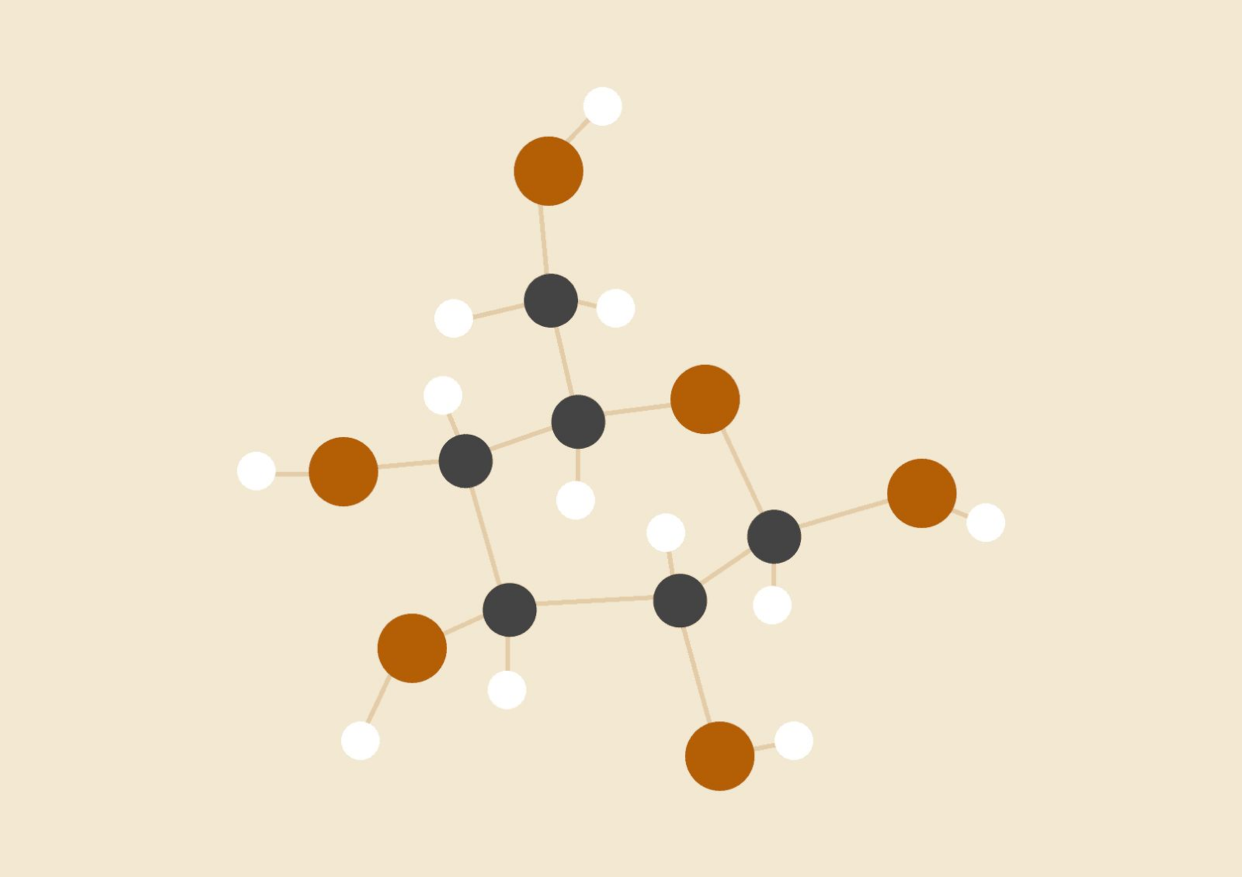
PROJECT-1 REPORT

Introduction to Machine Learning - CSE574



Jayant Solanki

UBIT Name: jayantso
Person Number: 50246821
Fall 2017 CSE

INTRODUCTION

This report contains the implementation report for the Task 1 , 2 and 3 of the Project 1. The report talks about the implementation in chronological fashion, right from the data acquisition from the DataSet to the computation of loglikelihood for the given 4 feature columns mentioned in the project description pdf.

OBJECTIVES ACHIEVED

I have used different statistical tools based upon numpy and python. I calculated, mean, variance, standard deviation on 4 separate feature columns which are **CS Score (USNews)**, **Research Overhead %**, **Admin Base Pay$** and **Tuition(out-state)$** of the university data set. As per project requirement I also calculated covariance and correlation matrices for those 4 feature columns. Scatter plots graphs have been plotted for each feature pairs. In the end I calculated univariate loglikelihood and multivariate loglikelihood.

IMPLEMENTATION

Using **openpyxl** python library all the 4 relevant columns from the **"university data.xlsx"** were read and stored into a **'data'** numpy array of 49x4 shape.

