Probability

Chapter 6

Test yourself 6

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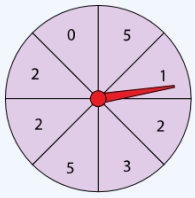
1. The spinner has 8 equal sectors. Find the probability of

(i) spinning a 5 (ii) not spinning a 5

(iii) spinning a 2 (iv) spinning a 7

(v) not spinning a 7.



(i) $P(5) = \frac{2}{8} = \frac{1}{4}$

(ii) $P(\text{not } 5) = \frac{6}{8} = \frac{3}{4}$

(iii) $P(2) = \frac{3}{8}$

(iv) $P(7) = \frac{0}{8} = 0$

(v) $P(\text{not } 7) = \frac{8}{8} = 1$

181

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2. Ben rolls a fair dice 300 times.
How many times would you expect him to roll
(i) a 6 (ii) an even number?

(i) FAIR DICE SHOULD LAND $\frac{1}{6}$ OF TIME ON EACH SIDE

$$\text{Expected 6's} = \left(\frac{1}{6}\right)(300) = 50$$

(ii) SINCE HALF OF NUMBERS ARE EVEN

$$\text{EXPECTED EVENS} = \left(\frac{1}{2}\right)(300) = 150$$

181

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3. One letter is chosen at random from the letters of the word *DEALING*.
(i) Find the probability that the letter chosen is *G*.
(ii) Find the probability that the letter chosen is a vowel or *G*.

↖ 7 letters

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

(ii) $P(\text{Vowel or } G) = \frac{4}{7}$

181

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4. A bag contains 6 red beads, 4 blue beads and 2 green beads. If a bead is drawn at random from the bag, what is the probability that it is

(i) green (ii) blue

(iii) green or blue (iv) not red?

(i) $P(\text{Green}) = \frac{2}{12} = \frac{1}{6}$

(ii) $P(\text{Blue}) = \frac{4}{12} = \frac{1}{3}$

(iii) $P(\text{Green or Blue}) = \frac{1}{6} + \frac{1}{3} = \frac{1}{6} + \frac{2}{6} = \frac{3}{6} = \frac{1}{2}$

(iv) $P(\text{not Red}) = \frac{6}{12} = \frac{1}{2}$ [note not red is the same as green or blue!]

181

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5. There are four possible results in a fairground game. The table shows the probability of each result.

Result	Probability
Top prize	$\frac{1}{20}$
Consolation prize	$\frac{1}{10}$
Your money back	?
Lose	$\frac{3}{5}$ X

(i) What is the probability of getting your money back?

(ii) What is the most likely result?

(iii) What is the probability of not winning the top prize?

(iv) How many times would you expect to lose if you played the game 100 times?

(i) $\frac{1}{20} + \frac{1}{10} + X + \frac{3}{5} = 1$

$\frac{1}{20} + \frac{2}{20} + X + \frac{12}{20} = 1$

$\frac{15}{20} + X = 1 \Rightarrow X = \frac{5}{20} = \frac{1}{4}$

All options must add up 6 1

(ii) Most likely is to lose : $P(\text{Lose}) = \frac{3}{5}$

(iii) $P(\text{not top prise}) = 19/20$

(iv) Expected losses out of 100 $= (100)(\frac{3}{5}) = 60$

181

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6. James takes a book from a shelf at random.
The table shows the probability of getting different types of book.

Subject	Hardback	Paperback
Fiction	0.1	0.3
Sport	0.2	0
Computers	0.1	0.15
Animals	0.05	0.1

What is the probability that the book chosen will be
(i) a paperback (ii) a book about computers?
If there are 120 books on the shelf altogether,
(iii) how many of them are about animals?

