MEDICAL INSURANCE PREDICTION

INTRODUCTION :

OVERVIEW :

The gross insurance premiums across the world are increasing day by day. But, most of these costs can be prevented just by eliminating smoking and lowering BMI(Body Mass Index).In this project we study and perform analysis on age, smoker, gender, BMI, region and how much difference they make on a person Medical Insurance Premium.Hence, the customers can see the make drastic lifestyle choices make on their insurance charges.

PURPOSE :

The purpose of this project is to predict the insurance premium of a person by analyzing his lifestyle choices and making him aware of the impact of more smoking , Unbalanced Bmi in his life.By this Project we make a Person understand that by how much smoking he make can increase/decrease his Medical insurance Premium by predicting the data.

LITERATURE SURVEY

EXISTING PROBLEM :

The problem of this project is to consider the effects of smoking, BMI, gender and region to determine how much these factors can account for our increase/decrease in insurance premium.

Proposed solution :

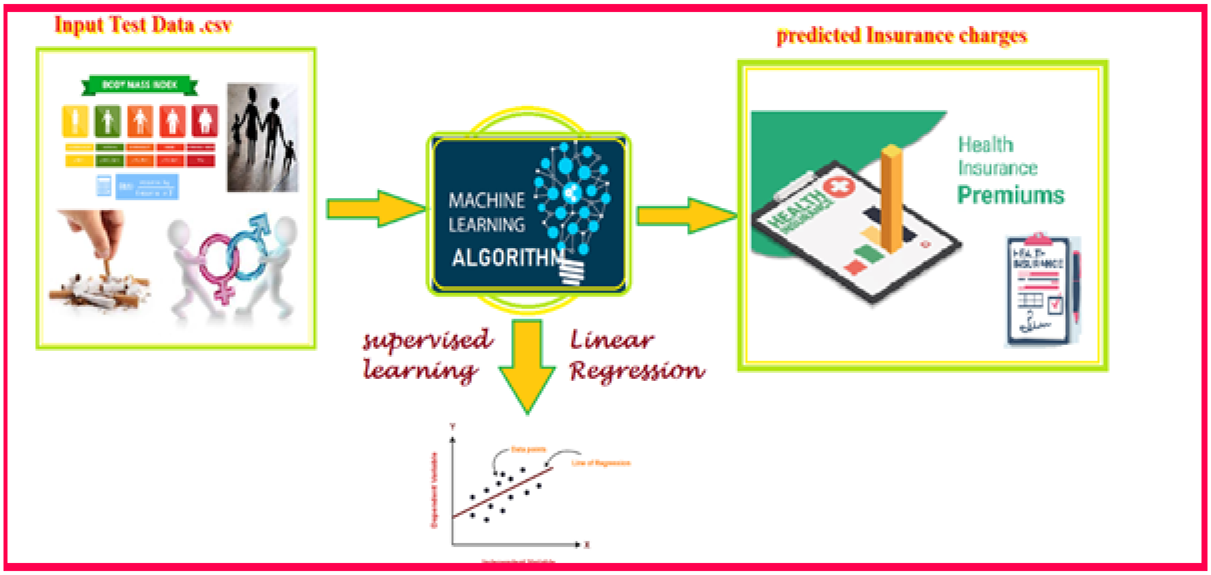
The solution is by implementing the model using LINEAR REGRESSION. InLinear regression algorithm, it shows a linear relationship between a dependent/predicted value (y) and one or more independent/training data (X) variables.

1. The dependent variable in this project refers to "charges "
2. The independent variables refers to age,Bmi,smoker,children,region.

Hence, by determining the PREDICTED Value of the data, we can determine the insurance that needs to be paid by a customer.

THEORITICAL ANALYSIS :

Block diagram :



BLOCK DIAGRAM DESCRIPTION:

Step1: The Machine model takes the input a dataset/csv file where the dataset/csv file contains different columns like

1. Age: age of primary beneficiary
2. Sex: insurance contractor gender, female, male
3. BMI: Body mass index, providing an understanding of body, weights that are relatively high or low relative to height,
4. Children: Number of children covered by health insurance / Number of dependents
5. Smoker: smoking
6. Region: the beneficiary's residential area in the US, northeast, southeast, southwest, northwest.
7. Charges: Individual medical costs billed by health insurance.

Step2: MachineLearning Algorithm

An appropriate algorithm is applied to the Dataset and necessary outputs are obtained.In prediction of Medical insurance premium we use: LINEAR REGRESSION.

> In linear regression we calculate data and obtain results in the form of **$y=mx+c$**

> The equation for Medical insurance premium can be referred as:

CHARGES = BASECOST + m * ATTRIBUTE

By applying the above algorithm the actual and predicted values are calculated along with the error.

Step3 : RESULT

By comparing actual and predicted values, we can obtain the detailed information about the project and the difference/errors in the charges in Medical Insurance Premium.

HARDWARE OR SOFTWARE REQUIREMENTS :

HARDWARE REQUIREMENTS :

> Processor: INTEL core i5 Processor – 4 core processor, 4.20 GHz
Turbo frequency, 6 MB intel smart cache.
> 8 GB memory; 1 TB hard disk drive
> 12 GB DDR4-2933 SDRAM (1 x 4 GB, 1 x 8 GB)
> Intel Heat sink to keep temperature under control

SOFTWARE REQUIREMENTS :

1. WEKA :

weka stands for **WAIKATO ENVIRONMENT FOR KNOWLEDGEANALYSIS.**

a. It is a machine learning software that is written in Java.
b. It consists of several machine learning algorithms and it is an open source GUI.
c. The dataset can be compiled without writing any java code as it contains inbuilt functions to perform all the activities.

2.Eclipse :

- Eclipse is an integrated development environment (IDE) used in computer programming.
- The java code in eclipse is compared with the weka software and results obtained are compared and checked.

3.Microsoft Excel :

- Through Microsoft excel we can organize, format and calculate data with formulas and is useful for data analysis for machine learning.

EXPERIMENTAL INVESTIGATIONS :

STEP1 : EXPLORATORY DATA ANALYSIS :

1. In Exploratory data analysis, we will learn about the number of different techniques used to understand the dataset(“ insurance.csv”) which is being used.

