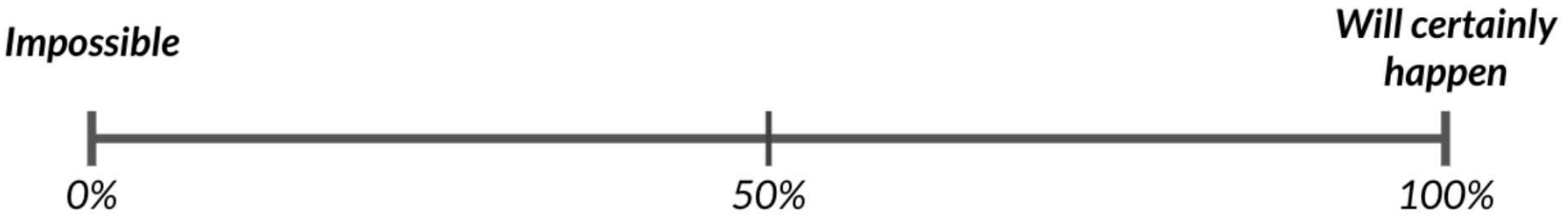
Measuring chance

What's the probability of an event?

$$P(\text{event}) = \frac{\#\text{ ways event can happen}}{\text{total }\#\text{ of possible outcomes}}$$

Example: a coin flip

$$P(\text{heads}) = \frac{1\text{ way to get heads}}{2\text{ possible outcomes}} = \frac{1}{2} = 50\%$$



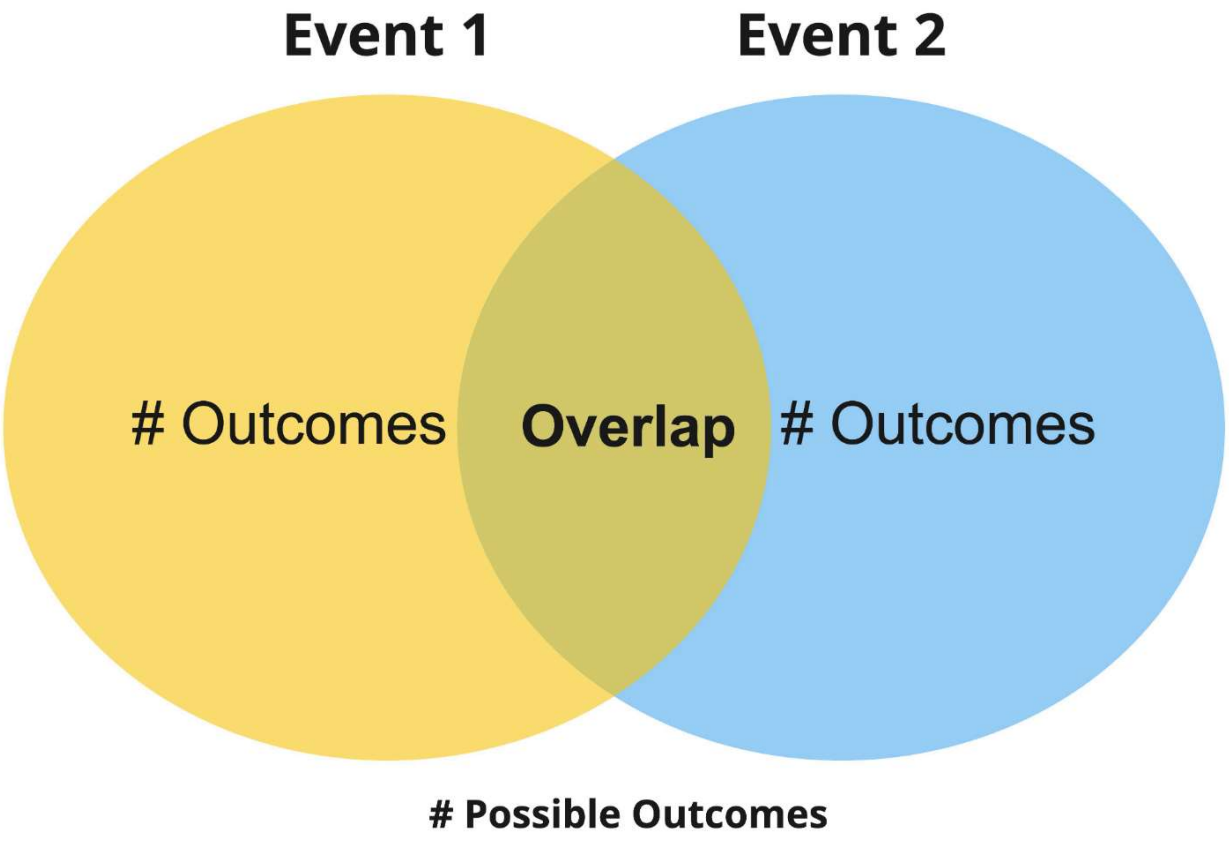
Probability of an order for a jewelry product

