

## Section 4.2 - Theoretical Probability

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The \_\_\_\_\_ of any outcome of a chance process is a number between \_\_\_\_ and \_\_\_\_ that describes the \_\_\_\_\_ of times the outcome would occur in a very long series of repetitions.

### Part 1: Video on Probability

<http://www.learner.org/courses/againstallodds/unitpages/unit19.html>

Answer the following questions while watching the video:

1. What is a probability model (distribution)?
2. Describe the sample space for the sum of two dice.
3. What is the probability of rolling two dice and getting a sum of seven?
4. If you know the probability that event A occurs, how do you calculate the probability that event A does not occur?
5. What probability can you find using the Addition Rule? 6. What probability can you find using the Multiplication Rule?
6. What probability can you find using the Multiplication Rule?

## Part 2: Theoretical Probability

Assuming that all outcomes are equally likely, the probability of an event in an experiment is the ratio of the number of outcomes that make up that event to the total number of possible outcomes.

The formula for the probability of an event  $A$  is:

\_\_\_ is the collection of all possible outcomes of the experiment (the sample space)

\_\_\_ is the collection of outcomes that correspond to the event of interest (the event space)

\_\_\_ and \_\_\_ are the numbers of elements in the two sets.

### **Examples of Theoretical Probability**

We know that there are \_\_\_ possible outcomes when a die is rolled. Only one of these outcomes is the event of rolling a 4. Since the outcomes are all equally likely to happen, it is reasonable to expect that the fraction of the time you roll a 4 is the ratio of the number of ways a 4 can occur to the number of possible outcomes.

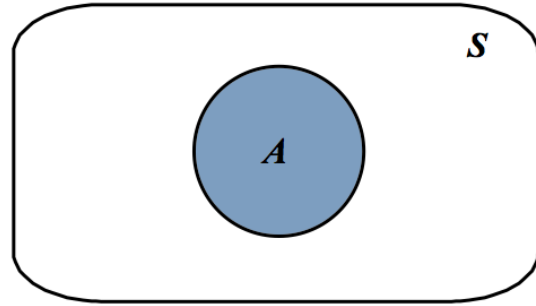
What is the probability of rolling an even number?

*Given a large enough number of trials, the experimental probability should trend towards the theoretical probability*

## Venn Diagrams

A Venn diagram can be used to show the relationship between the event space, \_\_\_\_\_, and the sample space, \_\_\_\_\_. Venn diagrams will be used more in section 4.3.

The Venn diagram shows  $A$  as the shaded region within  $S$ .



### Example 1

If a single die is rolled, determine the probability of rolling:

**a)** an odd number

**b)** a 5 or a 2

**c)** A number greater than 2

### Example 2

A bag contains 20 marbles

4 Blue, 6 Orange, 7 Green, 3 Purple

What is the probability of pulling a green marble?

### Example 3

Roulette was invented by Blaise Pascal in his search for a perpetual motion machine...

$P(\text{red}) =$

$P(\text{even}) =$

$P(14) =$

$P(\text{1st } 12) =$

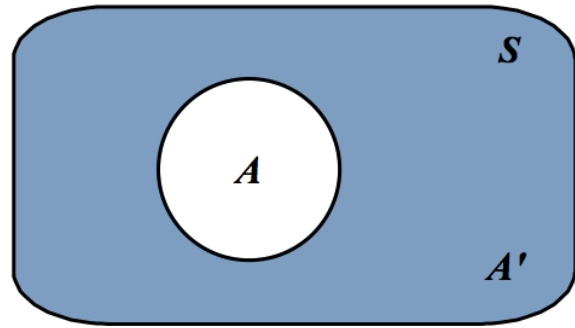
		0	00
1 - 18 -1st 12- Even	1	2	3
	4	5	6
	7	8	9
	10	11	12
	13	14	15
	16	17	18
19 - 36 -2nd 12- Odd	19	20	21
	22	23	24
	25	26	27
	28	29	30
	31	32	33
	34	35	36
		2 to 1	2 to 1

### Part 3: Probability and Complimentary Events

The complement of a set ( $A$ ), is written as  $P(A')$  and consists of all the outcomes in the sample space that are \_\_\_\_\_ in  $A$ .

$$A' = \{\text{outcomes in } S \text{ that are NOT in } A\}$$

The Venn diagram shows  $A'$  as the shaded region within  $S$  that is entirely outside of  $A$ .



#### Example 4

In example 1b, we calculated the probability of rolling a 2 or a 5 to be  $\frac{1}{3}$ . Use this to calculate the probability of NOT rolling a 2 or a 5.

#### Example 5

A standard deck of cards comprises 52 cards in four suits - clubs, hearts, diamonds, and spades. Each suit consists of 13 cards - ace through 10, jack, queen, and king.

a) What is the probability of drawing an ace from a well-shuffled deck?

b) What is the probability of drawing anything but an ace?

c) What is the probability of selecting a face card (J, Q, K)?

d) What is the probability of NOT selecting a face card (J, Q, K)?

