RAMA UNIVERSITY

www.ramauniversity.ac.in

FACULTY OF AGRICULTURAL SCIENCES

AND ALLIED INDUSTRIES

RAMA UNIVERSITY

www.ramauniversity.ac.in

FACULTY OF AGRICULTURAL SCIENCES AND ALLIED INDUSTRIES

PROBABILITY AND CHI-SQUARE

Likelihood of occurrence of an event is known as probability (the number of times an event can occur in a large number of trials).

Probability for occurrence of an event (P) = number of times in which the event occurs (m)/ total number of trials (n).

Example: if a coin is tossed, what will be the probability of getting a head?

$$P = 1/1+1/1 = 1/2 = 0.5$$

Probability ranges from 0 to 1.

Rules of probability:

1. If the occurrence of one event, A, excludes the occurrence of the second event, B, the probability that X or Y will occur is the sum of their individual probabilities.

   $$P (A,B) = P (A) + P (B)$$

   Ex. In throwing a dice, what is the probability of either 3 or 6?

   $$P = 1/6 + 1/6 = 2/6 = 1/3$$

2. If the occurrence of one event, A, is independent of a second event, B, the probability that both A and B will occur is the product of their individual probabilities.

   $$P (A+B) = P (A) \times P (B)$$

   Ex. If a coin is tossed 3 times, what is the probability of getting tail all the three times?

   $$P = 1/2 \times 1/2 \times 1/2 = 1/8$$

3. If the occurrence of a second event depends on the occurrence of the first event, than the case will be different:

   Ex. Probability of getting 2 kings from a deck of cards is:

   $$P (2 \text{ kings}) = 4/52 \times 3/51 = 12/2652 = 1/221$$

4. If the probability of occurrence of an event A is p and the probability of occurrence of an event B is q, then the probability that in 'n' trials, event A will occur 's' times and event B will occur 't' times can be calculated by this formula:

   $$P = n! / s!\, t! \times p^s q^t$$

   Sign is called as factorial, eg. 5! = 5×4×3×2×1

   Example: in a family of 5, what is the probability that there will be 3 girls and 2 boys?

   $$P = 5 / 3\ 2 \times (½)^3 (1/2)^2$$

It should be noted that zero factorial equals 1 and any number raised to the zero power also equals one.

Chi- square test:

The Chi-square test is a method of statistical analysis that is used to identify it's deviations from expected outcomes are due to random chance.

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

X^2 = Sum [(Observed- Expected)- 1/2]^2/Expected Number

Chi-square is to find out the actual measurement of the size of the discrepancy between observed and expected results, so that we may accept or reject a hypothesis.

The reduction of ½ from the absolute value of the observed and expected value deviation is known as the Yates correction factor and adds to the accuracy of chi square determinations, when the number of the any of the expected classes is small.

For example, in a cross between individuals heterozygous at a given locus (Aa x Aa) we should expect a 3:1 ratio of dominant to recessive phenotype. The Chi-square test will provide a probability measure that any deviations from the 3:1 ratio are due to random chance vs. something else.

QUANTITATIVE AND QUALITATIVE INHERITANCE

The phenotypic traits of the different organisms may be of two kinds, viz., qualitative and quantitative. The qualitative traits are the classical Mendelian traits of kinds such as form (e.g., round or wrinkle seeds of pea); structure (e.g., horned or hornless condition in cattles); pigments (e.g., black or white coat of guinea pigs); and antigens and antibodies (e.g., blood group types of man).

Qualitative trait may be under genetic control of two or many alleles of a single gene with little or no environmental modifications to obscure the gene effects. The organisms possessing qualitative traits have distinct (separate) phenotypic classes and are said to exhibit discontinuous variations.

