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. 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?

3. Consider the following set of haplotype frequencies:

   \[ p_{AB} = 0.2, \; p_{Ab} = 0.2; \; p_{aB} = 0.1; \; p_{ab} = 0.5 \]

   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) If a particular disease has prevalence 0.20 among homozygotes for genotype b/b and zero (0) otherwise, what is the NCP when allele b is examined in a study of 100 cases and 100 controls?

   d) What if allele A were examined instead?