$$P(Jewelry) = \frac{Order\ Count(Jewelry)}{Sum(Total\ Order\ Count)}$$

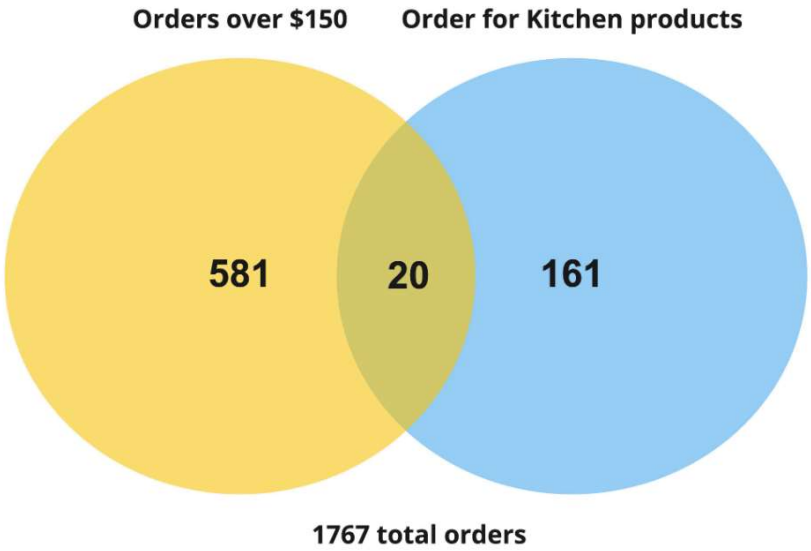
$$P(Jewelry) = \frac{210}{1767}$$

$$P(Jewelry) = 11.88\%$$

Venn diagrams



Kitchen sales over $150



$$P(Order > 150|Kitchen) = \frac{\frac{20}{1767}}{\frac{181}{1767}}$$

$$P(Order > 150|Kitchen) = \frac{20}{181}$$

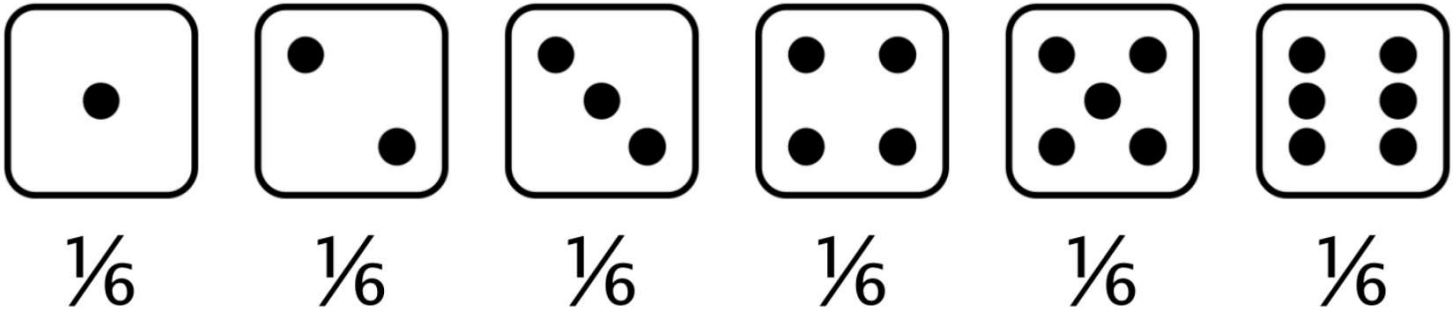
Conditional probability formula

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

- $P(A|B)$ → Probability of event A, given event B
- $P(A \cap B)$ → Probability of event A **and** event B
  - Divided by the probability of event B → $P(B)$

