Statistical Learning

E222

Week 1 review Questions

1. Review the pages 42-51 in the textbook. Try copying and pasting commands into R from this section using the PDF version of the textbook.

2. Assume a genetic system of three alleles (a_1, a_2, a_3) at a single locus. The only forces changing these allele frequencies is mutation. The rate of mutation of a_i to a_j is μ_{ij}. Then the system of equations defining the allele frequency change over a single generation is given by,

$$x_{1,t+1} = (1 - \mu_{12} - \mu_{13})x_{1,t} + \mu_{21}x_{2,t} + \mu_{31}x_{3,t}$$

$$x_{2,t+1} = \mu_{12}x_{1,t} + (1 - \mu_{21} - \mu_{23})x_{2,t} + \mu_{32}x_{3,t}$$

$$x_{3,t+1} = \mu_{13}x_{1,t} + \mu_{23}x_{2,t} + (1 - \mu_{31} - \mu_{32})x_{3,t}$$

If we let $\mathbf{x}_t = (x_{1,t}, x_{2,t}, x_{3,t})^T$, then find an expression for $\mathbf{x}_t$ in terms of the initial allele frequencies, $\mathbf{x}_0$, and the mutation rates in the equations above.

3. Suppose the random variable X, has a mean μ_x and variance σ_x^2. Find the variance of $\ln(X)$.