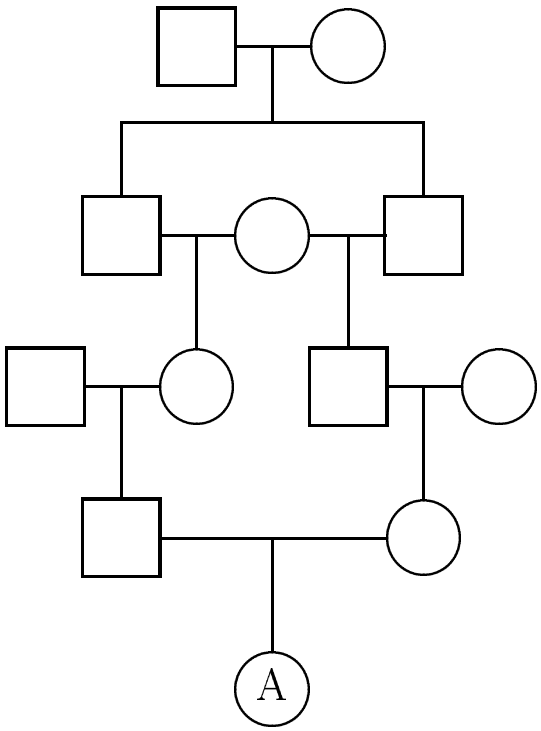
Problem Set 2 140.668 Statistical Genetics
Due 24 April 2001

1. Calculate the inbreeding coefficient for individual A in the following pedigree.



2. Consider an autosomal marker with alleles $a_1, a_2, \ldots a_k$ at frequencies $p_1, p_2, \ldots p_k$, and consider a pair of non-inbred individuals. Let $X_1, X_2 =$ the numbers of a_1 alleles that the two individuals have, respectively. ($X_i = 0$, 1 or 2.) Show that, under Hardy-Weinberg equilibrium,

$$\begin{aligned} \mathrm{var}(X_i) &= 2p_1(1-p_1) \\ \mathrm{cov}(X_1, X_2) &= 4\Phi p_1(1-p_1) \\ \mathrm{corr}(X_1, X_2) &= 2\Phi \end{aligned}$$

where Φ is the kinship coefficient for the pair.

3. Again consider an autosomal marker with alleles $a_1, a_2, \ldots a_k$ at frequencies $p_1, p_2, \ldots p_k$, and a pair of non-inbred individuals. Let IBD = the number of alleles they share identical by descent and IBS = the number of alleles they share identical by (or in) state. Calculate, under Hardy-Weinberg equilibrium, $\Pr(\mathrm{IBS} = i | \mathrm{IBD} = j)$ for $i, j = 0, 1, 2$.