

# Random variables

A **random variable** is a variable whose value depends on the outcome of a random (probabilistic) event.

Random variables can be **discrete** (finite list of outcomes) or **continuous** (infinite range of outcomes).

The **probability model** of a random variable is a list of its outcomes and their probabilities.

## Random variable: Coin flipping game #1

I flip a coin 3 times.

I pay you \$1 for each heads.

### Probability model:

Outcomes (Values of the random variable)	Probabilities
\$0	1/8
\$1	3/8
\$2	3/8
\$3	1/8

The **mean** or **expected value** of a random variable  $X$  is

$$\mu = E(X) = \sum xP(X = x)$$

The **standard deviation** of a random variable  $X$  is

$$\sigma = SD(X) = \sqrt{\sum (x - \mu)^2 P(X = x)}$$

Compare to the old formulas for mean and standard deviation:

Mean

$$\bar{y} = \frac{\text{sum of the values}}{\text{number of cases}} = \frac{\sum y}{n}$$

Standard deviation

$$s = \sqrt{\frac{\sum (y - \bar{y})^2}{n-1}}$$