

It's a Random World

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We are exploring the language of random numbers
We are exploring random number concepts and interpretations
We are exploring the properties of random numbers in context

Exercise 1: Are You Random?

You will need a die and a table of random numbers.

Task 1: How random are you?

Choose numbers at random from 1, 2, 3, 4, 5 or 6 and write them down in the table.

Record a way to test if you have chosen these numbers at random.

Make a comment about how random you were.

Task 2: Is a die random? (Language note...one die, two dice)

Toss a six sided die 30 times and record the results in this table.

Make a comment about the randomness of a die.

Task 3: Are the tables random?

Select 30 numbers from the random number tables.

Make a comment about the randomness of numbers in the tables.

Which of the above tools is the most random?

Exercise 2: Using Random Number Tables

Here is a table of random numbers.

4372642424	7314143723	1495965364	1444304159	7474143653
9406184123	8999350023	1709466538	6258098622	1833110026
2755600119	9440063906	7004248173	2120873170	6032983174
6323543161	6394964935	5411818548	2088035029	5262363298
5667900078	8167958100	2997038372	6994888469	9247172802
4266091944	5738475399	5462166377	6340649938	3025872706
9814791469	4613718979	2994696288	3447166378	3916293208
9637668451	1316222759	6715187556	8632754677	3112528772
2820777553	6459025117	7811269474	4897600594	4716030335
8795344562	2563648280	8418537549	5930150461	3790090475

- 1) How many numbers are there in the table? How do you work that out?

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- 2) Every time you use this table you should get a different set of numbers. Think up a way in which you might be able to do this and write down your method.

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- 3) Use your method and select ten random numbers. Do this 10 times and see if your selection changes every time. Make a comment about your method.

My comment.

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- 4) Randy has a method which he describes as follows.
- (a) Throw a ten sided die to get a number (X) from 1 to 5 (e.g. 3). Throw it again if the number is from 6 to 10
 - (b) Throw the die again to get another number (Y) from 1 to 10 (e.g. 7)
 - (c) Move to the block X across and Y down. (e.g. 3 across and 7 down)
 - (d) Start using numbers in that block and keep moving to the right and down. Then go to the top and keep going.

Use Randy's method to select 10 random numbers and record them.

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5. Write down your method as a series of steps like Randy did.

The _____ Method

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Exercise 3: Random? How do you know?

Knowing that a set of numbers are random can be very important. Some methods to generate random numbers are very good, some not so good and some are very poor. There are also some very strange and some very obvious methods.

A simple test of randomness is to expect that every number has an equal chance of being selected. If this happens, once we have selected a reasonably large group of numbers, sorted them and graphed the totals the columns would all be the same height. There should be equal numbers of each number. Let's see if this works.

1) Count up all the 0, 1, 2 ...9 in the following random number table.

4372642424	7314143723	1495965364	1444304159	7474143653
9406184123	8999350023	1709466538	6258098622	1833110026
2755600119	9440063906	7004248173	2120873170	6032983174
6323543161	6394964935	5411818548	2088035029	5262363298
5667900078	8167958100	2997038372	6994888469	9247172802
4266091944	5738475399	5462166377	6340649938	3025872706
9814791469	4613718979	2994696288	3447166378	3916293208
9637668451	1316222759	6715187556	8632754677	3112528772
2820777553	6459025117	7811269474	4897600594	4716030335
8795344562	2563648280	8418537549	5930150461	3790090475

Record your totals here.

# of 0s =	1s =	2s =	3s =	4s =
5s =	6s =	7s =	8s =	9s =

2) Are the numbers of each the same? How many of each would you expect to have?

Comment

3) Use the space below to make a bar chart of your results.



Does the chart confirm that these numbers are indeed random?

Comment

Exercise 4: Some Random Events!

You will need a creative thinking cap and a buddy.

You are to list some ways to generate or make random numbers. Then you are going to choose a method to make the numbers and test to see if they are random.