Probability distribution

Describes the probability of each possible outcome in a scenario

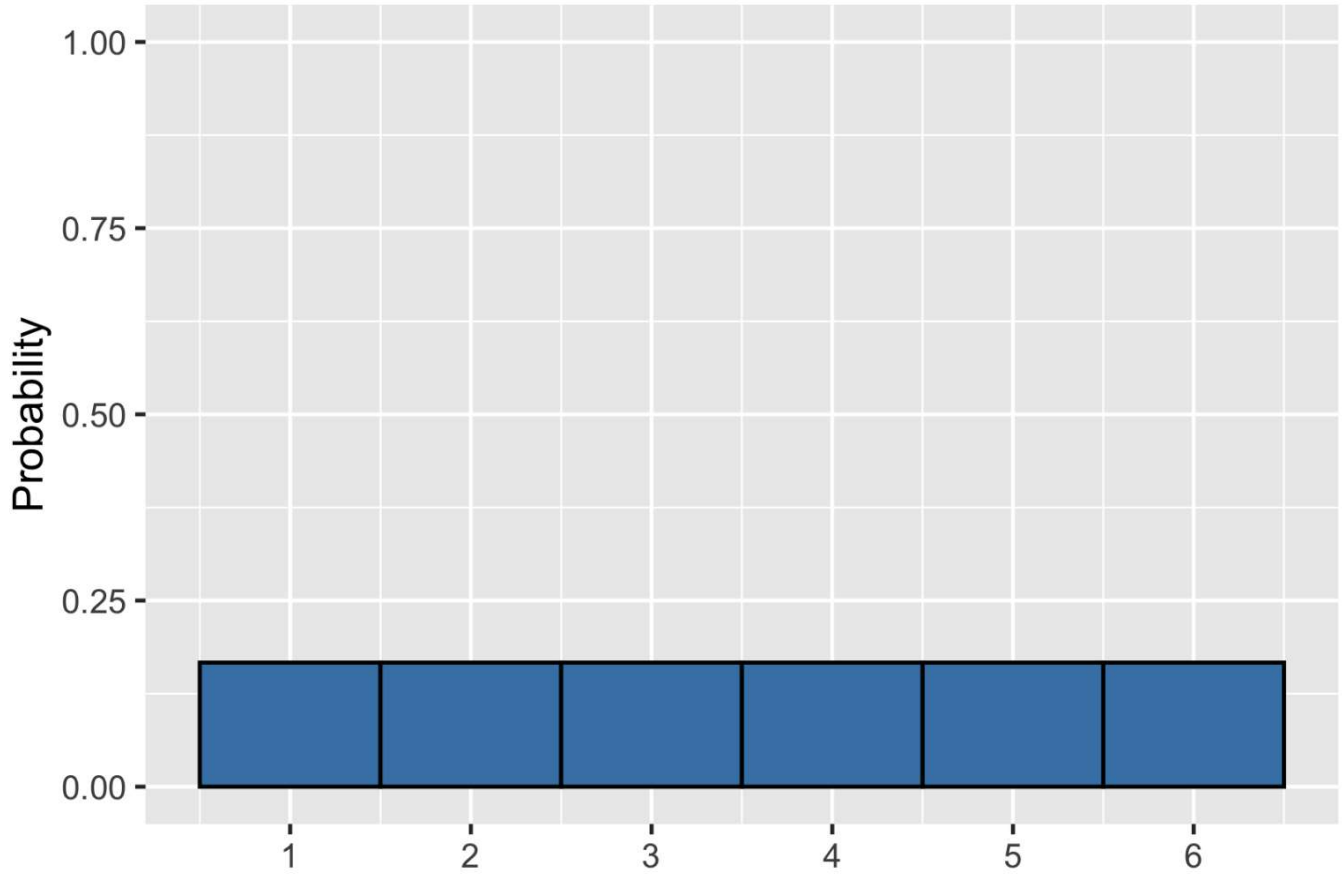


Expected value: The ***mean*** of a probability distribution

Expected value of a fair die roll =

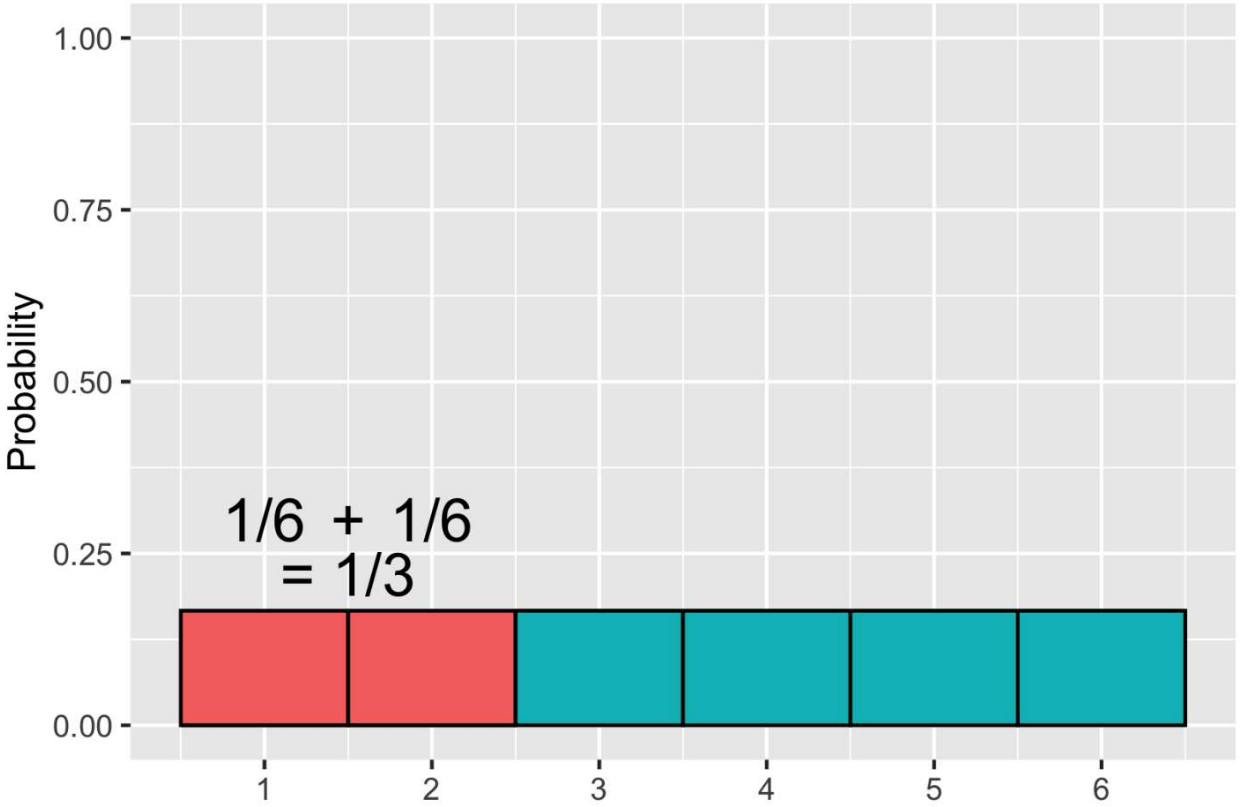
$$(1 \times \frac{1}{6}) + (2 \times \frac{1}{6}) + (3 \times \frac{1}{6}) + (4 \times \frac{1}{6}) + (5 \times \frac{1}{6}) + (6 \times \frac{1}{6}) = 3.5$$

