Alternative Explanation of Breeding Values

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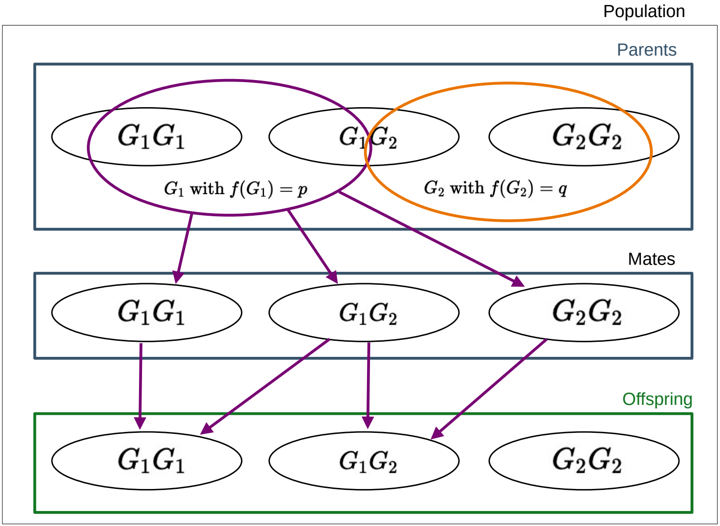
Alleles

- Look at effect of alleles instead of genotypes
- Compute for each allele: deviation of expected genotypic value from population
- Breeding value is sum of allele deviations

Effect of Allele G_1



Deviation from Population Mean for G_1

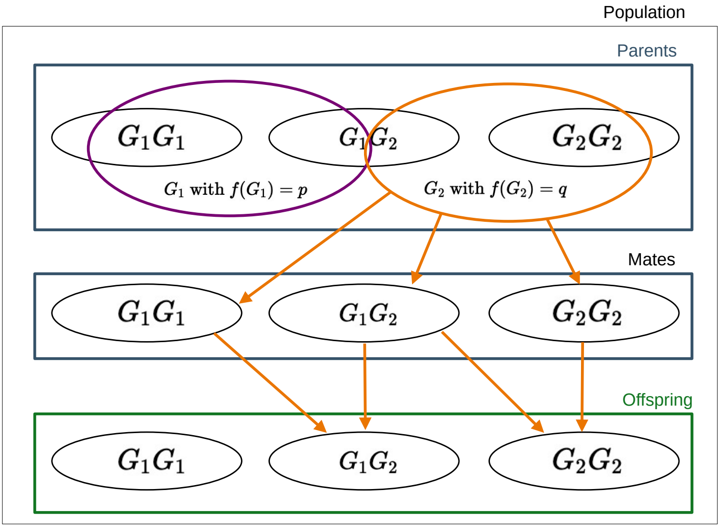
- Expected genotypic value (μ_1) for offspring resulting from G_1

$$\mu_1 = p * a + q * d$$

* Deviation of μ_1 from population mean μ

$$\begin{aligned}
\alpha_1 &= \mu_1 - \mu \\
&= p * a + q * d - [(p - q)a + 2pqd] \\
&= q(a + (1 - 2p)d) \\
&= q(a + (q - p)d) \\
&= q\alpha
\end{aligned}$$

Effect of Allele G_2



Deviation from Population Mean for G_2

- Expected genotypic value (μ_2) for offspring resulting from G_2

$$\mu_2 = p * d - q * a$$

* Deviation of μ_2 from population mean μ

$$\begin{aligned}
\alpha_2 &= \mu_2 - \mu \\
&= p * d - q * a - [(p - q)a + 2pqd] \\
&= -pa + pd - 2pqd \\
&= -p(a - d + 2qd) \\
&= -p(a - (1 - 2q)d) \\
&= -p(a + (q - p)d) \\
&= -p\alpha
\end{aligned}$$

Properties and Breeding Values

- Property: linear in number of G_1

$$\alpha_1 - \alpha_2 = q\alpha - (-p\alpha) = \alpha$$

- Breeding values: sum of allele effects
  - G_1G_1: $BV_{11} = \alpha_1 + \alpha_1 = 2q\alpha$
  - G_1G_2: $BV_{12} = \alpha_1 + \alpha_2 = (q - p)\alpha$
  - G_2G_2: $BV_{22} = \alpha_2 + \alpha_2 = -2p\alpha$