1. Discuss and list at least 10 ways of making, finding or generating random numbers.

Our ways are:

2. Choose one of these ways.

Our chosen experiment is:

3. Generate enough numbers to test if your experiment is random.

Our numbers are:

4. Record how you are going to test them.

Our test is:

5. Now do it.

6. Make a comment about the randomness of your method.

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Exercise 5: Random or Not?

Here is a long list of experiments that could generate or be used to generate random results. Your task is to make a comment about the randomness of each experiment. Some of the tasks might not be very random at all.

Event	Comments
1) Tossing a six sided dice	
2) The last digit on number plates of cars.	
3) Tossing a coin	
4) Using RAND function on a calculator or computer.	
5) Throwing a dart at a dart board	
6) Kicking a ball at some numbered drums	
7) Order of race horses finishing	
8) Looking at the second hand on a clock	
9) Heights of students	
10) Thinking of a number between 1 to 10	
11) Looking at the digits in the number π	
12) Drawing cards from a pack	
13) Tossing a drawing pin	
14) Dropping the toast on the floor	
15) Where rain drops fall	
16) Flicking to a page in a book	
17) Looking at the date today	
18) Pocketing a ball of a pool break	
19) Looking at the digits of one seventh	
20) Amount of money of a power bill	
21) Estimating the length of a line	
22) Number of children in families of your class.	
23) Number of children in a class from day to day	
24) The number of cricket balls you can hold.	
25) Length of time you can hold your breath	
26) Number of marks you get in a test	
27) Rolling marbles down a slope	
28) How many coins in your pocket	
29) The number of clouds in the sky	

Exercise 6: How Many Do I Need?

You will need a ten sided die and a friend.

Your task is to make a **conjecture** about how many times you need to toss a dice to know that this is a random way of generating numbers.

1) Since there are ten numbers (0, 1, 2, ... 8, 9) we will toss the dice ten times and graph the results.

(a) How many of each number do you expect?

Comment

(b) Toss the die ten times. How many of each number did you get?

Results

2) Graph your results. Were ten tosses enough to show the numbers are random?

Comment

3) How many times do you think you will need to throw the dice to convince someone that tossing a die has a random outcome?

My guess is

4) Investigate your idea and summarise what you find out in the box below. Make a conjecture about how many is enough!

Investigation space.

My conjecture.

Exercise 7: Making a Random Spinner

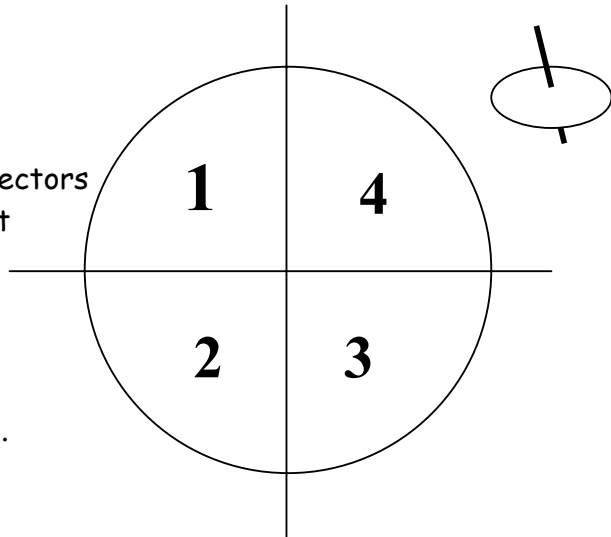
You will need some card, a round tin about 8cm across, scissors, colouring pencils and a tooth pick.

TASK A - Making the Spinner

You are going to make a spinner that will select the numbers 1, 2, 3 or 4 randomly where all of the numbers are equally likely to be selected. You might need to discuss with your teacher what this means.

Steps

- 1) Draw a circle on your card.
- 2) Divide the circle into four equal sectors (The lines must cross at the exact middle of the circle)
- 3) Number and colour the sectors
- 4) Put the tooth pick through the exact centre.
- 5) Spin to generate random numbers.



The number touching the desk
is the chosen number.

Have a few practise spins.

