

expectation ($E(X)$, μ)

The *average* value of all possible values of a *random variable*, weighted by *probability*. The expectation is also referred to as the *mean* and then the letter μ is used to refer to it. For the computation of the mean value of a *data set*, see *mean*. The expectation of a numeric frequency distribution is computed as follows:

$$E(X) = \sum_{i=1}^n x_i \cdot P(x_i)$$

For instance, when buying lottery tickets at a cost of 1 currency unit each, the random variable X described by the following frequency table may list the probabilities of winning a prize:

X	-1	10	50	100
$P(X)$	0.9655	0.03	0.004	0.0005

Then the expectation $E(X)$ of the variable is:

$$0.9655 \cdot -1 + 0.03 \cdot 10 + 0.004 \cdot 50 + 0.0005 \cdot 100 \approx -0.42$$

That is, the average return from buying a ticket will be -0.42 currency units.

The expectation of a *probability distribution* is the value x for which the *cumulative distribution function* (CDF) F of the distribution yields $F(x) = 0.5$, i.e. the point x at which the area under the CDF curve is split in half or, more formally, where $P(X \leq x) = 0.5$ and $P(X \geq x) = 0.5$. The expectation of a probability distribution can be computed using the *quantile function* F^{-1} of that distribution or by using a closed formula that is specific to the distribution.