"Climate is what we expect, weather is what we get."

In this activity, you will use ideas about probability to consider the difference between theoretical and experimental results.

Each time you roll the dice, it tells you the 'weather', e.g. 1 means sunny, 2 means sunny intervals, and so on (see the table below).

Roll a dice 100 times and keep a tally of the numbers that appear.

In the FREQUENCY column, note the number of times each number appears.

In the TOTAL column, put the sum of the numbers in that row. (e.g., if 6 appears 10 times, write 60.)

Number	Weather	Tally	Frequency	TOTAL
1				
2				
3				
4				
5				
6				
			Total=100	

Q1 Do you have a *biased* dice? Explain your answer.

Q2 What is the *probability* of rolling each number?

Q3 What is the *average* (mean) of all the numbers you have rolled? (Add up all the numbers in the TOTAL column, and divide by 100.)

We can compare this to the weather and climate. Each of the numbers on the die correspond to a particular 'weather', with an equal probability of getting each different kind of 'weather' (or number on the die).

The 'climate' is the average 'weather' – so in this example, the climate is the average of all the numbers you have thrown.

Q4 What is the average (mean) weather associated with the numbers you have rolled? This is the climate.

Q5 If you throw the die another 100 times, can you predict what the 'climate' will be? Can you predict what the 'weather' will be on the next throw?

Q6 If the sides of the die were labelled 11-16 instead of 1-6, can you predict what the new 'climate' would be? But could you predict the 'weather' (the number on the next throw) with any more certainty?

Scientists find it difficult to predict what the weather is going to be like in 5 days time, but that doesn't mean they can't discover how the climate may change. The climate, or average weather, is determined by large scale features – such as how much energy the Earth is getting from the Sun. The day to day weather is much less predictable: it can be very similar to, or very different from, the climate.

Can you bias your dice (change the climate) e.g. by sticking a bit of blue tack on one face?

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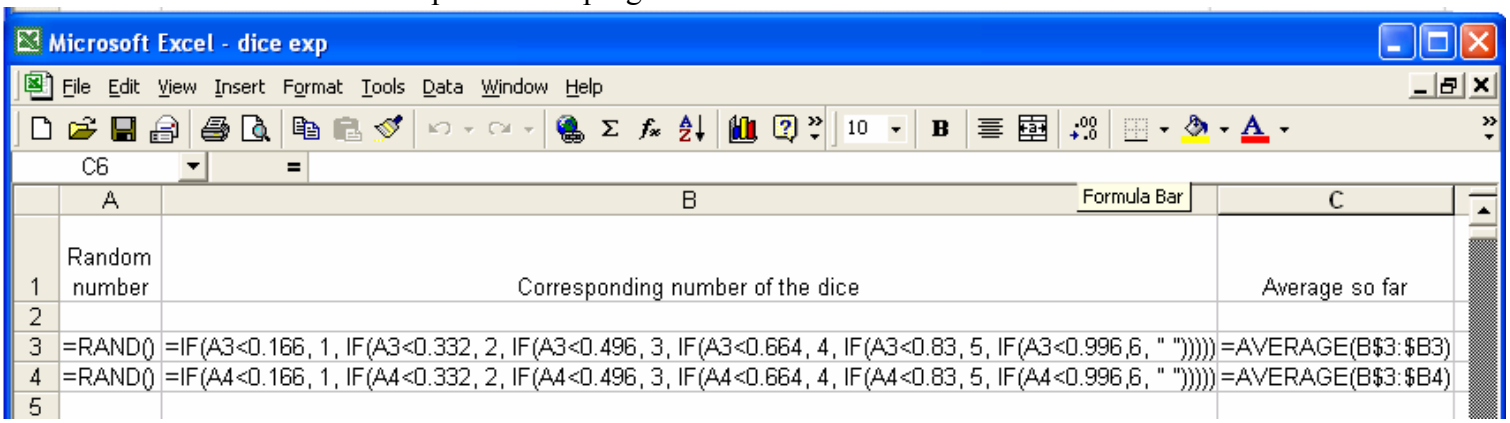
Using a spreadsheet model instead of a dice

You should have found that the average value on the dice was about 3.5; if you rolled it 1000 times instead of 100, you would get closer to this value. But that would be tedious!

Here you can use a spreadsheet to do the hard work for you, and extend the results. The Excel spreadsheet program uses a random number generator to create results. The function RAND() generates random numbers between 0.000 and 0.999.

Here's how to set up the Excel program:



	A	B	C
1	Random number	Corresponding number of the dice	Average so far
2			
3	=RAND()	=IF(A3<0.166, 1, IF(A3<0.332, 2, IF(A3<0.496, 3, IF(A3<0.664, 4, IF(A3<0.83, 5, IF(A3<0.996,6, " ")))))	=AVERAGE(B$3:$B3)
4	=RAND()	=IF(A4<0.166, 1, IF(A4<0.332, 2, IF(A4<0.496, 3, IF(A4<0.664, 4, IF(A4<0.83, 5, IF(A4<0.996,6, " ")))))	=AVERAGE(B$3:$B4)
5			

The second column converts the random numbers into numbers on the die by assigning the first 166 numbers to be equivalent to a '1', the next 166 numbers to a '2', and so on.

The final column will calculate the average score on the die (or the average weather, and therefore the climate).

Enter these three functions as shown above in the Excel spreadsheet.

In the manual experiment you rolled the die 100 times. Copy the formulae down the page so that you produce a set of 100 results.

In order to visualise how these results eventually come to represent a single climate, rather than a series of weather events, plot the average so far on a line graph. To do this highlight column C by clicking on the top of the column. Now select the chart wizard from the tool bar. Select line graph and follow the instructions.

Q6 How well do the results agree with the expected average value of 3.5?

By pressing F9 you can change the set of random numbers. Fix the vertical scale on the graph to minimum 0 and maximum 6, and change the numbers 4 or 5 times.

Q7 Do the results vary significantly from trial to trial?

If you copy columns A, B and C to D, E and F you can produce a second set of results, and plot these on the same graph to produce an even easier comparison. Extend your experiment by copying the code down the spreadsheet.

Q8 How many trials do you think you are going to need to get a consistent set of results?