Flipping coins in R

FOUNDATIONS OF PROBABILITY IN R

David Robinson
Chief Data Scientist, DataCamp

Flipping a coin

50% chance of heads

50% chance of tails

Flipping a coin in R

```
rbinom(1, 1, .5)
# [1] 1
```


```
rbinom(1, 1, .5)
# [1] 0
```

Flipping multiple coins

```
rbinom(10, 1, .5)
# [1] 0 1 1 0 1 1 1 0 1 0
```

```
rbinom(10, 1, .5)
# [1] 0 0 0 1 0 1 0 1 0 0
```

```
rbinom(1, 10, .5)
# [1] 4
```

```
rbinom(10, 10, .5)
# [1] 3 6 5 7 4 8 5 6 4 5
```

Unfair coins

```
rbinom(10, 10, .8)
# [1]  6  7  9 10  7  7  8  9  9  8
```

```
rbinom(10, 10, .2)
# [1] 2 2 1 2 2 4 3 1 0 2
```

Binomial distribution

$$X_{1\ldots n} \sim \text{Binomial}(\text{size}, p)$$

Let's practice!

FOUNDATIONS OF PROBABILITY IN R

Density and cumulative density

FOUNDATIONS OF PROBABILITY IN R

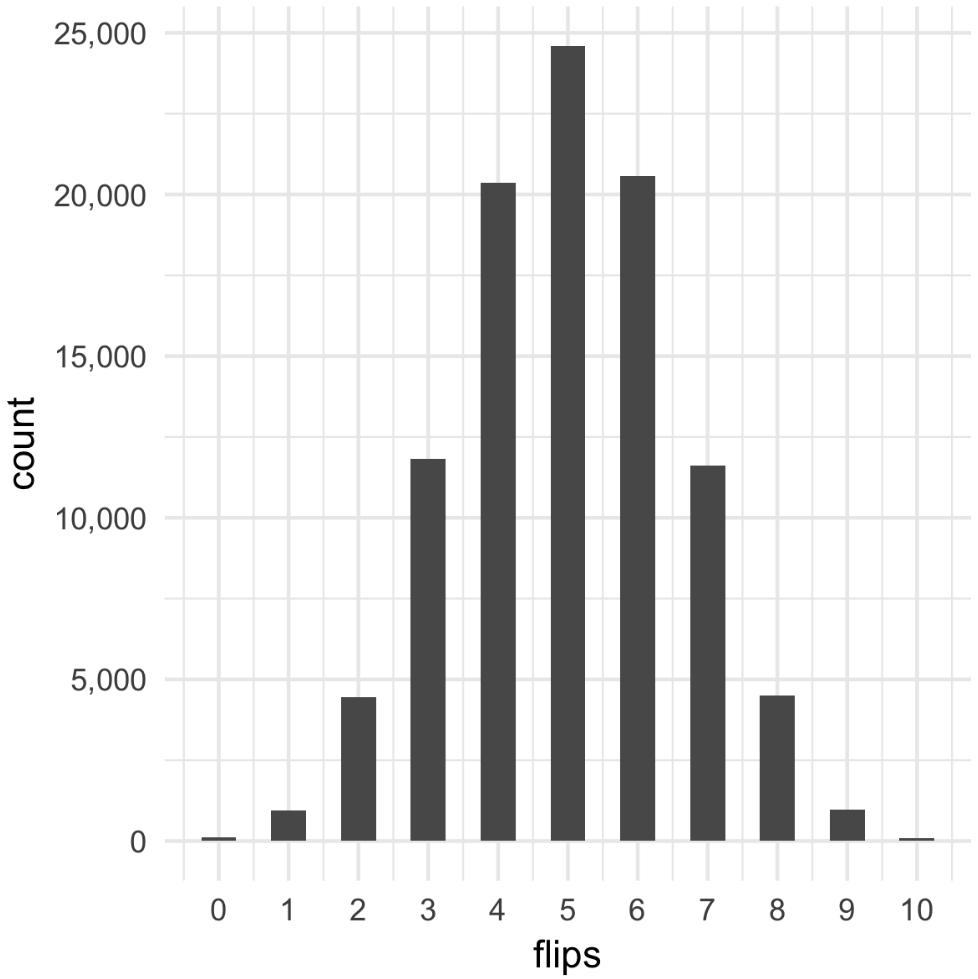
David Robinson
Chief Data Scientist, DataCamp

