1. (10 pts) You roll a **fair** 8-sided die 100 times. The sides of the die are labeled 1 through 8.

   (a) (6 pts) What is the expected value for the number of times that a 3 will appear on the die? Make sure to highlight any assumptions underlying your calculations.

   (b) (4 pts) Write a sentence or two that gives a real world interpretation for the answer you get in part (a).

2. (15 pts = 5 pts each) We would like to simulate the following situation using a Markov Chain.

   Math majors and computer science (CS) majors are very indecisive and often change their major. Every month, one third of the math majors decide to become CS majors and remainder decide to stay math majors. At the same time, every month, one half of the CS majors decide to become math majors and the remainder decide to stay CS majors.

   (a) Model the Markov chain for this situation. (In other words, determine the transition matrix A.)

   (b) Suppose that in January 2015 there are 800 CS majors and 300 math majors. Using matrix multiplication, determine how many CS majors there will be in March 2015. Show your work.

   (c) Determine the equilibrium distribution for **the number** of CS majors and math majors. (Not the percentages.) Write one or two sentences explaining what your answer means.

3. (5 pts) In a few sentences, explain what the `Tally` command does. Make sure to give the syntax of the command and give the input and output of the command.

4. (15 pts) Suppose that in our waiting room simulation, there are only four seats in the waiting room, and so if a patient arrives and the waiting room is full, the patient leaves without being seen by the doctor.

   (a) (3 pts) First, describe in words (one or two sentences) how this would affect the algorithm of the waiting room experience. You should describe what changes in the way the doctor sees her patients.

   (b) (7 pts) Now, explain how you would modify the provided code to take this into account. To receive partial credit, make sure to **explain in words** what you are trying to do in each line you write.

```
nwait = 0; busy = 0; endTime = 0;
For[i = 0, i < 180, i++,
   If[endTime == i, busy = 0];
   newPatient = If[RandomReal[] <= 0.075, 1, 0];
   If[newPatient == 1, nwait++];
   If[busy == 0 && nwait > 0, nwait--; busy = 1; endTime = i + 15];]
```

   (c) (5 pts) Using at least three sentences, discuss how you would be able to modify the algorithm to **keep track** of how many people leave without being seen by the doctor **throughout the whole day**.
   [*You do* ***NOT*** *need to provide explicit Mathematica code.*]