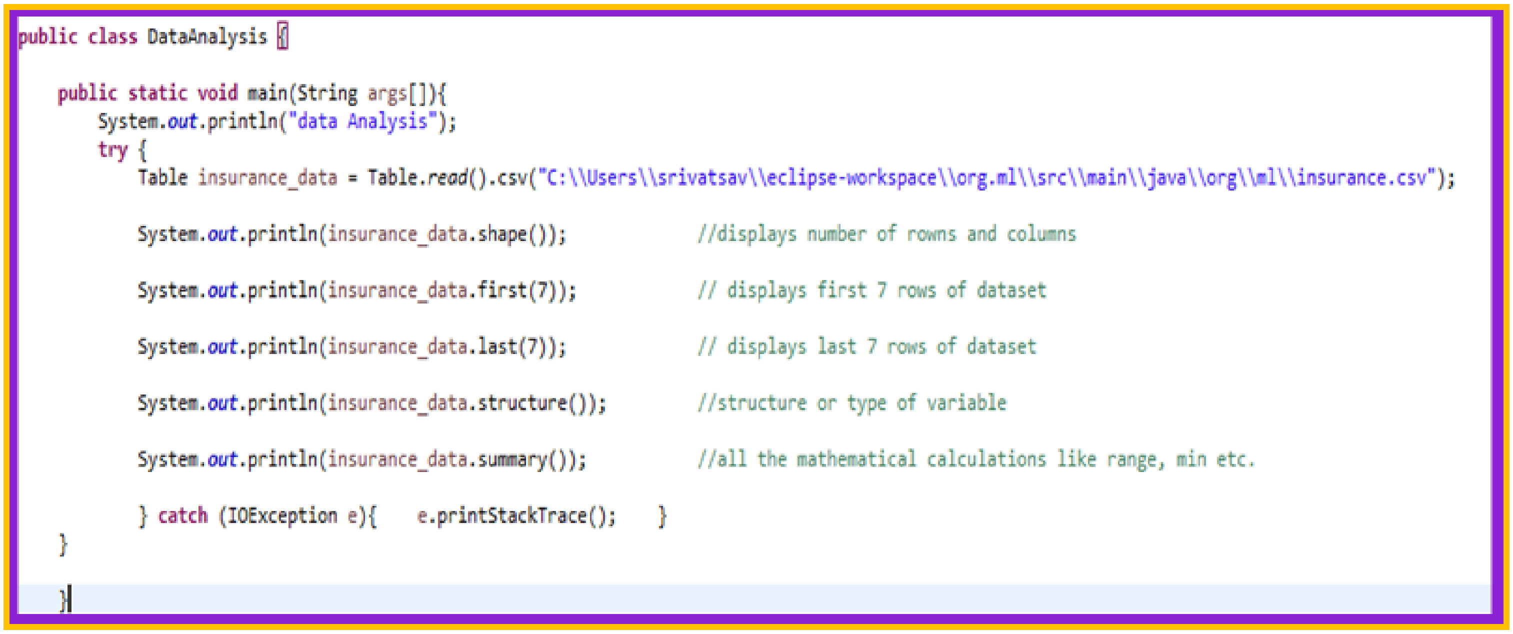
2. Resource for Dataset: https://www.kaggle.com/mirichoi0218/insurance

3. In EDA , we will :

    a. 1.understand the types of variables in dataset.

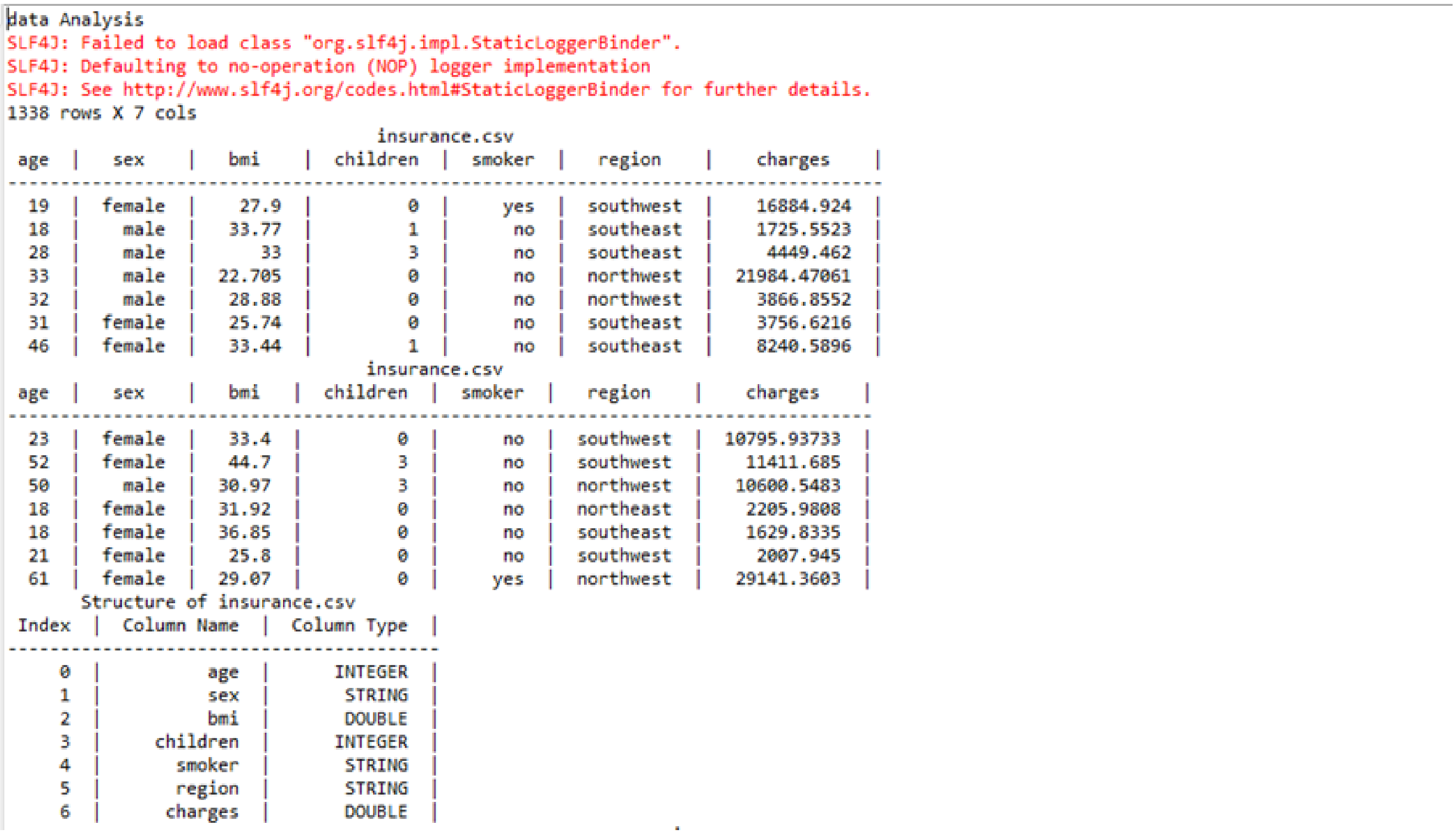
    b. 2. perform Data cleaning

4. The type of variable can be understood by performing different operations in eclipse. The head, shape, summary about the data set can be obtained by the following code.