Simulating many outcomes

$$X \sim \text{Binomial}(10, .5)$$

$$\Pr(X = 5)$$

```r
flips <- rbinom(100000, 10, .5)
```

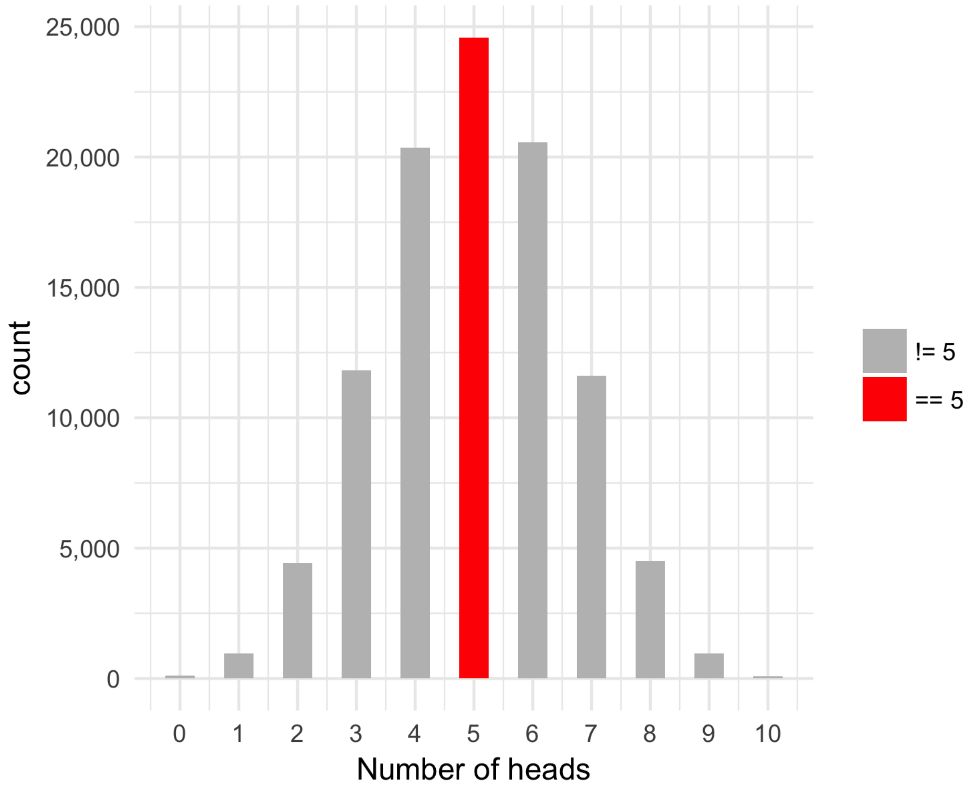


Finding density with simulation

```
flips <- rbinom(100000, 10, .5)
```

```
flips == 5
# [1] FALSE TRUE FALSE FALSE...
```

```
mean(flips == 5)
# [1] 0.2463
```



Calculating exact probability density

```
dbinom(5, 10, .5)
# [1] 0.2460938
```

```
dbinom(6, 10, .5)
# [1] 0.2050781
```

```
dbinom(10, 10, .5)
# [1] 0.0009765625
```