Visualizing a probability distribution

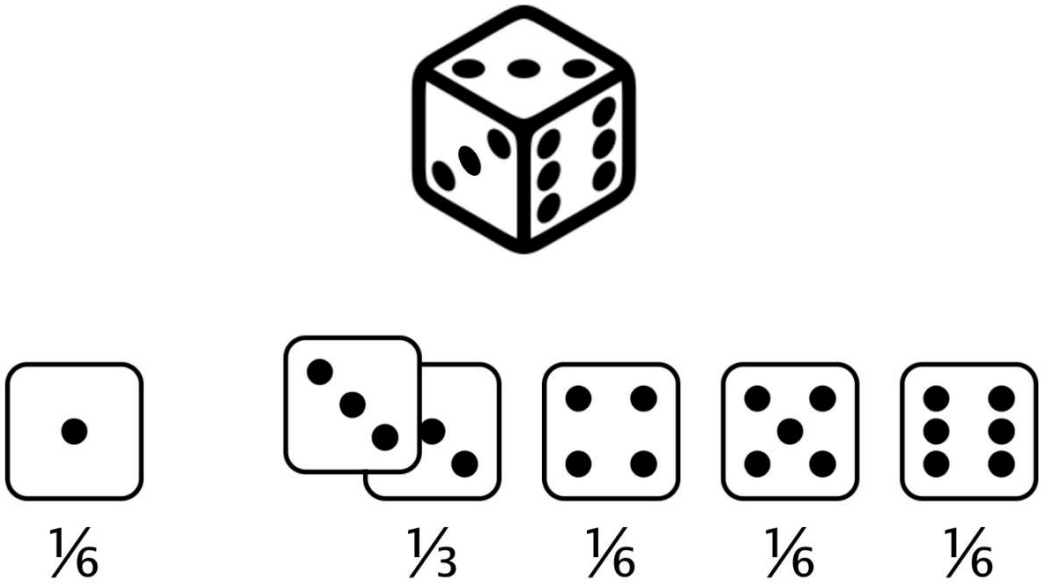


Probability = area

$$P(\text{die roll}) \leq 2 = 1/3$$



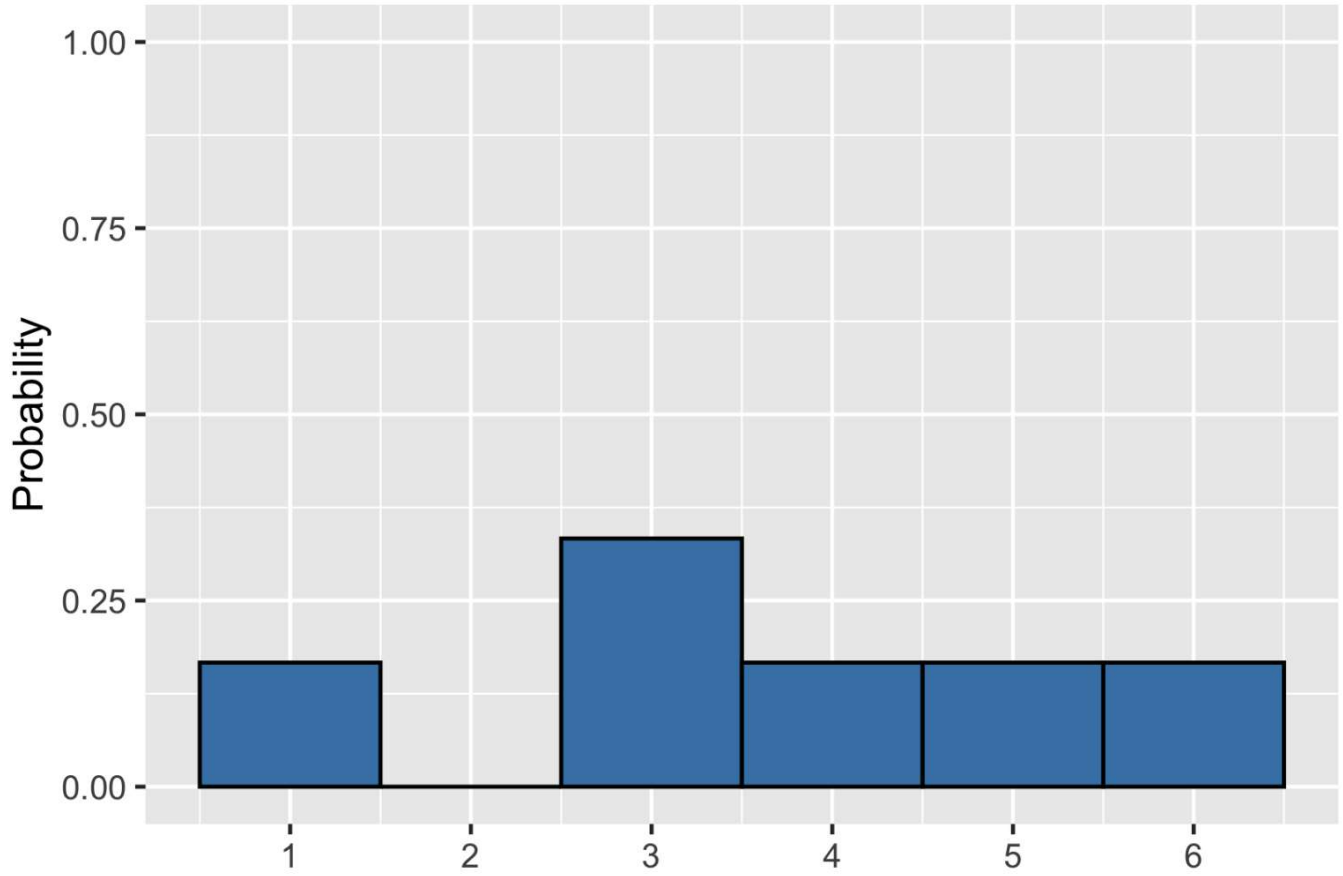
Uneven die



Expected value of uneven die roll =

$$(1 \times \frac{1}{6}) + (2 \times 0) + (3 \times \frac{1}{3}) + (4 \times \frac{1}{6}) + (5 \times \frac{1}{6}) + (6 \times \frac{1}{6}) = 3.67$$

