# Lecture 2

# Agenda

- HW 1 released on course website, due next Friday

- Continuing intro to probability simulations

- Time permitting: start HW 1 in class

- Office hours (Manchester 329):

  - 3 - 4pm Monday

  - 1 - 2pm Thursday

- TA study session (Manchester 121): 7-8pm Thursday

# Warm-up question

- A roulette wheel has 38 slots numbered 00, 0, and 1–36. Two are green, 18 are red, and 18 are black.

- If a gambler bets based on color, the return on a $1 bet is $2

- A gambler has $50, and will continuously bet $1 on red until they double their money (have $100) or lose the money they came with

- What is the probability the gambler doubles their money?

**Question:** Without calculating probabilities, how could you design an experiment to estimate this probability?

# Designing an experiment

# Step 1: representing the roulette wheel

```r
1  wheel <- c(rep("green", 2), rep("black", 18), rep("red", 18))
2
3  wheel
```

```
 [1] "green" "green" "black" "black" "black" "black" "black" "black"
"black"
[10] "black" "black" "black" "black" "black" "black" "black" "black"
"black"
[19] "black" "black" "red"   "red"   "red"   "red"   "red"   "red"
"red"
[28] "red"   "red"   "red"   "red"   "red"   "red"   "red"   "red"
"red"
[37] "red"   "red"
```

- `rep` repeats a value a specified number of times

- `c()` combines vectors into a single vector

# Step 2: spin the wheel!

```r
spin <- sample(wheel, size = 1)

spin
```

```
[1] "red"
```

# Step 3: change in money

```r
1  money <- 50
2  spin <- sample(wheel, size = 1)
3
4  if(spin == "red"){
5    money <- money + 1
6  } else {
7    money <- money - 1
8  }
9
10 spin
```

```
[1] "black"
```

```r
1  money
```

```
[1] 49
```

- if the result was red, gain a dollar

- otherwise, lose a dollar

# Step 3: change in money

Another way of writing the conditional statement:

```r
1  money <- 50
2  spin <- sample(wheel, size = 1)
3
4  money <- ifelse(spin == "red", money + 1, money - 1)
5
6  spin
```

```
[1] "black"
```

```r
1  money
```

```
[1] 49
```

# Step 4: keep spinning

The gambler continues to bet until they have $0 or $100.

**Question:** Is a `for` loop appropriate for iterating the betting process?

# Step 4: keep spinning

```r
1  money <- 50 # starting money
2
3  while(money > 0 & money < 100){
4    spin <- sample(wheel, size = 1)
5    money <- ifelse(spin == "red", money + 1, money - 1)
6  }
7
8  money
```
[1] 0

- `while` loop: repeat the process until the condition is true

# Step 5: repeat the process

```r
1  set.seed(279)
2
3  nsim <- 1000
4  results <- rep(NA, nsim)
5
6  for(i in 1:nsim){
7    money <- 50 # starting money
8
9    while(money > 0 & money < 100){
10     spin <- sample(wheel, size = 1)
11     money <- ifelse(spin == "red", money + 1, money - 1)
12   }
13
14   results[i] <- ...
15 }
```

- What should I check at each iteration?

# Step 5: repeat the process

```r
 1  set.seed(279)
 2
 3  nsim <- 1000
 4  results <- rep(NA, nsim)
 5
 6  for(i in 1:nsim){
 7    money <- 50 # starting money
 8
 9    while(money > 0 & money < 100){
10      spin <- sample(wheel, size = 1)
11      money <- ifelse(spin == "red", money + 1, money - 1)
12    }
13
14    results[i] <- money == 100
15  }
16
17  mean(results)
```
```
[1] 0.008
```