ECE 111 - Homework #12

Chi-Squared Tests

Problem 1: The following Matlab code generates 90 random die rolls for a six sided die

```
RESULT = zeros(1,6);
for i=1:90
   D6 = ceil( 6*rand );
   RESULT(D6) = RESULT(D6) + 1;
   end
RESULT
```

Determine whether this is a fair or loaded die using a Chi-Squared test.

Problem 2: The following Matlab code generates 90 rolls of a loaded six-sided die (12% of the time, you roll a 6):


```
RESULT = zeros(1,6);
for i=1:90
   if(rand < 0.12)
      D6 = 6;
   else
      D6 = ceil( 6*rand );
      end
   RESULT(D6) = RESULT(D6) + 1;
   end
RESULT
```


Am I Psychic?

Problem #3:   Shuffle a deck of 52 playing cards and place it face down on a table.
- Predict the suit of the top card then reveal it. If correct, place the card in one pile (correct). If incorrect, place it in another pile.
- Repeat for all 52 cards.

Use a chi-squared test to test the hypothesis that you're just guessing (probability of being correct is 25%)

Normal Approximation

The mean and standard deviation for a fair 6-sided die and 8-sided die are:

$$\bar{x}_{d6} = 3.5 \qquad\qquad \bar{x}_{d8} = 4.5$$

$$s_{d6} = 1.7078 \qquad\qquad s_{d8} = 2.291$$

Problem 4: Let Y be the sum of rolling five 6-sided dice (5d6) plus five 8-sided dice (5d8).

$$Y = 5d6 + 5d8$$

a) What is the mean and standard deviation of Y?

b) Using a normal approximation, what is the 90% confidence interval for Y?

c) Using a normal approximation, what is the probability that the sum the dice will be more than 54.5?

Problem 5: Check your answer using a Monte-Carlo simulation in Matlab with 100,000 rolls:

```
N = 0;
for i=1:1e5
   Y = sum( ceil( 6*rand(5,1) ) ) + sum( ceil( 8*rand(5,1) ) );
   if(Y > 54.5)
      N = N + 1;
      end
   end
N / 1e5
```

t-Tests

Problem 6: Using Matlab, cast five level-7 fireballs (the sum of seven 6-sided dice, or 7d6)

```
damage = [];
for i=1:5
   x = sum( ceil( 6*rand(7,1) ) );
   damage = [damage ; x];
   end
```

From this, determine the mean and standard deviation of your data set.

Problem 7: Use a t-test to determine
- The 90% confidence interval for a level 7 fireball.
- The probabillity of doing 35 damage or more with a level-7 fireball

Problem 8) Check your answer using a Monte-Carlo simulation in Matlab by casting 100,000 level-7 fireballs:

```
Nx = 0;
Ny = 0;

for i=1:1e5
   damage = sum( ceil( 6*rand(7,1) ) );
   if( (damage > 20)*(damage<30) )
      Nx = Nx + 1;
      end
   if( damage >= 35)
      Ny = Ny + 1;
      end
   end
[Nx,Ny] / 1e5;
```