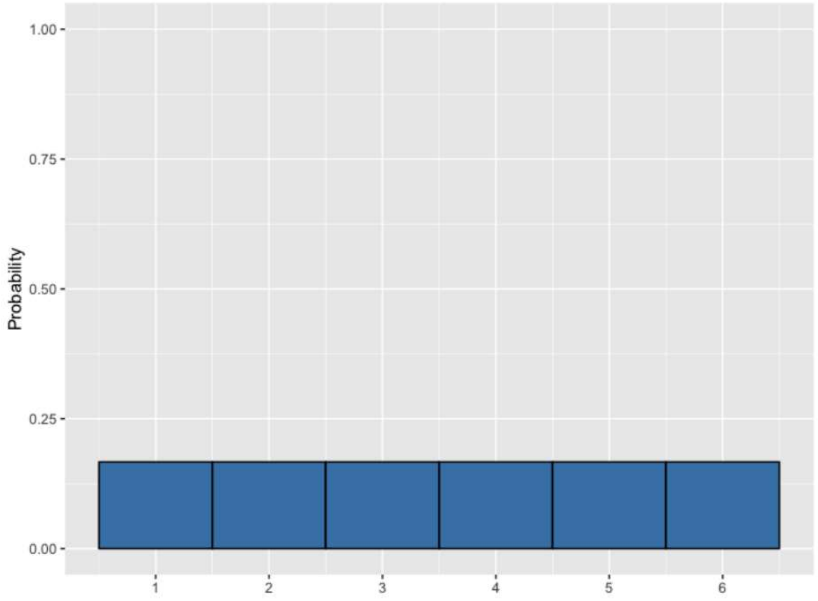
Visualizing uneven probabilities



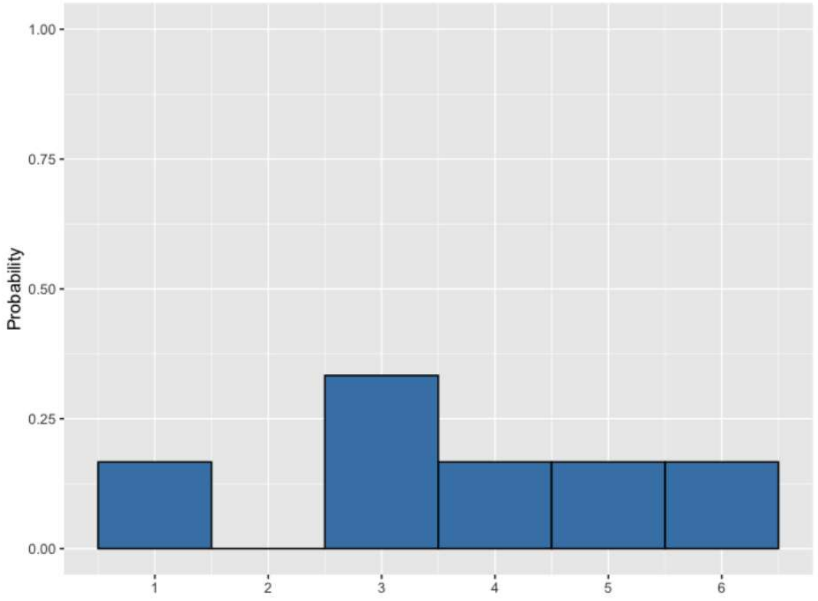
Discrete probability distributions

Describe probabilities for discrete outcomes

Fair die

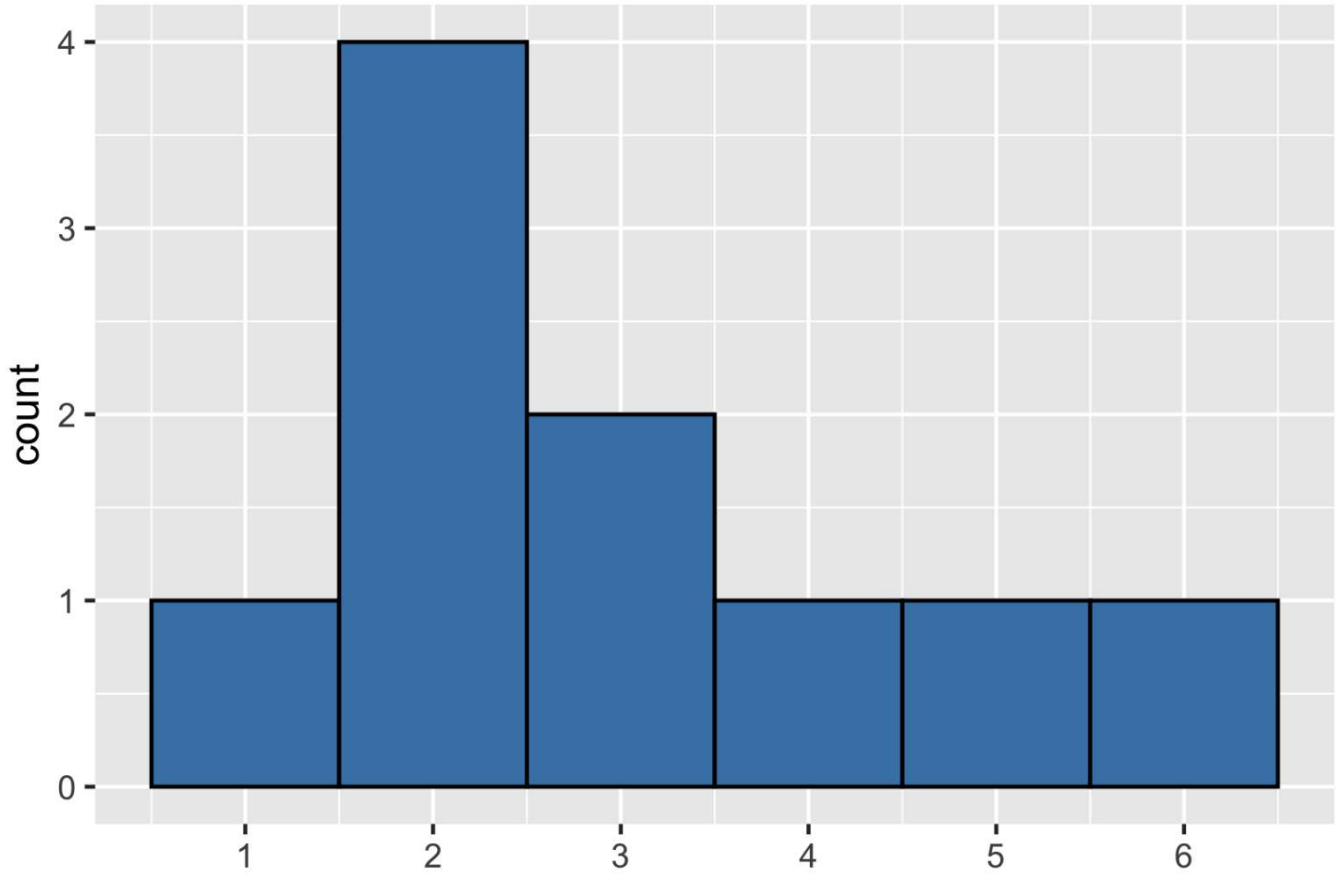


Uneven die

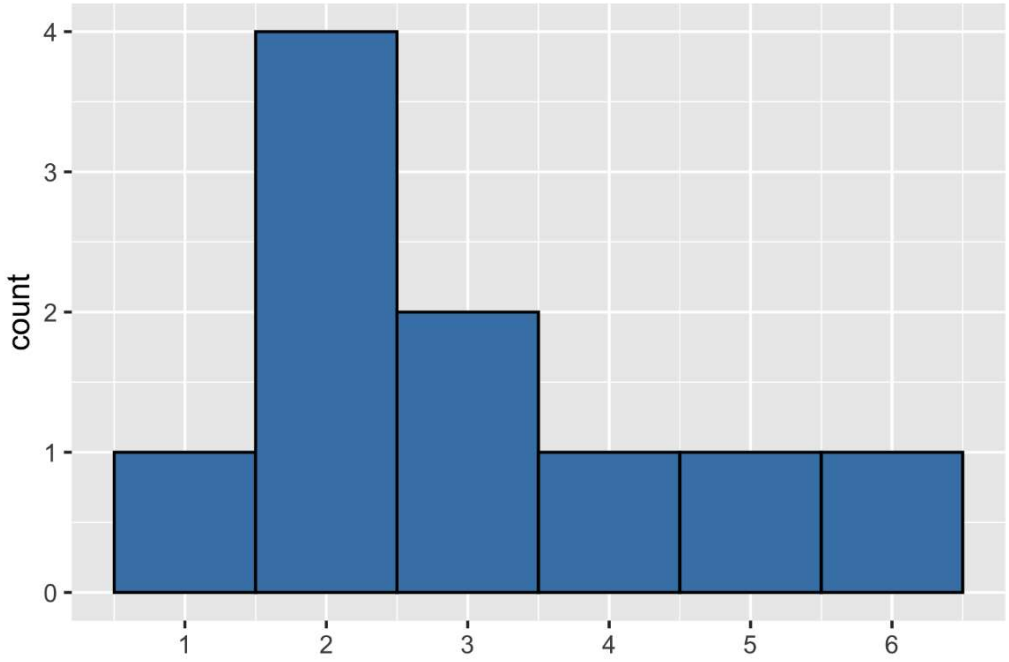


