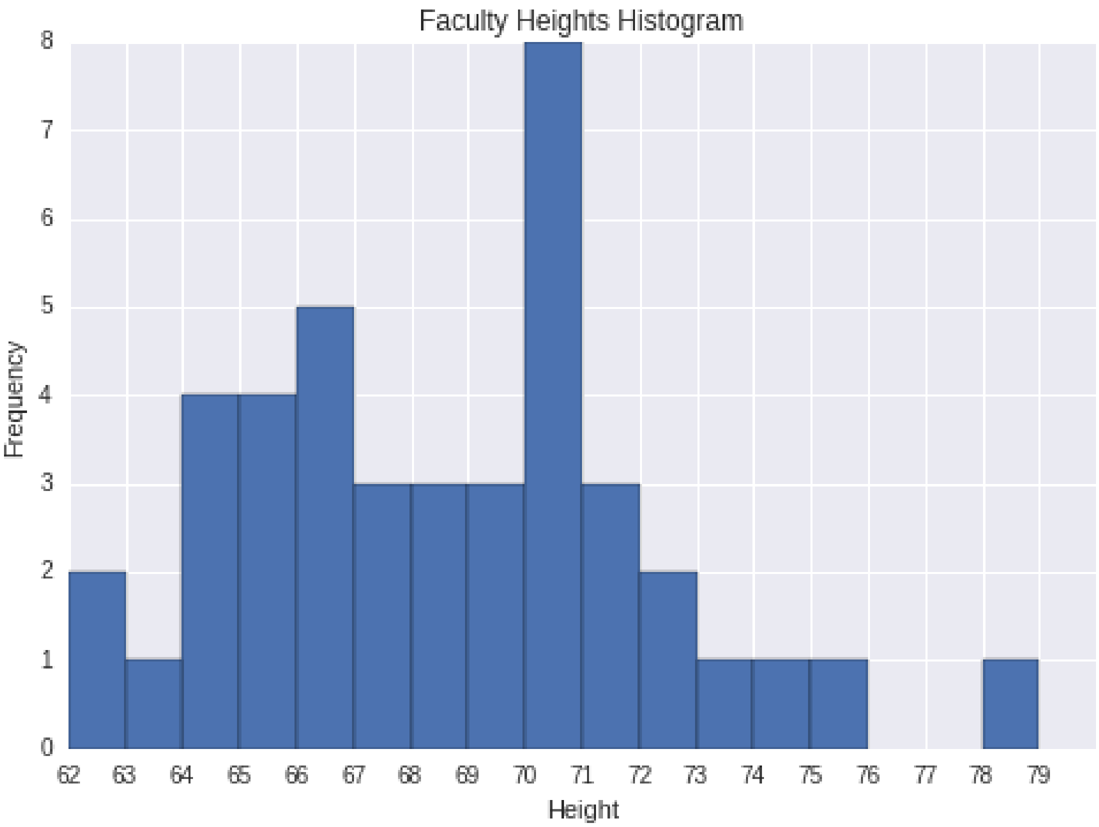
qea_day5_beforeclass

March 30, 2016

```
In [1]: %matplotlib inline
        import pandas as pd
        import numpy as np
        import matplotlib.pyplot as plt
        import seaborn as sns
        import csv
        #import scipy.io.wavfile
        import scipy.ndimage as sp
        #import calendar
```

0.1 Histograms, Means, and Standard Deviations

```
In [2]: h = [63, 66, 71, 65, 70, 66, 67, 65, 67, 74, 64, 75, 68, 67, 70, 73, 66, 70, 72, 62, 68,
             70, 62, 69, 66, 70, 70, 68, 69, 70, 71, 65, 64, 71, 64, 78, 69, 70, 65, 66, 72, 64]

        d = {}
        for i in h:
            d[i] = d.get(i, 0)+1

        histlist = []
        for i in d:
            histlist.append((i, d.get(i)))

        sorted(histlist)
        hist0 = [i for (i,j) in histlist]
        hist1 = [j for (i,j) in histlist]

In [3]: plt.bar(hist0, hist1, width=1)
        plt.title("Faculty Heights Histogram")
        plt.xlabel("Height")
        plt.xticks(np.arange(78-62+2)+62)
        plt.ylabel("Frequency")

        fig = plt.gcf()
```



```
In [4]: heights_mean = sum(h)/len(h)
        heights_stdDev = sqrt(sum([(heights_mean-i)**2 for i in h])//len(h))

        heights_mean_auto = np.mean(h)
        heights_stdDev_auto = np.std(h)

        print [heights_mean, heights_mean_auto] #these are equal
        print [heights_stdDev, heights_stdDev_auto] #these are equal
```

```
[477/7, 68.142857142857139]
[1/7*sqrt(1831/3), 3.5292750407024345]
```