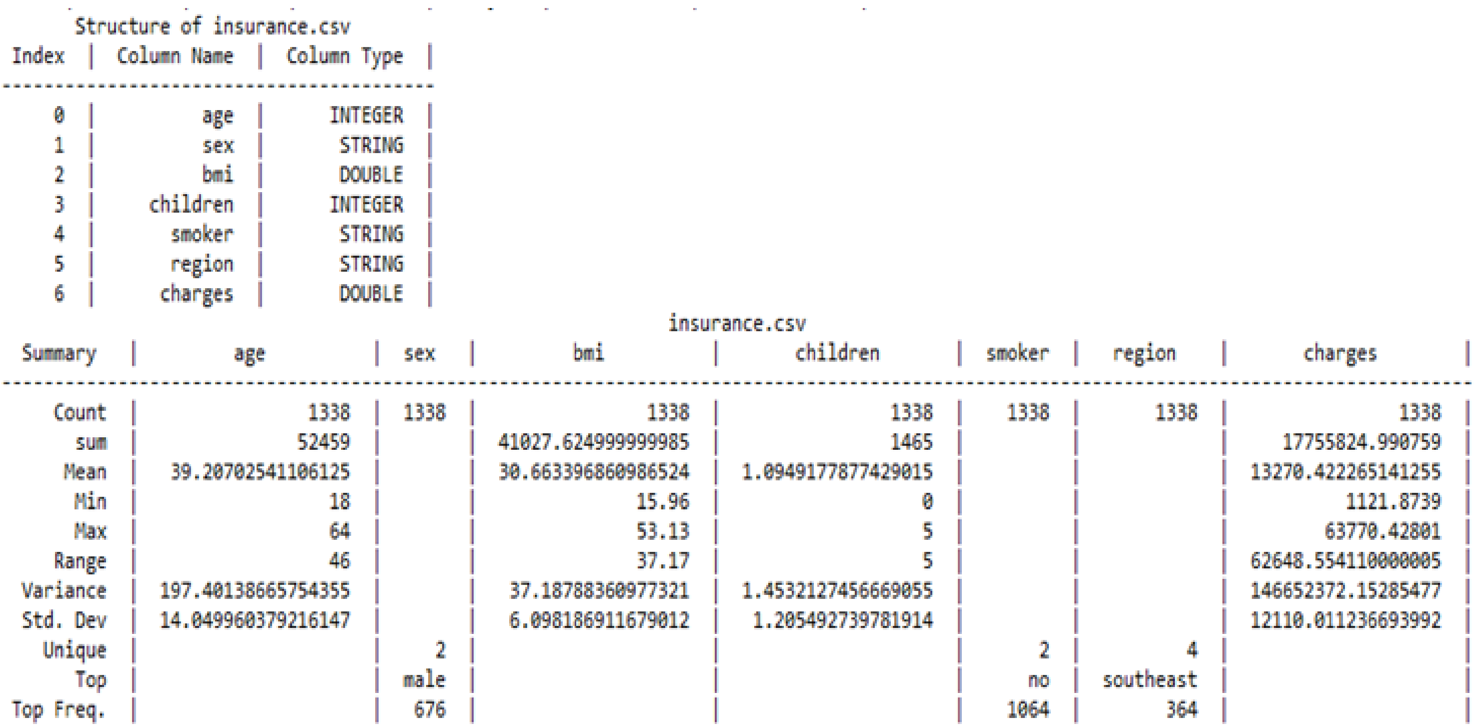


```
public class DataAnalysis {

    public static void main(String args[]){
        System.out.println("data Analysis");
        try {
            Table insurance_data = Table.read().csv("C:\\Users\\srivatsav\\eclipse-workspace\\org.ml\\src\\main\\java\\org\\ml\\insurance.csv");

            System.out.println(insurance_data.shape());           //displays number of rowns and columns

            System.out.println(insurance_data.first(7));          // displays first 7 rows of dataset

            System.out.println(insurance_data.last(7));           // displays last 7 rows of dataset

            System.out.println(insurance_data.structure());       //structure or type of variable

            System.out.println(insurance_data.summary());         //all the mathematical calculations like range, min etc.

            } catch (IOException e){    e.printStackTrace();    }
    }

    }
```

output :



```
Data Analysis
SLF4J: Failed to load class "org.slf4j.impl.StaticLoggerBinder".
SLF4J: Defaulting to no-operation (NOP) logger implementation
SLF4J: See http://www.slf4j.org/codes.html#StaticLoggerBinder for further details.
1338 rows X 7 cols
                                    insurance.csv
 age  |   sex    |   bmi    |  children  |  smoker  |   region    |    charges    |
-----------------------------------------------------------------------------------
  19  |  female  |    27.9  |         0  |     yes  |  southwest  |    16884.924  |
  18  |    male  |   33.77  |         1  |      no  |  southeast  |    1725.5523  |
  28  |    male  |      33  |         3  |      no  |  southeast  |     4449.462  |
  33  |    male  |  22.705  |         0  |      no  |  northwest  |  21984.47061  |
  32  |    male  |   28.88  |         0  |      no  |  northwest  |    3866.8552  |
  31  |  female  |   25.74  |         0  |      no  |  southeast  |    3756.6216  |
  46  |  female  |   33.44  |         1  |      no  |  southeast  |    8240.5896  |
                                   insurance.csv
 age  |   sex    |   bmi   |  children  |  smoker  |   region    |    charges    |
----------------------------------------------------------------------------------
  23  |  female  |   33.4  |         0  |      no  |  southwest  |  10795.93733  |
  52  |  female  |   44.7  |         3  |      no  |  southwest  |    11411.685  |
  50  |    male  |  30.97  |         3  |      no  |  northwest  |   10600.5483  |
  18  |  female  |  31.92  |         0  |      no  |  northeast  |    2205.9808  |
  18  |  female  |  36.85  |         0  |      no  |  southeast  |    1629.8335  |
  21  |  female  |   25.8  |         0  |      no  |  southwest  |     2007.945  |
  61  |  female  |  29.07  |         0  |     yes  |  northwest  |   29141.3603  |
       Structure of insurance.csv
 Index  |  Column Name  |  Column Type  |
-----------------------------------------
     0  |          age  |      INTEGER  |
     1  |          sex  |       STRING  |
     2  |          bmi  |       DOUBLE  |
     3  |     children  |      INTEGER  |
     4  |       smoker  |       STRING  |
     5  |       region  |       STRING  |
     6  |      charges  |       DOUBLE  |
```



```
        Structure of insurance.csv
 Index  |  Column Name  |  Column Type  |
-----------------------------------------
     0  |          age  |      INTEGER  |
     1  |          sex  |       STRING  |
     2  |          bmi  |       DOUBLE  |
     3  |     children  |      INTEGER  |
     4  |       smoker  |       STRING  |
     5  |       region  |       STRING  |
     6  |      charges  |       DOUBLE  |
                                                       insurance.csv
  Summary  |         age          |  sex  |          bmi          |       children        |  smoker  |   region   |      charges       |
---------------------------------------------------------------------------------------------------------------------------------------
    Count  |                1338  |  1338 |                 1338  |                 1338  |    1338  |      1338  |              1338  |
      sum  |               52459  |       |   41027.624999999985  |                 1465  |          |            |   17755824.990759  |
     Mean  |   39.20702541106125  |       |   30.663396860986524  |   1.0949177877429015  |          |            | 13270.422265141255 |
      Min  |                  18  |       |                15.96  |                    0  |          |            |         1121.8739  |
      Max  |                  64  |       |                53.13  |                    5  |          |            |       63770.42801  |
    Range  |                  46  |       |                37.17  |                    5  |          |            | 62648.554110000005 |
 Variance  |  197.40138665754355  |       |    37.18788360977321  |   1.4532127456669055  |          |            | 146652372.15285477 |
 Std. Dev  |  14.049960379216147  |       |     6.09818691167901 2 |   1.205492739781914   |          |            | 12110.011236693992 |
   Unique  |                      |     2 |                       |                       |       2  |         4  |                    |
      Top  |                      |  male |                       |                       |      no  |  southeast |                    |
Top Freq.  |                      |   676 |                       |                       |    1064  |       364  |                    |
```