TASK B - Using the Spinner

Now use the spinner to generate enough numbers to test and see if you have made a random 1, 2, 3, 4 number generator.

Comment on your spinner.

TASK C - Designing a Spinner • EASY

Twirl needs to have a spinner that generates the numbers 1 and 2
but the 2 must come up twice as often as the 1.

Your task is to make the spinner to do this and test it to see if you are correct.

TASK D - Designing a Spinner • HARD

Twirl needs to have a spinner that generates the numbers 1, 2 and 3
but the 2 must come up twice as often as the 1

and the 3 has to come up three times as often as the 2.

Your task is to make this spinner and test it to see if you are correct.

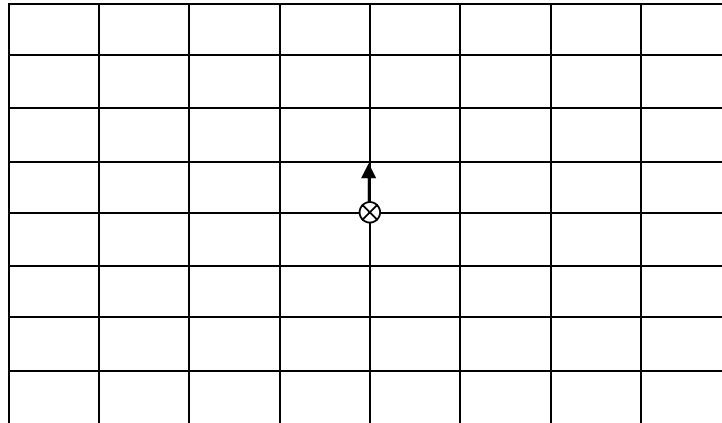
Exercise 8: Going on a Random Walk

You will need a die.

This is a fun game.

Steps to follow.

1. Put your pencil on the dot at the centre of the grid.
2. Toss the die and move
 - forward one and turn right if you throw an even number
 - forward one and turn left if you throw an odd number.
3. Repeat moving and turning for 30 tosses of the die drawing your path.



Make a comment about the path you travelled.

Change to a different colour pencil and try again.

Make another comment about the new path.

Random Robot Game

Mark 10 red dots on the grid and have a friend mark 10 blue dots. Now do a random walk for 30 tosses. Score a point for every one of your colour visited by the robot. Winner has the most points.

Invent a new game.

Rules...

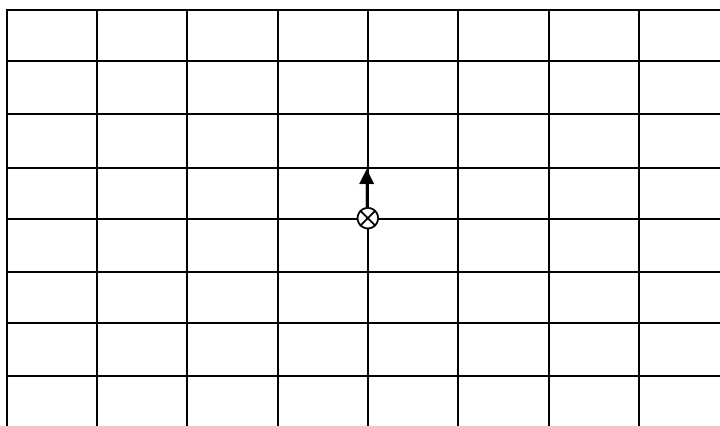
Exercise 9: Random Walk with No Returns!

You will need a die.

This is a fun game and has applications in chemistry and molecule design. In this game you are never allowed to return to a place you have visited. In chemistry, two atoms cannot be in the same place so this game is used to explore molecule manufacturing.

Steps to follow.

1. Put your pencil on the dot at the centre of the grid.
2. Toss the die and move
 - forward one and turn right if you throw an even number
 - forward one and turn left if you throw an odd number.
 - but if you end up in a place you have been before ...throw again.
3. Repeat moving and turning for 30 tosses of the die drawing your path.



Make a comment about the path you travelled.

Are there any holes or other curious new features?

