

ECE 341 - Homework #14

Chi-Squared Tests.

In-Person vs. Online:

1) Use a Chi-Squared test to determine whether people who sign up for the in-person section of a class have a higher chance of getting an A.

	In-Person		Online	
	# A's	Total #	# A's	Total #
ECE 111	30	49	13	33
ECE 376	15	38	3	11
ECE 461	8	20	2	9

Loaded Dice

2) The following Matlab code generates 60 random numbers from 1..6 (sixty 6-sided dice)

```
RESULT = zeros(1,6);  
for i=1:60  
    d6 = ceil(rand*6);  
    RESULT(d6) = RESULT(d6) + 1;  
end
```

Use a chi-squared test to determine if this is a fair die.

3) The following Matlab code generates 60 random die rolls with 5% loading (5% of the time you roll a 6)

```
RESULT = zeros(1,6);  
for i=1:60  
    if(rand < 0.05) d6 = 6;  
    else d6 = ceil(rand*6);  
    end  
    RESULT(d6) = RESULT(d6) + 1;  
end
```

Use a chi-squared test to determine if this is a fair die.

4) Repeat problem #3 with 600 die rolls.

Am I psychic?

5) Shuffle a deck of 52 playing cards. Without looking at the top card, predict the suit (clubs, diamonds, hearts, and spades). Repeat for all 52 cards, keeping track of how many you got right and how many you got wrong.

- From the results, use a chi-squared test to determine if you are just guessing (25% chance of getting the suit correct.)

Central Limit Theorem:

6) The following code sums four uniform distributions

```
Y = sum(rand(4,1));
```

The Central Limit Theorem states that this will converge to a normal distribution with

- mean = 2
- variance = 4/12

Use a chi-squared test to determine if Y does / does not have a normal distribution.

Poisson approximation for a binomial distribution.

7) Let X be the number of 1's you get when you roll 60 dice. The Poisson approximation for the pdf is

$$\binom{60}{x} \left(\frac{1}{6}\right)^x \left(\frac{5}{6}\right)^{60-x} \approx \left(\frac{1}{x!}\right) 10^x e^{-10}$$

- Use Matlab to count the number of 1's you get when you roll 60 dice
- Repeat 200 times
- Check whether the result is consistent with a Poisson distribution with $\lambda = Np = 10$ using a Chi-squared test

Code:

```
Result = zeros(60,1);
for i=1:200
    Dice = ceil(6*rand(60,1));
    N = sum(Dice == 1);
    Result(N) = Result(N) + 1;
end

k = [1:30]';
Result = Result(k);

Poisson = 1./ factorial(k) .* (10.^k) * exp(-10) * 200;

plot(k,Result,'*',k,Poisson)
```