STEP2 : DATA PREPROSESSING :

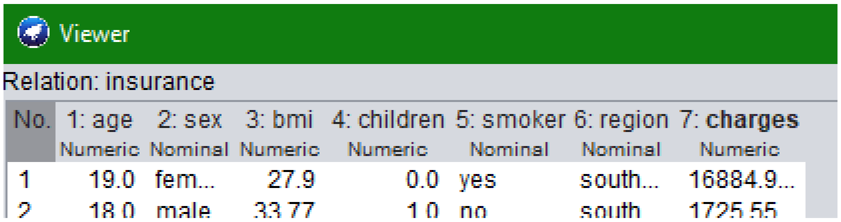
In the insurance.csv dataset, since there is no missing data available,there is no need to perform any data cleaning or integration or etc. Hence , the dataset is ready to perform data visualization for all the available attributes in data set.

STEP3 : DATA VISUALIZATION :

DATA VISUALIZATION Can be done by **HISTOGRAMS , SCATTER PLOT , BOX TRACE etc.**.These histograms, boxplot are represented in both eclipse and weka. In weka the graphs are plotted for each and evary individual attribute.The dataset has 7 ATTRIBUTES/VARIABLES and 1338 INSTANCES . We have two types of variables available in this dataset.they are :

Continuous variable
Categorical variable.

They are also refered as Numeric or Nominal Type.



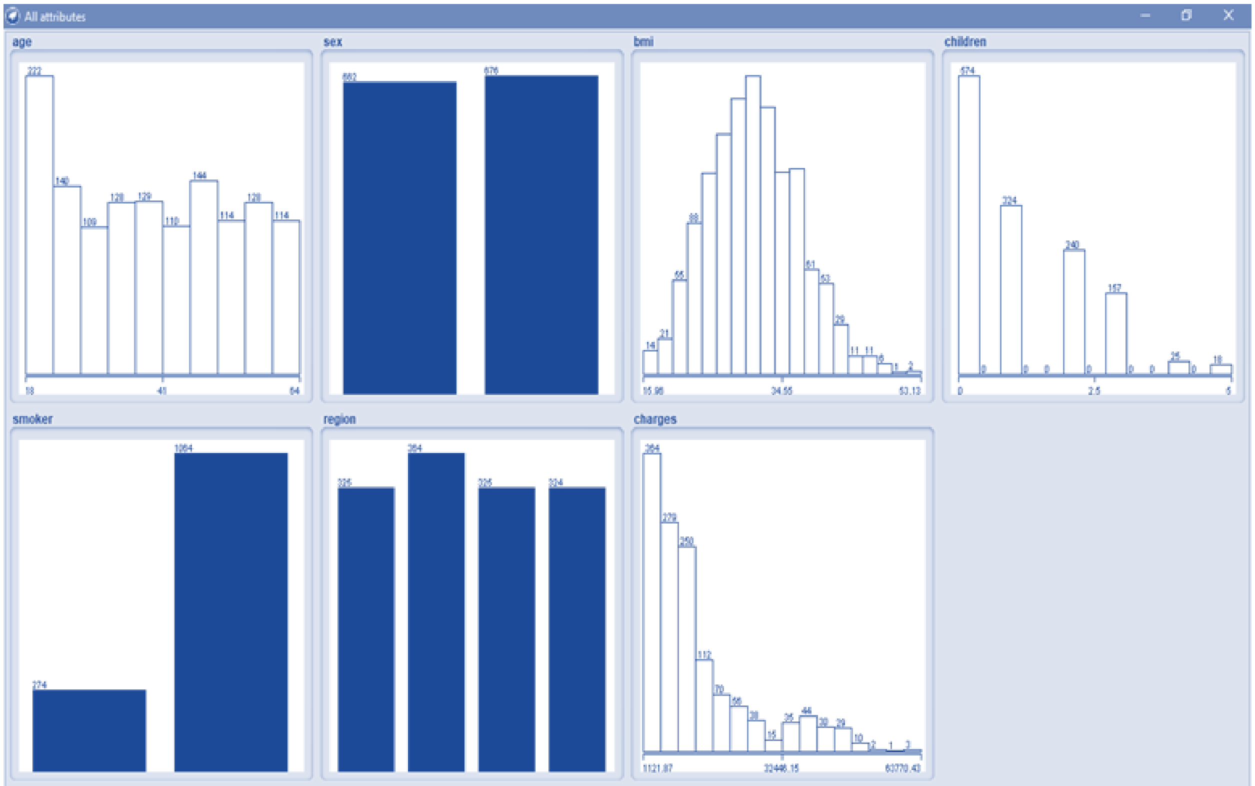
Relation: insurance

No.	1: age Numeric	2: sex Nominal	3: bmi Numeric	4: children Numeric	5: smoker Nominal	6: region Nominal	7: charges Numeric
1	19.0	fem...	27.9	0.0	yes	south...	16884.9...
2	18.0	male	33.77	1.0	no	south	1725.55

Based on type of variable,

The mean , mode , min ,max , unique , top, top frequency , range ,variance, are calculated for each and every attribute by weka.

