Table of Contents

10-6 Theoretical Probability.....#

Objectives

Determine the theoretical probability of an event.

Convert between probabilities and odds.

Feb 15-9:11 AM

When the outcomes in the sample space of an experiment have the same chance of occurring, the outcomes are said to be **equally likely**.

Equally likely outcomes	Not equally likely outcomes
	
There is the same chance that the spinner will land on any of the colors.	There is a greater chance that the spinner will land on blue than on any other color.

Feb 15-9:13 AM

The **theoretical probability** of an event is the ratio of the number of ways the event can occur to the total number of equally likely outcomes.

Theoretical Probability

$$\text{theoretical probability} = \frac{\text{number of ways the event can occur}}{\text{total number of equally likely outcomes}}$$

An experiment in which all outcomes are equally likely is said to be **fair**. You can usually assume that experiments involving coins and number cubes are fair.

Feb 15-9:13 AM

Why is it impossible for a probability to be an improper fraction?

An experiment consists of rolling a number cube. Find the theoretical probability of each outcome.

rolling a 5 $\frac{1}{6}$

rolling an odd number 1, 3, 5, $\frac{3}{6} = \frac{1}{2}$

rolling a number less than 3 1, 2 $\frac{2}{6} = \frac{1}{3}$

Feb 15-9:13 AM

When you toss a coin, there are two possible outcomes, heads or tails. The table below shows the theoretical probabilities and experimental results of tossing a coin 10 times.

	P(heads)	*P*(tails)	*P*(heads) + *P*(tails)
Experimental Probability	$\frac{3}{10}$	$\frac{7}{10}$	$\frac{3}{10} + \frac{7}{10} = \frac{10}{10} = 1$
Theoretical Probability	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2} + \frac{1}{2} = \frac{2}{2} = 1$

Reading Math

The probability of an event can be written as *P*(event). *P*(heads) means "the probability that heads will be the outcome."

$P(\text{event A}) + P(\text{event B}) = 1$

Feb 15-9:15 AM

The sum of the probability of heads and the probability of tails is 1, or 100%. This is because it is certain that one of the two outcomes will always occur.

P(event happening) + *P*(event not happening) = 1

The **complement** of an event is all the outcomes in the sample space that are not included in the event. The sum of the probabilities of an event and its complement is 1, or 100%, because the event will either happen or not happen.

P(event) + *P*(complement of event) = 1

Feb 15-9:15 AM

A box contains only red, black, and white blocks. The probability of choosing a red block is $\frac{1}{4}$ the probability of choosing a black block is $\frac{1}{2}$ What is the probability of choosing a white block?

$P(\text{red}) + P(\text{black}) + P(\text{white}) = 100\%$ *Either it will be a white block or not.*

$25\% + 50\% + P(\text{white}) = 100\%$

$75\% + P(\text{white}) = 100\%$

$-75\% \quad -75\%$ *Subtract 75% from both sides.*

$P(\text{white}) = 25\%$

$\frac{1}{4}$

Feb 15-9:17 AM

A jar has green, blue, purple, and white marbles. The probability of choosing a green marble is 0.2, the probability of choosing blue is 0.3, the probability of choosing purple is 0.1. What is the probability of choosing white?

$.2 + .3 + .1 + W = 1$

$.6 + W = 1$

$-.6 \quad -.6$

$W = .4$

$\frac{4}{10} = \frac{2}{5}$

Feb 15-9:18 AM

Odds are another way to express the likelihood of an event. The *odds in favor of an event* describe the likelihood that the event will occur. The *odds against an event* describe the likelihood that the event will not occur.

Odds are usually written with a colon in the form $a:b$, but can also be written as a to b or $\frac{a}{b}$.

Odds

ODDS IN FAVOR OF AN EVENT

$$\text{odds in favor} = \frac{\text{number of ways an event can happen}}{\text{number of ways an event can fail to happen}} = a:b$$

ODDS AGAINST AN EVENT

$$\text{odds against} = \frac{\text{number of ways an event can fail to happen}}{\text{number of ways an event can happen}} = b:a$$

a represents the number of ways an event can occur.
b represents the number of ways an event can fail to occur.

Feb 15-9:18 AM

The two numbers given as the odds will add up to the total number of possible outcomes. You can use this relationship to convert between odds and probabilities.

Reading Math

You may see an outcome called "favorable." This does not mean that the outcome is good or bad. A favorable outcome is the outcome you are looking for in a probability experiment.

1. **What are the odds of rolling a 2 on a number cube?**

1 : 5

ODDS Heads

1 : 1

BAG MARBLES

6 Red 4 Blue 2 Yellow

4 : 8 Not Yellow

1 : 2 10 : 2

5 : 1

Feb 15-9:19 AM

2. **The odds in favor of winning a free drink are 1:24. What is the probability of winning a free drink?**

$\frac{1}{25}$

3. What are the odds against rolling a 3 or a 4 on a number cube?

4 : 2

2 : 1

4. The odds in favor of Mike wearing a blue shirt are 2:7. What is the probability of him wearing a blue shirt?

$\frac{2}{9}$

40% chance snow

Odds snowing $\frac{40}{100} = \frac{4}{10} = \frac{2}{5}$

2 : 3

70% rain

Odds $\frac{70}{100} = \frac{7}{10}$ 7 : 3

Feb 15-9:20 AM

Assignment: p. 723 #1-28, 40-45

Feb 15-9:24 AM