

## Achievement Standard 91268 (Mathematics and Statistics 2.13)

## Investigate a situation involving elements of chance using a simulation

## Practice assessment

## Solution

Answers will vary – an outline solution follows.

A simulation is designed to estimate the average number of bottles that needs to be purchased in order to collect the four letters Z, O, O and M:

- Random numbers: 1, 2, 3 and 4 are generated (by calculator using  $4\text{Ran}\# + 1$  and taking the whole-number part). Numbers are assigned:  
1 → Z  
2, 3 → O  
4 → M
- Trial: Generate random numbers until there is one 1 (one Z), two of 2 and/or 3 (two O's) and one 4 (one M) or there are 6 random numbers (whichever occurs sooner). Count the number of random numbers (bottles purchased) in each trial. Tick the trials which resulted in an eligible entry for Katie.
- Carry out at least thirty trials as described, recording results in a table or graph; for example, the first few lines of the table shown below:

Trial	Ran# 1 letter	Ran# 2 letter	Ran# 3 letter	Ran# 4 letter	Ran# 5 letter	Ran# 6 letter	Number bought	Eligible
1	2 0	3 0	1 Z	2 0	4 M		5	✓
2	2 0	4 M	3 0	2 0	1 Z		5	✓
3	3 0	4 M	3 0	2 0	3 0	1 Z	6	✓
4	2 0	3 0	1 Z	1 Z	1 Z	2 0	6	-

- Calculate the mean (or median) number of random numbers generated (bottles purchased); or calculate the proportion of trials that resulted in an eligible competition entry (divide the number of ticks by the number of trials).

For higher grades the following may be included:

- Explaining why the random numbers were allocated as they were (using the ratio: 1 in 4 letters is a Z, 2 in 4 letters is an O, 1 in 4 letters is an M; large numbers produced of each letter so likelihood of each letter stays same throughout simulation).
- Drawing a dot plot for the experimental distribution from the simulation and relating it to the distribution of the population.
- Explaining which type of average was selected and why (e.g. median used as unaffected by outliers).
- Acknowledging the variability of simulations so that averages/proportions produced are only estimates and would vary each time a simulation was run.
- Discussion of assumptions made (letters well mixed without 'runs' of one letter; constant availability of drinks for purchase; Katie's strategy of stopping after six purchases remains in place, no swapping of letters, etc.).
- Further investigations suggested (such as two or more friends working together so that letters could be swapped; or varying the total number of bottles Katie is prepared to buy (or removing this restriction altogether, etc.).