

ECE 376 - Homework #6

Data Collection & Chi-squared Test - Due Monday, February 26th

Data Collection

1) Measure one of the following with at least two data sets and 20+ data points per run:

- The voltage across a capacitor as it discharges
- The temperature of a cup (or can) of hot water as it cools off
- The temperature of a can of cold water as it warms up
- Other

Plot the resulting data vs. time.

2) Come up with an exponential curve fit for your data in the form of

$$V = a \cdot \exp(bt)$$

or

$$\ln(V) = bt + \ln(a)$$

3) Use a chi-squared test to determine if your data has an exponential distribution

- Split the data into N bins (N different times)
- Count the number of data points in each bin
- Compare to the expected frequency using a chi-squared test)

Fair & Loaded Dice

4) Determine experimentally using a chi-squared test whether or not the following C code produces a fair 6-sided die:

```
while(1) {  
    while(!RB0);  
    while(RB0) DIE = (DIE + 1) % 6;  
    DIE += 1;  
    LCD_Move(1,0);    LCD_Out(DIE, 1, 0);  
    SCI_Out(DIE, 1, 0);  
    SCI_CRLF();  
}
```

5) Determine experimentally using a chi-squared test whether or not the following C code produces a fair 6-sided die:

```
while(1) {
    while(!RB0);
    while(RB0) {
        DIE = (DIE + 1) % 6;
        X = (X + 1) % 7;
    }
    DIE = DIE + 1;
    if(X == 0) DIE = 6;

    LCD_Move(1,0);  LCD_Out(DIE, 1, 0);
    SCI_Out(DIE, 1, 0);
    SCI_CRLF();
}
```

Am I Psychic?

6) Write a C program which tests if you're psychic with a 4-sided die:

- Each round, predict which number is going to come up (0..3)
- Press the corresponding button RB0..RB3.
- When you release the button, a random number in the range of 0..3 is generated
- If you were right, the PIC records that. Likewise if you were wrong.
- The LCD display displays how many times you were right and wrong.

7) Collect data with your program.

8) Determine the chance that you were not just guessing using a chi-squared test

- Null hypothesis: you are just guessing (correct 25% of the time).