Task - 1 : Calculated mean, variance, and standard deviation on the 4 respective columns in the **data** array using **numpy.mean(), numpy.var()** and **numpy.std()**. Stored the results in the respective mu1, mu2….m4, var1,…var4 and sigma1…sigma4 variables.

Task - 2 : Calculated covariance matrix and correlation matrix on the 4 columns using **numpy.cov()** and **numpy.corrcoef()** functions. Here the data array was transposed before using it as an input for the two functions. Results were stored inside the covarianceMat and correlationMat. Based upon the correlation matrix I found that columns **CS Score (USNews)** and **Research Overhead %** were most correlated variable pairs and columns **CS Score (USNews)** and **Admin Base Pay$** were least correlated variable pairs. Below is the scatter plot graphs between each pair of feature columns in the respective Figure 1, 2 and 3.

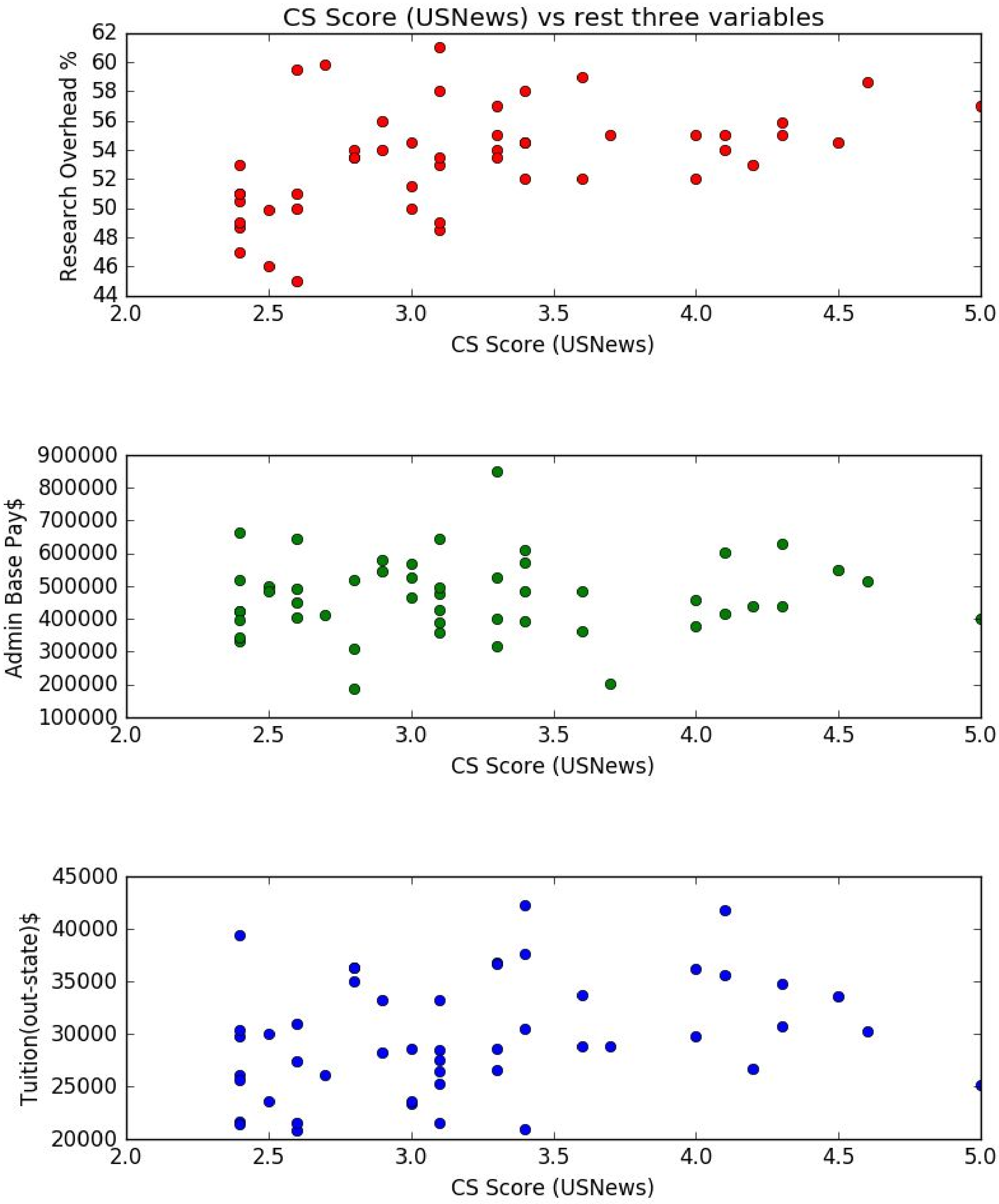

CS Score (USNews) vs rest three variables
Research Overhead %
62
60
58
56
54
52
50
48
46
44
Admin Base Pay$
900000
800000
700000
600000
500000
400000
300000
200000
100000
Tuition(out-state)$
45000
40000
35000
30000
25000
20000
2.0
2.5
3.0
3.5
4.0
4.5
5.0
CS Score (USNews)