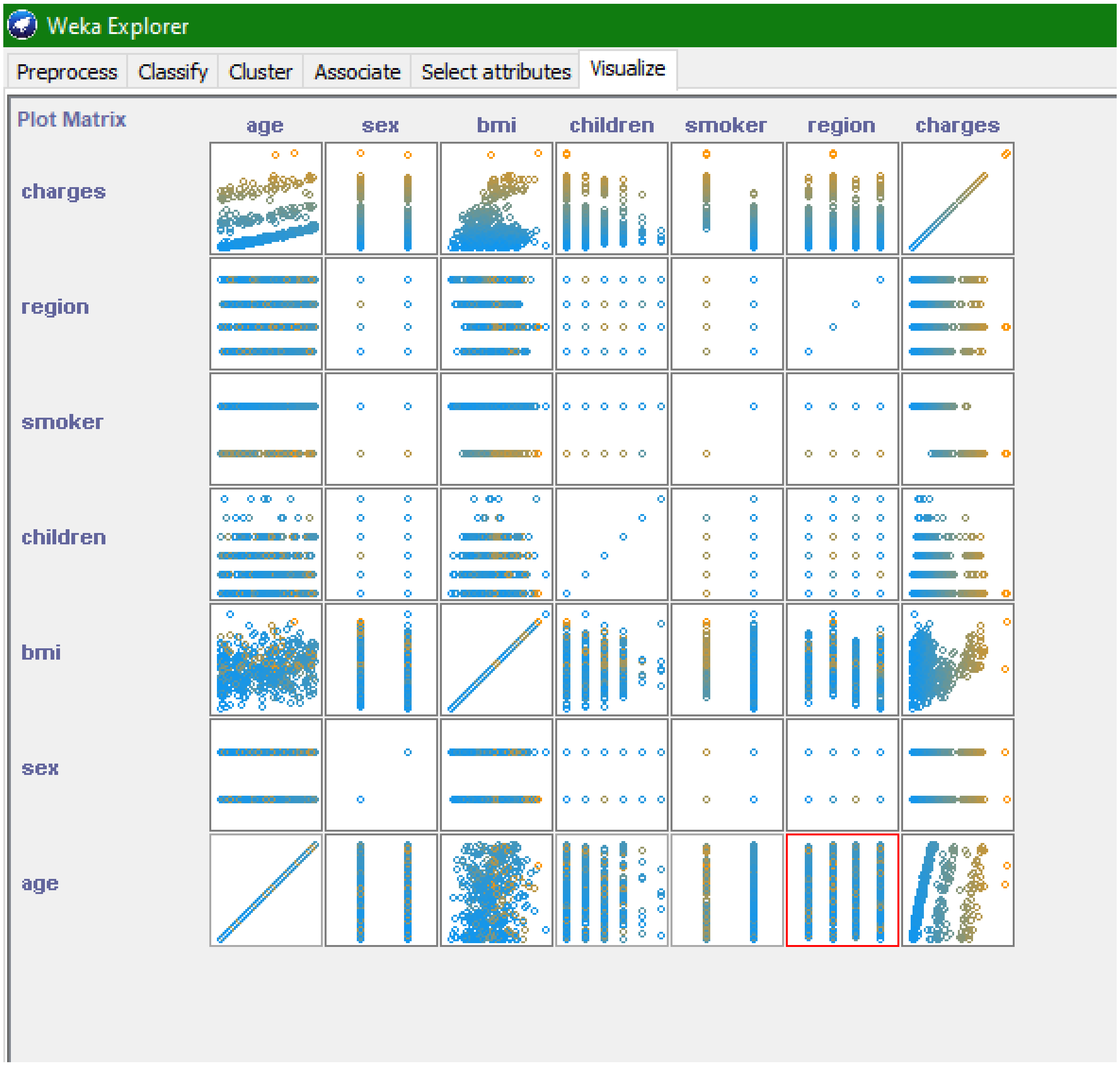
> Every attribute has its own mean, range etc. as mentioned in above figure.
>The data visualization based on HISTOGRAM of the attributes are shown below.
> Every attribute is measured against the charges and the histograms are represented as shown below..



SCATTER PLOTS :

Scatter plots' primary uses are to observe and show relationships between two numeric variables. The dots in a **scatter plot** not only report the values of individual data points, but also patterns when the data are taken as a whole. Identification of correlational relationships are common with **scatter plotS**

> The following shows the scatter ploting among various attributes present in dataset.

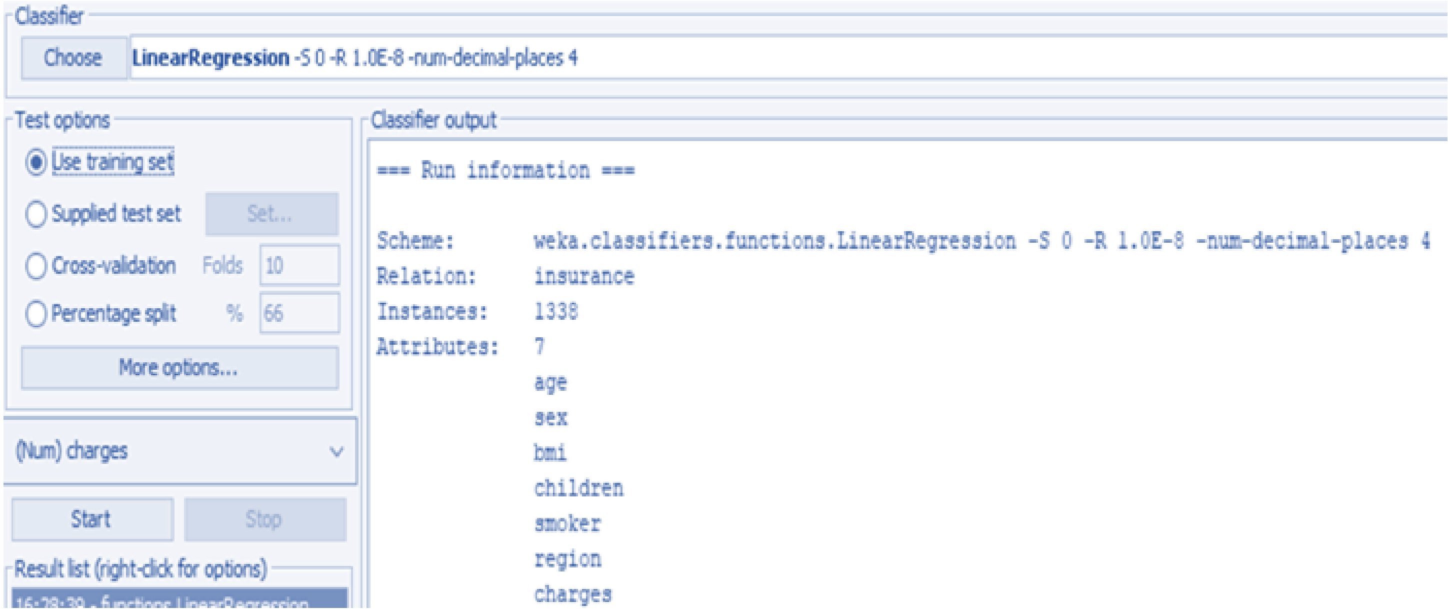


4.BUILDING AND TESTING MACHINE LEARNING MODEL :

AS we have the whole data which is cleaned and no missing values, we will build a model which can predict the charges for medical insurance premium.

a. Hence a linear regression model can be used to predict thecharges. Generally it is used when we want to predict the value of a variable based on the value of another variable.

The linear regression can be done in both weka and Eclipse . where after compiling both the software produces the Predicted charges with respect to actual charges.
The error is also obtained along with actual and predicted values.Hence for every actual value, we can obtain an predicted value which is charges.
Since we are using linear Regression , the output equation will be of the form y=mX+C , where y,x are dependent and independent variables.
In our project , we use the training data set to obtain the values.
The process of linear Regression in weka is depicted as follows :



LinearRegression -S 0 -R 1.0E-8 -num-decimal-places 4

● Use training set
○ Supplied test set
○ Cross-validation Folds 10
○ Percentage split % 66

(Num) charges

```
=== Run information ===

Scheme:       weka.classifiers.functions.LinearRegression -S 0 -R 1.0E-8 -num-decimal-places 4
Relation:     insurance
Instances:    1338
Attributes:   7
              age
              sex
              bmi
              children
              smoker
              region
              charges
```

