# New Turf

## Purpose:

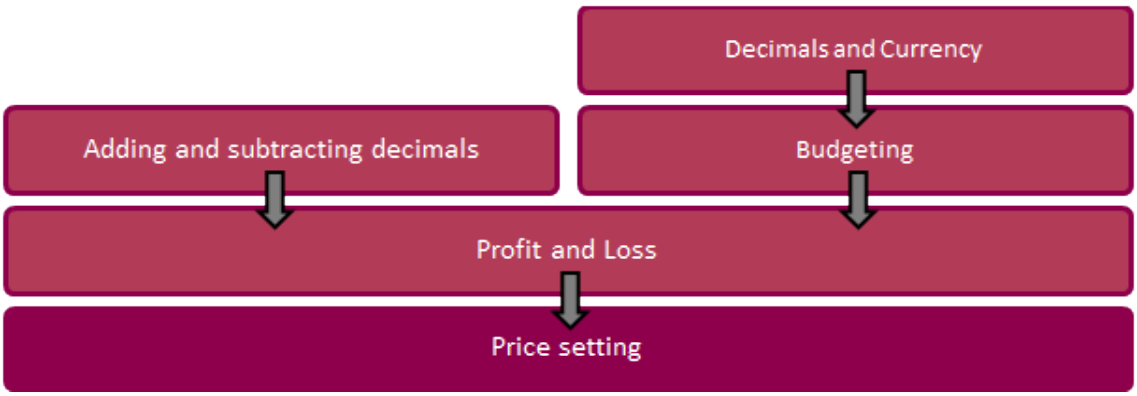
The purpose of this activity is to engage students in solving a probability problem using both theoretical and experimental (modelling) methods.

## 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.
S4-4: Use simple fractions and percentages to describe probabilities.

## 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:




**Decimals and fractions**
Write 0.125 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?

**Calculation expected values**
If the probability of forgetting to pack my lunch is ⅕, how many times can I expect to forget my lunch in a school term (50 days)?

**Running a probability simulation**
To model forgetting my lunch (probability = 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.

**Using random numbers to run a probability simulation**
To model forgetting my lunch (probability = 1/5), I use random numbers (given on a sheet or using a calculator) to represent forgetting (2, 3) and to represent remembering (0, 1, 4, 5, 6, 7, 8, 9) to pack my lunch. Record the results of the first 50 random numbers to find how many times I can expect to forget my lunch in a term.

**Comparing probabilities/expected values found by theory and experiment/simulation**
The probability of my forgetting to pack my lunch is 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 experimental values you have found for the expected number of times 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:

At the local hockey grounds, there are four fields, with one of the four being brand new artificial turf. The allocation of fields to play on for the draw in a ten round competition is random.

How many games would a team expect to play on the new turf?

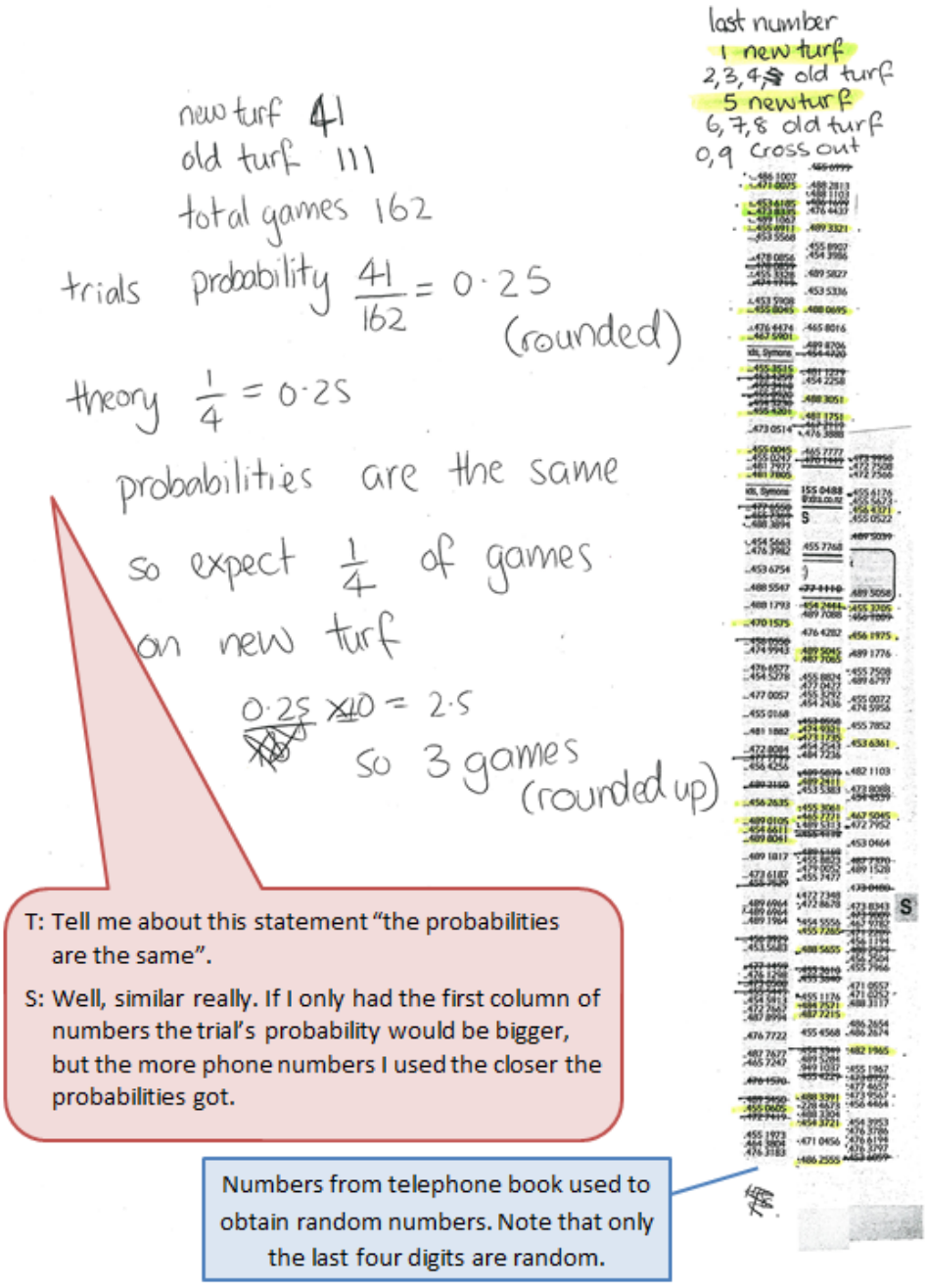
Use random numbers to set up a simulation of this problem. Comment on the results of your simulation.

