



- 1 The probability that it rains in a town on Saturday is 0.3.
The probability that it rains in the town on Sunday is 0.4.
The two events are independent.
Work out the probability that it rains on both days.

(2 marks)

For independent events, multiply the probabilities

$$P(\text{rain both days}) = 0.3 \times 0.4 = 0.12$$

0.12

- 2 Zak plays two games of darts. He draws a probability tree diagram.
On the first pair of branches he writes $P(\text{win}) = 0.6$ and $P(\text{lose}) = 0.5$.
He then works out $P(\text{win both games}) = 0.6 + 0.6 = 1.2$.
Write down **two** mistakes Zak has made.

The games are independent, with the same probability of winning each game. There are no draws.

(2 marks)

The probabilities on any pair of branches must sum to 1, but $0.6 + 0.5 = 1.1$

To combine two events along a path you multiply the probabilities, so $P(\text{win both})$ should be $0.6 \times 0.6 = 0.36$, and 1.2 is impossible because a probability cannot be greater than 1

- 3 Femi plays two games of table tennis.
The probability that he wins each game is $\frac{2}{3}$.
The results of the games are independent.
Work out the probability that Femi loses at least one of the games.

(3 marks)

$$P(\text{wins both games}) = \frac{2}{3} \times \frac{2}{3} = \frac{4}{9}$$

Losing at least one game is the opposite of winning both

$$P(\text{loses at least one}) = 1 - \frac{4}{9} = \frac{5}{9}$$

$\frac{5}{9}$

- 4 To win a chess tournament, Jamal must win his semi-final and then win the final.
The probability that he wins his semi-final is 0.7.
If he reaches the final, the probability that he wins it is 0.55.
Work out the probability that Jamal wins the tournament.

(2 marks)

Semi-final win: 0.7

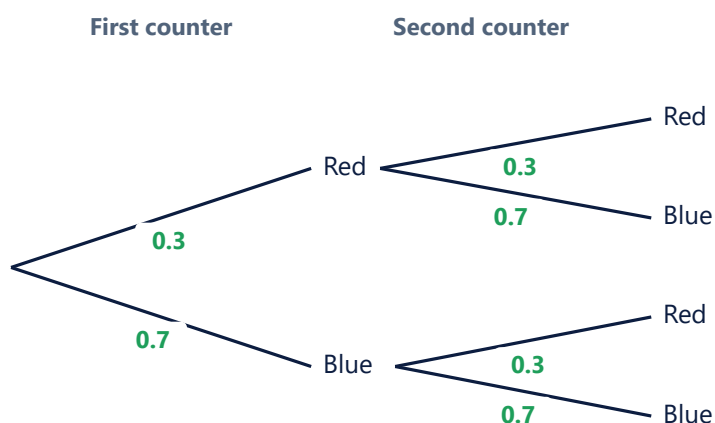
Final win: 0.55

Both needed, so multiply along the branch

$$= 0.7 \times 0.55$$

0.385

- 5 A bag contains 3 red counters and 7 blue counters.
Kira takes a counter at random, notes its colour and puts it back.
She then takes a second counter at random.
- Complete the probability tree diagram for the two picks.
 - Work out the probability that both counters are blue.



(3 marks)

$$P(\text{red}) = \frac{3}{10} = 0.3 \text{ and } P(\text{blue}) = \frac{7}{10} = 0.7$$

The counter is replaced, so the second pick has the same probabilities

$$P(\text{both blue}) = 0.7 \times 0.7 = 0.49$$

6

The probability that Ravi's bus is on time on any day is 0.8.

Whether the bus is on time on one day does not affect any other day.

Ravi catches the bus on Monday and on Tuesday.

- Work out the probability that the bus is on time on both days.
- Work out the probability that the bus is late on exactly one of the two days.

(3 marks)

$$P(\text{on time}) = 0.8, P(\text{late}) = 0.2$$

a) On time, on time

$$= 0.8 \times 0.8$$

$$\boxed{0.64}$$

b) Two branches give exactly one late

$$\text{On time, late: } 0.8 \times 0.2 = 0.16$$

$$\text{Late, on time: } 0.2 \times 0.8 = 0.16$$

$$= 0.16 + 0.16$$

$$\boxed{0.32}$$

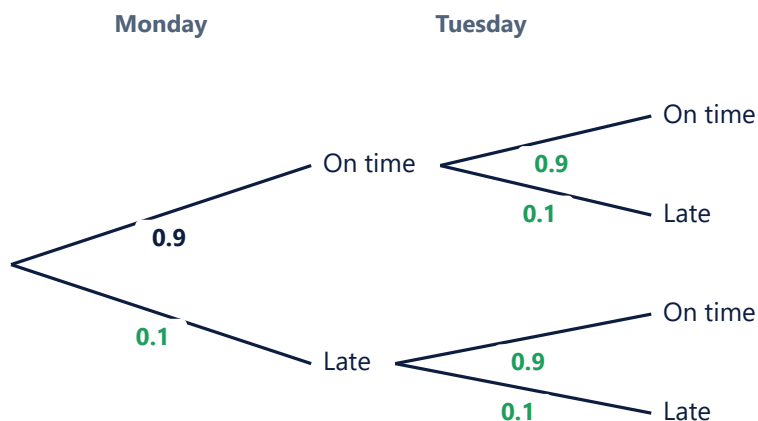
7

The probability that Jon's bus is on time on any day is 0.9.

