IC252 Lab 3

1. Simulate a fair coin from the throw of a fair die in three different ways. These can be:

   - Method 1: Output H if $d = 1, 2, \text{or } 3$ and T if $d = 4, 5, \text{or } 6$
   - Method 2: Output H if $d = 1$ and T if $d = 2$ and don't output anything for other values of d. This is a wasteful method.
   - Method 3: Your own method, different from the above.

   How will you be sure that the output is correct? Suppose your function is called *die2coin*. If you call this function N number of times ($\approx 10,000$ and above), and count the number of times it gave H and the number of times it gave T, then we can decide if *die2coin* is correct.
   Expected output: A plot, with proper labels, that convinces you that the generated coin is fair.
   Required input: Accept the type of method used (1,2 or 3), N
   Interface of the function: `die2coin(int m, int N)`, where m is the type of method used; N, the number of times to repeat; and returns 'H' or 'T'.

2. Same as the previous question, but this time, generate a biased coin from a fair die. Plots are required as before. You can just use one method.
   Expected output: A plot, with proper labels, that convinces you that the generated coin is biased.
   Required input: N, the number of times to repeat.
   Use a similar function interface: `die2BiasedCoin(int N)`; returns 'H' or 'T'.

3. This question is derived from the birthday paradox. Let the number of people in the room be n. Generate a random number between 1 and 365, n times. This simulates n birthdays. Count how many common birthdays are present between at least two people, and let this be denoted by c. Plot c versus n, as n varies from 1 to 366 for the following cases:

   (a) When each birthday is equally likely. c should be 2 when n is around 25 or so.

   (b) When the birthdays are computed on Mars. Each Martin year is 687 days. c should be 2 for n around 32.

   (c) For n around 50, there is a high chance that c is at least 2. Demonstrate this by simulating this situation 1000 times and computing the average probability. You should get the average probability close to 0.99. This basically means that in a group of 50 people, you can be almost sure that two of them share the same birthday.

   (d) When birthdays between 1-150 are twice as likely as 151-365.