Probability problem solving 2

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Date: _____

Probability problem solving 2

Sit down with a pen and paper.

Calculator allowed

Continued...

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You need to complete probability problem solving 1 before doing this lesson.

All 7 events were carried out for real.

Question	+/- Counters	Total (7)
1		
2		
3		
4		
5		
6		
7		

The aim is to get as many counters as possible by making smart choices.

Bet 4

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1 counter to play

Roll 2 dice

If both numbers are 4 or less you win 2 counters

Take the bet

What's my chances?

Not playing

What are my chances?

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1 counter to play

Roll 2 dice

If both numbers are 4 or less you win 2 counters

To understand this problem we need to consider all the possible outcomes.

We can do this by drawing a **sample space diagram**.

What are my chances?

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1 counter to play

Roll 2 dice

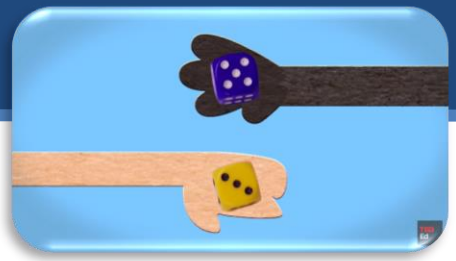
If both numbers are 4 or less you win 2 counters

Dice 2

Dice 1	**1**	**2**	**3**	**4**	**5**	**6**
1	1,1	1,2	1,3	1,4	1,5	1,6
2	2,1	2,2	2,3	2,4	2,5	2,6
3	3,1	3,2	3,3	3,4	3,5	3,6
4	4,1	4,2	4,3	4,4	4,5	4,6
5	5,1	5,2	5,3	5,4	5,5	5,6
6	6,1	6,2	6,3	6,4	6,5	6,6

Outcomes

What are my chances?



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1 counter to play

Roll 2 dice

If both numbers are 4 or less you win 2 counters

Dice 2

Dice 1	**1**	**2**	**3**	**4**	**5**	**6**
1	1,1	1,2	1,3	1,4	1,5	1,6
2	2,1	2,2	2,3	2,4	2,5	2,6
3	3,1	3,2	3,3	3,4	3,5	3,6
4	4,1	4,2	4,3	4,4	4,5	4,6
5	5,1	5,2	5,3	5,4	5,5	5,6
6	6,1	6,2	6,3	6,4	6,5	6,6

You win

You lose

What are my chances?

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1 counter to play

Roll 2 dice

If both numbers are 4 or less you win 2 counters

1. How many outcomes are there?
2. How many desired outcomes are there?

Lets say you roll the dice **36 times** and **win 16** of them.

3. How much have you paid to play?
4. How much have you won?
5. How much have you lost altogether?
6. How would the answer to **Q5** change if you rolled **360 times** instead?

This is what we expect to happen.

Answers

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1 counter to play

Roll 2 dice

If both numbers are 4 or less you win 2 counters

1 How many outcomes are there? **36 outcomes**

2 How many desired outcomes are there? **16 desired outcomes**

Lets say you roll the dice **36 times** and **win 16** of them.

3 How much have you paid to play? **36 counters**

4 How much have you won? **32 counters**

5 How much have you lost altogether? **4 counters**

40 counters

6 How would you expect **Q5** to change if you rolled **360 times** instead?

Update your table

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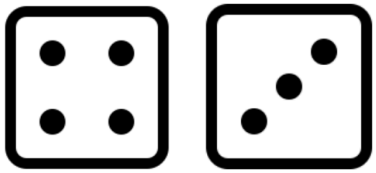
1 counter to play

Roll 2 dice

If both numbers are 4 or less you win 2 counters

Outcome



Looks like you were lucky.

Take the bet

Question	+/- Counters	Total (7)
4	-1 + 2 = +1	

Not playing

Question	+/- Counters	Total (7)
4	0	

Update

Bet 5

Back

1 counter to play

Look out the window

If the next car that drives past is grey you win 3 counters

Take the bet

What's my chances?

Not playing

In 2018, grey became the UK's most popular car colour with **495,127** new models bearing the shade, **up 1.2% on 2017**.

