The deviation cannot be attributed to chance. The data is not fit for the ratio of 3:1. The mendelian principle of inheritance is not operated. The observations need alternative genetical explanations.

Problem:

2. Dihybrid experiment was repeated on *Pisum sativum* to confirm the principle of independent assortment. The following data recorded for the F2 population represented by 4 phenotypic classes-

Tall+Red =907
Tall+White =293
Dwarf+Red =295
Dwarf+White =905
.....
Total=2400

Analysis the data for 9:3:3:1 ratio and comment whether Mendelian principle of Independent Assortment is operating or not.

The deviation fit the Mendelian principle of heredity.