Saudi Arabia King Abdulaziz University
The Faculty of Computer and Information Technology
Computer Science Department

MACHINE LEARNING APPLICATION ON RAPIDMINER AND WEKA

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Artificial Intelligence | CPCS 331

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Task Assignment

Task	Wajd Alharbi	Renad Baghdadi
Introduction	**50%**	**50%**
The chosen dataset	**50%**	**50%**
The machine learning	**100%**	**0%**
Linear Regression algorithm	**100%**	**0%**
Multilayer Perceptron algorithm (Neural Net)	**0%**	**100%**
Conclusion	**50%**	**50%**

Table of Contents

1-Introduction

Artificial Intelligence and computer science's field of machine learning is concerned with utilizing algorithms and data to mimic how individuals learn in order to increase accuracy over time. Machine learning algorithms are used to generate a prediction, regression, or classification. Based on certain input data, which may be labeled or unlabeled, our algorithms will offer an estimate about a pattern in the data.

2-Purpose of the project

This project's objective is to employ the tools to apply machine learning algorithms to massive amounts of data. The methods we chose include the Multilayer Perceptron algorithm and the Linear Regression algorithm, both of which leverage machine learning tools like Rapid-miner and Weka. Examining how various validations use the same method and the same data to get different results that rely on the qualities of the validations is the aim.

3-The chosen dataset

- Metro Interstate Traffic Volume Data Set

  Traffic volume is determined by observing the temperature, weather, if there is snow, clouds, or rain, and if there is a holiday or not. This data set uses anomaly detection, a method that makes use of AI to spot unusual activity in comparison to a pre-existing pattern. An anomaly is something that deviates from the accepted baseline pattern. The AI in Dynatrace automatically creates baselines, finds abnormalities, fixes underlying causes, and notifies users. Metro Interstate Traffic Volume Data Set is a multivariate, sequential, time-Serried type of data set. The characteristics of its 9 attributes are Integer and Real for the most part, but it also included date and time, as well as polynomial attributes The tasks associated with the data is Regression, for this reason, we chose regression algorithms for our regression problem

- Attribute Information

1. holiday Categorical US National holidays plus regional holiday, Minnesota State Fair
2. temp Numeric Average temp in kelvin
3. rain_1h Numeric Amount in mm of rain that occurred in the hour
4. snow_1h Numeric Amount in mm of snow that occurred in the hour
5. clouds_all Numeric Percentage of cloud cover
6. weather_main Categorical Short textual description of the current weather
7. weather_description Categorical Longer textual description of the current weather
8. date_time DateTime Hour of the data collected in local CST time
9. traffic_volume Numeric Hourly I-94 ATR 301 reported westbound traffic volume

- Sample of data set on Rapid Miner

Row No.	traffic_volu...	holiday	temp	rain_1h	snow_1h	clouds_all	weather_m...	weather_de...	date_time
1	5545	None	288.280	0	0	40	Clouds	scattered clo...	Feb 10, 2012 ...
2	4516	None	289.360	0	0	75	Clouds	broken clouds	Feb 10, 2012 ...
3	4767	None	289.580	0	0	90	Clouds	overcast clou...	Feb 10, 2012 ...
4	5026	None	290.130	0	0	90	Clouds	overcast clou...	Feb 10, 2012 ...
5	4918	None	291.140	0	0	75	Clouds	broken clouds	Feb 10, 2012 ...
6	5181	None	291.720	0	0	1	Clear	sky is clear	Feb 10, 2012 ...
7	5584	None	293.170	0	0	1	Clear	sky is clear	Feb 10, 2012 ...
8	6015	None	293.860	0	0	1	Clear	sky is clear	Feb 10, 2012 ...
9	5791	None	294.140	0	0	20	Clouds	few clouds	Feb 10, 2012 ...
10	4770	None	293.100	0	0	20	Clouds	few clouds	Feb 10, 2012 ...
11	3539	None	290.970	0	0	20	Clouds	few clouds	Feb 10, 2012 ...
12	2784	None	289.380	0	0	1	Clear	sky is clear	Feb 10, 2012 ...
13	2361	None	288.610	0	0	1	Clear	sky is clear	Feb 10, 2012 ...
14	1529	None	287.160	0	0	1	Clear	sky is clear	Feb 10, 2012 ...
15	963	None	285.450	0	0	1	Clear	sky is clear	Feb 10, 2012 ...
16	506	None	284.630	0	0	1	Clear	sky is clear	Mar 10, 2012 ...
17	321	None	283.470	0	0	1	Clear	sky is clear	Mar 10, 2012 ...
18	273	None	281.180	0	0	1	Clear	sky is clear	Mar 10, 2012 ...