1 Correlation

```
In [5]: #not used any more - panda data frames are easier
        stringData = []
        with open(’./stateData.csv’,’rb’) as csvfile:
            stateData = csv.reader(csvfile, delimiter=’ ’, quotechar=’|’)
            for line in stateData:
                stringData.append(line)
        data = []
        for j in range(len(stringData)-1):
            data.append([i for i in stringData[j][0].split(’,’)])
```

```
In [6]: pd.read_csv('./stateData.csv')
```

```
Out[6]:      State Name  Poverty  Infant Mort  White  Crime  Doctors  Traf Deaths  \
        0       Alabama     15.7          9.0   71.0    448    218.2         1.81
        1        Alaska      8.4          6.9   70.6    661    228.5         1.63
        2       Arizona     14.7          6.4   86.5    483    209.7         1.69
        3      Arkansas     17.3          8.5   80.8    529    203.4         1.96
        4    California     13.3          5.0   76.6    523    268.7         1.21
        5      Colorado     11.4          5.7   89.7    348    259.7         1.14
        6   Connecticut      9.3          6.2   84.3    256    376.4         0.86
        7      Delaware     10.0          8.3   74.3    689    250.9         1.23
        8       Florida     13.2          7.3   79.8    723    247.9         1.56
        9       Georgia     14.7          8.1   65.4    493    217.4         1.46
        10       Hawaii      9.1          5.6   29.7    273    317.0         1.33
        11        Idaho     12.6          6.8   94.6    239    168.8         1.60

            University  Unemployed  Income
        0         22.0         5.0   42666
        1         27.3         6.7   68460
        2         25.1         5.5   50958
        3         18.8         5.1   38815
        4         29.6         7.2   61021
        5         35.6         4.9   56993
        6         35.6         5.7   68595
        7         27.5         4.8   57989
        8         25.8         6.2   47778
        9         27.5         6.2   50861
        10        29.1         3.9   67214
        11        24.0         4.9   47576
```

```
In [7]: #This was easier than calculating it by hand, and more useful to me.

        def findCorrelation(df, test1, test2):
            mean1 = df[test1].mean()
            mean2 = df[test2].mean()
            r=0
            elements = len(df[test1])
            for i in range(elements):
                r+=((df[test1][i])-mean1)*((df[test2][i])-mean2)
            rxy = r/elements/df[test1].std()/df[test2].std()
            return rxy

        data = pd.read_csv('./stateData.csv')
        findCorrelation(data,'University','Income')
```

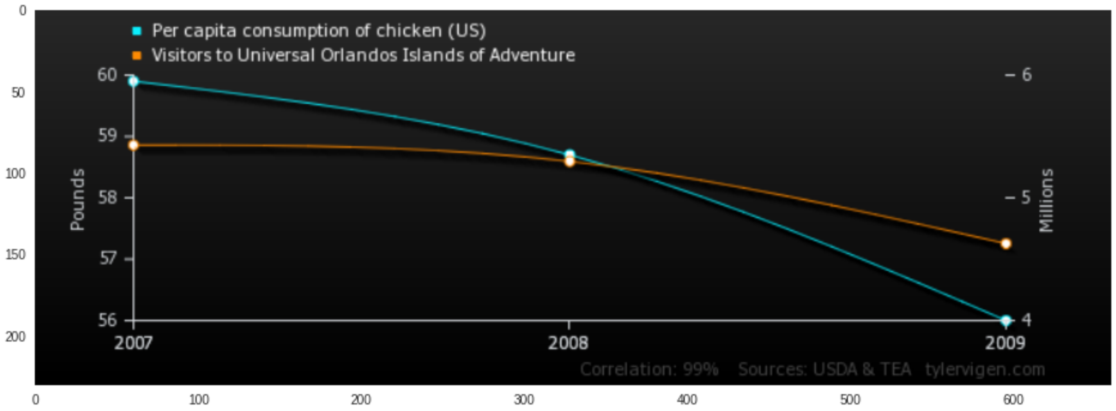
```
Out[7]: 0.69420837297396532
```

```
In [8]: #Create three column vector of (data-mean)/stdDev for 3 given categories in dataframe

        row_vectors = []
        for i in ['University','Income','Infant Mort']:
            l = data[i]
            l_vector = (l-l.mean())/l.std()
            row_vectors.append(l_vector)
```

```
col_vectors = np.transpose(row_vectors)
print col_vectors
row_vectors = np.transpose(col_vectors)
print row_vectors
```

```
[[-1.08551776 -1.21397563  1.57928167]
 [-0.00509633  1.34335929 -0.06525957]
 [-0.45357315 -0.39186889 -0.45681701]
 [-1.73784768 -1.59578135  1.18772423]
 [ 0.4637658   0.60582287 -1.55317784]
 [ 1.68688441  0.20646856 -1.00499742]
 [ 1.68688441  1.3567438  -0.61343999]
 [ 0.03567429  0.30521654  1.03110125]
 [-0.31087598 -0.70714861  0.24798638]
 [ 0.03567429 -0.40148592  0.87447828]
 [ 0.36183925  1.21982516 -1.08330891]
 [-0.67781156 -0.72717581 -0.14357106]]
[[-1.08551776 -0.00509633 -0.45357315 -1.73784768  0.4637658   1.68688441
   1.68688441  0.03567429 -0.31087598  0.03567429  0.36183925 -0.67781156]
 [-1.21397563  1.34335929 -0.39186889 -1.59578135  0.60582287  0.20646856
   1.3567438   0.30521654 -0.70714861 -0.40148592  1.21982516 -0.72717581]
 [ 1.57928167 -0.06525957 -0.45681701  1.18772423 -1.55317784 -1.00499742
  -0.61343999  1.03110125  0.24798638  0.87447828 -1.08330891 -0.14357106]]
```

```
In [13]: correlation = sp.imread('./correlation.png')

         fig = plt.figure(figsize=(15,15))
         plt.grid(False)
         plt.imshow(correlation);
```



