

## Random Variable

What's a random variable?

Formally

### Random Variable

$X: \Omega \rightarrow \mathbb{R}$  is a random variable  
 $X(\omega)$  is the summary of the outcome  $\omega$

Support  $\Omega_X$   
 the set of values  
 $X$  can take.

Probability Mass  
 Function  
 (pmf  $p_X(x)$ )  
 on input  $x$ , tells  
 you  $\mathbb{P}(X = x)$ .

Informally: A random variable is a way to **summarize** the important (numerical) information from your outcome.

1

## Try It Yourself

There are 20 balls, numbered  $1, 2, \dots, 20$  in a jar.

You'll draw out a size-three subset. (i.e. without replacement)

$\Omega = \{\text{size three subsets of } \{1, \dots, 20\}\}$ ,  $\mathbb{P}()$  is uniform measure.

Let  $X$  be the largest value among the three balls.

If outcome is  $\{4, 2, 10\}$  then  $X = 10$ .

Write down the pmf of  $X$

2

## Describing a Random Variable

The most common way to describe a random variable is the PMF.  
But there's a second representation:

The cumulative distribution function (CDF) gives the probability  $X \leq x$   
More formally,  $\mathbb{P}(\{\omega: X(\omega) \leq x\})$   
Often written  $F_X(x) = \mathbb{P}(X \leq x)$

$$F_X(x) = \sum_{i:i \leq x} p_X(i)$$

3

## Try it yourself

What is the CDF of  $X$  where  
 $X$  be the largest value among the three balls. (Drawing 3 of the 20  
without replacement)

4