Math153: Problem set 2. Due 28 October 2004.

Exercise 1: Take a binary quasi-species of length $L = 5$. Take the following fitness landscape:

00000.... 10

01111.... 8.5

10111.... 8.8

11110.... 8.9

11111.... 9

All other sequences have fitness 1.

Plot the equilibrium distribution of the quasispecies as a function of the mutation rate u. Discover something interesting. If nothing interesting happens change slightly the value of the fitness landscape. Guess what I want to happen.

What does 'survival of the fittest' mean?

Exercise 2: Try other fitness landscapes. Ignore back mutation.

Exercise 3:

Gene A has length m. Gene B has length n. The mutation rate per base is u. Ignore back mutation. A mutation in any single base leads to a loss of function of that gene. There are four different genotypes: AB, Ab, aB, ab. Capital letters mean the gene is unmutated. Small letters mean the gene is mutated and has lost its function. The fitness landscape is $f_{AB} = 1$, $f_{aB} = 1 - a$, $f_{Ab} = 1 - b$, $f_{ab} = 1 - c$.

Calculate error thresholds.

Choose interesting parameter values for a, b, c, m and n. Plot the equilibrium values of the genotype frequencies x_{AB}, x_{aB}, x_{Ab}, x_{ab} versus mutation rate u.