Discrete uniform distribution

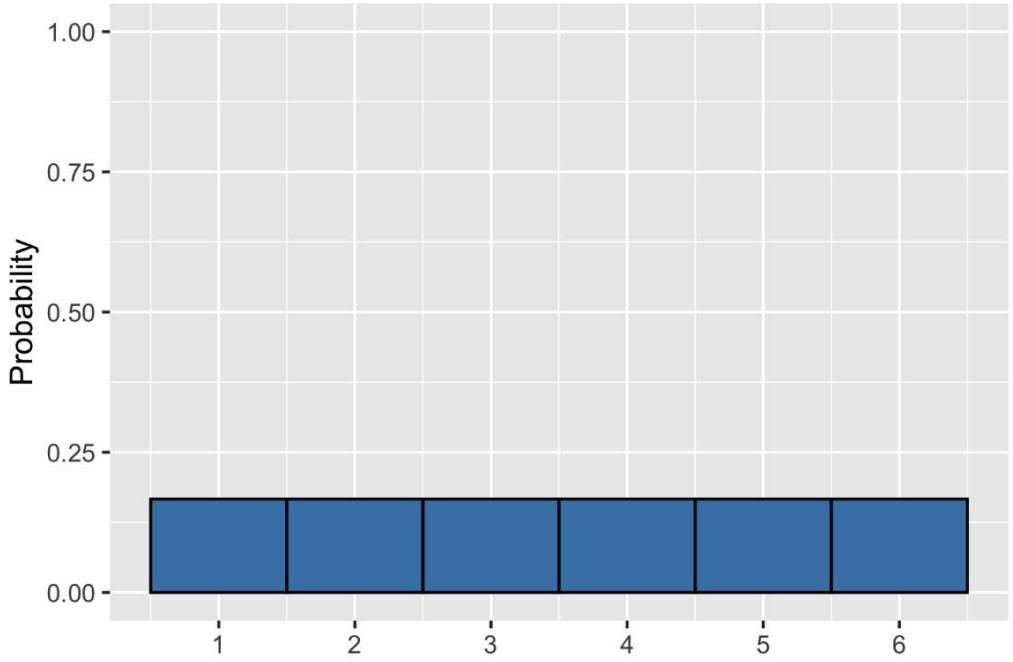
Visualizing a sample



Sample distribution vs theoretical distribution



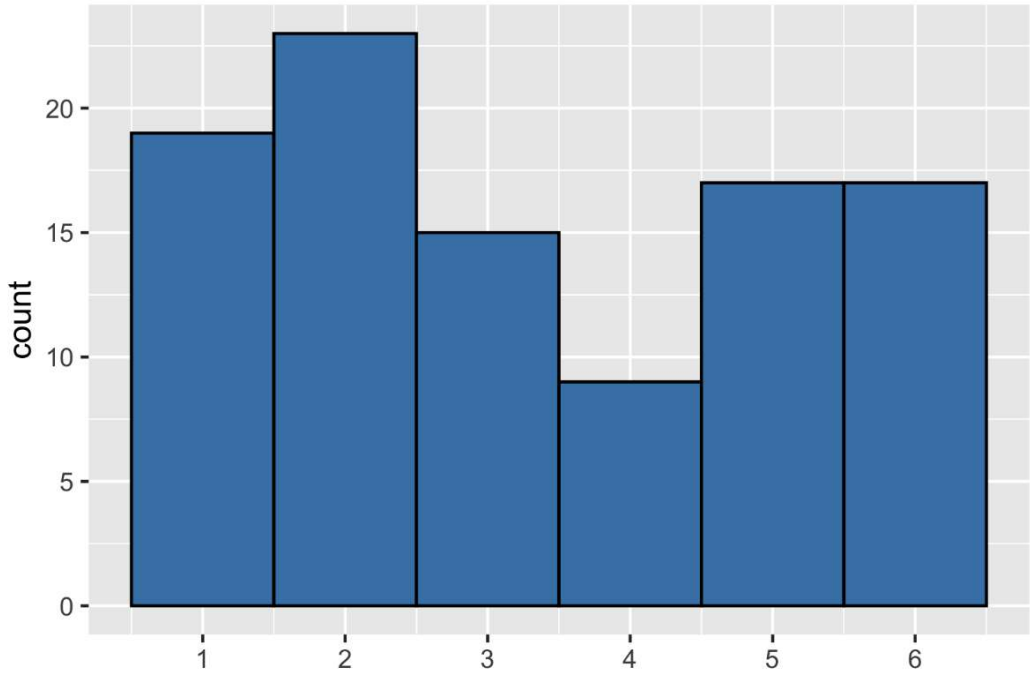
$Mean = 3.0$



$Mean = 3.5$

A bigger sample

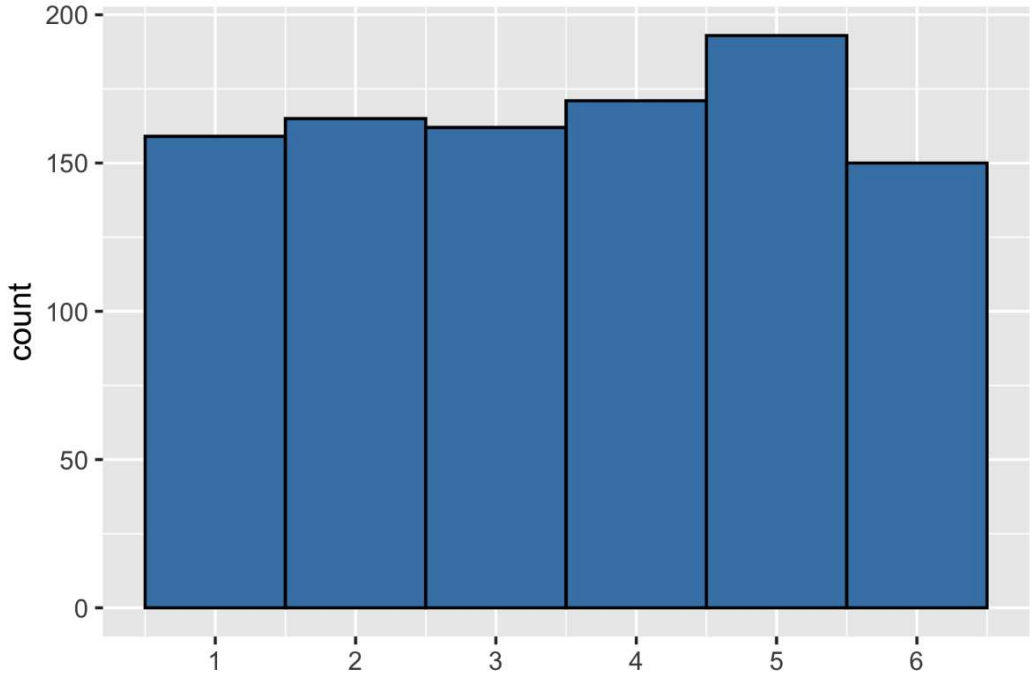
Sample of 100 rolls