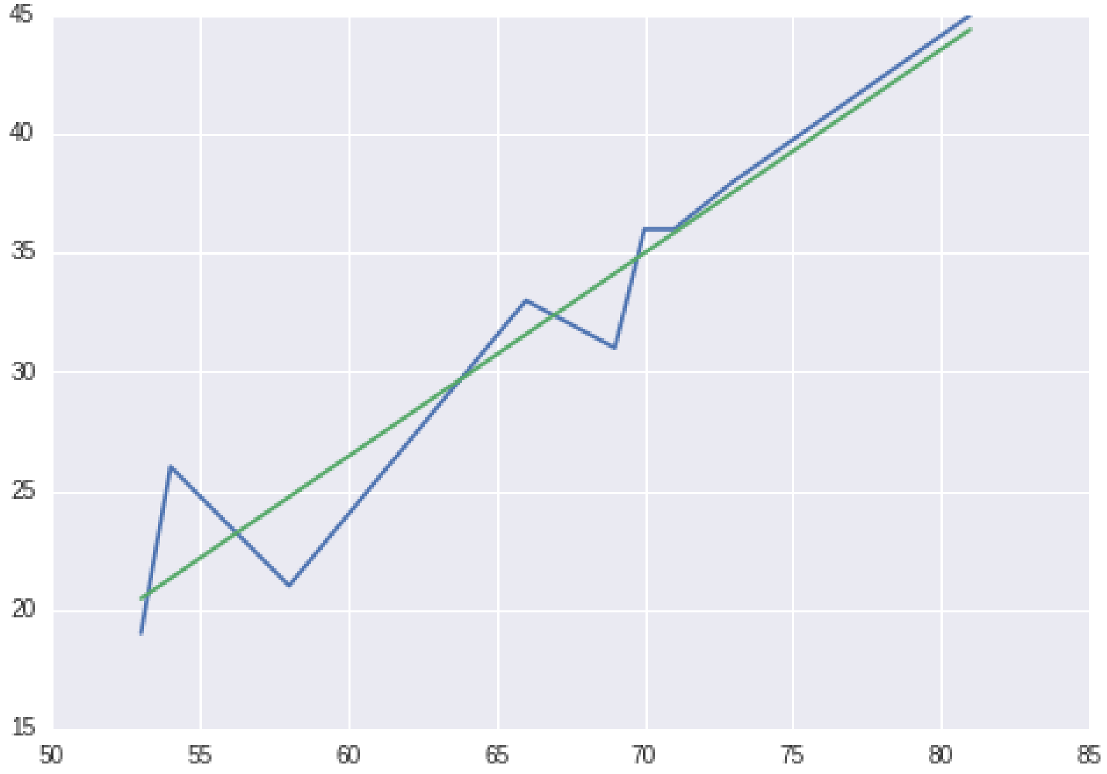
1.1 Linear Regression

```
In [10]: t = [53,54,58,66,69,70,71,73,81]
         c = [19,26,21,33,31,36,36,38,45]

         xi = sum(t)
         yi = sum(c)
         xsqr = sum([i**2 for i in t])
         xiyi = sum([t[i]*c[i] for i in range(len(t))])
         n  = len(t)

         print xi
         print yi
         print xsqr
         print xiyi
         print n
```

```
595
285
40037
19441
9
```

```
In [11]: a = [[xsqr, xi],[xi,n]]
         a_inv = np.linalg.inv(a)
         v = [[xiyi],[yi]]

         [[a],[b]] = np.dot(a_inv,v) #find a and b

         #find two points on line of best fit for plotting
         y1 = a*t[0]+b
         y2 = a*t[n-1]+b
```

```
In [12]: plt.plot(t,c)
         plt.plot([t[0], t[n-1]],[y1, y2]) #line of best fit
         plt.show()
```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