Figure 1

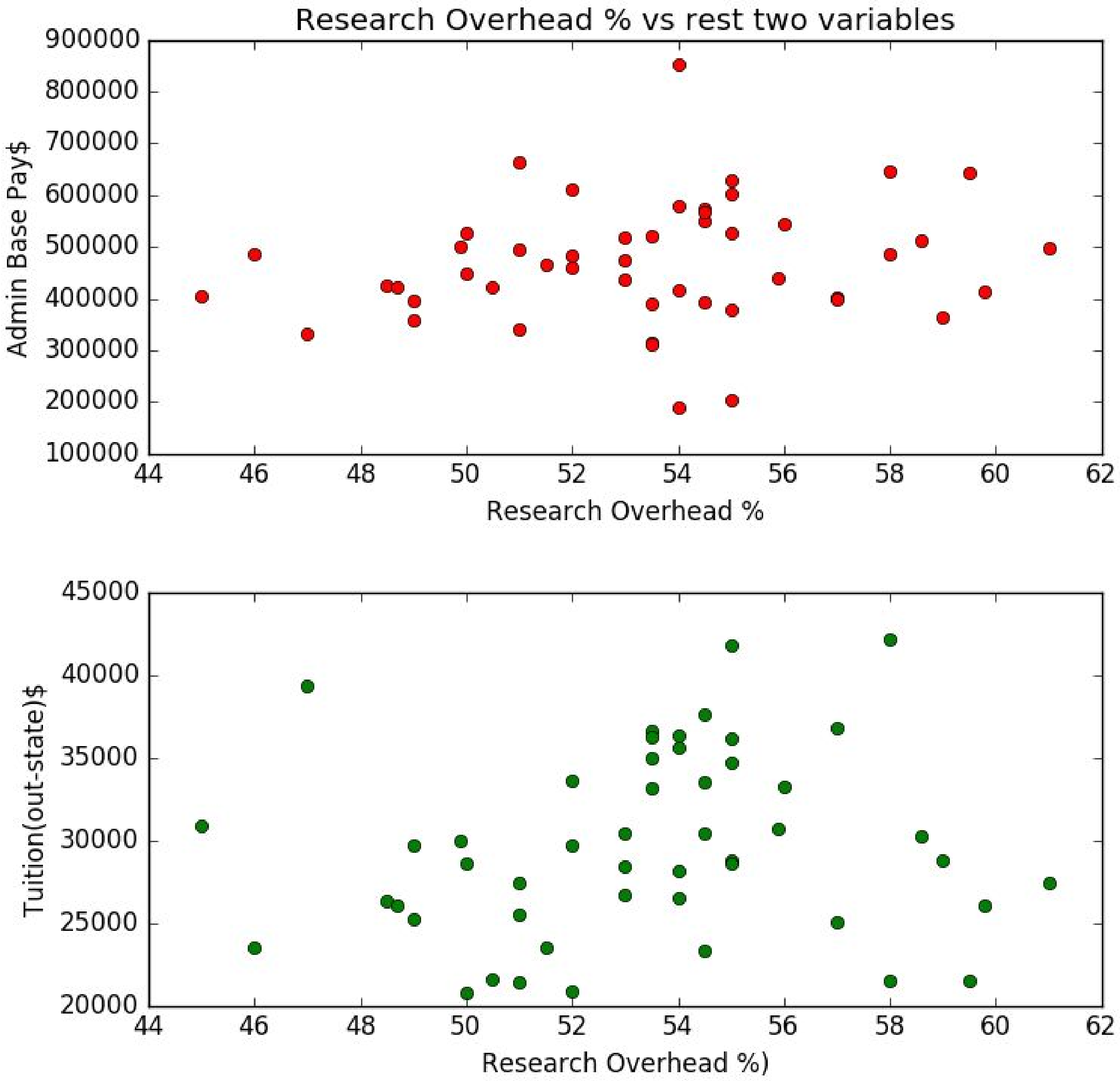

Research Overhead % vs rest two variables
Admin Base Pay$
900000
800000
700000
600000
500000
400000
300000
200000
100000
44
46
48
50
52
54
56
58
60
62
Research Overhead %
Tuition(out-state)$
45000
40000
35000
30000
25000
20000
44
46
48
50
52
54
56
58
60
62
Research Overhead %)

