

# DISTRIBUTION COVARIANCE

## Why

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

#### Definition

The covariance (or variance) of a random variable  $x: \Omega \to \mathbb{R}$  is  $\mathsf{E}((x-\mathsf{E}(x))^2)$ , 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.<sup>1</sup>

#### Notation

We denote the covariance of x by cov(x). Another common notation is var(x).

#### Standard deviation

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

<sup>&</sup>lt;sup>1</sup>Future editions will give example.