4-The machine learning method

Regression is a method for determining how independent traits or variables relate to a dependent feature or result. It is a technique for machine learning predictive modeling, where an algorithm is utilized to estimate continuous outcomes. One of the most popular uses of machine learning models, particularly in supervised machine learning, is to solve regression issues. The link between an outcome or result of events occurring and independent factors is something that algorithms are designed to grasp. The model may then be used to forecast the results of fresh, unforeseen input data or to complete a data gap.

There are many error metrics that are commonly used for evaluating and reporting the performance of a regression model; they are:

- Correlation Coefficient
- Root Mean Squared Error (RMSE).
- Mean Absolute Error (MAE)
- Mean Squared Error (MSE).
- Mean Absolute error.
- Relative Absolute Error.

However, the most common ones are **Root Mean Squared Error**, and **Correlation**, which are the ones we will be using for comparison. The lower the Root mean squared error, the better the model is. The correlation coefficient ranges between 0 – 1, and the closer the correlation is to 1, the better the model. A correlation of 1 means 100% accuracy.

In this project we are going to use Two regression task suitable algorithms:

5- Linear Regression Algorithm:

An algorithm for machine learning based on supervised learning is linear regression. Given that it is one of the most extensively utilized regression analysis approaches, it is frequently employed for tasks and issues involving regression. Based on independent variables, regression models a goal prediction value. Finding the connection between variables and predicting is its main purpose. The linear regression procedure, often known as linear regression, illustrates a linear connection between one or more independent variables (y) and a dependent variable (y). As a result of displaying a linear connection, linear regression may be used to determine how the values of the dependent variable variable changes in proportion to the values of the independent variable.

- Result of the experiment

1- Split validation:

In Rapid Miner and In Weka "Look at the appendix "

Rapid Miner vs Weka

	Split validation	
	Rapid Miner	Weka
Split Ratio	70%	70%
Root Mean Squared Error	1968.796	1960.8132
Correlation Coefficient	0.146	0.1589
Mean Absolute Error	1717.258	1709.0488
Relative absolute error	215.70%	98.168 %

2- Split validation :

In Rapid Miner and In Weka "Look at the appendix "

Rapid Miner vs Weka

	Split validation	
	Rapid Miner	Weka
Split Ratio	80%	80%
Root Mean Squared Error	1972.306	1960.5496
Correlation Coefficient	0.142	0.1477
Mean Absolute Error	1717.684	1707.4839
Relative absolute error	187.75%	98.3212 %

1- Cross validation :

In Rapid Miner and In Weka "Look at the appendix "

Rapid Miner vs Weka

	Cross validation	
	Rapid Miner	Weka
FOLDS	10	10
Root Mean Squared Error	2945.127	
Correlation Coefficient	0.137	0.0076
Mean Absolute Error	1730.589	1730.2904
Relative absolute error	295.54%	99.1521 %

2- Cross validation :

In Rapid Miner and In Weka "Look at the appendix "

Rapid Miner vs Weka

	Cross validation	
	Rapid Miner	Weka
FOLDS	20	20
Root Mean Squared Error	2676.623	4143.6945
Correlation Coefficient	0.144	0.0076
Mean Absolute Error	1730.178	1730.3893
Relative absolute error	295.48%	99.1574 %

6-Multilayer Perceptron Algorithm (Neural Net):

A feed-forward artificial neural network that produces a set of outputs from a collection of inputs and it is a supervised learning algorithm called a multilayer perceptron (MLP), MLP is characterized by several layers of inputs, it consists of three types of layers, the input layer, output layer and hidden layer. MPL is a deep learning method and it trains the network through backpropagation. MPL was created to approximate any continuous function and can resolve issues that cannot be divided linearly. Pattern classification, recognition, prediction, and approximation are the main applications of MLP.

- Result of the experiment

1- Split validation :

In Rapid Miner and In Weka "Look at the appendix "

Rapid Miner vs Weka

	Split validation	
	Rapid Miner	Weka
Split Ratio	70%	70%
Root Mean Squared Error	1982.307	1966.8953
Correlation Coefficient	0.164	0.1415
Mean Absolute Error	1730.491	1719.0456
Relative absolute error	196.56%	98.7422 %

2- Split validation :

In Rapid Miner and In Weka "Look at the appendix "

Rapid Miner vs Weka

	Split validation	
	Rapid Miner	Weka
Split Ratio	80%	80%
Root Mean Squared Error	1972.886	2082.3326
Correlation Coefficient	0.156	0.129
Mean Absolute Error	1722.592	1756.4698
Relative absolute error	179.24%	101.1419 %

1- Cross validation :

In Rapid Miner and In Weka "Look at the appendix "

