ECE 111 - Homework #12

Week #12: ECE 341 Random Processes. Due 11am November 15th

Chi-Squared Tests

Problem 1: The following Matlab code generates 240 random die rolls for a six sided die

```
RESULT = zeros(1,6);
for i=1:240
   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 240 rolls of a loaded six-sided die (5% of the time, you roll a 6):

```
RESULT = zeros(1,6);
for i=1:240
   if(rand < 0.05)
      D6 = 6;
   else
      D6 = ceil( 6*rand );
      end
   RESULT(D6) = RESULT(D6) + 1;
   end
RESULT
```

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

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 4-sided die are:

$$\mu_{d4} = 2.5 \qquad \mu_{d6} = 3.5 \qquad \mu_{d8} = 4.5$$

$$\sigma_{d4} = 1.118 \qquad \sigma_{d6} = 1.7078 \qquad \sigma_{d10} = 2.2913$$

(continued back side)

Problem 4: Let Y be the sum of rolling two 4-sided dice (2d4) plus three 6-sided dice (3d6) plus four 8-sided dice.

   Y = 2d4 + 3d6 + 4d8

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 39.5?

Problem 5: Check your answer using a Monte-Carlo simulation in Matlab with 100,000 rolls:
   • LEFT and RIGHT are the left and right bounds found in problem 4b

```
N = 0;
L = 0;
R = 0;
for i=1:1e5
   d4 = ceil( 4*rand(2,1) );
   d6 = ceil( 6*rand(3,1) );
   d8 = ceil( 8*rand(4,1) );
   Y = sum(d4) + sum(d6) + sum(d8);
   if(Y > 39.5) N = N + 1;    end
   if(Y < LEFT) L = L + 1;    end
   if(Y > RIGHT) R = R + 1;    end
   end
[N, L, R] / 1e5
```

t-Tests

Problem 6: Using Matlab, determine four values for Y

   Y = 2d4 + 3d6 + 4d8

6a) From this, determine the mean and standard deviation of your data set.

```
DATA = [];
for i=1:5
   d4 = ceil( 4*rand(2,1) );
   d6 = ceil( 6*rand(3,1) );
   d8 = ceil( 8*rand(4,1) );
   Y = sum(d4) + sum(d6) + sum(d8);
   DATA = [DATA, Y];
   end
x = mean(DATA)
s = std(DATA)
```

6b) Use a t-test to determine
   • The 90% confidence interval
   • The probabillity of scoring more than 39.5 points

Problem 7: Using Matlab, determine ten values for Y

   Y = 2d4 + 3d6 + 4d8

7a) From this, determine the mean and standard deviation of your data set.

7b) Use a t-test to determine
   • The 90% confidence interval
   • The probabillity of scoring more than 39.5 points