Whether the bus is on time on one day is independent of any other day.

Jon catches the bus on Monday and on Tuesday.

- Complete the probability tree diagram.
- Work out the probability that the bus is on time on both days.



(4 marks)

Each pair of branches sums to 1, so $P(\text{late}) = 1 - 0.9 = 0.1$

$$P(\text{on time both days}) = 0.9 \times 0.9 = 0.81$$

8

A bag contains 4 red counters and 6 blue counters.

Eva takes a counter at random, records its colour and puts it back. She then takes a second counter at random.

- Work out the probability that both counters are red.
- Work out the probability that exactly one of the counters is red.

(3 marks)

$$P(\text{red}) = 0.4, P(\text{blue}) = 0.6 \text{ both times}$$

$$RR: 0.4 \times 0.4 = 0.16$$

$$RB: 0.4 \times 0.6 = 0.24$$

$$BR: 0.6 \times 0.4 = 0.24$$

$$BB: 0.6 \times 0.6 = 0.36$$

a)

$$\boxed{0.16}$$

b) $RB + BR$

$$= 0.24 + 0.24$$

$$\boxed{0.48}$$

9

Amy and Beth each take one penalty kick.

The probability that Amy scores is 0.7.

The probability that Beth scores is 0.55.

The two events are independent.

Work out the probability that neither of them scores.

(4 marks)

$$P(\text{Amy misses}) = 1 - 0.7 = 0.3$$

$$P(\text{Beth misses}) = 1 - 0.55 = 0.45$$

$$P(\text{neither scores}) = 0.3 \times 0.45 = 0.135$$

$$\boxed{0.135}$$

10

Ella and Fraser each take their driving test on the same day. Their results are independent.

The probability that Ella passes is 0.75.

The probability that Fraser passes is 0.6.

- Work out the probability that both pass.
- Work out the probability that exactly one of them passes.
- Work out the probability that at least one of them passes.

(4 marks)

Ella: pass 0.75, fail 0.25

Fraser: pass 0.6, fail 0.4

a) Pass, pass

$$= 0.75 \times 0.6$$

0.45

b) Ella only, or Fraser only

$$0.75 \times 0.4 = 0.3$$

$$0.25 \times 0.6 = 0.15$$

$$= 0.3 + 0.15$$

0.45

c) At least one = 1 - both fail

$$0.25 \times 0.4 = 0.1$$

$$= 1 - 0.1$$

0.9

11

A bag contains 2 green sweets and 3 yellow sweets.

Cal takes a sweet at random, notes its colour and puts it back in the bag.

He then takes a second sweet at random.

Work out the probability that the two sweets are the same colour.

(4 marks)

$P(\text{green}) = \frac{2}{5}$ and $P(\text{yellow}) = \frac{3}{5}$ on each pick, because the sweet is replaced

$$P(\text{both green}) = \frac{2}{5} \times \frac{2}{5} = \frac{4}{25}$$

$$P(\text{both yellow}) = \frac{3}{5} \times \frac{3}{5} = \frac{9}{25}$$

$$P(\text{same colour}) = \frac{4}{25} + \frac{9}{25} = \frac{13}{25}$$

Add the two paths because both green and both yellow cannot happen together in the same two picks. These are the only ways to obtain the same colour

$$\frac{13}{25}$$

12

Zainab takes three free throws in a basketball game. The probability that she scores with any one throw is 0.7, and the throws are independent.

a. Work out the probability that she scores with all three throws.

b. Work out the probability that she misses at least once.

c. Work out the probability that she scores with at least two of the three throws.

(4 marks)

Score 0.7, miss 0.3

a)

$$= 0.7 \times 0.7 \times 0.7$$

$$0.343$$

b) Opposite of all three

$$= 1 - 0.343$$

$$0.657$$

c) Exactly two: SSM, SMS, MSS

$$\text{Each} = 0.7 \times 0.7 \times 0.3 = 0.147$$

$$3 \times 0.147 = 0.441$$

$$= 0.441 + 0.343$$

$$0.784$$

13

A warehouse has two independent fire alarms.

The probability that each alarm works correctly in a test is 0.95.

Both alarms are tested.

Work out the probability that at least one of the alarms works correctly.

(4 marks)

$$P(\text{an alarm fails}) = 1 - 0.95 = 0.05$$

$$P(\text{both alarms fail}) = 0.05 \times 0.05 = 0.0025$$

$$P(\text{at least one works}) = 1 - 0.0025 = 0.9975$$

$$\boxed{0.9975}$$

14

A gardener sows three seeds. Each seed has probability 0.9 of germinating, independently of the others.

Work out the probability that exactly two of the three seeds germinate.

