



Why

We want a measure of the *spread* of a random variable.

Definition

The *covariance* (or *variance*) of a random variable $x : \Omega \rightarrow \mathbf{R}$ is $\mathbf{E}((x - \mathbf{E}(x))^2)$, the expectation of the square of the random variable's distance from its mean. The covariance measures the mean square difference from the mean.

Interpretation

The covariance of x summarizes how “wide” the induced distribution of x is. If the covariance is small, then the induced distribution is concentrated around its mean.¹

Notation

We denote the covariance of x by $\mathbf{cov}(x)$. Another common notation is $\mathbf{var}(x)$.

Standard deviation

If x has units meters, then $\mathbf{cov}(x)$ has units square meters. It can be useful to work instead with the *standard deviation* of x , defined as $\sqrt{\mathbf{cov}(x)}$, which has the same units as x . We denote the standard deviation of x by $\mathbf{std}(x)$.

¹Future editions will give example.