Rapid Miner vs Weka

	Cross validation	
	Rapid Miner	Weka
FOLDS	10	10
Root Mean Squared Error	2029.831	2108.8495
Correlation Coefficient	0.171	0.0464
Mean Absolute Error	1750.541	1805.6282
Relative absolute error	287.83%	103.4693 %

2- Cross validation :

In Rapid Miner and In Weka "Look at the appendix "

Rapid Miner vs Weka

	Cross validation	
	Rapid Miner	Weka
FOLDS	20	20
Root Mean Squared Error	2007.699	2156.026
Correlation Coefficient	0.167	0.0369
Mean Absolute Error	1734.916	1827.4707
Relative absolute error	290.46%	104.7205 %

7-Conclusion

For Linear Regression					
		Split validation 70%	Split validation 80%	Cross validation 10 folds	Cross validation 20 folds
Rapid Miner	Root Mean Squared Error	1968.796	1972.306	2945.127	2676.623
Weka	Root Mean Squared Error	1960.8132	1960.54	4161.0686	4143.6945

As the previous result for the linear regression algorithm, we approved a difference between each program in predicting the target. In Spilt validation, the Root mean squared error values are better in Weka than in RapidMiner. However, in Cross validation, we noticed that RapidMiner was better than Weka in Root mean square error.

For Multilayer Perceptron					
		Split validation 70%	Split validation 80%	Cross validation 10 folds	Cross validation 20 folds
Rapid Miner	Root Mean Squared Error	1982.307	1972.886	2029.831	2007.699
Weka	Root Mean Squared Error	1966.8953	2082.3326	2108.8495	2156.026

As the previous result for the Multilayer Perceptron Algorithm (Neural Net) we approved a difference between eachprogram in predicting the target. In Split validation and the Root mean squared error we noticed both values were better in RapidMiner than Weka

In conclusion, Linear regression seems to perform better in split validation than Multilayer perception on both RapidMiner and Weka. On the contrary, Multilayer perceptron performs better in cross validation than linear regression did on all programs. However, the root mean squared error in cross validation in Weka for linear regression spiked to the worst case, so we will only be looking at the good side, (split validation). Linear regression has noticeably performed better in split validation, in comparison to multilayer perceptron's best-case performance in any of the validation methods and programs. For this reason, we have considered linear regression to be the better algorithm in performance.

8-References

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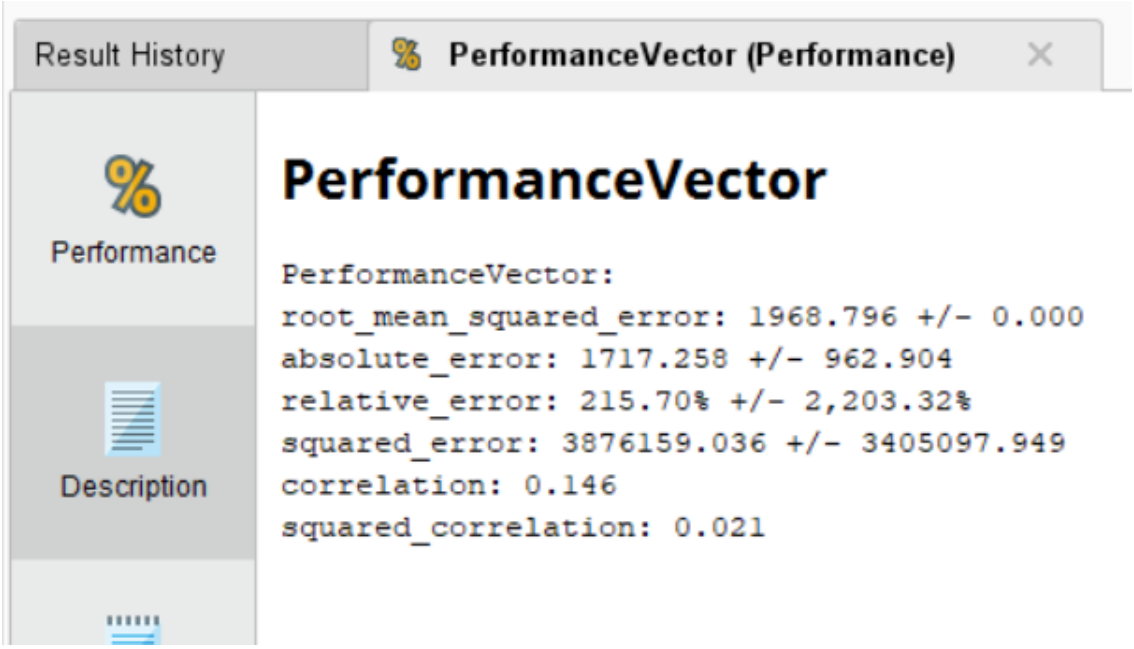
9-Appendix