The quantitative traits, however, are economically important measurable phenotypic traits of degree such as height, weight, skin pigmentation, susceptibility to pathological diseases or intelligence in man; amount of flowers, fruits, seeds, milk, meat or egg produced by plants or animals, etc. The quantitative traits are also called metric traits. They do not show clear cut

differences between individuals. Such genes which are non-allelic and effect the phenotype of a single quantitative trait, are called polygenes or cumulative genes. The inheritance of poly genes or quantitative traits is called quantitative inheritance, multiple factor inheritance, multiple gene inheritance or polygenic inheritance. The genetical studies of qualitative traits are called qualitative genetics.

The quantitative inheritance has following characteristics:

1. The segregation phenomenon occurs at an indefinitely large number of gene loci.

2. If a substitution of a allele occurs in a gene locus then such allelic substitutions have trivial effects.

3. The genes for a multiple trait have different biochemical functions but similar phenotypic effects, therefore, the phenotypic effects of gene substitutions are interchangeable.

4. Blocks of genes are bound together by inversions and transmitted as units from inversion heterozygotes to their progeny, but such blocks are broken up by crossing over in insersion homozygotes.

5. The polygenes have pleiotropic effects; that is, one gene may modify or suppress more than one phenotypic trait. A single allele may do only one thing chemically but may ultimately affect many characters.

6. The environmental conditions nave considerable effect the phenotypic expression of poly genes for the quantitative traits. For example, height in many plants (e.g., corn, tomato, pea, marigold) is genetically controlled quantitative trait, but some environmental factors as soil, fertility, texture, and water, the temperature, the duration and wavelength of incident light, the occurrence of parasites, etc., also affect the height. Similarly, identical twins with identical genotypes, if grow up in different kinds of environments, show different intelligence quotients.

Examples of Quantitative Inheritance 1. Kernel Colour in Wheat Nilsson-Eble (1909) and East (1910, 1916) gave first significant clue of quantitative inheritance by their individual works on wheat. They crossed a strain of red kernel wheat plant with another strain of white kernel. Grain from the F1 was uniformly red, but of a shade intermediate between the red and white of the parental generation. This might suggest incomplete dominance, but when F1 off-springs were crossed among themselves, the F2 zygotes showed five different phenotypic classes in a. ratio of 1 : 4 : 6 : 4:1

Qualitative characters are the easiest characters, or traits, to deal with are those involving discontinuous, or qualitative, differences that are governed by one or a few major genes. Many such inherited differences exist, and they frequently have profound effects on plant value and utilization. Examples are starchy versus

sugary kernels (characteristic of field and sweet corn, respectively) and determinant versus indeterminate habit of growth in green beans (determinant varieties are adapted to mechanical harvesting). Such differences can be seen easily and evaluated quickly, and the expression of the traits remains the same regardless of the environment in which the plant grows. Traits of this type are termed highly heritable.

A qualitative trait is expressed qualitatively, which means that the phenotype falls into different categories. These categories do not necessarily have a certain order. The pattern of inheritance for a qualitative trait is typically monogenetic, which means that the trait is only influenced by a single gene. Inherited diseases caused by single mutations are good examples of qualitative traits. Another is blood type. The environment has very little influence on the phenotype of these traits.

IMPORTANT QUESTIONS:

1. What is the probability of getting an ace from the deck of cards?

1. What is the probability of getting either an ace or a queen from the deck of cards?
2. Two brown eyed parents are each heterozygous for a recessive blue eye gene. What is the probability that the first two children will be blue eyed?
3. What is the probability that the family of five will consist of a blue, a brown, a blue, a blue and a brown-eyed child in this order?
4. A couple has two girls and is expecting their third child. They hope it will be a boy. What is the probability that their wish will be realized?
5. A certain cross produces an F1 ratio of 157:43. By the means of the chi square test, determine the probability of the chance deviation this large or larger on the basis of 13:3 expectancy.
6. When 250 seedlings were grown from a sample of seeds produced by testcrossing a hybrid green corn plant with one having yellow-striped leaves, 142 of the seedlings had green leaves and 108 had yellow striped leaves. Using the chi-square method, test this result for agreement with the expected 1:1 ratio.