

ECE 111 - Homework #12

Week #12: ECE 341 Random Processes. Due 8am April 12th

Please submit as a Word or pdf file to BlackBoard or email to Jacob_Glower@yahoo.com with header ECE 111 HW#12
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Chi-Squared Tests

Problem 1: The following Matlab code generates 60 random die rolls for a six sided die

```
RESULT = zeros(1,6);  
for i=1:60  
    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 60 rolls of a loaded six-sided die (20% of the time, you roll a 6):

```
RESULT = zeros(1,6);  
for i=1:60  
    if(rand < 0.2)  
        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:

$$\mu_{d6} = 3.5$$

$$\mu_{d4} = 2.5$$

$$\sigma_{d6} = 1.7078$$

$$\sigma_{d4} = 1.118$$

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

$$Y = 3d6 + 4d4$$

- What is the mean and standard deviation of Y ?
- Using a normal approximation, what is the 90% confidence interval for Y ?
- Using a normal approximation, what is the probability that the sum the dice will be more than 24.5?

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(3,1) ) ) + sum( ceil( 4*rand(4,1) ) );
    if(Y > 24.5)
        N = N + 1;
    end
end
N / 1e5
```

t-Tests

Problem 6: Using Matlab, cast six level-10 fireballs (the sum of ten 6-sided dice, or 10d6)

```
damage = [];
for i=1:6
    x = sum( ceil( 6*rand(10,1) ) );
    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 10 fireball.
- The probability of doing 45 or more damage with a level-10 fireball

Problem 8) Check your answer using a Monte-Carlo simulation in Matlab by casting 100,000 level-10 fireballs:

```
N = 0;

for i=1:1e5
    damage = sum( ceil( 6*rand(10,1) ) );
    if( damage >= 45)
        N = N + 1;
    end
end
N / 1e5
```