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covariance

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The *covariance* of two random variables X_1 and X_2 with <http://planetmath.org/ExpectedVal> μ_1 and μ_2 respectively is defined as

$$\text{cov}(X_1, X_2) := E[(X_1 - \mu_1)(X_2 - \mu_2)]. \quad (1)$$

The covariance of a random variable X with itself is simply the variance, $E[(X - \mu)^2]$.

Covariance captures a measure of the correlation of two variables. Positive covariance indicates that as X_1 increases, so does X_2 . Negative covariance indicates X_1 decreases as X_2 increases and vice versa. Zero covariance can indicate that X_1 and X_2 are uncorrelated.

The *correlation coefficient* provides a normalized view of correlation based on covariance:

$$\text{corr}(X, Y) := \frac{\text{cov}(X, Y)}{\sqrt{\text{var}(X)\text{var}(Y)}}. \quad (2)$$

$\text{corr}(X, Y)$ ranges from -1 (for negatively correlated variables) through zero (for uncorrelated variables) to +1 (for positively correlated variables).

While if X and Y are independent we have $\text{corr}(X, Y) = 0$, the latter does not imply the former.