1. Consider a population where allele frequencies differ between the sexes. Assume that there are equal numbers of males and females and that genotypes occur in Hardy-Weinberg proportions within each sex. Focus on a single di-allelic marker in this population. The marker has allele frequency \( p_M = p + \Delta \) in males and \( p_F = p - \Delta \) in females, where \( p = (p_F + p_M)/2 \).

   a) Calculate offspring genotype frequencies after one generation of random mating.

   b) How do genotype frequencies differ from those expected under Hardy-Weinberg equilibrium?

   c) How many additional generations are required before Hardy-Weinberg equilibrium is reached?

2. In a sample of 80 individuals, 75 homozygotes for allele A, 2 homozygotes for allele B and 3 heterozygotes were observed. Conditional on the number of observed A and B alleles, answer the following questions:

   a) What is the probability of this particular sample configuration?

   b) What is the probability of observing an equal or greater number of heterozygotes?

   c) What is the probability of observing a smaller number of heterozygotes?

   d) What is the chi-squared statistic for Hardy-Weinberg equilibrium?

3. Consider two loci in disequilibrium in a large population. Assume that the recombination fraction between the two loci is 0.01. In how many generations do you expect the disequilibrium coefficient \( D \) to be halved?

4. Consider the following set of haplotype frequencies:

   \[ p_{AB} = 0.3, \; p_{AB} = 0.2; \; p_{aB} = 0.1; \; p_{ab} = 0.4 \]

   a) Calculate \( D \), \( D' \) and \( \Delta^2 \) between the two markers.

   b) What is the probability that allele A will be present in a chromosome that carries allele b?

   c) What is the maximum possible value of \( r^2 \) for this marker pair?