Expected value

Expected value of a function f(x)

$$E\left[f(x)\right] = \sum_{x \in A} f(x)p(x)$$

Sample estimate of E[f(x)]: take N values x_i and average

$$\hat{f} = \frac{1}{N}\sum_{i=1}^{N} f(x_i)$$

Caution!! Expected "value" is a math-term which has nothing to do with the value-function!

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important examples:

Mean of a distribution:

$$E[x] = \mu = \sum_{x \in A} x\,p(x)$$

Sample mean:

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Variance of a distribution:

$$E[(x-\mu)^2] = \sigma^2 = \sum_{x \in A} (x-\mu)^2 p(x)$$

Sample variance:

$$\hat{\sigma}^2 = \frac{1}{N} \sum_{i=1}^{N} (x_i - \mu)^2$$