

## Lucky Sausages

### Purpose:

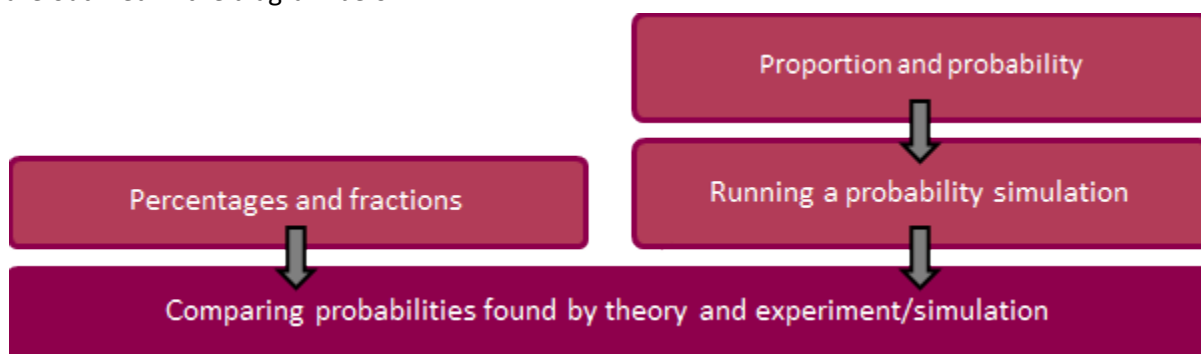
The purpose of this activity is for students to set up and run a simple probability simulation and to compare their experimental value of probability with the theoretical value.

### Achievement Objectives:

S4-3: Investigate situations that involve elements of chance by comparing experimental distributions with expectations from models of the possible outcomes, acknowledging variation and independence.

### Description of mathematics:

The background knowledge and skills that need to be established before and/or during this activity are outlined in the diagram below:



#### Percentages and fractions

Write 12.5% as a fraction.

#### Proportion and probability

If I have five white socks and one green sock, what is the probability that when I randomly select a sock, it is green?

#### Running a probability simulation

To model forgetting my lunch (probability =  $\frac{1}{5}$ ), I use one blue counter to represent forgetting and four red counters to represent remembering to pack my lunch. Randomly select a counter, record the colour and replace the counter. Repeat this 50 times to find how many times I can expect to forget my lunch in a term.

#### Comparing probabilities found by theory and experiment/simulation

The probability of my forgetting to pack my lunch is  $\frac{1}{5}$ . Calculate the number of times I can expect to forget my lunch in a term (50 days). Set up and run a simulation using random numbers to model this problem. Compare the theoretical and your experimental values for the probability that I will forget my lunch in a term.

This activity may be carried out with step by step guidance, or by allowing the student to follow their own method of solution. The approach should be chosen in sympathy with students' skills and depth of understanding.

## Activity:

A group of parents running a fundraising sausage sizzle are struggling to keep up with demand, so have got the BBQ turned up to the hottest setting.

As a result, one third of the sausages are burnt, a quarter are sold before they are cooked properly, but the rest are fine.

Use coloured counters to model this situation, to find the percentage probability, that the next customer is lucky enough to get a properly cooked sausage.

Comment on the results of your experiment.



## The procedural approach

The student is able to set up and run a simple probability simulation, with guidance and to compare the experimental value with the theoretical value of the probability.

Prompts from the teacher could be:

1. To run a simulation picking counters or cards, you will need to be able to assign  $\frac{1}{3}$  as raw and  $\frac{1}{4}$  as burnt. How many counters will you use?
2. Run your simulation and record the results. (Hint: 100 trials will give the same values as the probabilities as percentages)
3. Find the probability, as a percentage, that the next sausage served is properly cooked. This is the experimental probability.
4. Work out the theoretical probability, as a percentage, that the next sausage served is properly cooked.
5. Comment on the similarity or difference between the experimental and the theoretical values for the probability, as a percentage, that the next sausage served is properly cooked.

T: Let's talk about how you chose to use 12 cards.

S: It's the easiest number that can be cut into thirds and quarters.

T: And these statements like  $\frac{1}{4} = 3$ . They worry me.

S: Oh no,  $\frac{1}{4}$  doesn't equal 3; I meant  $\frac{1}{4}$  of 12 is 3.

What I used - 12 cards marked burnt, raw or good ✓

$\frac{1}{4} = 3$        $\frac{1}{3} = 4$        $12 - (3+4) = 5$

What I got -

$\checkmark R \checkmark \checkmark \checkmark \checkmark B B \checkmark \checkmark R \checkmark \checkmark B \checkmark R \checkmark R B B \checkmark \checkmark \checkmark B \checkmark$   
 $R R \checkmark B R R \checkmark B R R \checkmark B \checkmark B B R R \checkmark \checkmark \checkmark B R \checkmark R B$   
 $\checkmark R \checkmark \checkmark B R B R \checkmark B R R \checkmark \checkmark \checkmark R B B \checkmark \checkmark R R R B$   
 $\checkmark \checkmark \checkmark R \checkmark R \checkmark \checkmark R R B B R B R R \checkmark \checkmark \checkmark \checkmark \checkmark B R \checkmark$

$I = 46\%$   
 $R = 31\%$   
 $B = 23\%$

T: How did you use the squares on the paper here?

S: I wanted to do 100 picks to get percentages, so I counted 100 squares. 25 across and 4 rows. Then I knew when to stop.

Experiment = 46% chance of getting a good sausage

Theory = <sup>a bit</sup> More than 40%  
 $41.6\%$       used a calculator  
 $\leftarrow$  did  $5 = 12 \times 100$

Similar values but not the same

$\frac{5}{12} = 41.6\% = \frac{41.6}{100}$

T: What kind of simulation would give a probability closer to 41.6%?

S: One with more than 100 picks. At the start most of the sausages were good, and then it evened out a bit.

## The conceptual approach

The student is able to set up and run a simple probability simulation, and to compare the experimental value with the theoretical value of the probability.

Prompts from the teacher could be:

1. How many counters will you use to run a simulation of this problem?
2. Run your simulation and record the results.
3. Find the probability, as a percentage, that the next sausage served is properly cooked.
4. Work out the theoretical probability, as a percentage, that the next sausage served is properly cooked.
5. Comment on the similarity or difference between the experimental and the theoretical values for the probability, as a percentage, that the next sausage served is properly cooked.

Sausages need 12 counters  $\frac{1}{4} = 3 = \text{burnt} = \text{red}$   
 $\frac{1}{3} = 4 = \text{raw} = \text{yellow}$   
 $12 - 7 = 5 = \text{OK} = \text{blue}$

method - pick a counter from a box ~~100 times~~  
 50 times and double to get %

brryb	bbruy
yrbyb	rrybr
byrrib	bbybr
rbybr	rrybb
rbbyr	yybrb

tally - red    IIII IIII IIII    17    = 34 %  
 yellow    IIII IIII    13    = 26 %  
 blue    IIII IIII IIII    20    = 40% ← answer

T: Tell me about changing your mind.

S: Well, I was going to do 100 picks to save calculating, but it was taking a long time and I realised that I could stop when I got to 50 and just double everything.

T: Your experiment gave a probability of 40%. What do you think the theoretical probability would be?

S: About the same.

T: Can you work it out?

S: Well, a quarter, or 25% are burnt, and a third or 33% are raw. 25 plus 33 is 58, and that leaves 42, no, 42 percent ok, and that's about the same.