

Expectation, Variance, and Covariance

Expectation E[X]

Average value

$$E[X] = \sum xP(X=x) \text{ or } \int xf(x)dx$$

Properties

$$E[aX + b] = aE[X] + b$$

$$E[X + Y] = E[X] + E[Y]$$

Variance Var(X)

Spread around mean

$$\text{Var}(X) = E[(X - \mu)^2]$$

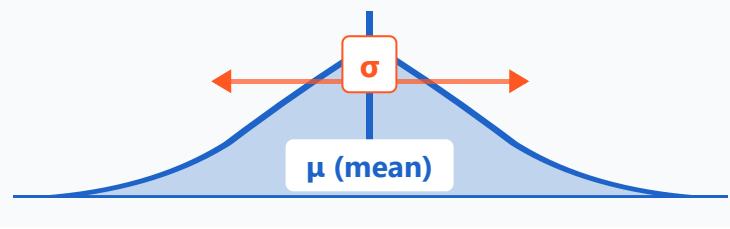
Standard Deviation σ

$$\sigma = \sqrt{\text{Var}(X)}$$

Covariance

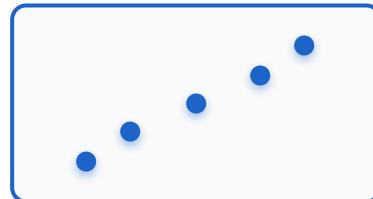
$$\text{Cov}(X, Y) = E[(X - \mu_X)(Y - \mu_Y)]$$

Variance: Spread Around Mean



Covariance Sign Interpretation

Positive Cov



Negative Cov



Covariance Matrix

$$\Sigma = [\text{Cov}(X_i, X_j)]$$

For multiple variables

Regression Application

Positive: X and Y increase together

Understanding variable relationships