

3. In *Positive Assortment* mating, individuals mate more frequently with those of the same genotype. As an extreme case assume that each genotype only mates with its own types. That is AA only mates with AA , Aa only mates with Aa , and aa only mates with aa . Let P_t , Q_t and R_t be the relative frequencies of AA , Aa , and aa , respectively.

(a) What genotypes result from the mating of Aa and Aa and in what proportions?

(b) Write down the difference equations for the relative frequencies P_t , Q_t and R_t .

(c) Solve the equation for Q_t as a function of time. What happens to Q_t as $t \rightarrow \infty$?

(d) The above difference equations indicate that the genotype frequencies change over time. Use these equations to show that the relative frequency of Allele A is constant (use the fact that $p_t = P_t + \frac{1}{2} Q_t$).

(e) Solve the difference equations in part (b) for P_t , Q_t and R_t in terms of P_0 and Q_0 . (Hint: Solve for Q_t first and then use the fact that $p_t = P_t + \frac{1}{2} Q_t = \text{constant}$, to solve for P_t .)

(f) What happens to the distribution of the genotypes over time?

4. Often times an allele A is neither completely dominant nor completely recessive, and the heterozygotes may be of intermediate fitness between the two homozygotes. Suppose $w_{AA} = 1 + 2s$, $w_{Aa} = 1 + s$ and $w_{aa} = 1$.

(a) Show that

$$p_{t+1} = p_t + \frac{sp_tq_t}{1 + 2sp_t}$$

(b) Find the equilibria for this model and specify their stability.

(c) Show that under weak selection the model corresponds to logistic growth. Specify the intrinsic growth rate and the carrying capacity.