## The arithmetic approach

The student is able to run a probability simulation, and to calculate using a theoretical probability, to find an expected value.

Prompts from the teacher could be:

1. What is the probability of having a game on the new turf.
2. Calculate the (theoretical) expected number of games that will the team will play on the turf.
3. Using the random numbers provide, set up a simulation to model this situation.
    - Choose suitable digits to represent games on the new turf and games on the old.
    - Decide how many trials you will run.
4. Find the experimental probability of playing on the new turf.
5. Calculate the (experimental) expected number of games that will the team will play on the turf.
6. Compare the values you calculated.



## The conceptual approach

The student is able to run a probability simulation, and to calculate using a theoretical probability, to find an expected value and to compare the results of the two methods.

Prompts from the teacher could be:

1. Calculate the (theoretical) expected number of games that will the team will play on the turf.
2. Using the random numbers provide, set up a simulation to model this situation.
    - Choose suitable digits to represent games on the new turf and games on the old.
    - Decide how many trials you will run.
    - Find the (experimental) expected number of games that the team will play on the new turf.
3. Compare the values you calculated.

T: Tell me about this "01-25".

S: I have to have 25% of the phone numnbers meaning new turf, so since percentage is 100, I used the last two digits, coz there's 100 of them 1 to 99, and 00. I made 1-25 of them new turf.

01 - 25 = new turf

1. 25% = 1/4 = 0.25
   × 10 games
   = 2.5
   so expect 2 or 3

2. 28 ÷ 10 = 2.8
   so expect 3 games.

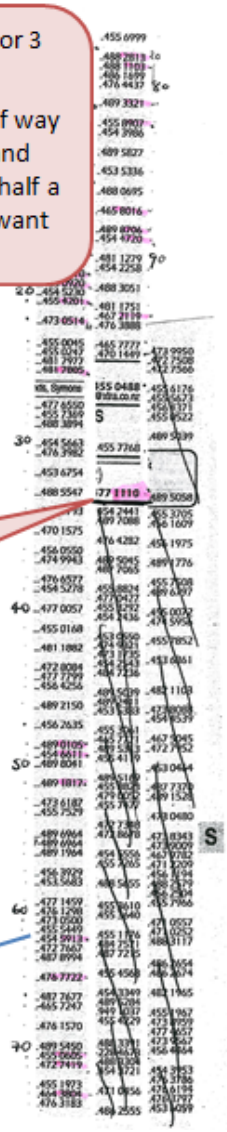
3. Both methods give about the same answer.

T: I see you've said 2 or 3 games.

S: Yeah, coz 2.5 is half way between the two and you won't just get half a game and I didn't want to round.

T: You've stopped after this number.

S: Yeah, coz that's 100 numbers and I'm looking at ten games so 100 is ten lots of ten games which is easier to divide.



Numbers from telephone book used to obtain random numbers. Note that only the last four digits are random.