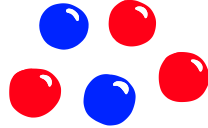# Simulation Example

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We're going to run a simulation using loops and `replicate()`.

You have a bag of five marbles. Three are red and two are blue. You draw one marble. Without replacing it, you then draw another marble. What is the probability that the two marbles are the same colour?

Step 1: Build a bag

The first step is to create a vector that represents the sample space (the bag of marbles):

```
bag <- c("red", "red", "red", "blue", "blue")

?rep
rep("R", 3)
```

```
## [1] "R" "R" "R"
```

```
bag <- c(rep("R", 3), rep("B", 2))
bag
```

```
## [1] "R" "R" "R" "B" "B"
```

Step 2: Draw two marbles

Now let's simulate drawing two marbles from the bag:

```
?sample

draw <- sample(bag, 2, replace = FALSE)
draw
```

```
## [1] "R" "R"
```

Step 3: Are the marbles the same color?

We can check to see if the two marbles we drew are the same color by using an if else statement or an ifelse function:

```
if (draw[1] == draw[2]) {
  same_color <- TRUE
} else {
  same_color <- FALSE
```

```
}
same_color
```

```
## [1] TRUE
```

```
?ifelse
same_color <- ifelse(draw[1] == draw[2], TRUE, FALSE)
same_color
```

```
## [1] TRUE
```

Step 4: Draw the marbles lots of times

But this only runs one simulation. How do I do this many times?

Method 1: Loops

One way is to use loops:

```
num_sims <- 10000

sim_results <- rep(NA, num_sims) # Initialize the vector sim_results with NAs

for (i in 1:num_sims) {
  draw <- sample(bag, 2)
  # Check if the two marbles we drew are the same colour
  same_color <- ifelse(draw[1] == draw[2], TRUE, FALSE)
  sim_results[i] <- same_color # Store results in the vector sim_results
}

summary(sim_results)
```

```
##    Mode   FALSE    TRUE    NA's
## logical    6044    3956       0
```

```
mean(sim_results)
```

```
## [1] 0.3956
```

Method 2: Replicate

Another way is to use `replicate()`:

```
## First, we need to declare a function
run_simulation <- function(sample_space) {
  draw <- sample(sample_space, 2)
  same_color <- ifelse(draw[1] == draw[2], TRUE, FALSE)
  return(same_color)
}

run_simulation(bag) # Function call
```

```
## [1] TRUE
```

```
## Second, we use replicate, which is a wrapper for apply to call
## the function multiple times
```

```
?replicate

sim_results_repl <- replicate(num_sims, run_simulation(bag))

mean(sim_results_repl)
```

```
## [1] 0.3949
```