(i) $P(\text{Paperback}) = 0.1 + 0.2 + 0.1 + 0.05 = 0.45$

(ii) $P(\text{computers}) = 0.1 + 0.15 = 0.25$

(iii) $P(\text{Animals}) = 0.05 + 0.1 = 0.15$

expect no. out of 120 $= (120)(0.15) = 18$

181

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7. A school snack bar offers a choice of four snacks.
The four snacks are burgers, pizza, pasta and salad.
Students can choose **one** of these four snacks.
The table shows the probability that a student will choose burger or pizza or salad.

Snack	burger	pizza	pasta	salad
Probability	0.35	0.15	x	0.2

300 students availed of the snack bar on Tuesday.
Work out an estimate for the number of students who chose pasta.

$0.35 + 0.15 + x + 0.2 = 1$

$0.65 + x = 1$

$x = 0.35$

out of 300 $\Rightarrow$ estimate pasta $= (300)(0.35)$

$= 105$

182

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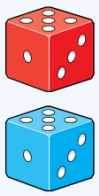
8. Jane throws a red dice and a blue dice at the same time.
Show all the possible outcomes in a sample space.
Find the probability that Jane obtains

(i) a total of 10
(ii) a total of 12
(iii) a total less than 6
(iv) the same number on both dice.



	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

SAMPLE SPACE SHOWING POSSIBLE OUTCOMES

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

(ii) $P(12) = \frac{1}{36}$

(iii) $P(<6) = \frac{10}{36} = \frac{5}{18}$

(iv) $P(\text{same}) = \frac{6}{36} = \frac{1}{6}$

182

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9.

Cliona picks two cards at random from the 3, 4, 5 and 6 of hearts.
Find the probability that the sum of the numbers on the two cards is more than 9.

SAMPLE SPACE

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

$P(>9) = \frac{6}{16} = \frac{3}{8}$

182

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10. Four friends, Ava, Brian, Cloe and Dara, each write their name on a card and the four cards are placed in a hat.
Ava chooses two cards to decide who does the maths homework that night.
List all the possible combinations.
What is the probability that Cloe and Dara have to do the homework?

A B C D

	A	B	C	D
A		AB	AC	AD
B			BC	BD
C				CD
D				

SAMPLE SPACE SHOWING ALL POSSIBLE OUTCOMES

IF Cloe and Dara don't have to do work then Ava and Brian must be picked.

$P(\text{not Cor D}) = \frac{1}{6}$

182

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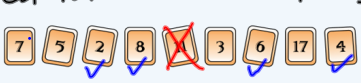
11. These number cards are shuffled and put into a row.

John picks one card at random and does not replace it. He then picks a second card.

(i) If the first card was the '11', find the probability that John selects an even number with the second draw.

(ii) If the first card was the '8', find the probability that he selects a number higher than 9 with the second draw.

(i) P(even in Second draw) = ?



$P(\text{even}) = \frac{4}{8} = \frac{1}{2}$

(ii) P(>9 in Second draw) = ?

$P(>9) = \frac{2}{8} = \frac{1}{4}$

182

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12. In a small school, a class consists of children of a variety of ages as given in the table.

5-year-old girls	5-year-old boys	6-year-old girls	6-year-old boys	7-year-old girls	7-year-old boys
3	4	6	8	5	2

= 27

A pupil is selected at random.
What is the probability that the pupil is

(i) a 6-year-old boy
(ii) a girl
(iii) a 6 or 7-year-old child
(iv) a boy or a 6-year-old child?

(i) P(Boy of 6) = 8/27

(ii) P(Girl) = 14/27

(iii) P(6 or 7) = 20/27

(iv) P(Boy or 6 year old) = 20/27

183

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13. (i) Aidan has a dice with 3 red faces, 2 blue faces and 1 green face. 6 FACES
He throws the dice 300 times.
The results are shown in the following table.

Red	Blue	Green
156	98	46

(a) What is the relative frequency of getting a red face?
(b) Do you think the dice is fair?
Explain your answer.

a) Relative freq. Red = 156/300

b) Fair? expected that 3/6 or 150/300 would happen
this seems close to result
⇒ it is fair.