$$Mean = 3.33$$

An even bigger sample

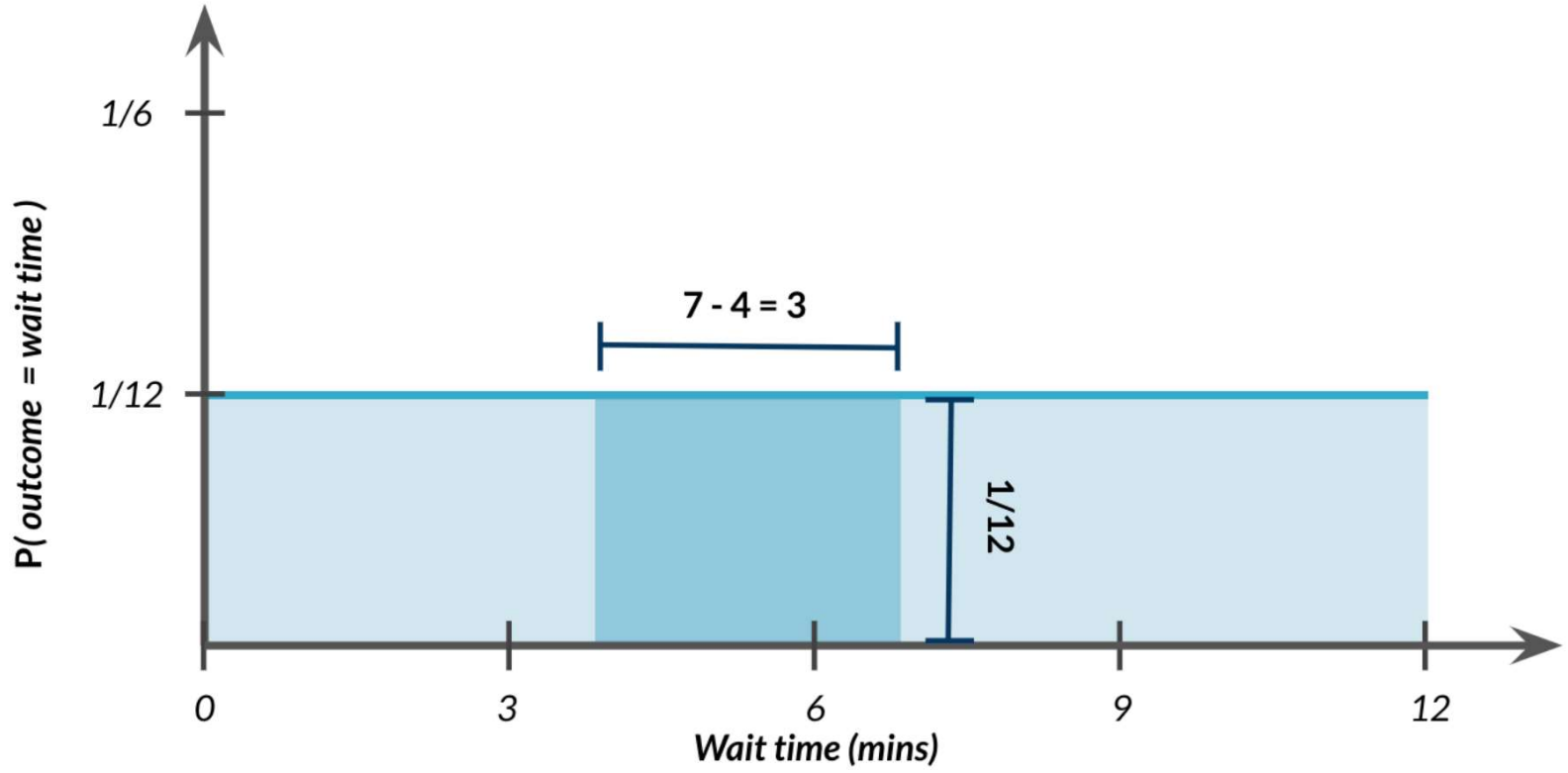
Sample of 1000 rolls



$$Mean = 3.52$$

Probability still = area

$$P(4 \leq \text{wait time} \leq 7) = 3 \times 1/12 = 3/12$$

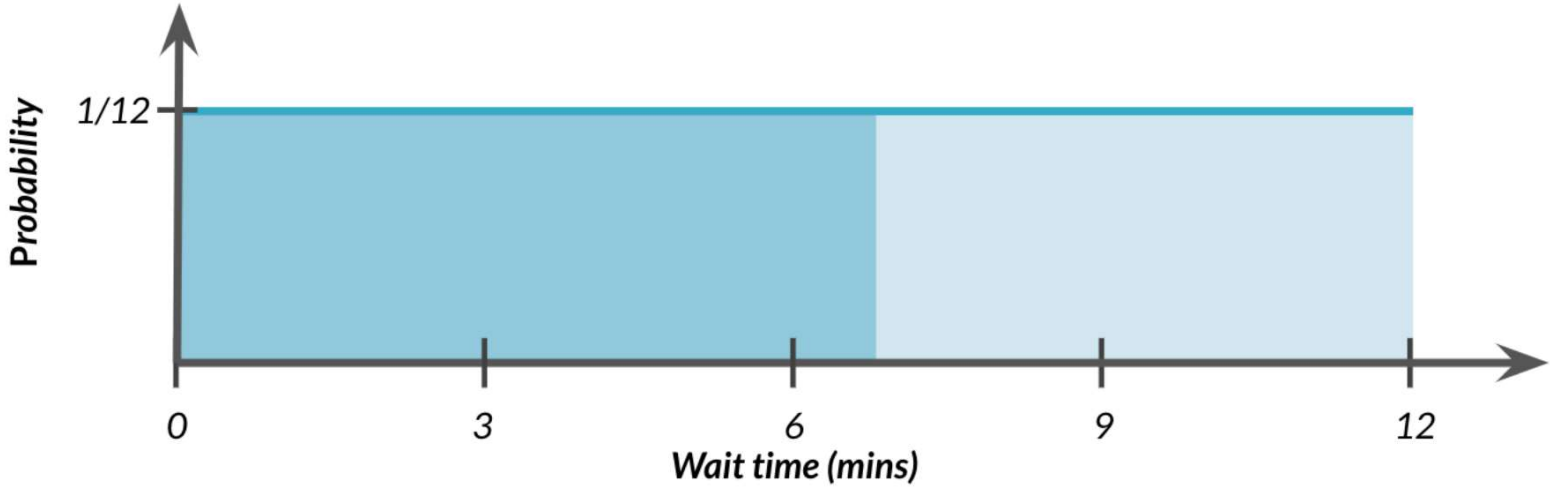


Waiting seven minutes or less