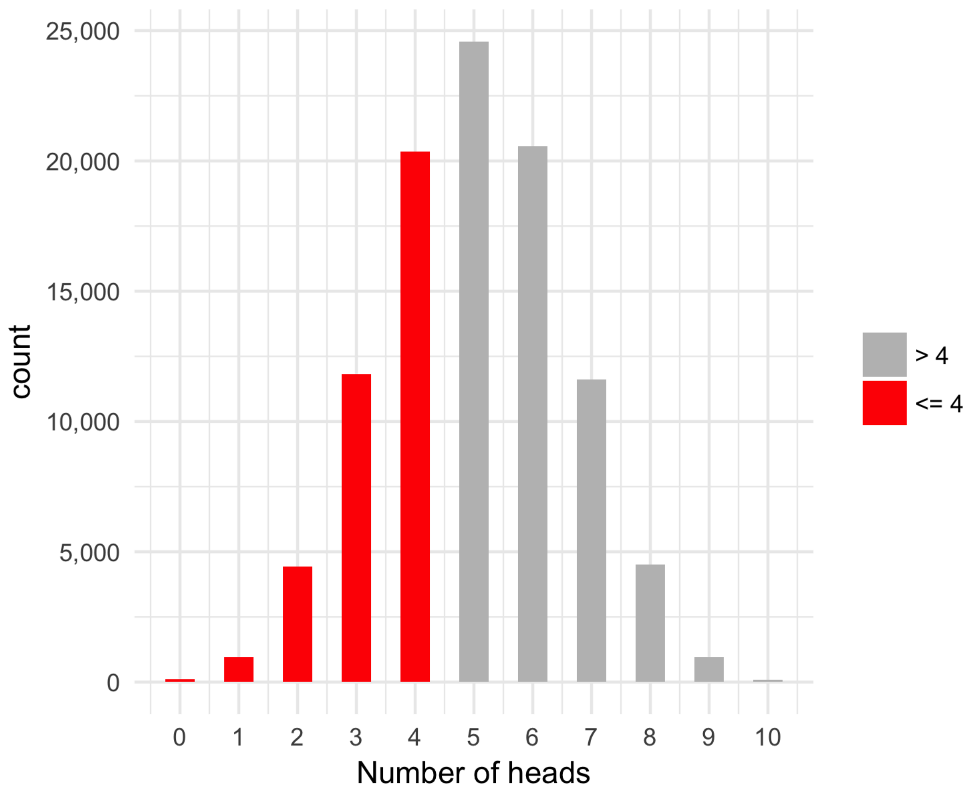
Cumulative density

$$X \sim \text{Binomial}(10, .5)$$

$$\Pr(X \leq 4)$$

```
flips <- rbinom(100000, 10, .5)
mean(flips <= 4)
# [1] 0.37682
```

```
pbinom(4, 10, .5)
# [1] 0.37695
```



Let's practice!