183

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(ii) Emma has a dice with 4 red faces and 2 blue faces.
She throws the dice 10 times and gets 2 reds.
Emma says the dice is **not** fair.
Explain why Emma could be wrong.

$P(\text{Red}) = \frac{4}{6} = \frac{2}{3}$

Expected value in 10 throws $= \left(\frac{2}{3}\right)(10) = 6.66$

So 2 reds is low.

But Emma may be wrong because 10 throws is too small a sample to make any certain statement

183

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14. A coin is biased so that the probability of a head is $\frac{2}{3}$.
The coin is thrown three times.
Find the probability of obtaining
(i) tails on each of the first two throws (ii) the first head on the third throw.

(i) $P(T,T) = \left(\frac{1}{3}\right)\left(\frac{1}{3}\right) = \frac{1}{9}$

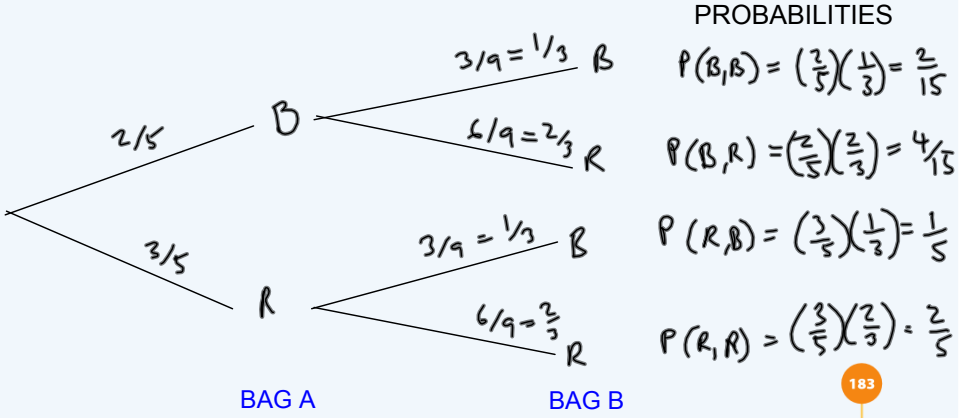
(ii) $P(T,T,H) = \left(\frac{1}{3}\right)\left(\frac{1}{3}\right)\left(\frac{2}{3}\right) = \frac{2}{27}$

183

Test yourself 6

15. Bag A contains 2 blue beads and 3 red beads.
Bag B contains 3 blue beads and 6 red beads.
A bead is picked at random from each bag.
Draw a tree diagram to show all the possible outcomes.

(i) What is the probability that both discs are blue? 2/15
(ii) What is the probability that both discs are red? 2/5
(iii) What is the probability that both discs are the same colour? 2/5 + 2/15 = 8/15
(iv) What is the probability that the discs are of different colours? 7/15



183

Test yourself 6

16. A game consists of rolling a fair dice.
If the outcome is 1, you win €1; if the outcome is 2 you win €2; for 3, 4, 5 and 6 you win €3, €4, €5 and €6 respectively.
It costs €4 to roll the dice once.
Find the expected amount you could win or lose if you played this game.
Do you think the game is fair? Explain your answer.

Roll	Win/lose (€)
1	-3
2	-2
3	-1
4	0
5	1
6	2
Total =	-3

(€) Average Win/lose = Total / 6

$= \frac{-3}{6} = -\frac{1}{2}$

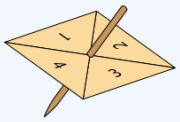
ie.. you expect to lose €0·50 each time

This is not fair as there is not an even chance of winning

183

Test yourself 6

17. Here is a 4-sided spinner.
The sides of the spinner are labelled 1, 2, 3 and 4.
The spinner is biased.
The probability that the spinner will land on each of the numbers 2 and 3 is given in the table below.



Number	1	2	3	4
Probability	x	0.3	0.2	x

The probability that the spinner will land on 1 is equal to the probability that it will land on 4.

