- We want to be able to quantify the variation in the different values (genotypic, breeding values, ...) by a single number or quantity.
- From statistics, the concept of variance is used:
  For a given discrete random variable X the variance is defined as:

$$Var[X] = \sum_{x_i \in X} (x_i - \mu_x)^2 \cdot f(x_i)$$

$$\mu_x = E[X] \quad \text{(expected value, population mean.)}$$

- Variance of genotypic values V_{ij}:

$$\underbrace{\sigma_G^2 = Var(V)}_{\text{total genetic Variance}} = (V_{11} - \mu)^2 \cdot f(G_1G_1) + (V_{12} - \mu)^2 \cdot f(G_1G_2) + (V_{22} - \mu)^2 \cdot f(G_2G_2)$$

- Use $V_{ij} - \mu = BV_{ij} + D_{ij}$ insert in $Var[V]$ (Appendix 28)

Result: σ_G^2