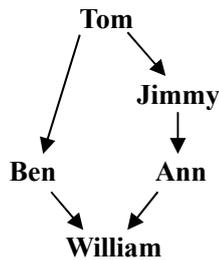


Ann in parallel resulting in the genotype “aa” is  $(1/2)^6=1/64 \approx 1.56\%$ . You must see why “1/2” is taken to the sixth power, because there are six arrows in the schema drawn above.

This means that William has 3×3 incross of Tom; however, if his father Ben had been not Tom’s son but his grandson, it would be 2×3 incross, resulting in the following schema:



Then, the probability that William inherits the Tom’s identical genes through both Ben and Ann to have the genotype “aa” is  $(1/2)^5=1/32 \approx 3.13\%$ , because the number of arrows decreased by one. In other words, 2×3 has twice the “effect” of 3×3 on inbreeding.

As you can see from the above, when one arrow is removed, the “effect” doubles. Therefore, because 2×3 has two fewer arrows than 3×4, the “effect” is “2 times × 2 times = 4 times” greater.

Incidentally, because Tom should have carried both the recessive gene “a” and its dominant allele “A,” the probability that William would have the genotype “AA” is also 1/64. The inbreeding coefficient is the sum of the probability of “AA” and that of “aa,” so that the William’s inbreeding coefficient is  $1/64 + 1/64 = 1/32$ . The following is its formula:

$$F = \Sigma [(1/2)^n (1 + F_A)]$$

F: Inbreeding coefficient

n: Number of individuals in “loop” from one-parent to the other through the common ancestor  
 \* It is 5 in case of the former loop above, but is 4 in case of the latter loop above.

F<sub>A</sub>: Inbreeding coefficient of common ancestor itself  
 \* Tom’s is assumed to be zero in this case.

Σ: Sum in case of multi-common ancestors  
 \* If David and Jimmy are full-brothers sharing the same mother Betty, there will be another “loop” as drawn on the following page; thus the value is  $(1/2)^5 + (1/2)^5 = 1/16$ .

Thoroughbred has persistently undergone the repeated inbreeding. Consequently, within each individual, there are a lot of common ancestors, which appear on both paternal and maternal sides, and therefore it is impossible to fully grasp all of them within a five-generation pedigree chart. Furthermore, if these ancestors themselves were bred by inbreeding, their F<sub>A</sub> values increase, ultimately leading to a rise in the inbreeding coefficient. In other words, even when simply referring to the 3×4 cross, the situation