Inbreeding & Relationship Coefficients

Inbreeding Coefficients
An animal’s Inbreeding Coefficient (Wright’s Coefficient or F) is a numerical value that responds to the presence of common ancestors on both the dam’s and the sire’s side of the animal’s pedigree. The Inbreeding Coefficient is expressed as a percentage. The more common ancestors there are in a pedigree, and the closer they are in terms of generations to their descendant, the higher the Inbreeding Coefficient of that descendant.

The standard definition of inbreeding is that it is any scheme which results in the sire and dam having common ancestors. Many breeders use the term ‘inbreeding’ for close relatives and ‘line-breeding’ for more distantly related individuals, but there is no fundamental difference.

The parameter used to express this common heritage is called the ‘inbreeding coefficient’ and was first proposed by Sewell Wright in 1922. Designated F by Wright (but more commonly IC or COI by breeders), it can theoretically range from 0% to 100%, and indicated the probability that the two alleles for any gene are identical by descent.

The inbreeding coefficient is a function of the number and location of the common ancestors in a pedigree. It is not a function, except indirectly, of the inbreeding of the parents. Thus one can mate two highly inbred individuals who share little common ancestry and produce a litter with a very low IC. Conversely, it is possible to mate two closely related dogs, both of which have low ICs, and boost the IC substantially.

Like many other genetic calculations, the IC is based on probabilities, not certainties. An individual may be more or less highly inbred than the number computed.

If we had only a single common ancestor to deal with, life would be relatively simple. However, there are two complications to deal with. The first is that there will be more than one common ancestor. Let’s consider the case of first cousins. In human populations such a pairing is prohibited in some societies but allowed in others. First cousins have two shared grandparents. The second complication is that the common ancestor may be inbred. If so, his or her IC will have to be calculated.

Unfortunately in the average pedigree there are a large number of shared ancestors. Therefore, the total inbreeding for a dog cannot generally be calculated manually. Calculation of inbreeding for only the first few generations is not particularly useful. If there are more than one or two common ancestors in four or five generation pedigree, the inbreeding is probably already higher than desirable. Unfortunately, having none is no guarantee that common ancestors will not occur in abundance further back, and some pedigrees of this type still achieve moderately high inbreeding coefficients. Neither can the number of shared ancestors be used as a reliable guide, as the inbreeding coefficient is very sensitive to when and where they occur in a pedigree.
Relationship Coefficient (R)

The Relationship Coefficient estimates the probable percentage of genes passed down from a particular common ancestor.

The coefficient of relationship provides a way of objectively assessing the similarity of two pedigrees by giving a number that is a direct measure of shared ancestry. In most human populations two individuals picked at random would likely to have an RC of 0, a brother and sister 50% and identical twins 100%. Other relationships would fall between 0% and 50%.

The number generated may be viewed as analogous to the % composition, except that you are comparing two dogs instead of looking at one. A brother and sister will give a value of 50% as long as the ancestor is not repeated. Once ancestors start to repeat, the individuals no longer have an inbreeding coefficient of zero. Two siblings from a highly inbred line may have an RC of 80% or more, and two dogs that are not siblings may have an RC above 50%.