Inbreeding

24.10.2005
GE02: day 1 part 3

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Inbreeding

- … is breeding between relatives

Coefficient of inbreeding, *F*

- A genotype is called autozygous (or homozygous by descent) if it contains two alleles, which are copies of exactly the same ancestral allele
- Coefficient of inbreeding, *F*, is the chance of such event

Causes of inbreeding

- Deviation from random mating
  - Extreme: self-pollination
  - Systematic marriage between relatives
- Finite population size (to be considered later)

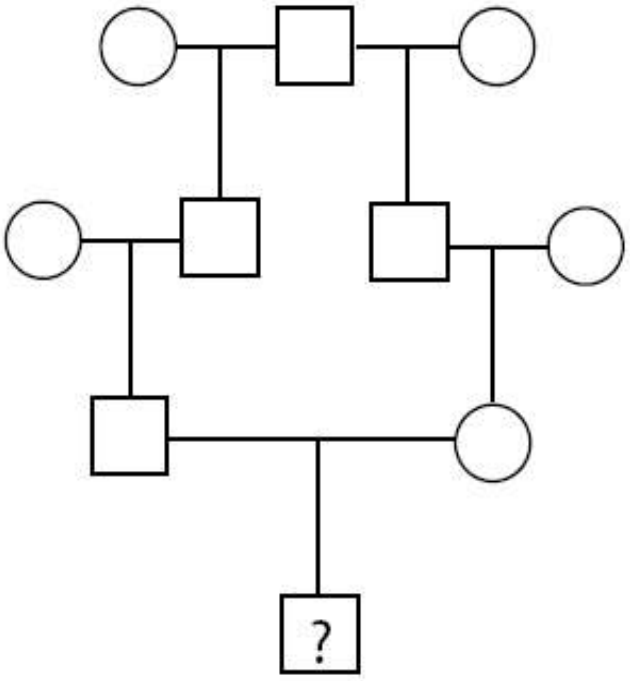
  (For drift populations, $F = 1/2n$)

Inbreeding in consanguineous marriages

- Two ancestral alleles, six meioses
- The chance of a transfer is ½
- Chance that an offspring will receive copy of the same ancestral allele is

  $\frac{1}{2}^{3+3-1} = \frac{1}{2}^{5} = 1/32$

- More general, $F = (\frac{1}{2})^{N-1}$, where N is number of meioses in inbred loop



Inbreeding when more then one loop present

- Sum over all independent loops:

