

# The Coins Problem

**Names of students in your group:**

**Submission:** Each student must submit their answer separately in PDF form to Moodle by the end of the class. No email submissions are allowed. Google how to convert a Google doc to a PDF if you haven't done it before.

## Question 1

You have a balance scale and 3 coins, 1 of which is counterfeit. Assume that the coins are numbered 1, 2 and 3. The counterfeit coin weighs less or more than the other coins (but you don't know which). How can you determine the counterfeit coin in 2 weightings, and tell if it is heavier or lighter?

## Question 2

After each weighting, the balance can either fall to the left (L), fall to the right (R), or balance (B). Enumerate all possibilities that could occur by filling out the table below.

Weighting 1	Weighting 2	Counterfeit coin	Heavier or lighter?

## Question 3

We have just created what is called a **sample space**. What is the definition of a sample space?

## Question 4

What is the difference between an outcome and an event? Show an example for each using your table.

**Question 5**

Now assume that you have 9 coins, 1 of which is counterfeit. How can you determine the counterfeit coin in 3 weightings, and tell if it is heavier or lighter?

**Question 6**

Now assume that you have 12 coins, 1 of which is counterfeit. How can you determine the counterfeit coin in 3 weightings, and tell if it is heavier or lighter?

**Question 7**

Enumerate all possibilities for the 12 coin problem by creating a table similar to that in q2.

**Question 8**

Now assume that you have 39 coins, 1 of which is counterfeit. How can you determine the counterfeit coin in 4 weightings, and tell if it is heavier or lighter?

**Question 9: Generalization**

Given  $k$  weightings, at most how many coins can we weigh to find the single counterfeit coin?