Why

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

Definition

The *covariance* (or *variance*) of a random variable $x : \Omega \to \mathbf{R}$ 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]

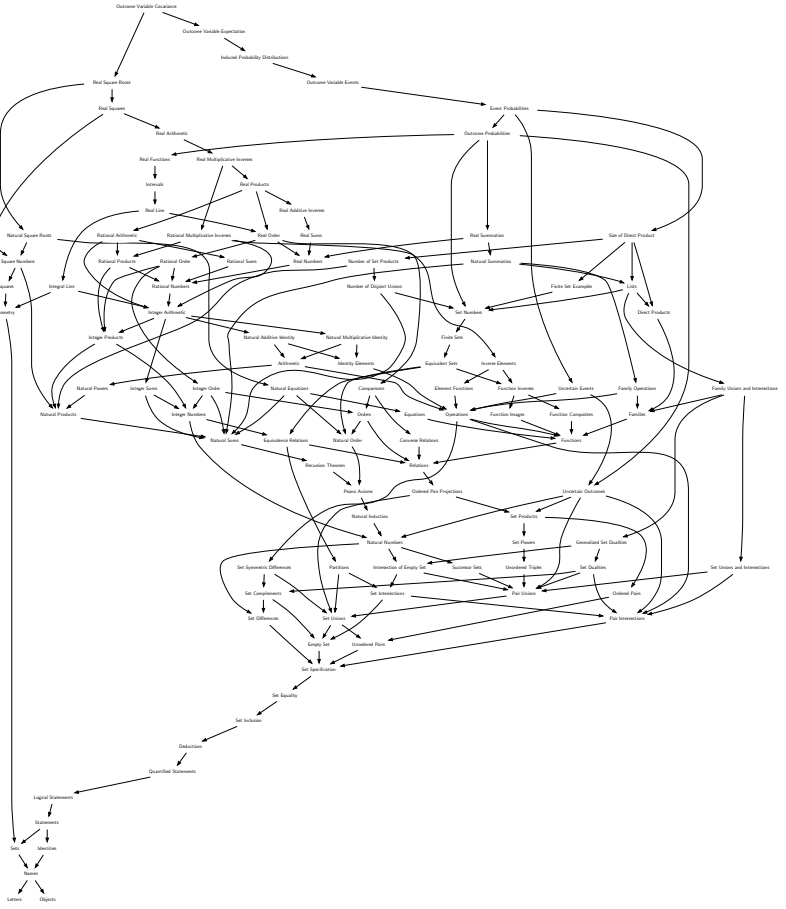
Notation

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

Standard deviation

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

[1] Future editions will give example.


Outcome Variable Covariance
Outcome Variable Expectation
Induced Probability Distribution
Outcome Variable Events
Real Square Roots
Real Squares
Event Probabilities
Real Arithmetic
Outcome Probabilities
Real Functions
Real Multiplicative Inverses
Intervals
Real Products
Real Line
Real Additive Inverses
Natural Square Roots
Rational Arithmetic
Rational Multiplicative Inverses
Real Order
Real Sums
Real Summation
Size of Direct Product
Square Numbers
Rational Products
Rational Order
Rational Sums
Real Numbers
Number of Set Products
Natural Summation
Squares
Integral Line
Rational Numbers
Finite Set Examples
Lists
Geometry
Integer Arithmetic
Number of Disjoint Unions
Set Numbers
Direct Products
Integer Products
Natural Additive Identity
Natural Multiplicative Identity
Finite Sets
Arithmetic
Identity Elements
Equivalent Sets
Inverse Elements
Natural Powers
Integer Sums
Integer Order
Natural Equations
Comparison
Element Functions
Function Inverses
Uncertain Events
Family Operations
Family Unions and Intersections
Natural Products
Integer Numbers
Orders
Equations
Operations
Function Images
Function Composites
Families
Natural Sums
Equivalence Relations
Natural Order
Converse Relations
Functions
Recursion Theorem
Relations
Peano Axioms
Ordered Pair Projections
Uncertain Outcomes
Natural Induction
Set Products
Natural Numbers
Set Powers
Generalized Set Dualities
Set Symmetric Differences
Partitions
Intersection of Empty Set
Successor Sets
Unordered Triple
Set Dualities
Set Unions and Intersections
Set Complements
Set Intersections
Pair Unions
Ordered Pairs
Set Difference
Set Unions
Pair Intersections
Empty Set
Unordered Pairs
Set Specification
Set Equality
Set Inclusion
Deductions
Quantified Statements
Logical Statements
Statements
Sets
Identities
Names
Letters
Objects