$$F_3 = \Sigma_{i=loops} (½)^{Ni-1} =$$

$$½^{3+3-1} + 2\ ½^{6+6-1} =$$

$$½^5 + ½^{10} =$$

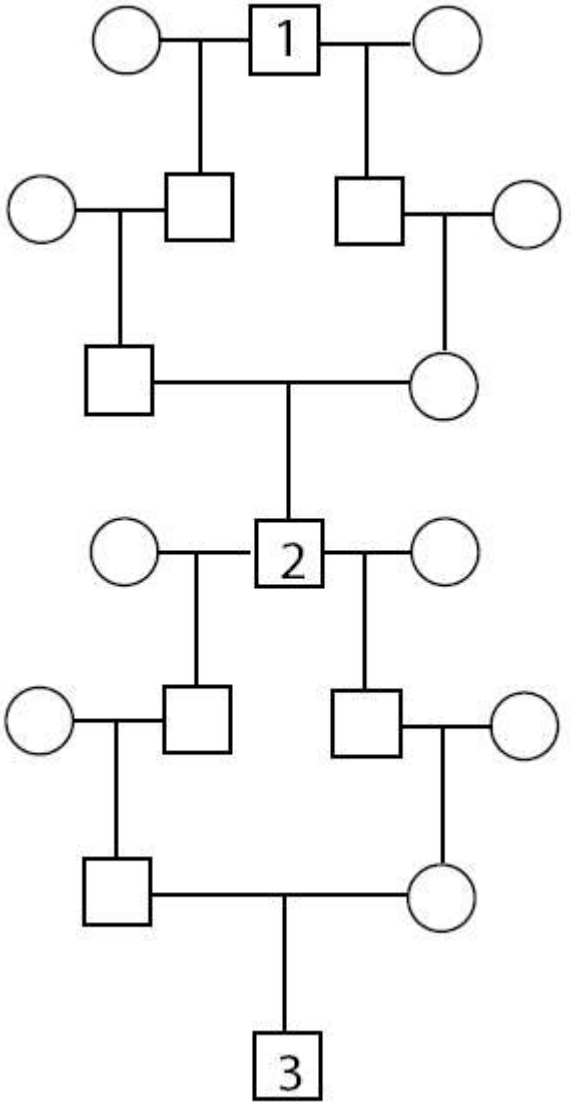
$$½^5 (1 + ½^5) = 33/1024$$

- Or apply recursive rule

$$F_3 = (½)^{Ni-1} (1 + F_{anc}) =$$

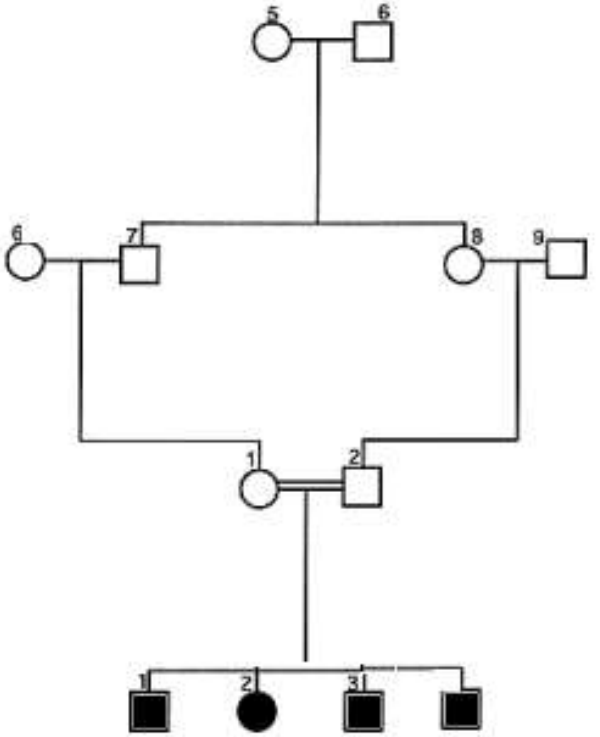
$$½^{3+3-1} (1 + F_2) =$$

$$½^5 (1 + ½^5) = 33/1024$$



Task

- Compute inbreeding for progeny of consanguineous marriage depicted at the figure
- What would be *F* if grand-grand-mother 5 was inbred with *F*=1/32?
- What would be *F* if grand-father 9 was inbred with *F*=1/64?



Answer

- Compute inbreeding for progeny of consanguineous marriage depicted at the figure

  $= 2\ (½)^5 = (½)^4 = 1/16$

- What would be *F* if grand-grand-mother 5 was inbred with *F*=1/32?

  $= 1/16\ (1 + 1/32) = 3/32$

- What would be *F* if grand-father 9 was inbred with *F*=1/64?

  Nothing would happen as 9 cannot serve as a source of shared genetic material

Inbreeding leads to the deviation from HWE

- Inbreeding => People with genotypes identical-by-descent => excess in homozygous
- HWE

$$p^2 \quad : 2\,p\,q \quad : q^2$$

- HWE under inbreeding

$$p^2\,(1-F) + pF \quad : 2\,p\,q\,(1-F) \quad : q^2\,(1-F) + qF$$

Task

- An allele is present with frequency of 0.01
- What is expected genotypic distribution in
  - Large outbred population with random mating?
  - A population of progeny from cousin-marriage?
  - In a finite population of size 10?
  - In a finite population of size 100?