• Linear Regression

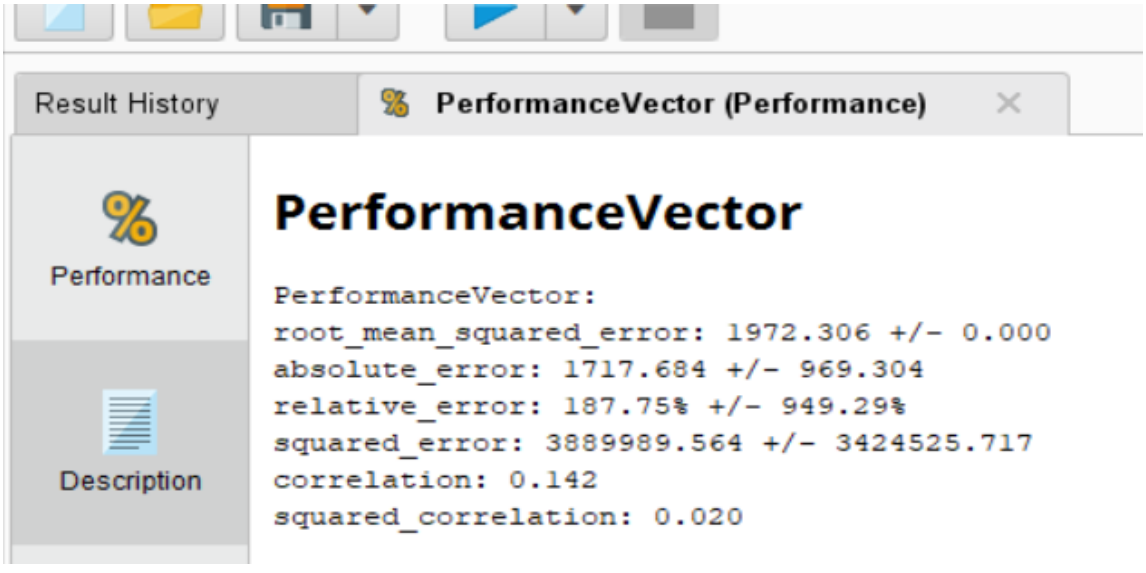
1- Split validation for **Linear Regression**:

In Rapid Miner With split ratio 0.7



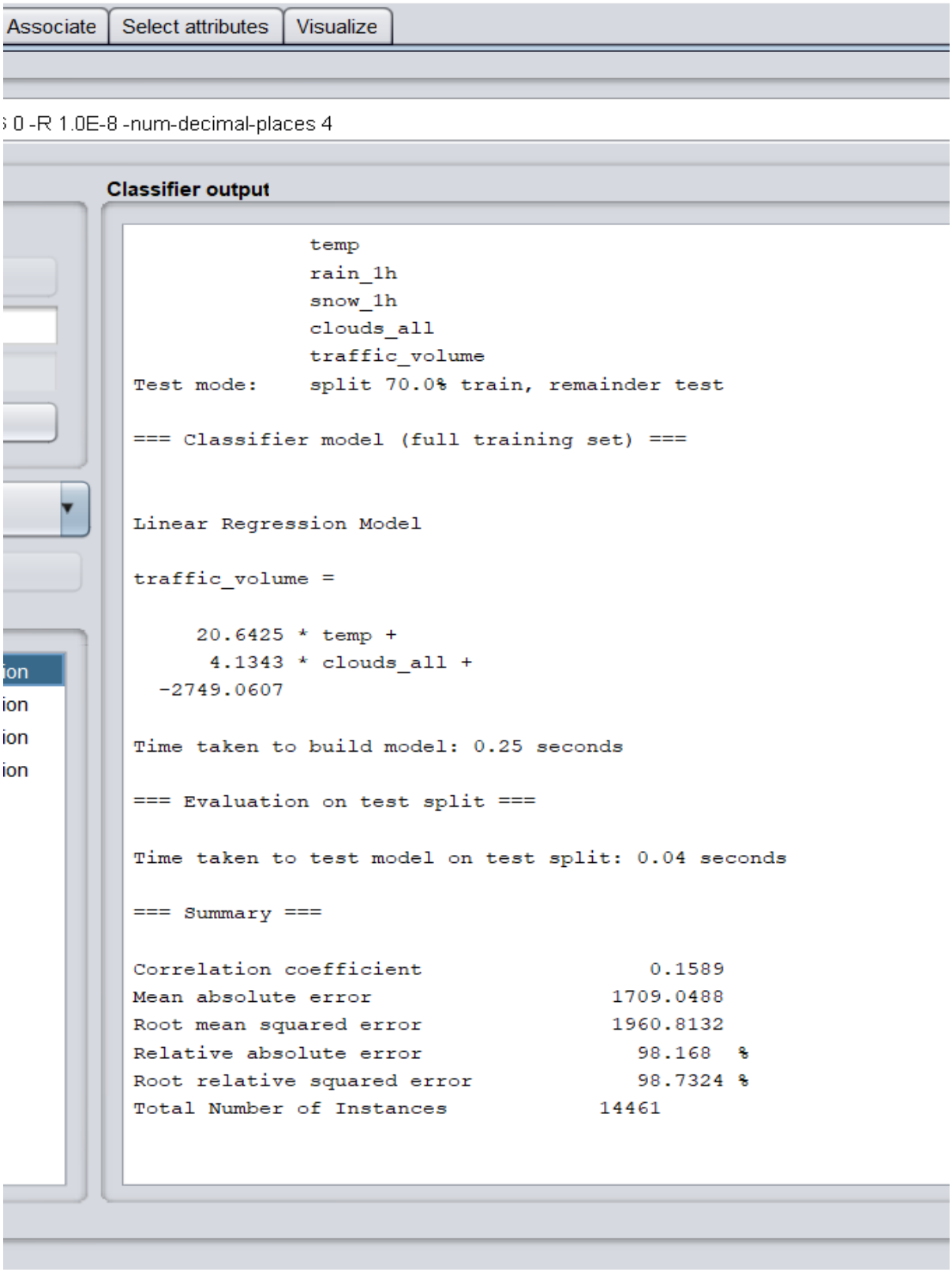
1- Split validation for **Linear Regression**:

In Rapid Miner With split ratio 0.8



2- Split validation for **Linear Regression**:

In weka With split ratio 0.7



2- Split validation for **Linear Regression**:

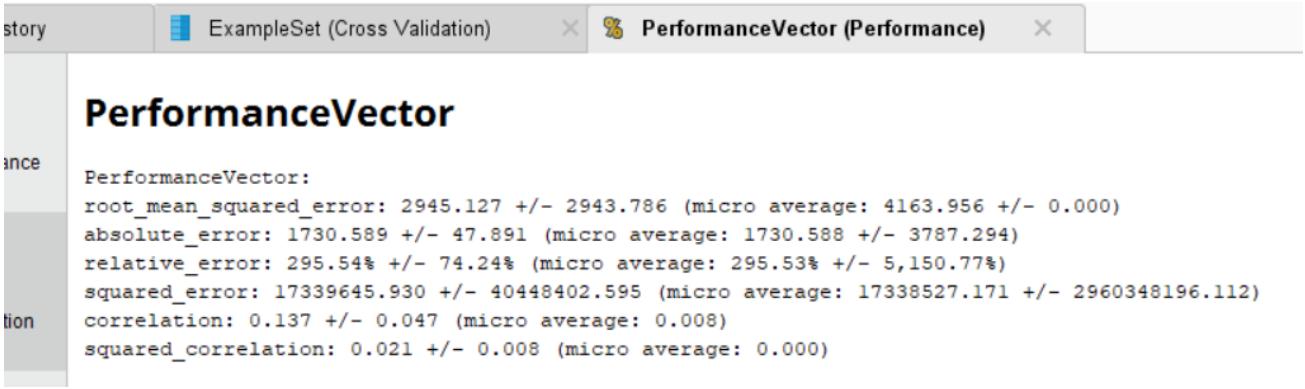
In weka With split ratio 0.8

Classifier output

```
               temp
               rain_1h
               snow_1h
               clouds_all
               traffic_volume
Test mode:     split 80.0% train, remainder test

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


Linear Regression Model

traffic_volume =

     20.6425 * temp +
      4.1343 * clouds_all +
  -2749.0607

Time taken to build model: 0.13 seconds

=== Evaluation on test split ===

Time taken to test model on test split: 0.01 seconds

=== Summary ===

Correlation coefficient                  0.1477
Mean absolute error                   1707.4839
Root mean squared error               1960.5496
Relative absolute error                 98.3212 %
Root relative squared error             98.9048 %
Total Number of Instances             9641
```

