Probability 1

chapter 1

Section 1.3 Elementary probability

$$P(\text{Event}) = \frac{\#\text{ favourable outcomes}}{\#\text{ total outcomes}}$$

1.3 Q1 - 6
H.W.

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Probability uses numbers to tell us how likely something is to happen.
The **probability** or **chance** of something happening can be described by using words such as:

Impossible **Unlikely** **Even Chance** **Likely** **Certain**

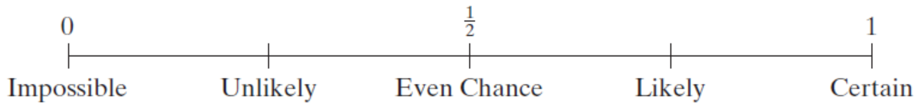
An event which is **certain to happen** has a **probability of 1**.

An event which **cannot happen** has a **probability of 0**.

All other probabilities will be a number greater than 0 and less than 1.

The more likely an event is to happen, the closer the probability is to 1.

The line shown below is called a **probability scale**.



Before you start a certain game, you must throw a dice and get a 6.
The act of throwing a dice is called a **trial**.
The numbers 1, 2, 3, 4, 5 and 6 are all the possible **outcomes** of the trial.
The required result is called an **event**.

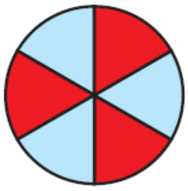
If you require an even number when throwing a dice, then the **event** or **successful outcomes** are the numbers 2, 4 and 6.

The result we want is called an **event**.

The chance of getting a red with this spinner is the same as the chance of getting a blue. Getting a red and getting a blue are **equally likely**.

In general, if E represents an event, the probability of E occurring, denoted by $P(E)$, is given below:

$$P(E) = \frac{\text{number of successful outcomes in } E}{\text{number of possible outcomes}}$$



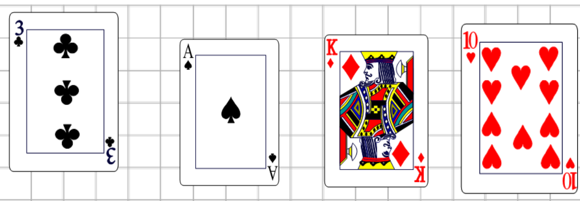
1. The probability of any event E cannot be less than 0 or greater than 1, i.e., $0 \leqslant P(E) \leqslant 1$.
2. The probability of a certainty is 1.
3. The probability of an impossibility is 0.
4. If E is an event, then the probability that E does not occur is 1 minus the probability that E occurs.
   This is written as $\mathbf{P(E \text{ not occurring}) = 1 - P(E)}$.

If A is an event, it will either happen or not happen.

$P(A \text{ happening}) = 1 - P(A \text{ not happening})$.

Deck of 52

(no jocker)



4 Suits

13 cards in each Suit

3 picture cards $\boxed{K}$ $\boxed{J}$ $\boxed{Q}$

2 Colours

Example 1

If a card is drawn from a pack of 52, find the probability that it is

(i) an ace (ii) a diamond (iii) a red card.

(i) $P(\text{Ace}) = \frac{1}{13}$

(ii) $P(\text{Diamond}) = \frac{1}{4}$

(iii) $P(\text{red}) = \frac{1}{2}$

Example 2

A letter is selected at random from the letters of the word STATISTICS.
Find the probability that the letter is
(i) C (ii) S (iii) S or T (iv) a vowel.

10 letters
3 S
3 T
2 I
1 A
1 C

(i) $P(C) = \frac{1}{10}$

(ii) $P(S) = \frac{3}{10}$

(iii) $P(S \text{ or } T) = \frac{3+3}{10} = \frac{3}{5}$

(iv) $P(\text{vowel}) = \frac{2+1}{10} = \frac{3}{10}$

Two events – use of sample spaces

When two coins are tossed, the set of possible outcomes is

$\{HH, HT, TH, TT\}$, where H = head and T = tail.

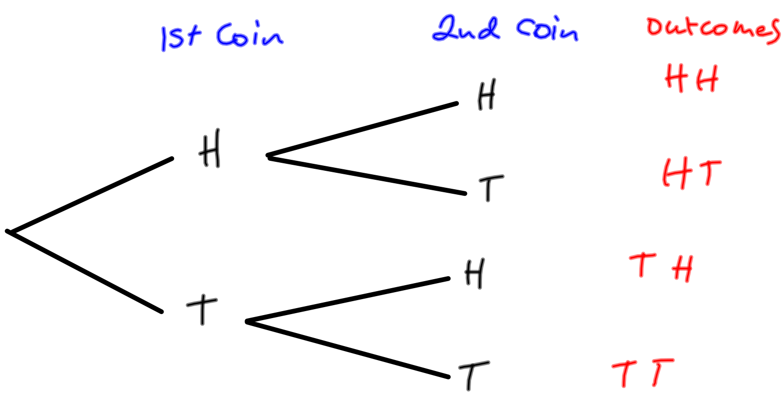
This set of possible outcomes is called a **sample space**.

By using this sample space, we can write down the probability of getting 2 heads, for example.

$P(HH) = \frac{1}{4}$ and $P(\text{one head and one tail}) = \frac{2}{4} = \frac{1}{2}$

In an experiment such as throwing two dice, for example, the construction of a sample space showing all the possible outcomes can assist in finding the probability of a given event.

	H	T
H	HH	HT
T	TH	TT



Example 3

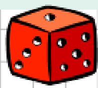
If two dice are thrown and the scores are added, set out a sample space giving all the possible outcomes. Find the probability that

(i) the total is exactly 7 (ii) the total is 4 or less

(iii) the total is 11 or more (iv) the total is a multiple of 5.

Fundamental Principle of Counting

$6 \times 6 = 36$



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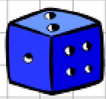


6

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

i $P(7) = \frac{6}{36} = \frac{1}{6}$

ii $P(4 \text{ or less}) = \frac{6}{36} = \frac{1}{6}$

iii $P(11 \text{ or more}) = \frac{3}{36} = \frac{1}{12}$

iv $P(\text{multiple of } 5) = \frac{7}{36}$

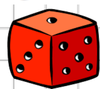
9. Two unbiased dice are thrown. Using the sample space given in Example 3 of this section, find the probability that

(i) the total is 10 (ii) both numbers are odd

(iii) the total is 4 or less (iv) the total is odd and greater than 6.

Fundamental Principle of Counting

$6 \times 6 = 36$



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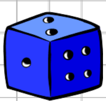

6

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

(i) $P(10) = \frac{3}{36} = \frac{1}{12}$

(ii) $P(\text{both odd}) = \frac{9}{36} = \frac{1}{4}$

(iii) $P(4 \text{ or less}) = \frac{6}{36} = \frac{1}{6}$

(iv) $P(\text{odd and more than } 6) = \frac{12}{36} = \frac{1}{3}$