Figure 2

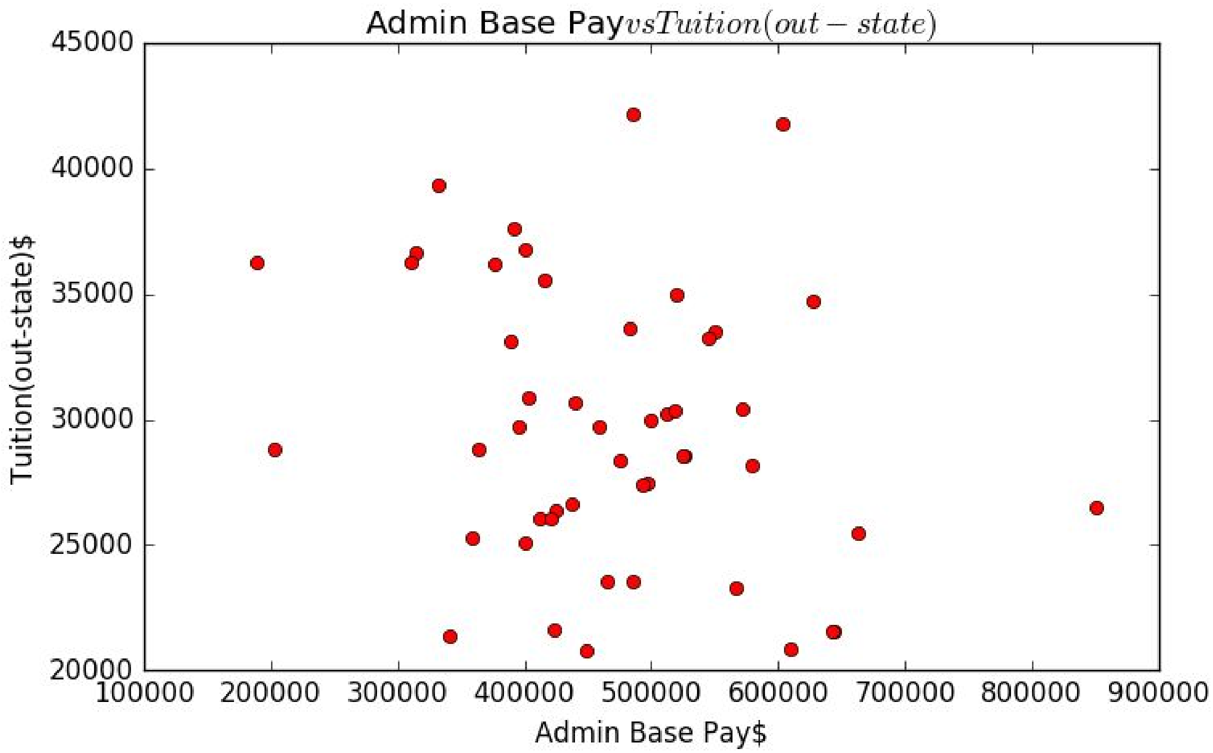


Figure 3

Task - 3 : Assuming that each column is normally distributed and that they are independent of each other I calculated the log-likelihood of each 4 columns using **scipy.stats.norm()** function, took the sum of their logs for each column data point and added all four values to find the overall log-likelihood.

Now considering the 4 feature columns are not independent, I calculated the multivariate log-likelihood. I used the probability distribution function for multivariate features. Created a mean vector, and by using the covariance matrix I calculated the multivariate log-likelihood for 4 feature variables.

MATERIALS

1. ProbabilityConcepts.pdf
2. Project1Desc.pdf
3. DataSet.zip

RESULTS

```
Ubit Name = jayantso
personNumber = 50246821
mu1 =  3.214
mu2 =  53.386
mu3 =  469178.816
mu4 =  29711.959
var1 =  0.448
var2 =  12.588
var3 =  13900134681.7
var4 =  30727538.733
sigma1 =  0.669
sigma2 =  3.548
sigma3 =  117898.832
sigma4 =  5543.243
covarianceMat =
 [[  4.575e-01   1.106e+00   3.880e+03   1.058e+03]
 [  1.106e+00   1.285e+01   7.028e+04   2.806e+03]
 [  3.880e+03   7.028e+04   1.419e+10  -1.637e+08]
 [  1.058e+03   2.806e+03  -1.637e+08   3.137e+07]]
correlationMat =
 [[ 1.     0.456  0.048  0.279]
 [ 0.456  1.     0.165  0.14 ]
 [ 0.048  0.165  1.    -0.245]
 [ 0.279  0.14  -0.245  1.   ]]
logLikelihood =  -1315.099
multilogLikelihood =  -1304.778
```

SOFTWARE/HARDWARE USED

- Sublime Text 3, Python 3 Environment based upon Anaconda, Ubuntu 16 System, Intel core i3 processor.
- Python libraries: numpy, openpyxl, matplotlib and scipy

REFERENCES

1. Ublearns
2. Stackoverflow.com
3. Python, Numpy and Matplotlib documentations.