Random Robot Game with No Returns

Mark 10 red dots on the grid and have a friend mark 10 blue dots. Now do a random walk for 30 tosses. Score a point for every one of your colour visited by the robot. Winner has the most points.

Invent a new game.

Rules...

Exercise 10: Random Numbers in Calculators

You will need a calculator that can generate random numbers.

On a CASIO calculator the function $RAND(0)$ generates a number between 0 and 1 and displays this number as a decimal.

Here is an example DISPLAY = 0.367198234

To simulate tossing a coin which has two outcomes, heads and tails we use the function $2 \times RAND(0)$ or more simply $RAND(2)$. Try this and keep pressing the ENTER button and see what happens.

Record your screen displays here.

What function would simulate tossing a dice with 6 sides?

My answer is
Does it work?

Exercise 11: Random Numbers in Computers

You will need access to a computer spreadsheet such as EXCEL.

On an EXCEL spreadsheet the function $RAND()$ generates a random number between 0 and 1 and displays it as a decimal. Select a cell and type $=RAND()$ and see what happens

Here is an example DISPLAY = 0.367198234

To simulate tossing a coin which has two outcomes, heads and tails we use the function $2 * RAND()$. Copy this calculation to an area of the spreadsheet and see if you can generate the outcomes for tossing a coin 50 times.

How could you simulate tossing a dice with 10 sides?

My answer is

Does it work?

Random Numbers

Answers

Exercise 1: Are You Random?

- Task 1. Various answers. Most people have numbers they prefer, and these are usually 3, 4, 7, 8. (These numbers include the traditional ‘lucky’ numbers, and are not near the middle or ends which are often avoided subconsciously.) Some number may also have been accidentally omitted, so there is a good chance that you were not random when you chose the numbers you wrote down!
- Task 2. The data will vary. As there are six possible outcomes, it is unlikely that all have similar frequencies, as 30 is a small number of trials for this sort of experiment. Overall, a die is random in about 90% of cases.
- Task 3. A similar result as task 2 but 30 is not be enough selections as there are 10 possible outcomes this time.

Exercise 2: Using Random Number Tables

The answers to this exercise should be discussed with the rest of the group and your teacher

- 1) 500, 10 groups of 10 numbers in 5 rows.
- 2) Various methods. Correct if a random way of starting is established, and some system used to find the next number
- 3) Various. Comment should support randomness.
- 4) Various
- 5) Various methods. Correct if a random way of starting is established and some system is used to find the next number

Exercise 3: Random? How do you Know?

The answers to this exercise should be discussed with the rest of the group and your teacher

- 1) Totals can vary a little! The totals will not be necessarily be exactly the same as the process is random.
- 2) 50 of each number is expected.
- 3) Graph. Discuss this answer with your teacher.

Exercise 4

The answers to this exercise should be discussed with the rest of the group and your teacher

Exercise 5

The answers to this exercise should be discussed with the rest of the group and your teacher

All are random events to some degree. Some will generate numbers, and others, like the coin, other results (though the head can be called a zero and a tail a one, so a coin can generate two random numbers...). Some of the experiments do not generate true random results. For example, when throwing a dart at a board a person is usually aiming for something, so the dart is more likely to land closer to the aimed point than further away – especially if that person has practised a lot!

Exercise 6

The answers to this exercise should be discussed with the rest of the group and your teacher

- 1) (a) 1 or 2. (b) various
- 2) No. Variation too great in small groups.
- 3) Various. About 50 tosses would be OK.
- 4) Conjectures will vary

Exercise 7

The answers to this exercise should be discussed with the rest of the group and your teacher

Task A. Successful manufacture needs a medal.

Task B. Various answers

Task C. The 'two' sector will be twice the angle of the 1 sector; 240° :to 120° .

Task D. 9 parts. Each part 40degrees. 1 is 40, 2 is 80 and 3 is 240 degrees. These areas do not have to be contiguous.

Exercise 8

All responses various and random.

Exercise 9

All responses various and random.

Exercise 10

All responses various and random.

Exercise 11

All responses various and random.