What are my chances?

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1 counter to play

Look out the window

If the next car that drives past is grey you win 3 counters

Although this is true –

*"In 2018, grey became the UK's most popular car colour with **495,127** new models bearing the shade, **up 1.2% on 2017**."*

It doesn't say what proportion of cars are grey. It turns out ≈20% of cars are grey.

$$20\% = 0.2 = \frac{1}{5}$$

What are my chances?

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1 counter to play

Look out the window

If the next car that drives past is grey you win 3 counters

1. If 100 cars drive past, how many do you expect to be grey?
2. If 20 cars drive past, how many do you expect to be grey?

Lets say you watch **10 cars** drive past and **two are grey.**

This is what we expect to happen.

3. How much have you paid to play?
4. How many counters have you taken for your winnings?
5. How much have you lost altogether?

Answers

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1 counter to play

Look out the window

If the next car that drives past is grey you win 3 counters

1 If 100 cars drive past, how many do you expect to be grey? **20**

2 If 20 cars drive past, how many do you expect to be grey?

Lets say you watch **10 cars** drive past and **two are grey.** $\frac{1}{5} \times 20 = 4$

3 How much have you paid to play? **10 counters**

4 How many counters have you taken for your winnings? **6 counters**

5 How much have you lost altogether? **4 counters**

Bet 5

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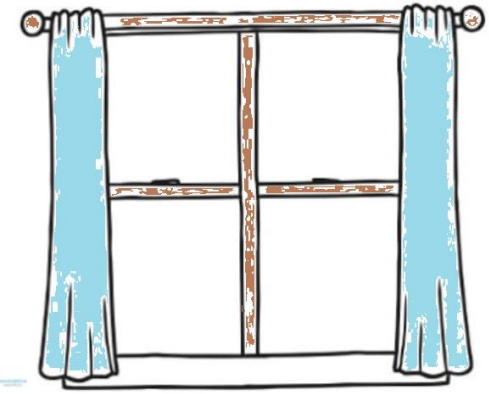
1 counter to play

Look out the window

If the next car that drives past is grey you win 3 counters



Take the bet

Question	+/- Counters	Total (7)
5		

Update

Not playing

Question	+/- Counters	Total (7)
5	0	

Bet 6

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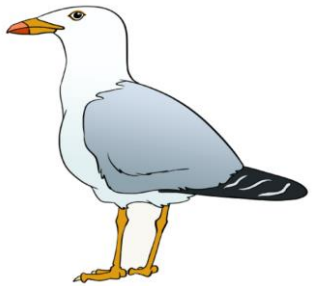
1 counter to play

Look out the window for 5 seconds

If you see a seagull you win 4 counters



Take the bet

What's my chances?

Not playing

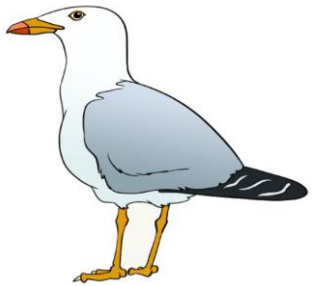
What are my chances?

Back

1 counter to play

Look out the window for 5 seconds

If you see a seagull you win 4 counters



Some probabilities are not obvious.

There is no formula for this one. The only way you can work out if it is a good bet is to do an **experiment**.

For example you could look out the window for **5 minutes** and record how much of the time a seagull is in view.

If you carry out these experiments you have to be aware of all the factors that may affect your answers. For example is there a time of day when there are more seagulls?