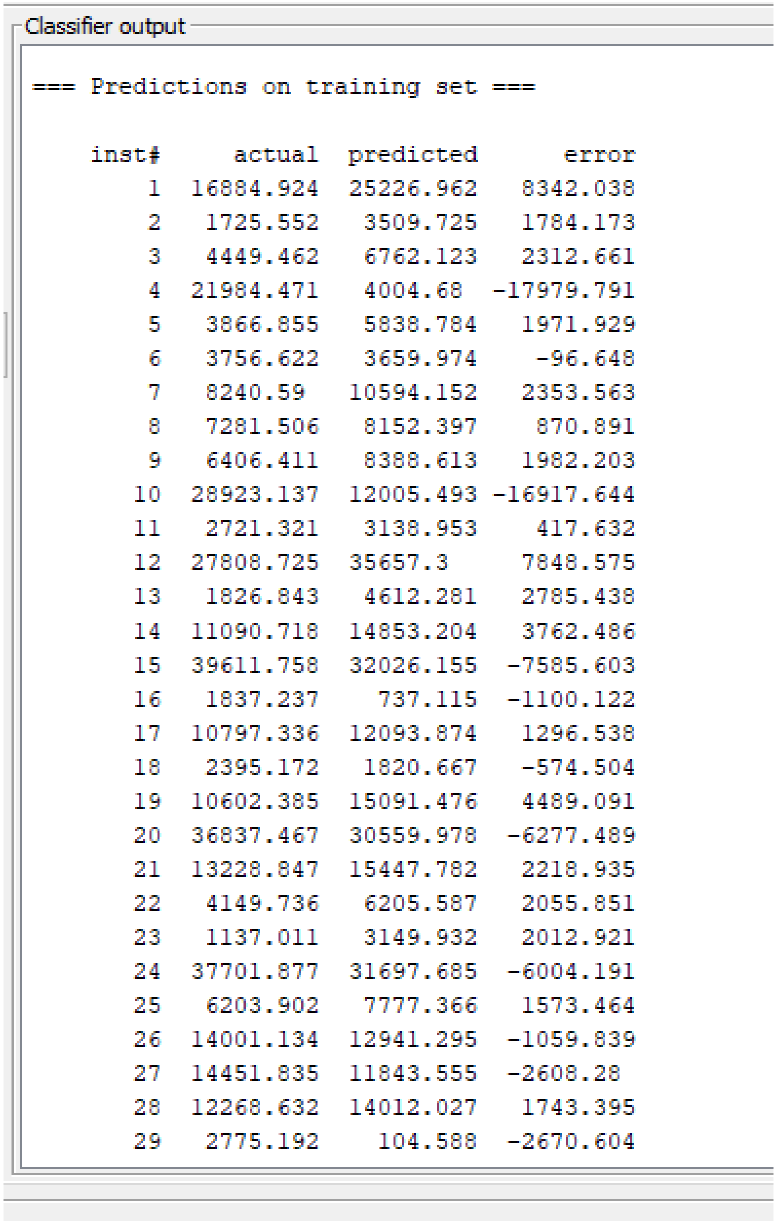
>The Dataset has 7 attributes with 1388 instances. As mentioned earlier each attribute has its own Data visualization based on its data.
>By using the training set, we predicts the charges.
>As in linear regression we express everything in the form

Y=mX+c

The predicted charges would also be in the Y=mX+c form and they are as follows :

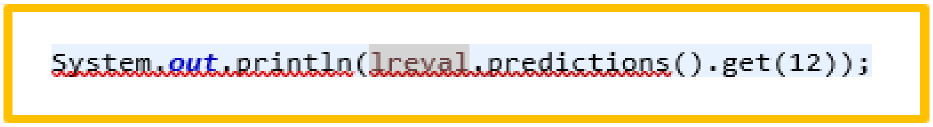
The equation if of the form: y=mx+c i.e ,
charges = (257.0064 * age) **+**(338.6413 * bmi) **+** (471.5441 * children)**+** (23843.8749 *smoker=yes) **+**(782.7452 * region=northwest,northeast,southeast) **+**(-858.4696 * region=southeast) **+** (-12948.1277)

>For each and every row , we obtained an actual and predicted value along with the error value in weka as follows:



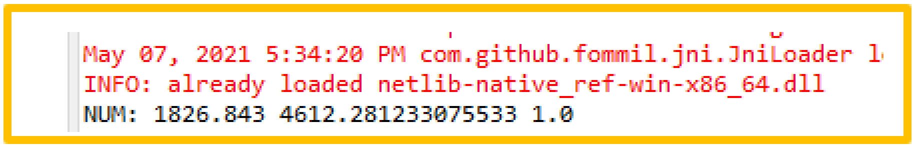
```
=== Predictions on training set ===

    inst#     actual  predicted      error
        1  16884.924  25226.962   8342.038
        2   1725.552   3509.725   1784.173
        3   4449.462   6762.123   2312.661
        4  21984.471   4004.68  -17979.791
        5   3866.855   5838.784   1971.929
        6   3756.622   3659.974    -96.648
        7   8240.59   10594.152   2353.563
        8   7281.506   8152.397    870.891
        9   6406.411   8388.613   1982.203
       10  28923.137  12005.493 -16917.644
       11   2721.321   3138.953    417.632
       12  27808.725  35657.3     7848.575
       13   1826.843   4612.281   2785.438
       14  11090.718  14853.204   3762.486
       15  39611.758  32026.155  -7585.603
       16   1837.237    737.115  -1100.122
       17  10797.336  12093.874   1296.538
       18   2395.172   1820.667   -574.504
       19  10602.385  15091.476   4489.091
       20  36837.467  30559.978  -6277.489
       21  13228.847  15447.782   2218.935
       22   4149.736   6205.587   2055.851
       23   1137.011   3149.932   2012.921
       24  37701.877  31697.685  -6004.191
       25   6203.902   7777.366   1573.464
       26  14001.134  12941.295  -1059.839
       27  14451.835  11843.555  -2608.28
       28  12268.632  14012.027   1743.395
       29   2775.192    104.588  -2670.604
```

* Since there are a number of instances available , we can obtain a single instance in Eclipse by the following code :



```
System.out.println(lreval.predictions().get(12));
```

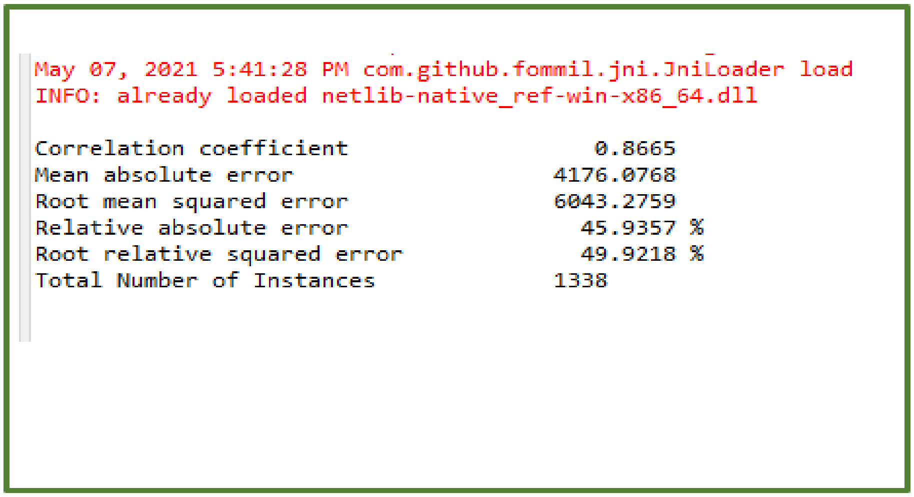
OUTPUT :



```
May 07, 2021 5:34:20 PM com.github.fommil.jni.JniLoader l
INFO: already loaded netlib-native_ref-win-x86_64.dll
NUM: 1826.843 4612.281233075533 1.0
```

