Programming, Probability, and the Modern Mathematics Classroom
Starter exercises — Part 1

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If you are reading this, please make sure to have read the blog post with the same topic name on the Math Misery website, otherwise this will be out of context.

Flipping a Coin

Have students identify what the code does in general and be able to explain what each line of code does.

Objectives

- Students should understand the assignment operator "=".
- Students should understand the notion of boolean equality "==" and how it is different from the assignment operator and how both of these are different from the equal sign used in a math equation.
- Students should understand a basic "if-else" block. ("if-elif-else" will come later.)
- Students should know what `return` does.
- Students should understand the notion of a function. (Function inputs will come later.)
- Let students explore the `random` and `math` modules.

Code Examples

What does this function do?

```
>>> import math
>>> import random
>>> def flipcoin():
        headsortails = None
        value = random.randint(0,1)
        if value == 0:
                headsortails = "Tails"
        else:
                headsortails = "Heads"
        return headsortails
```

```
>>> flipcoin()
'Heads'
>>> flipcoin()
'Heads'
>>> flipcoin()
'Tails'
```

What about this function? What proportion of coin flips will produce "Heads" in theory?

```
>>> def flipbiasedcoin():
        headsortails = None
        value = random.randint(0,2)
        if value == 0:
            headsortails = "Tails"
        else:
            headsortails = "Heads"
        return headsortails
```

How about this one? How often will the coin land on its side? What is the difference between `random.random` in this example and `random.randint` from the previous examples? What does `elif` do?

```
>>> def flipthickcoin():
        headstailsorside = None
        value = random.random()
        if value < 0.49:
            headstailsorside = "Tails"
        elif value >= 0.49 and value <= 0.51:
            headstailsorside = "Side"
        else:
            headstailsorside = "Heads"
        return headstailsorside
```

What if we wanted to flip the coin more than once? How does the code below accomplish that? What does the `for` block do? How does `range` work? What does `numflips` do?

```
>>> def flipcoinseveraltimes(numflips):
        headscount = 0
        for i in range(numflips):
            value = random.randint(0,1)
            if value == 1:
                headscount = headscount + 1
        return headscount, headscount/numflips

>>> flipcoinseveraltimes(10)
(8, 0.8)
>>> flipcoinseveraltimes(100)
(52, 0.52)
>>> flipcoinseveraltimes(42523)
(21165, 0.49773063988900124)
```

What about rolling dice? What does `dice = []` mean? What does `.append` do?

```
>>> def rolldice(numdice, numsides):
        dice = []
        for i in range(numdice):
            dice.append(random.randint(1,numsides))
        return dice, sum(dice)

>>> rolldice(3,6)
([3, 1, 3], 7)
>>> rolldice(3,20)
([16, 16, 18], 50)
>>> rolldice(2,10)
([6, 5], 11)
```

Summary

Hopefully, this will get you started on bringing programming into the math classroom. If you need help, have questions, or would like to set up a workshop at your school get in touch with me at help@mathmisery.com.