(3 marks)

Germinate 0.9, not 0.1

$$YYN: 0.9 \times 0.9 \times 0.1 = 0.081$$

$$YNY: 0.9 \times 0.1 \times 0.9 = 0.081$$

$$NY Y: 0.1 \times 0.9 \times 0.9 = 0.081$$

$$= 3 \times 0.081$$

$$\boxed{0.243}$$

15

Cara and Dan each take a driving test.

The probability that Cara passes is 0.6.

The probability that Dan passes is 0.75.

The two events are independent.

Work out the probability that exactly one of them passes.

(4 marks)

$$P(\text{Cara passes and Dan fails}) = 0.6 \times 0.25 = 0.15$$

$$P(\text{Cara fails and Dan passes}) = 0.4 \times 0.75 = 0.3$$

$$P(\text{exactly one passes}) = 0.15 + 0.3 = 0.45$$

$$\boxed{0.45}$$

- 16 A biased coin is flipped twice. The flips are independent.

The probability of getting tails on both flips is 0.36.

- Work out the probability that the coin lands on heads on one flip.
- Work out the probability of getting exactly one tail in the two flips.

(4 marks)

$$\text{Let } P(\text{tails}) = t. \text{ Then } t \times t = 0.36, \text{ so } t = 0.6$$

$$P(\text{heads}) = 1 - 0.6 = 0.4$$

$$P(\text{exactly one tail}) = P(TH) + P(HT) = 0.6 \times 0.4 + 0.4 \times 0.6 = 0.24 + 0.24 = 0.48$$

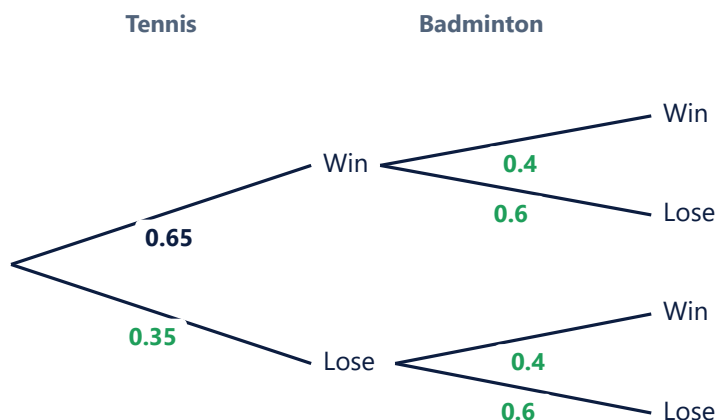
- 17 Ella plays a tennis match on Saturday and a badminton match on Sunday.

The probability that she wins the tennis match is 0.65.

The probability that she wins the badminton match is 0.4.

The results are independent.

- Complete the probability tree diagram.
- Work out the probability that Ella wins exactly one of the two matches.



(5 marks)

$$P(\text{lose tennis}) = 1 - 0.65 = 0.35 \text{ and } P(\text{lose badminton}) = 1 - 0.4 = 0.6$$

$$P(\text{win tennis, lose badminton}) = 0.65 \times 0.6 = 0.39$$

$$P(\text{lose tennis, win badminton}) = 0.35 \times 0.4 = 0.14$$

$$P(\text{exactly one win}) = 0.39 + 0.14 = 0.53$$

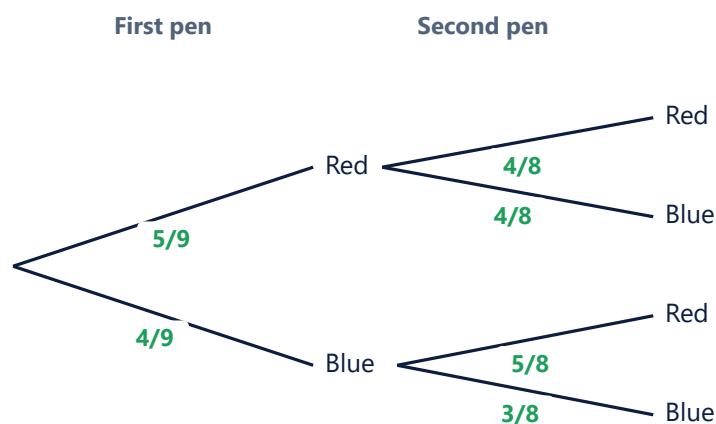
18

A box contains 5 red pens and 4 blue pens.

Milo takes a pen at random and does **not** replace it.

He then takes a second pen at random.

- Complete the probability tree diagram.
- Work out the probability that Milo takes at least one red pen.



(5 marks)

First pick

$$P(\text{red}) = \frac{5}{9}, P(\text{blue}) = \frac{4}{9}$$

The pen is not replaced, so 8 pens remain

after a red, $P(\text{red}) = \frac{4}{8}$ and $P(\text{blue}) = \frac{4}{8}$; after a blue,

$$P(\text{red}) = \frac{5}{8} \text{ and } P(\text{blue}) = \frac{3}{8}$$

$$P(\text{no red pens}) = P(\text{blue, blue}) = \frac{4}{9} \times \frac{3}{8} = \frac{12}{72} = \frac{1}{6}$$

$$P(\text{at least one red}) = 1 - \frac{1}{6} = \frac{5}{6}$$