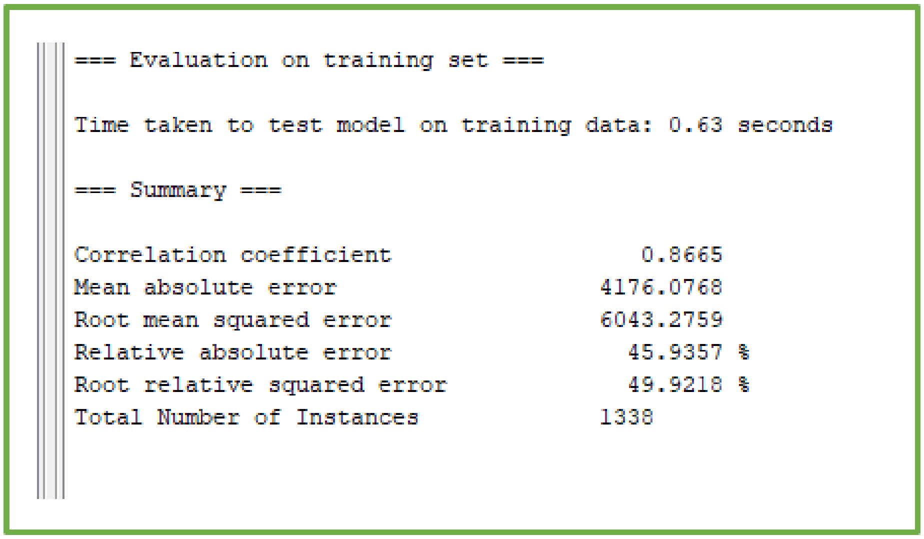
The above code returns the Actual and Predicted value of instance 12 in Dataset. As indexing starts from 0 in java , get(12) returns the 13th instance values….

> The overall Summary of the test data is also obtained both in eclipse and Weka. The final corelation coefficient , root mean square value etc.. all are obtained as follows :



```
May 07, 2021 5:41:28 PM com.github.fommil.jni.JniLoader load
INFO: already loaded netlib-native_ref-win-x86_64.dll

Correlation coefficient                  0.8665
Mean absolute error                   4176.0768
Root mean squared error               6043.2759
Relative absolute error                 45.9357 %
Root relative squared error             49.9218 %
Total Number of Instances             1338
```

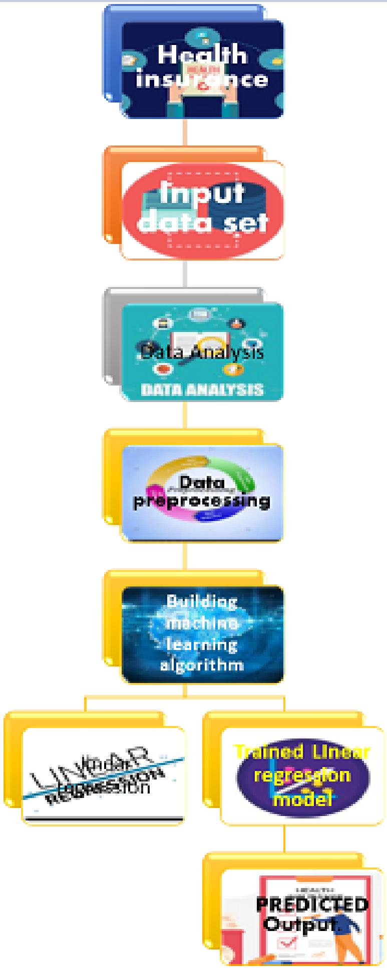
In eclipse



```
=== Evaluation on training set ===

Time taken to test model on training data: 0.63 seconds

=== Summary ===

Correlation coefficient                  0.8665
Mean absolute error                   4176.0768
Root mean squared error               6043.2759
Relative absolute error                 45.9357 %
Root relative squared error             49.9218 %
Total Number of Instances             1338
```

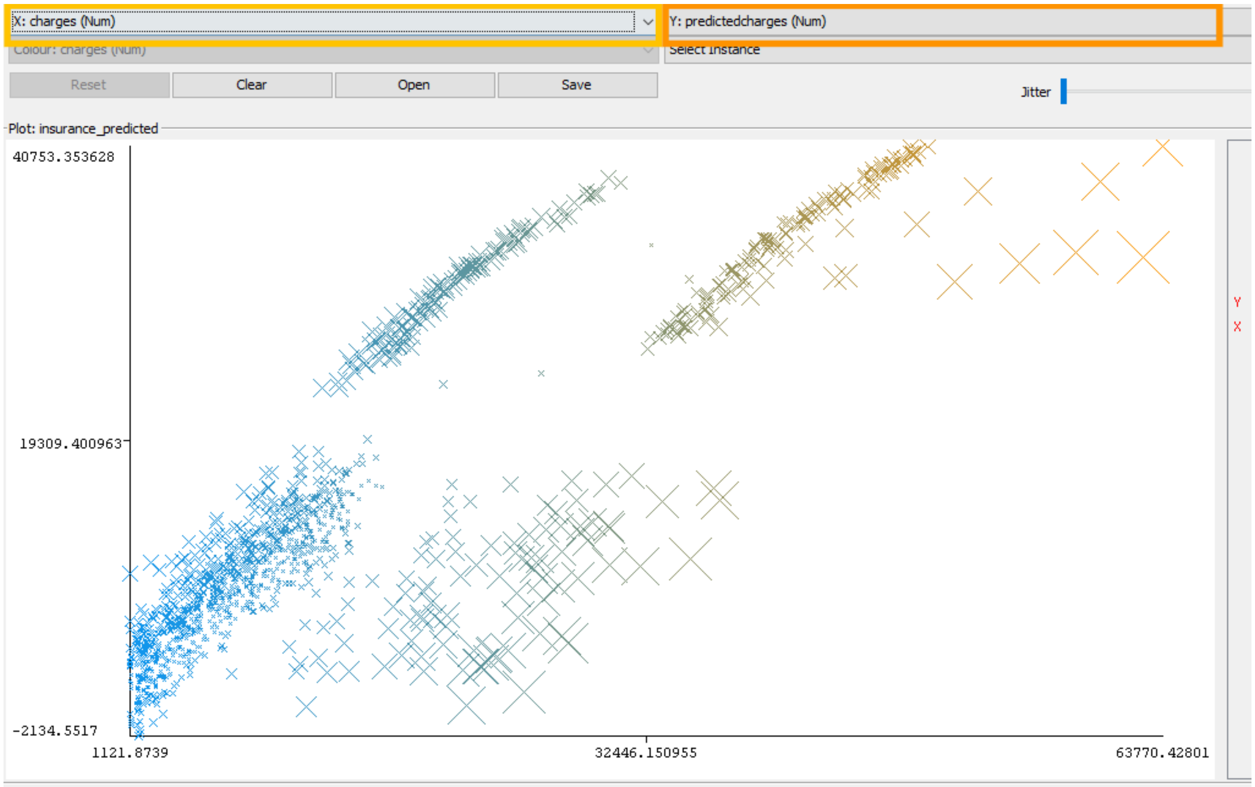
In Weka.