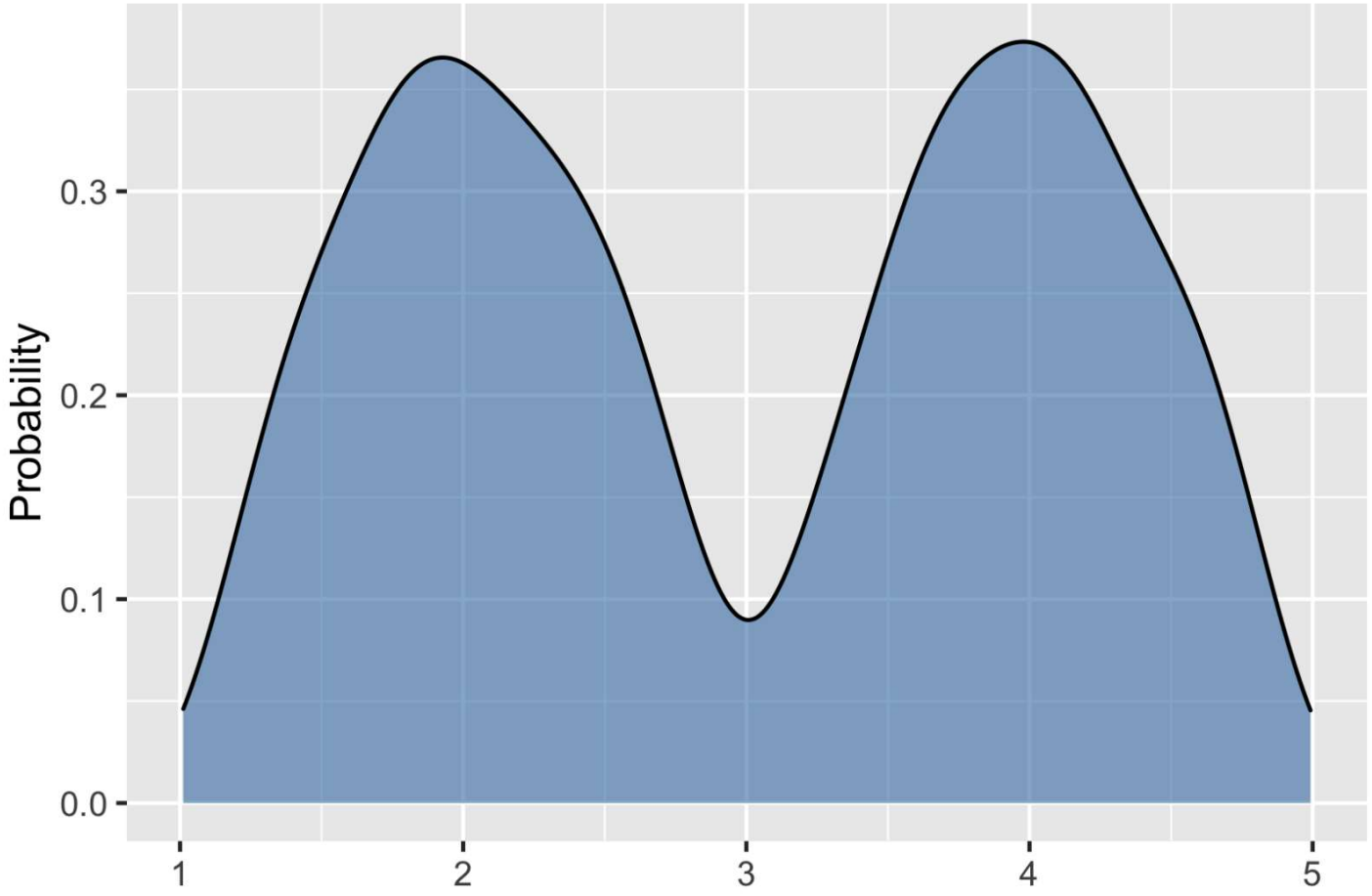
$$P(\text{wait time} \leq 7) = \ ?$$

$$P(\text{wait time} \leq 7) = \frac{7 - 0}{12}$$

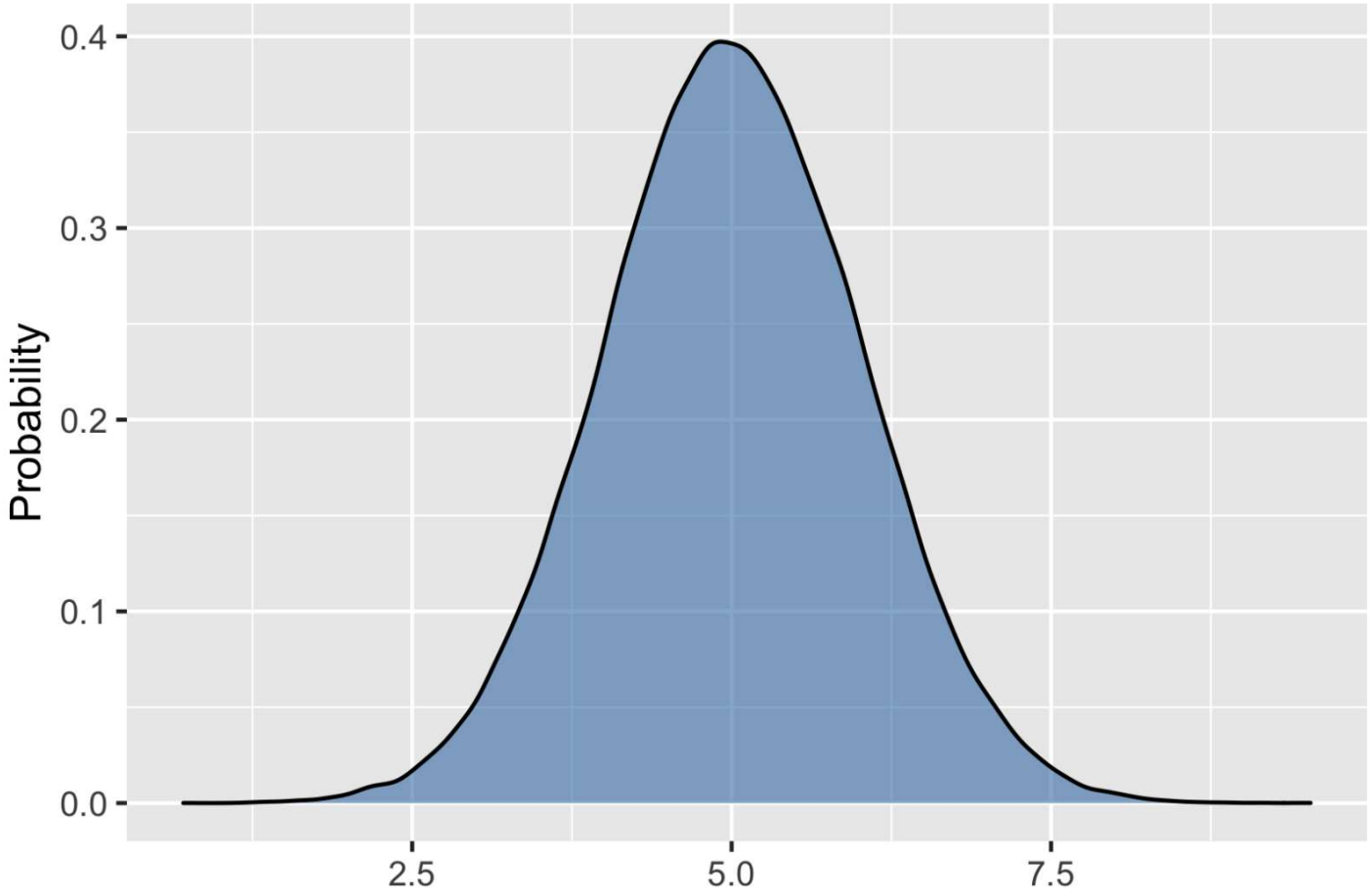
$$P(\text{wait time} \leq 7) = \frac{7}{12} = 58.33\%$$



Bimodal distribution



The normal distribution



Total area still = 1