Last name _____

First name _____

LARSON—MATH 350–CLASSROOM WORKSHEET 04
Coin Flips.

1. Log in to your Sage Cloud account.

   (a) Start Firefox or Chrome browser.

   (b) Go to `http://cloud.sagemath.com`

   (c) Click "Sign In".

   (d) Click project **Math 350**.

   (e) Click "New", call it **c04**, then click "Sage Worksheet".

   Here are the **Main Questions**:

   - When you flip a coin 100 times would you expects to see 6 heads or tails in a row at some point? We can investigate this question too by simulating coin flips and repeating our *experiment* a number of times.
   - If you flip a coin 100 times, you would expect about 50 heads. Its possible that you could get 100 heads. But this would be rare. How rare? We can *simulate* flipping a coin a hundred times, write down how many heads we got, and then repeating this experiment. This will give us a *distribution* of various possible outcomes.

2. We will use `random()` to define a function `coin_flip()` which randomly returns the string "H" (for heads) half the time and returns the string "T" (for tails) half the time. Check that it works.

```
def coin_flip():
    if random() < 0.5:
        return ''H''
    else:
        return ''T''
```

3. We now use `coin_flip()` to define a function `coin_flips(n)` which returns a list of n random H's or T's (representing the result of n coin flips).

```
def coin_flips(n):
  flip_results = []
  for i in [1..n]:
      flip_results.append(coin_flip())
  return flip_results
```

   Check that it works.

4. Here is a function that counts and *returns* the number of heads you get after flipping a coin n times.

```
def number_of_heads(n):
    flip_results = coin_flips(n)
    heads = 0
    for i in flip_results:
        if i == "H":
            heads = heads+1
    return heads
```

Evaluate `number_of_heads(100)` a few times. You should get different results!

5. When you flip a coin a number of times you will get runs of one heads, two heads, three heads, etc, before getting a tails (that ends the run). Here is a function `longest_run_of_heads(n)` that returns the length of a longest run of heads after flipping a coin n times.

```
def longest_run_of_heads(n):
    flip_results = coin_flips(n)
    count = 0
    longest = 0
    for i in [0..(n-1)]:
        if flip_results[i] == "H":
            count = count+1
            if count > longest:
                longest = count
        else:
            count = 0
    return longest
```

Try `longest_run_of_heads(100)` a few times. The results should vary.

6. If you flip a coin 100 times what is the average length of a longest run of heads? We can get an idea by repeating our experiment several times, collecting the data and finding the average.

```
def repeat_experiments(n):
    total = 0.0
    for i in [1..n]:
        current_experiment = longest_run_of_heads(100)
        total = total + current_experiment
    return total/n
```

Try `repeat_experiments(10)`, `repeat_experiments(100)`, and `repeat_experiments(1000)`.