

# Introduction to R lab solutions

## Exercises

### Problem 1

Let's write code for a Monte Carlo simulation that estimates the probability of getting exactly 1 four in 5 rolls of a die?

**Question** What is the exact probability (found using counting)? This will help us check whether our simulation is correct.

**Answer** The exact probability is  $5^5/6^5$ .

**Monte Carlo simulation** Write a trial simulation function and then use the `replicate` and `mean` functions to get an approximation of the desired probability. Try doing 100,000 trials of the simulation. Compare with the exact probability you found.

```
trial.simulation = function() { # this function is like our X_k random variables
  y = sample(1:6, size = 5, replace = TRUE)
  x = sum(y == 4)
  if (x == 1)
    return(1)
  else
    return(0)
}
# when we get 1 four in 5 rolls, this function returns 1;
# otherwise it returns 0

mean(replicate(n = 1e6, trial.simulation()))
```

```
## [1] 0.402117
```

```
5^5/6^5
```

```
## [1] 0.4018776
```

### Problem 2

Suppose we roll a pair of dice and sum the results. What is the probability of getting a sum of at least 9? Write a Monte Carlo simulation to verify your answer.

```
trial.simulation = function() { # this function is like our X_k random variables
  x = sum(sample(1:6, size = 2, replace = TRUE))
  if (x >= 9)
    return(1)
  else
    return(0)
}

mean(replicate(n = 1e6, trial.simulation()))
```

## [1] 0.277647

(4+3+2+1)/36

## [1] 0.2777778