

Q1

w_{11}	w_{12}	w_{22}
1	1.1	1.25

using selection formula

$$p' = \left(\frac{\bar{w}_1}{\bar{w}} \right) p$$

$$\text{where } \bar{w}_1 = p w_{11} + q w_{12}$$

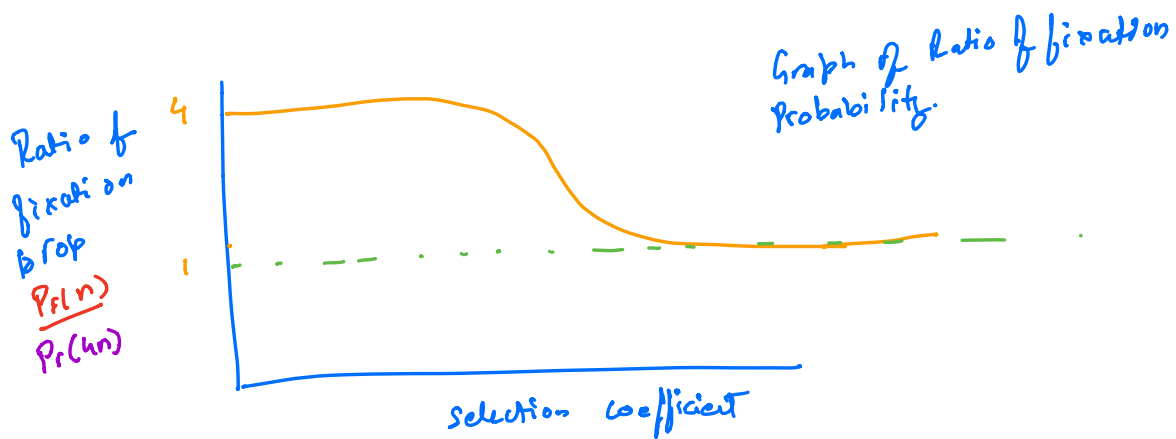
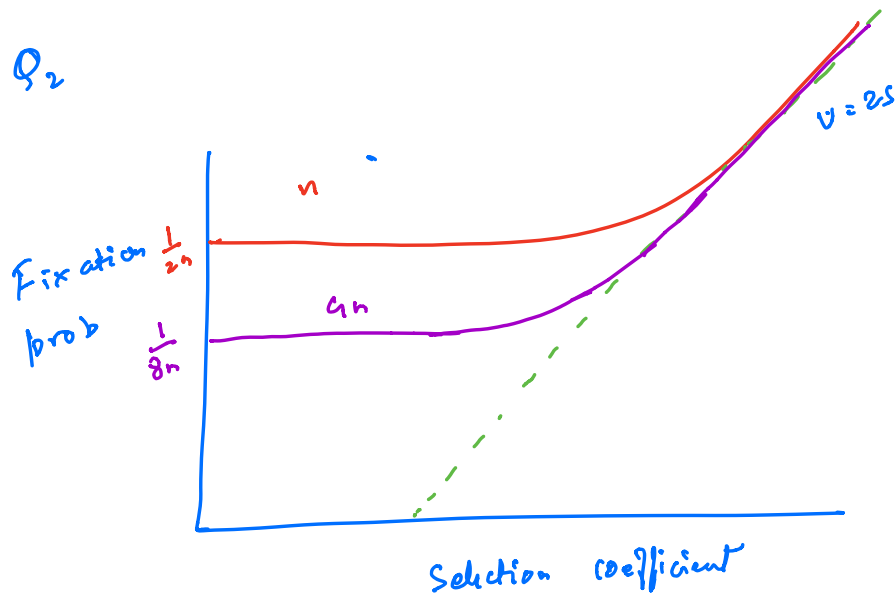
$$\bar{w} = p^2 w_{11} + 2pq w_{12} + q^2 w_{22}$$

$p = 0.4 \rightarrow \text{generation 0}$

using the above formula recursively we can get p in subsequent generations (I did calculations in Excel)

generation	p	\bar{w}_1	\bar{w}
0	0.4	1.06	1.123
1	0.377	1.062	1.129
2	0.355	1.064	1.133
3	0.333	1.066	1.138
4	0.312	1.068	1.142
5	0.292	1.070	1.146
6	0.273	1.072	1.150
7	0.254	1.074	1.154
8	0.237	1.076	1.158
9	0.220	1.078	1.162
10	0.2044	1.08	1.166

Q₂



When selection is small, the prob of fixation is same as if the mutation is neutral. This happens because when population is small, drift becomes stronger than Selection

Thus, the population with size n has higher probability of fixation than the population with size $4n$. But as the selection coefficient increases, the probability of fixation for both populations becomes the same $2s$. In this case, selection is stronger than drift

Q3

Factors that effect diversity in a genome

bottle neck

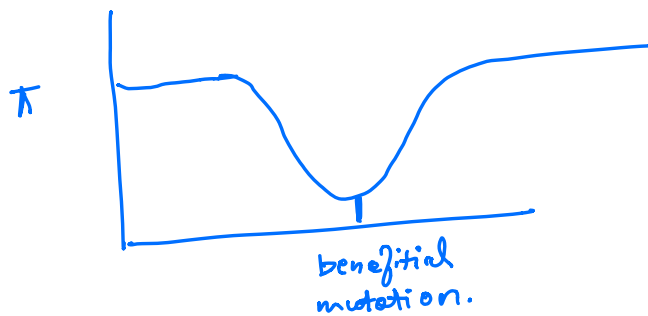
If the population contracts it might loose its genetic diversity due to ^{drift}. For example, reduction in genetic diversity of neutral site is

$$\Delta\pi = \left(\frac{1}{2N}\right)\pi$$

If $N \downarrow$, $\Delta\pi \downarrow$, $\pi \downarrow$

selection & sweeps

If a beneficial mutation arises, selection drives that mutation to fixation. Also, sites that are close to selected loci may also increase in frequency due to gene hitchhiking



Neutral Mutation Rate

Under standard neutral model, the diversity π is given by

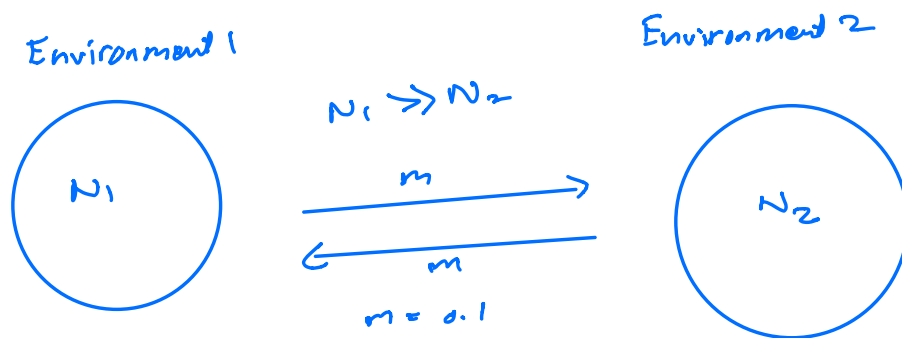
$$\theta = 4N\mu_n$$

where μ_n is neutral mutation rate.

Thus, the region of genome which have higher μ_n have higher π . For example, neutral sites.

Conversely, the regions of genome with low μ_n have lower π . For example, codons & exons.

Q4



- ④ Because $N_1 \gg N_2$, N_1 act as an isolated population which is undergoing a hard sweep. Thus, region near the selected site show variability statistics of a hard sweep.
- ⑤ But for N_2 , migration can introduce more diverse individuals. Thus, the region near the selected site show variability statistics of a soft sweep.

