ECE 111 - Homework #12

Week #12: ECE 341 Random Processes. Due Tuesday, April 11th
Please email to jacob.glower@ndsu.edu, or submit as a hard copy, or submit on BlackBoard

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
```

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%)

Monte-Carlo Simulation

Problem #4: Let y be the sum of six 4-sided dice plus five 6-sided dice plus four 8-sided dice

$$y = 6d4 + 5d6 + 4d8$$

a) Generate 100,000 values for y using Matlab and plot the frequency of each number on a bar chart

b) From your results, determine the probability that $y > 59.5$ (the number of times the sum is more than 59.5)

c) From your results, determine 'a' such that $y < a$ 5% of the time

d) From your results, determine 'b' such that $y > b$ 5% of the time

Note: the 90% confidence interval for y is $a < y < b$.

```
RESULT = zeros(90,1);
```

```
for i=1:1e5
   d4 = ceil( 4*rand(6,1) );
   d6 = ceil( 6*rand(5,1) );
   d8 = ceil( 8*rand(4,1) );
   Y = sum(d4) + sum(d6) + sum(d8);
   RESULT(Y) = RESULT(Y) + 1;
   end;
bar(RESULT)
sum(RESULT(70:90)) / 1e5
```

Normal Approximation

The mean and standard deviation for a fair 6-sided die and 4-sided die are:

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

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

Problem 5: Let Y be the sum of rolling six 4-sided dice (6d4) plus five 6-sided dice (5d6) plus four 8-sided dice.

Y = 6d4 + 5d6 + 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 59.5?

Student-t Test

Problem 6: Using Matlab, determine four values for Y

Y = 6d4 + 5d6 + 4d8

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

```
DATA = [];
for i=1:4
   d4 = ceil( 4*rand(6,1) );
   d6 = ceil( 6*rand(5,1) );
   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 59.5 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 59.5 points