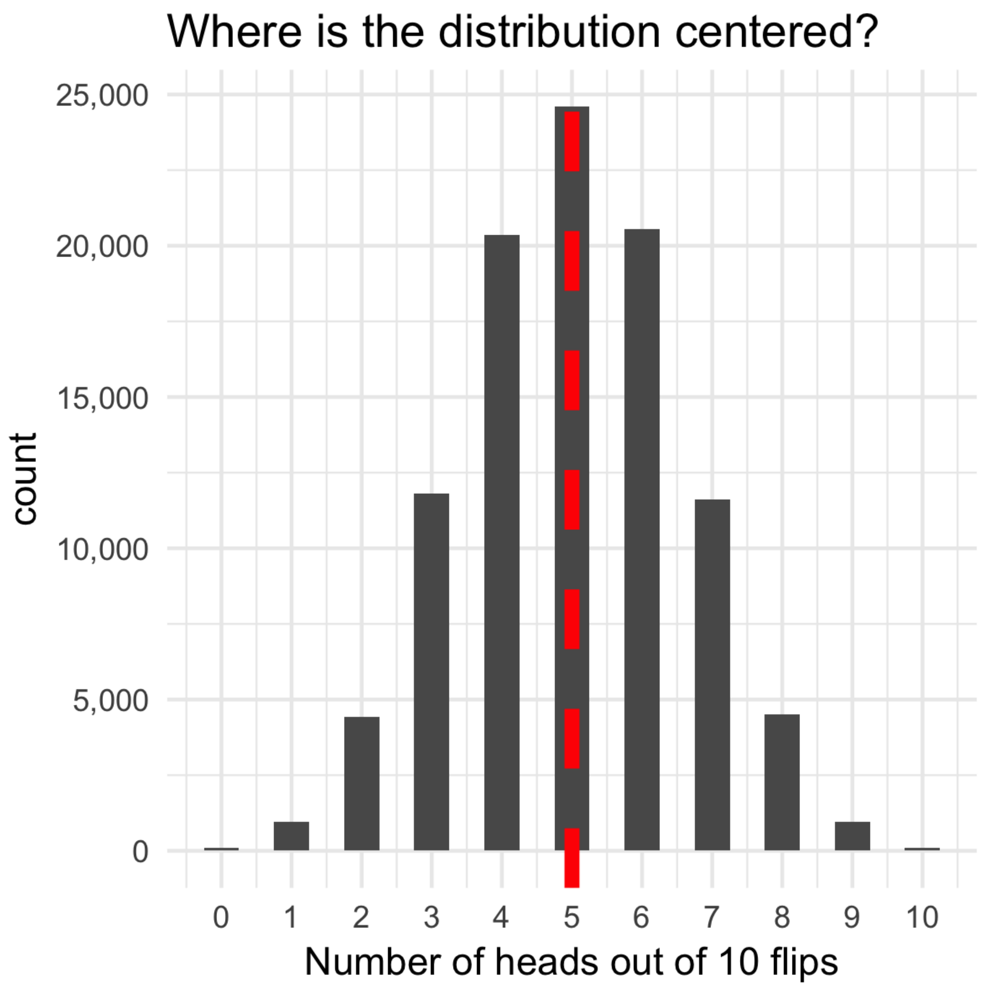
FOUNDATIONS OF PROBABILITY IN R

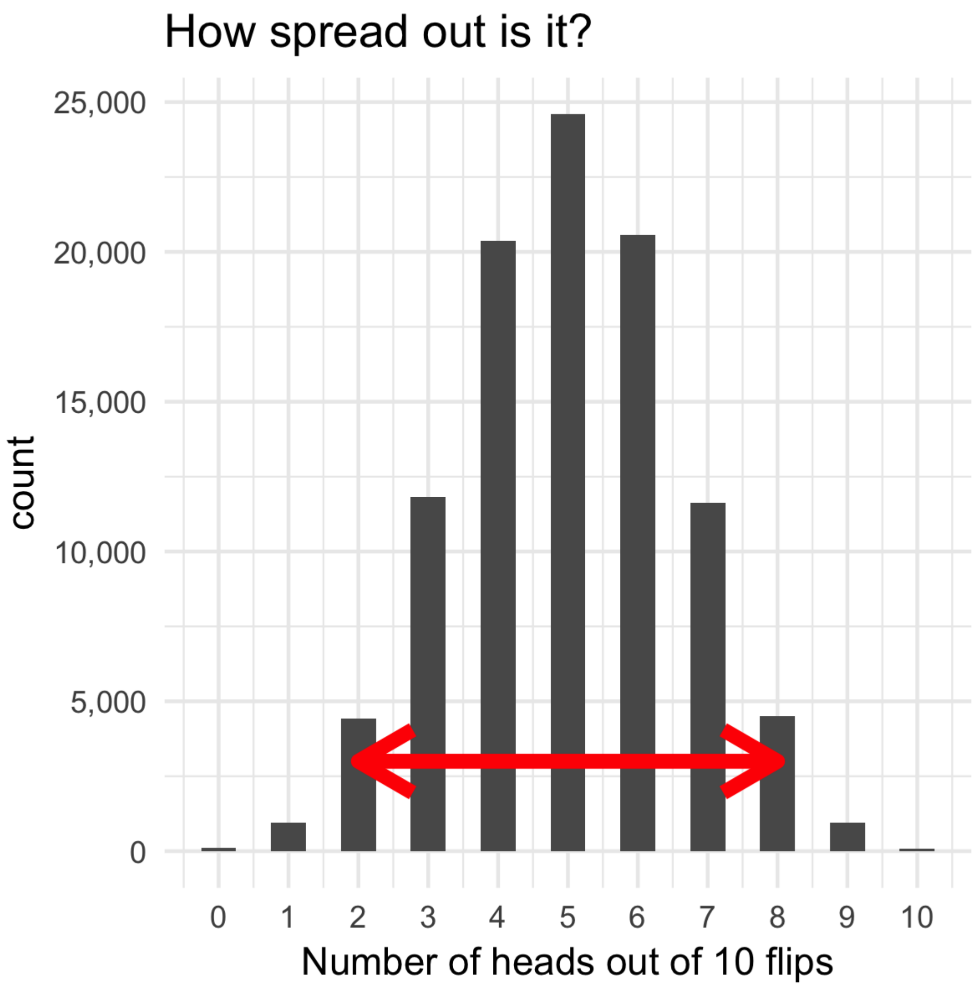
Expected value and variance

FOUNDATIONS OF PROBABILITY IN R

David Robinson
Chief Data Scientist, DataCamp

Properties of a distribution

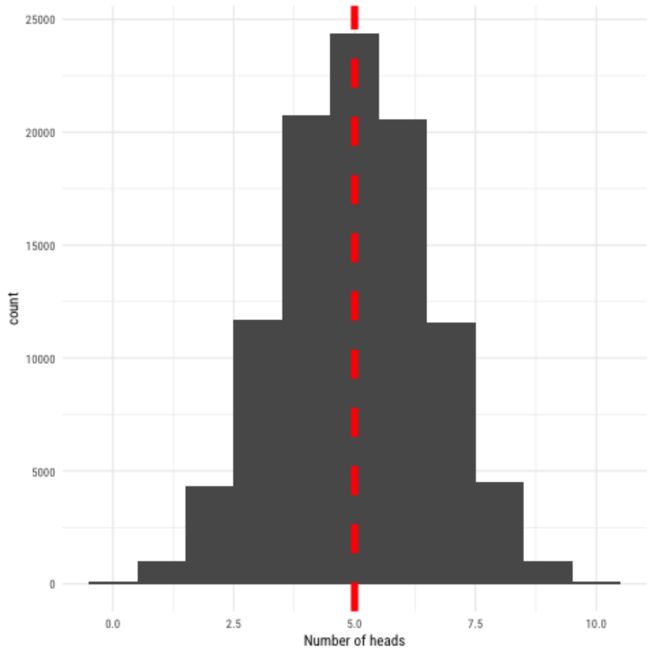




Expected value

$$X \sim \text{Binomial}(\text{size}, p)$$

$$E[X] = \text{size} \cdot p$$




```
flips <- rbinom(100000, 10, .5)
```

```
mean(flips)
# [1] 5.00196
```

```
mean(rbinom(100000, 100, .2))
# [1] 19.99053
```

Variance

$$X \sim \text{Binomial}(10, .5)$$

```
X <- rbinom(100000, 10, .5)
var(X)
# [1] 2.503735
```

$$\text{Var}(X) = \text{size} \cdot p \cdot (1 - p)$$

$$\text{Var}(X) = 10 \cdot .5 \cdot (1 - .5)$$

$$= 2.5$$

$$Y \sim \text{Binomial}(100, .2)$$

```
Y <- rbinom(100000, 100, .2)
var(Y)
# [1] 16.05621
```

$$\text{Var}(Y) = \text{size} \cdot p \cdot (1 - p)$$

$$\text{Var}(Y) = 100 \cdot .2 \cdot (1 - .2)$$

$$= 16$$

Rules for expected value and variance

$$X \sim \text{Binomial}(\text{size}, p)$$

$$E[X] = \text{size} \cdot p$$

$$\text{Var}(X) = \text{size} \cdot p \cdot (1 - p)$$

Let's practice!

FOUNDATIONS OF PROBABILITY IN R