(i) Work out the value of x.

Sarah is going to spin the spinner 200 times.

(ii) Work out an estimate for the number of times it will land on 2.

(i) $X + 0.3 + 0.2 + X = 1$

$2X + 0.5 = 1$

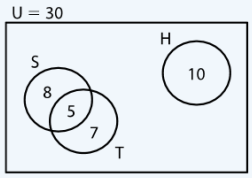
$2X = 0.5$

$X = 0.25$

(ii) estimate $= (0.3)(200) = 60$

Test yourself 6

18. Thirty students were asked to state the activities they enjoyed from swimming (S), tennis (T) and hockey (H).
The numbers in each set are shown.
One student is randomly selected.



(i) Which of these pairs of events are mutually exclusive?

(a) 'selecting a student from S', 'selecting a student from H' yes

(b) 'selecting a student from S', 'selecting a student from T'. No

(ii) What is the probability of selecting a student who enjoyed either hockey or tennis?

Mutually exclusive events can't happen at the same time
ie. no overlap in Venn diagram

(ii) $P(H \text{ or } T) = \frac{12}{30} + \frac{10}{30} = \frac{22}{30} = \frac{11}{15}$

Test yourself 6

19. A dice has the numbers 1, 1, 1, 2, 2, 3 on its faces.

(i) What is the probability of scoring 2?

The dice is thrown three times.

(ii) What is the probability of getting a 2 on each of the first two throws?

(iii) What is the probability of getting the first 2 on the third throw?

(i) $P(2) = \frac{2}{6} = \frac{1}{3}$

(ii) $P(2,2) = \left(\frac{1}{3}\right)\left(\frac{1}{3}\right) = \frac{1}{9}$

(iii) $P(\text{not } 2, \text{not } 2, 2) = \left(\frac{2}{3}\right)\left(\frac{2}{3}\right)\left(\frac{1}{3}\right) = \frac{4}{27}$

184

Test yourself 6

20. Adam and Mandy are playing a game in which three coins are tossed.

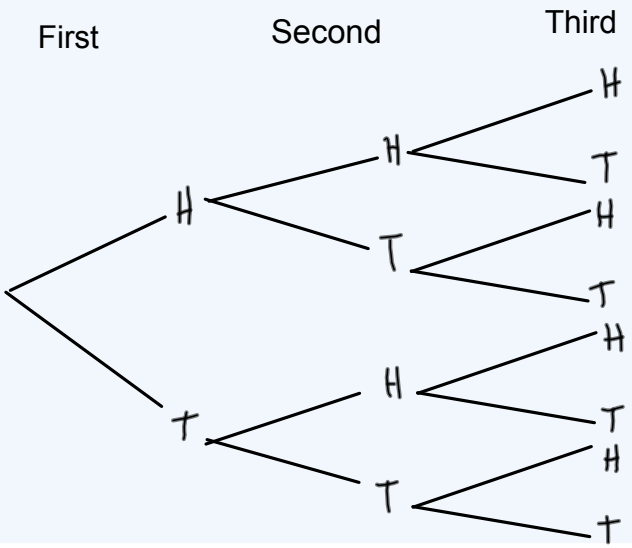
Adam wins if there are no heads or one head.

Mandy wins if there are either two or three heads.

Is the game fair to both players? Explain your answer.

Tree diagram would help

OUTCOMES ALL WITH 1 in 8 chance



HHH
HHT
HTH
HTT
THH
THT
TTH
TTT

H is FAIR each has a 50% chance of winning

184

Test yourself 6

21. How many different 3-digit numbers can be formed using the digits 1, 2, 3, 4, 5 if no digit is repeated in the number?

(i) How many of these numbers begin with 3?

(ii) How many of these numbers are greater than 300?

(i) $5 \times 4 \times 3 = 60$

(ii) If greater than 300 1st digit must be 3, 4 or 5

$3 \times 4 \times 3 = 36$