

## Section 4.2: Odds

**Odds** is the ratio that compares the number of favorable outcomes of an event to the number of unfavorable outcomes.

Odds are broken down into 2 types.

- 1) Odds against
- 2) Odds in favor

The **odds against** an event is a ratio of the probability that the event will fail to occur (failure) to the probability that the event will occur (success). Ratios are often represented as fractions. So we can write a formula for odds against using fractions as follows:

$$\text{Odds against event} = \frac{P(\text{event fails to occur})}{P(\text{event occurs})} = \frac{P(\text{failure})}{P(\text{success})}$$

To find “odds” you must first know how to determine the probability of success and the probability of failure. (The “odds” given at horse races and at table games and at Casinos are always odds against unless otherwise specified.)

**Example:** A single 6 sided dice is rolled one time and the number that is face up is recorded. Determine the **odds against** rolling a 2.

In this case:

Failure will be rolling any number other than a 2

Success will be rolling a 2.

$$P(\text{failure}) = P(\text{failure to roll a 2}) = \frac{5}{6}$$

$$P(\text{success}) = P(\text{rolling a 2}) = \frac{1}{6}$$

$$\text{odds against rolling 2} = \frac{P(\text{failure})}{P(\text{success})} = \frac{5/6}{1/6} = \frac{5}{6} \div \frac{1}{6} = \frac{5}{6} \times \frac{6}{1} = \frac{5}{1}$$

Odds are often written using : or “ to ” instead of being written as a fraction. So the odds against rolling a 2 can be written as:

Answer:  $\frac{5}{1}$  or better yet 5 to 1 or best yet 5:1

(this means it is 5 times more likely that you will roll a number that is not a 2).

There is a short cut to do most odds problems. I almost exclusively use this short cut when I compute odds.

Odds against event = # of ways event fails to occur : # of ways the event occurs

**Example:** Use the short cut method to find the odd against rolling a 2.

In this case there are 5 ways the event of rolling a 2 fails, namely rolling 1,3,4,5,6, so I will write the number 5 first in my answer.

There is 1 way to roll a 2, so I will write the number 1 second.

Answer: the odds against rolling a 2 are 5:1

Although odds are generally given against an event, at times they may be given in favor of an event.

$$\text{Odds in favor of event} = \frac{P(\text{event occurs})}{P(\text{event fails to occur})} = \frac{P(\text{success})}{P(\text{failure})}$$

In general, if the odds against an event are a:b then the odds for an event are b:a.

**Example:** A single 6 sided dice is rolled one time and the number that is face up is recorded. Determine the **odds in favor** rolling a 2 on one roll of a die.

This is easy, if I know the odds against I just switch the order to get the odds in favor.

Answer: 1:5 (I almost always write odd using a colon as opposed to writing them as a fraction or using the word "to").

Homework:

1) In her wallet, Anne Kelly has 14 bills. Seven are \$1 bills, two are \$5 bills, four are \$10 bills and one is a \$20 bill. She passes a volunteer seeking donations for the Salvation Army and decides to select one bill at random from her wallet and give it to the Salvation Army.

Determine:

- a) The probability she selects a \$5 bill
- b) The probability she does not select a \$5 bill
- c) The odds in favor of her selecting a \$5 bill
- d) The odds against her selecting a \$5 bill

2) A box contains 9 red and 2 blue marbles and 3 yellow marbles. If you select one at random from the box, determine:

- a) The probability the marble is red.
- b) The odds in favor of selecting a red marble.
- c) The probability the marble is blue.
- d) The odds against selecting a blue marble

#3 – 14: A card is picked from a deck of cards. Find the odds against and odds in favor of selecting:

- |                          |                         |                         |
|--------------------------|-------------------------|-------------------------|
| 3) a heart               | 4) a red card           | 5) a seven              |
| 6) a queen               | 7) a seven or a queen   | 8) a diamond or a spade |
| 9) a seven and a heart   | 10) a queen and a spade | 11) the three of spades |
| 12) the four of diamonds | 13) a red king          | 14) a black four        |

15) A pair of dice is rolled and the sum of the dice is recorded. Here is the sample space.