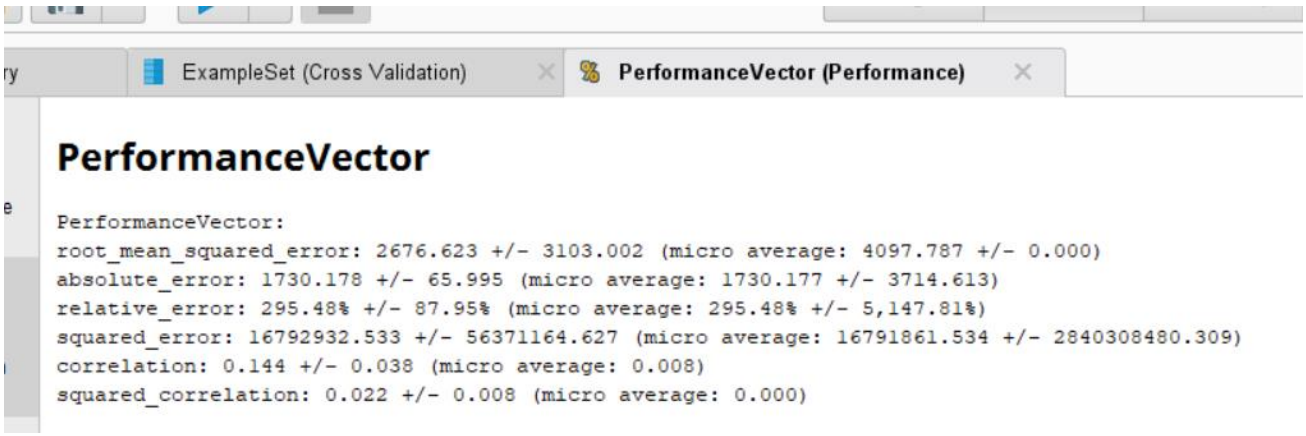
1- Cross validation for **Linear Regression**:

In Rapid Miner With 10 Folds



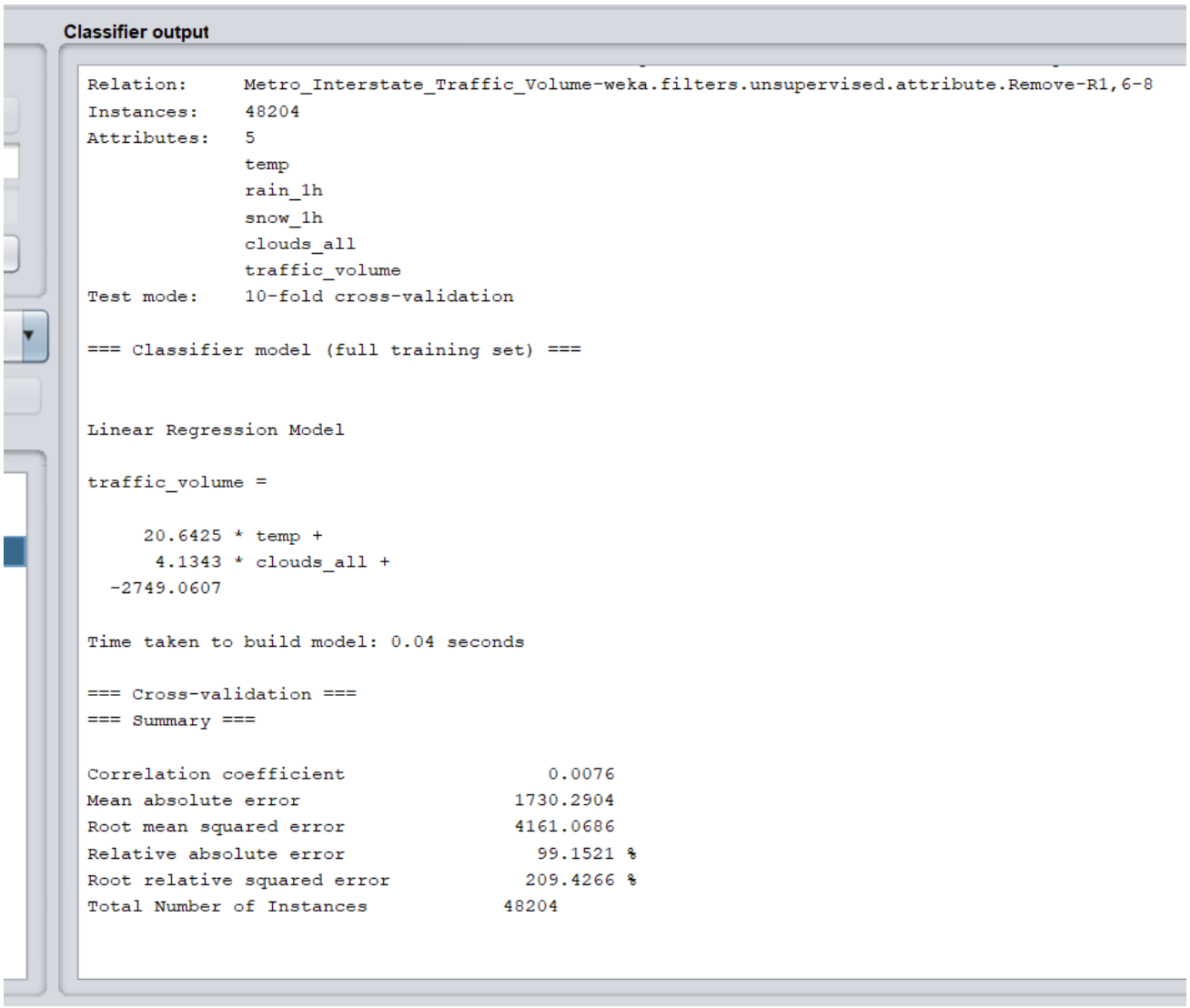
1- Cross validation for **Linear Regression:**

