Unit 10: Probability

Probability Events

Single Events

P(**event**) = $\frac{\text{outcomes matching event}}{\text{total outcomes}}$

Probabilities add up to 1

If P(event) = 0.4

The P(not event) = 1-0.4 = 0.6

Combined Events

Listing Outcomes

I flip two non biased coins.

List systematically all the outcomes

HH
HT
TH
TT

There are 4 outcomes if we flip two non biased coins

Sample Space Diagrams

Sample space diagrams are a way of showing multiple outcomes in one diagram.

After throwing 2 fair die and adding.

1st Die \ 2nd Die	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

What is the probability that after throwing two dice you get a prime number?

There are 15 prime numbers, and 36 outcomes all together,

So the probability is $\frac{15}{36}$

Finding missing probabilities from a table

As probabilities sum to 1, you must add together all the known probabilities and then subtract from 1

Red	Blue	Yellow	Green
0.1	x	0.4	0.2

$0.1 + 0.4 + 0.2 = 0.7$

$1 - 0.7 = 0.3$

Expected Frequency

Expected frequency of an event = probability of event x number of trials

This is also known as theoretical probability

I throw an unbiased dice 60 times.

How many times would you expect to roll a 6?

Probability of the event is $\frac{1}{6}$

Number of trials = 60

$\frac{1}{6} \times 60 = 10$

Expected and Relative frequency

Relative Frequency

$$relative\ frequency = \frac{number\ of\ successes}{number\ of\ trials}$$

This is also known as experimental probability

Score	Frequency	Relative Frequency
1	12	= 12 ÷ 50 = **0.24**
2	25	= 25 ÷ 50 = **0.5**
3	9	= 9 ÷ 50 = **0.18**
4	4	= 4 ÷ 50 = **0.12**

Total of 50 spins

Relative frequency is called experimental probability because it has already happened.

Expected frequency is called theoretical probability because it has not yet happened.

Independent Events

If A and B are independent events, then the outcome of one doesn't affect the other. Then:

P(A **and** B) = P(A) × P(B)

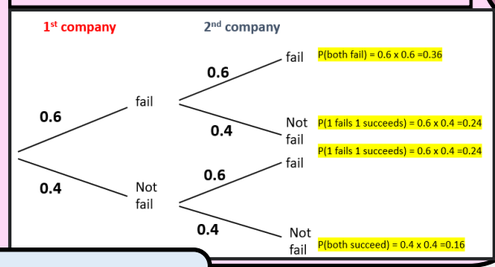
Mutually Exclusive Events

If A and B are mutually exclusive events, they can't happen at the same time. Then:

P(A **or** B) = P(A) + P(B)

Tree Diagrams: Independent Events

The probability that a new company will fail in its first 5 years is 0.6. Two companies are chosen at random.



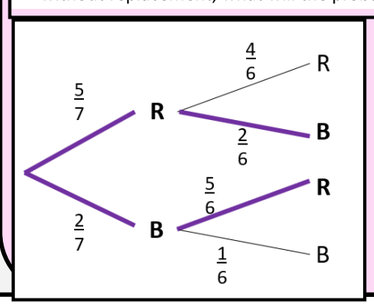
You always multiply along the branches in a tree diagram

Conditional Probability

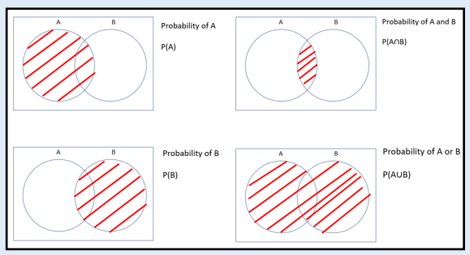
Conditional Probability is the probability of an event (*A*), given that another (*B*) has already occurred.

Tree Diagrams

Given there's 5 red balls and 2 blue balls. If I taken two balls without replacement, what will the probability tree look like?



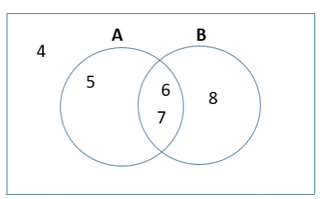
Sets and Venn Diagrams



This symbol means all the numbers in the set

$\xi = \{4,5,6,7,8\}, \quad A = \{5,6,7\}$
$B = \{6,7,8\}$

Construct a Venn Diagram to show these sets.

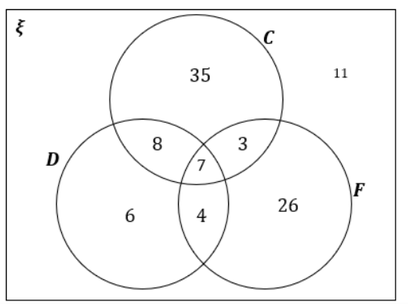


Venn Diagrams with frequencies

A vet surveys 100 of her clients. She finds that
25 own dogs, 15 own dogs and cats, 11 own dogs and tropical fish, 53 own cats, 10 own cats and tropical fish, 7 own dogs, cats and tropical fish, 40 own tropical fish.

Fill in this Venn Diagram, and hence answer the following questions:

a) $P(owns\ dog\ only)$
b) $P(does\ not\ own\ tropical\ fish)$
c) $P(does\ not\ own\ dogs,\ cats, or\ tropical\ fish)$



a) $\frac{6}{100}$

b) $\frac{60}{100}$

c) $\frac{11}{100}$

Tree Diagrams

Venn Diagrams