DICE 2 →	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
Dice 1 ↓						
<b>1</b>	(1,1) Sum 2	(1,2) Sum 3	(1,3) Sum 4	(1,4) Sum 5	(1,5) Sum 6	(1,6) Sum 7
<b>2</b>	(2,1) Sum 3	(2,2) Sum 4	(2,3) Sum 5	(2,4) Sum 6	(2,5) Sum 7	(2,6) Sum 8
<b>3</b>	(3,1) Sum 4	(3,2) Sum 5	(3,3) Sum 6	(3,4) Sum 7	(3,5) Sum 8	(3,6) Sum 9
<b>4</b>	(4,1) Sum 5	(4,2) Sum 6	(4,3) Sum 7	(4,4) Sum 8	(4,5) Sum 9	(4,6) Sum 10
<b>5</b>	(5,1) Sum 6	(5,2) Sum 7	(5,3) Sum 8	(5,4) Sum 9	(5,5) Sum 10	(5,6) Sum 11
<b>6</b>	(6,1) Sum 7	(6,2) Sum 8	(6,3) Sum 9	(6,4) Sum 10	(6,5) Sum 11	(6,6) Sum 12

- Find the probability of rolling a sum of 7.
- Find the probability of not rolling a sum of 7
- Find the odds in favor of the sum being 7.
- Find the odds against the first dice showing a 5.
- Find the probability the sum is less than 7.
- Find the odds against of the sum being less than 7.
- Find the probability of rolling a double (both dice have the same number).
- Find the odds against rolling a double.

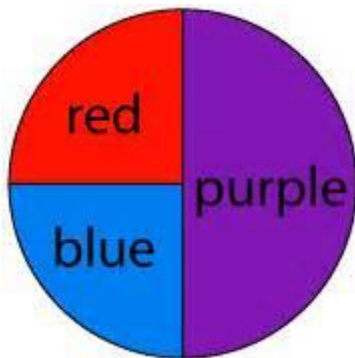
16) Use the sample space from problem 15 to answer the following.

- a) Find the probability of rolling a sum of 8.
- b) Find the probability of the first dice shows the number 2.
- c) Find the odds in favor of the sum being 8.
- d) Find the odds against the first dice showing a 2.
- e) Find the probability the sum is greater than 9.
- f) Find the odds in favor of the sum being greater than 9.
- g) Find the probability of **not** rolling a double (both dice have the same number).
- h) Find the odds in favor of the sum being an odd number.

17) One person is selected at random from a class of 16 men and 14 women. Find the odds against selecting:

- a) A woman
- b) A man

18 – 21: A dart is thrown at this target and the color it lands on is noted. Find the requested odds.



- 18) Odds in favor of landing in the purple region.
- 19) Odds in favor of landing in the blue region.
- 20) Odds against landing in the red region.
- 21) Odds against landing in the purple region.

Answers:

- 1a)  $1/7$       1b)  $6/7$       1c) 2:12 or 1:6      1d) 12:2 or 6:1  
3) against 39:13 or 3:1 favor 13:39 or 1:3  
5) against 48:4 or 12:1 favor 4:48 or 1:12  
7) against 44:8 or 11:2 favor 8:44 or 2:11  
9) against 51:1 favor 1:51  
11) against 51:1 favor 1:51  
13) against 50:2 or 25:1 favor 2:50 or 1:25  
15a)  $6/36$  or  $1/6$       15b)  $30/36$  or  $5/6$       15c) 6:30 or 1: 5  
15d) 30:6 or 5: 1      15e)  $15/36$  or  $5/12$       15f) 21:15 or 7:5  
15g)  $6/36$  or  $1/6$       15h) 30:6 or 5:1  
17a) 16:14 or 8:7      17b) 14:16 or 7:8  
19) 1:3      21) 2:2 or 1:1