

1. The North Carolina State Fair is the testing grounds for the Biology Club's Secret Pig Breeding Program. The Biology Club has been breeding pigs for the past several years in order to win the Pig Races. Of course, with their knowledge of quantitative genetics, they have decided on a mass breeding program. They have found that pig speed has a mean value of 16.2 km/hour, with a standard deviation of 0.8 km/hour. In addition, they have found that heritability in the broad sense is 0.75 and heritability in the narrow sense is 0.35. The Biology Club will select the fastest 25% of the pigs and mate these at random.

- a) What is the expected selection response for this experiment?

$$(1.27)(0.35)(0.8\text{km/h}) = 0.3556 \text{ km/h}$$

- b) What is the expected mean speed for the pigs for next year?

$$16.2\text{km/h} + 0.36\text{km/h} = 16.56 \text{ km/h}$$

2. Consider a population with the following genotypic frequencies:

$$0.4225 \text{ DD} + 0.4550 \text{ Dd} + 0.1225 \text{ dd}$$

- a) Give the gene frequencies for alleles **D** and **d**.

$$\mathbf{D} \quad \underline{0.65} \quad \mathbf{d} \quad \underline{0.35}$$

- b) We will take this population and apply a **systematic system of inbreeding** until the inbreeding coefficient rises to 0.25. Give the genotypic frequencies when this experiment is completed.

$$\mathbf{DD} \quad \underline{0.4794} \quad \mathbf{Dd} \quad \underline{0.3412} \quad \mathbf{dd} \quad \underline{0.1794}$$

- c) Consider the original population in a). We will follow this population through a generation of natural selection. We know that the fitness of the dd individuals is only half of the DD individuals, and that the fitness of the heterozygotes is three-fourths of the DD individuals. Give the gene frequencies after one generation.

$$\mathbf{D} \quad \underline{0.7189} \quad \mathbf{d} \quad \underline{0.2811}$$

- d) Consider the original population in a). Assume the mutation rate is 1×10^{-5} and 3×10^{-7} for A to a and a to A, respectively. Give the gene frequencies after one generation.

$$\mathbf{D} \quad \underline{0.649993605} \quad \mathbf{d} \quad \underline{0.350006395}$$

- e) Consider the original population in a). Assume this is an island population, migration from a large mainland population. The genotypic array on the mainland is: .09DD+.42Dd+.49dd, and the migration rate is 1%. Give the gene frequencies after one generation.

$$\mathbf{D} \quad \underline{0.6465} \quad \mathbf{d} \quad \underline{0.3535}$$