Bet 6

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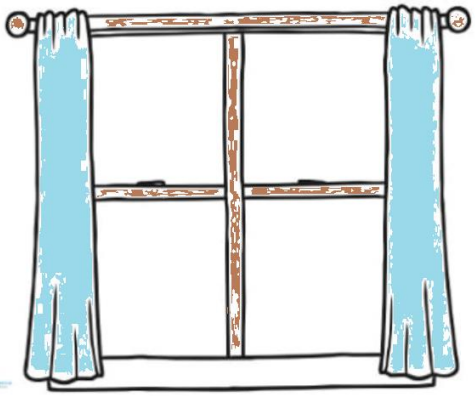
1 counter to play

Look out the window for 5 seconds

If you see a seagull you win 4 counters



Take the bet

Question	+/- Counters	Total (7)
6		

Update

Not playing

Question	+/- Counters	Total (7)
6	0	

Bet 7

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1 counter to play

Pick a number from the board

If your number is chosen you win 8 counter

1	2	3
4	5	6
7	8	9

1. What is the probability your number is chosen?
2. If you play the game 90 times how many would you expect to win?
3. How much will you expect to lose if you play the game 9 times?
4. How much will you expect to lose if you play 90 times?
5. What fraction of your counters do you lose when you play this game?

Answers

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1 counter to play

Pick a number from the board

If your number is chosen you win 8 counter

1	2	3
4	5	6
7	8	9

1 What is the probability your number is chosen? $\frac{1}{9}$

2 If you play the game 90 times how many would you expect to win?

$\frac{1}{9} \times 90 = 10$

3 How much will you expect to lose if you play the game 9 times?

1 counters

4 How much will you expect to lose if you play 90 times? **10 counters**

5 What fraction of your money do you lose when you play this game? $\frac{1}{9}$

Bet 7

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1 counter to play

Pick a number from the board

1	2	3
4	5	6
7	8	9

If your number is chosen you win 8 counter

I ask year 7 students if they will take the bet.

There are **243 students** in year 7. $\frac{2}{3}$ of the students take the bet.

1. How many students take the bet?
2. How many students should I expect to correctly guess the number?
3. How many counters in total will I give to those winners?
4. How many counters am I left with?

Can you create a formula to show how much I will make in counters?

Let **p = probability of winning**
n = number of people betting
c = cost to take bet
w = how much they win

Answers

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1 counter to play

Pick a number from the board

If your number is chosen you win 8 counter

1	2	3
4	5	6
7	8	9

There are **243 students** in year 7. $\frac{2}{3}$ of the students take the bet.

1 How many students take the bet?

$$\frac{2}{3} \times 243 = \mathbf{162}$$

2 How many students should I expect to correctly guess the number?

$$\frac{1}{9} \times 162 = \mathbf{18}$$

3 How many counters in total will I give to those winners?

$$18 \times 8 = \mathbf{144}$$

4 How many counters am I left with?

$$162 - 144 = \mathbf{18}$$

Click for explanation

Answers

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1 counter to play

Pick a number from the board

If your number is chosen you win 8 counter

1	2	3
4	5	6
7	8	9

Let **p = probability of winning** **c = cost to take bet**

n = number of people betting **w = how much they win**

$$p = \frac{1}{9} \quad c = 1 \quad n = 162 \quad w = 8$$

Total counters in play 162 x 1 = 162 **c x n**

Number of winners $162 \times \frac{1}{9} = 18$ **n x p**

Test your formula

Total counters out 18 x 8 = 144 **n x p x w**

Total counters left 162 - 144 = 18 **c x n - n x p x w** **or** **Total = cn - npw**

Test your formula

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3 counter to play. Pick a number from the board

If your number is chosen you win 15 counters

500 people take the bet.

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

Total = cn - npw

Answer

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

3 counter to play. Pick a number from the board

If your number is chosen you win 15 counters

500 people take the bet.

Total = cn - npw

$$\text{Total} = 3 \times 500 - 500 \times \frac{1}{12} \times 15 = \textbf{875 counters}$$

Bet 7

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1 counter to play

Pick a number from the board

If your number is chosen you win 8 counter

1	2	3
4	5	6
7	8	9

Take the bet

Not playing

Update your table

Back Next

1 counter to play

Pick a number from the board

If your number is chosen you win 8 counter

1	2	3
4	5	6
7	8	9

Take the bet

Question	+/- Counters	Total (7)
7		

Update

Not playing

Question	+/- Counters	Total (7)
7	0	

How did you do?

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How many counters are you left with?

How much of a risk taker are you?

End of the lesson

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Well done for completing the lesson.

Reflections