In Rapid Miner With 20 Folds



2- Cross validation for **Linear Regression:**

In Weka With 10 Folds



2- Cross validation for **Linear Regression:**

In Weka With 20 Folds

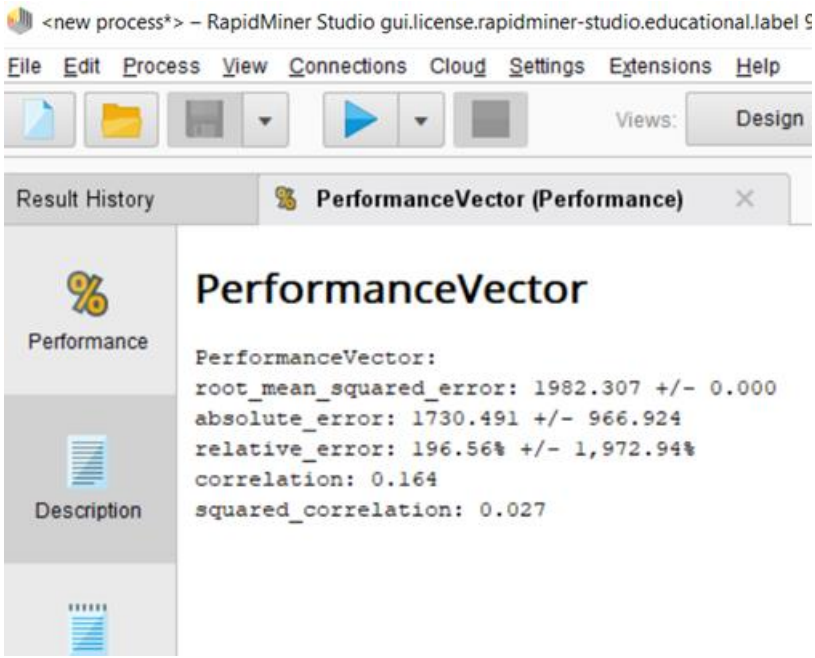
Classifier output

```
Relation:     Metro_Interstate_Traffic_Volume-weka.filters.unsupervised.attribute.Remove-R1,6-8
Instances:    48204
Attributes:   5
              temp
              rain_1h
              snow_1h
              clouds_all
              traffic_volume
Test mode:    20-fold cross-validation

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


Linear Regression Model

traffic_volume =

     20.6425 * temp +
      4.1343 * clouds_all +
  -2749.0607

Time taken to build model: 0.06 seconds

=== Cross-validation ===
=== Summary ===

Correlation coefficient                  0.0076
Mean absolute error                   1730.3893
Root mean squared error               4143.6945
Relative absolute error                 99.1574 %
Root relative squared error            208.552  %
Total Number of Instances            48204
```

- **Multilayer Perceptron**

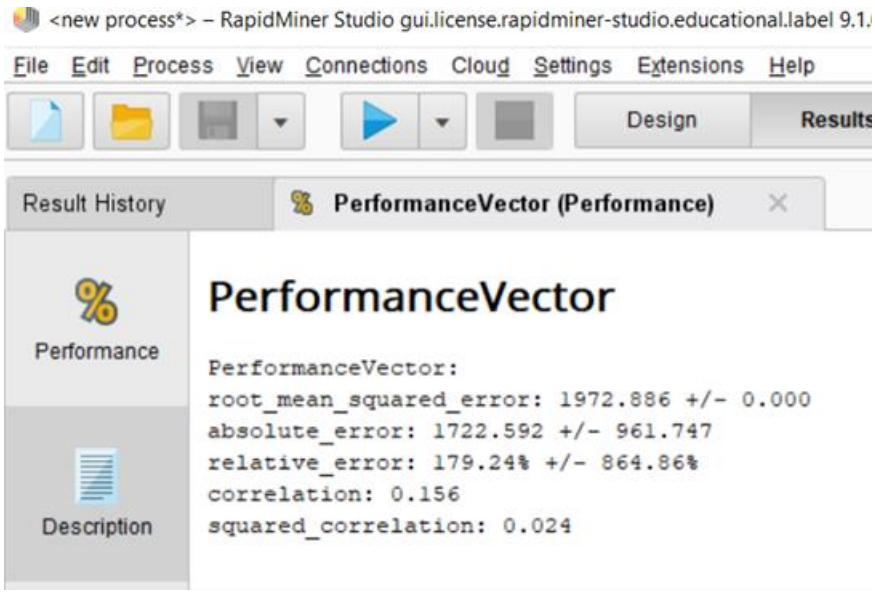
1- Split validation for **Multilayer Perceptron:**