FLOWCHART :



RESULT :

The output of the Medical insurance prediction model is shown in the below figure . Finally we obtained actual and predicted values and obtained an equation in the form y-mx+c which proves the dataset had turned it into LINEAR REGRESSION model and we obtained the predicted charges for every current charges in an diagrammatically model.

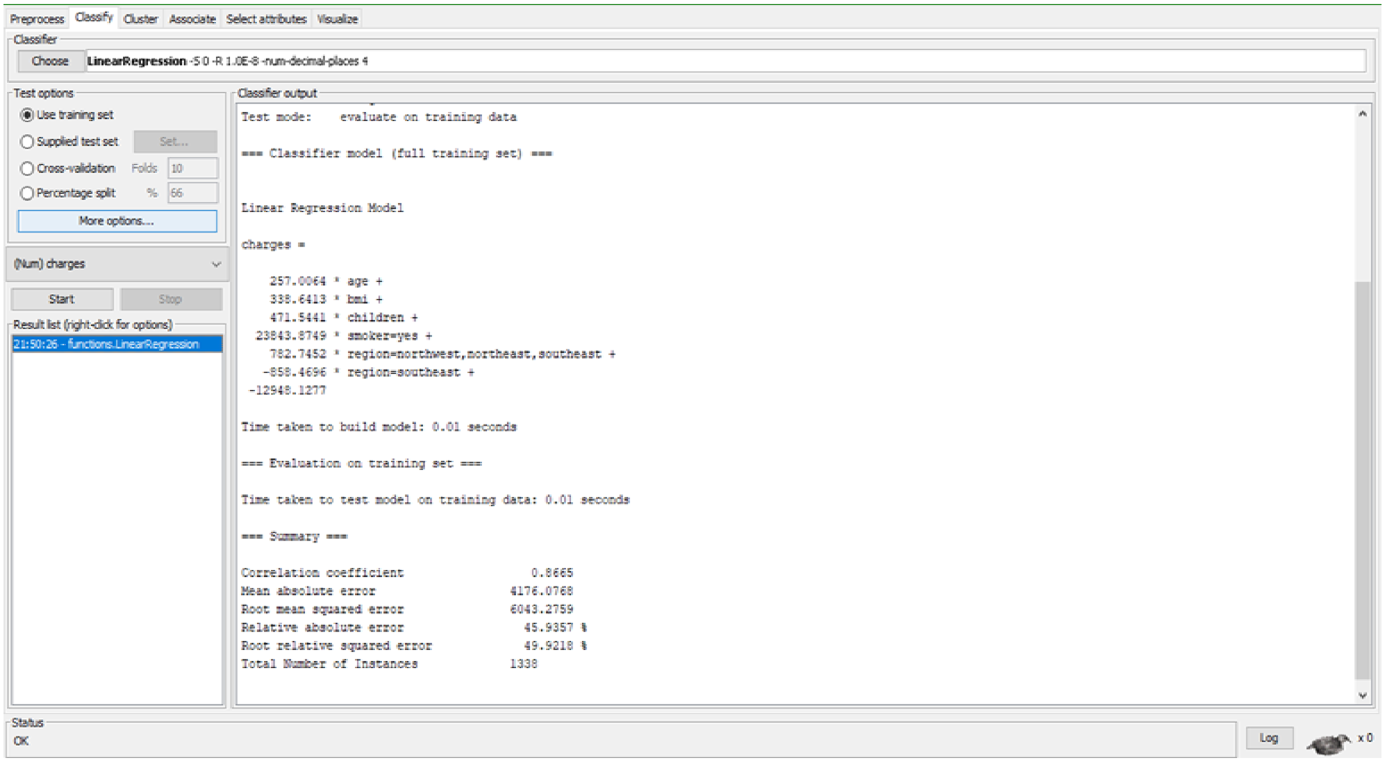


X: charges (Num)

Y: predictedcharges (Num)

Colour: charges (Num)

Plot: insurance_predicted



Classifier

LinearRegression -S 0 -R 1.0E-8 -num-decimal-places 4

Test options

● Use training set

○ Supplied test set

○ Cross-validation Folds 10

○ Percentage split % 66

(Num) charges

Result list (right-click for options)

21:50:26 - functions.LinearRegression

Classifier output

```
Test mode:    evaluate on training data

=== Classifier model (full training set) ===


Linear Regression Model

charges =

    257.0064 * age +
    338.6413 * bmi +
    471.5441 * children +
  23843.8749 * smoker=yes +
    782.7452 * region=northwest,northeast,southeast +
   -858.4696 * region=southeast +
 -12948.1277

Time taken to build model: 0.01 seconds

=== Evaluation on training set ===

Time taken to test model on training data: 0.01 seconds

=== Summary ===

Correlation coefficient                  0.8665
Mean absolute error                   4176.0768
Root mean squared error               6043.2759
Relative absolute error                 45.9357 %
Root relative squared error             49.9218 %
Total Number of Instances             1338
```

Status

OK

ADVANTAGES & DISADVANTAGES

Early health insurance amount prediction can help in better contemplation of the amount needed. Where a person can ensure that the amount he/she is going to opt is justified. Also it can provide an idea about gaining extra benefits from the health insurance.

Our project does not give the exact amount required for any health insurance company but gives enough idea about the amount associated with an individual for his/her health insurance.

There are no disadvantages in checking into a medical insurance prediction. It is the basic responsibility of every customer/Person to check his Insurance and Predict the charges based on his lifestyle choices.

APPLICATIONS

There are many applications of linear regression in our day to day life.it is probably one of the most popular and well inferential algorithms in statistics.

1.Marks scored by students based on number of hours studied (ideally)- Here marks scored in exams are independent and the number of hours studied is independent.

2.Predicting crop yields based on the amount of rainfall- Yield is a dependent variable while the measure of precipitation is an independent variable.

3.Predicting the Salary of a person based on years of experience- Therefore, Experience becomes the independent while Salary turns into the dependent variable.

CONCLUSION

Various factors were used and their effect on the predicted amount was examined. It was observed that a person’s age and smoking status affects the prediction most in every algorithm applied.

Attributes which had no effect on the prediction were removed from the features. The effect of various independent variables on the premium amount was also checked. The attributes also in combination were checked for better accuracy results and the charges are predicted for the insurance premium.

FUTURE SCOPE

Premium amount prediction focuses on persons own health rather than other companies ' insurance terms and conditions. The models can be applied to the data collected in coming years to predict the premium. This can help not only people but also insurance companies to work in tandem for better and more health centric insurance amount.

BIBILOGRAPHY

- https://www.kaggle.com/mirichoi0218/insurance
- https://waikato.github.io/weka-wiki/
- https://en.wikipedia.org/wiki/Linear_regression

APPENDIX

- Source Code- Github