In RapidMiner With 0.7 split



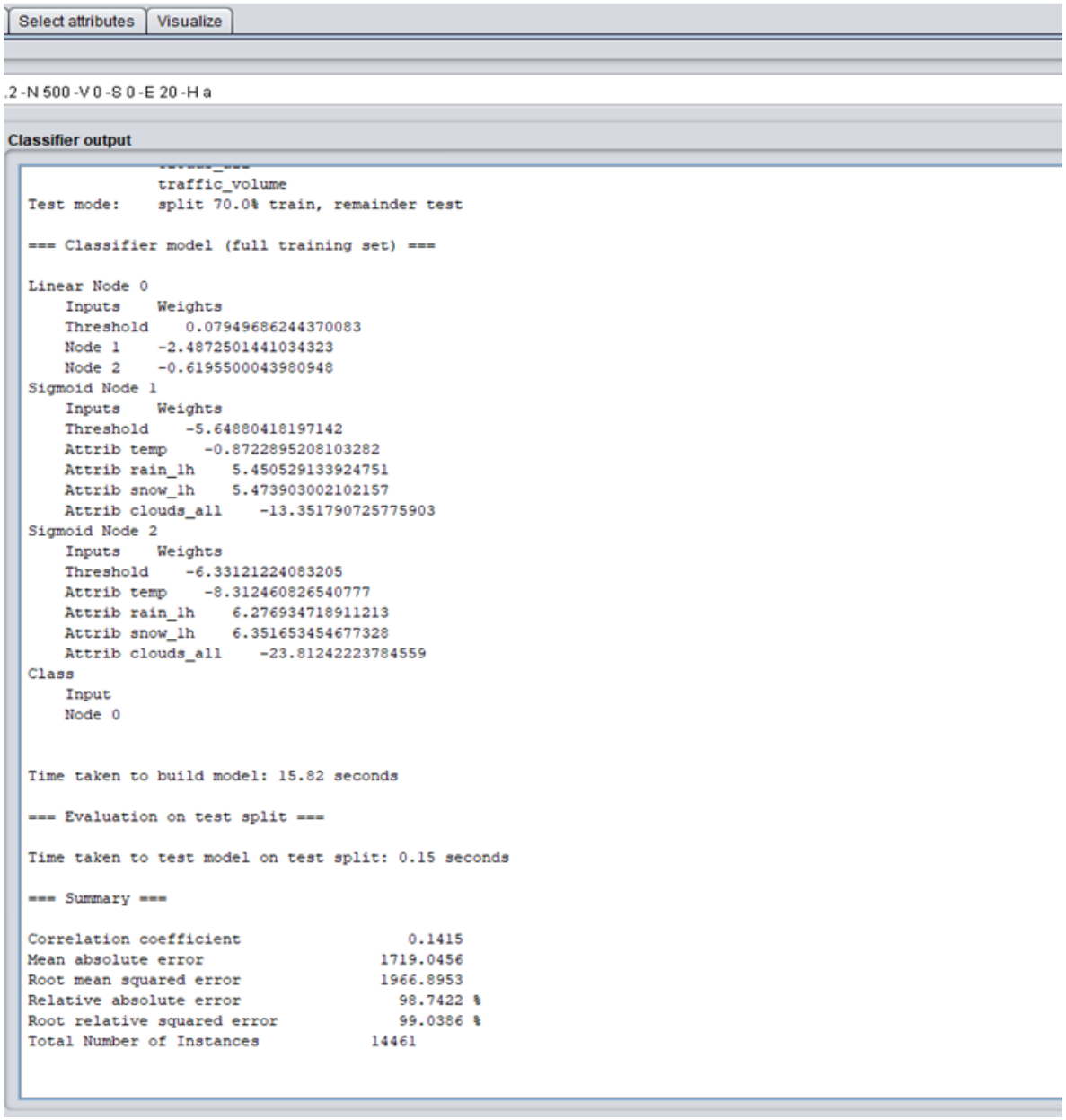
1- Split validation for **Multilayer Perceptron:**

In RapidMiner With 0.8 split



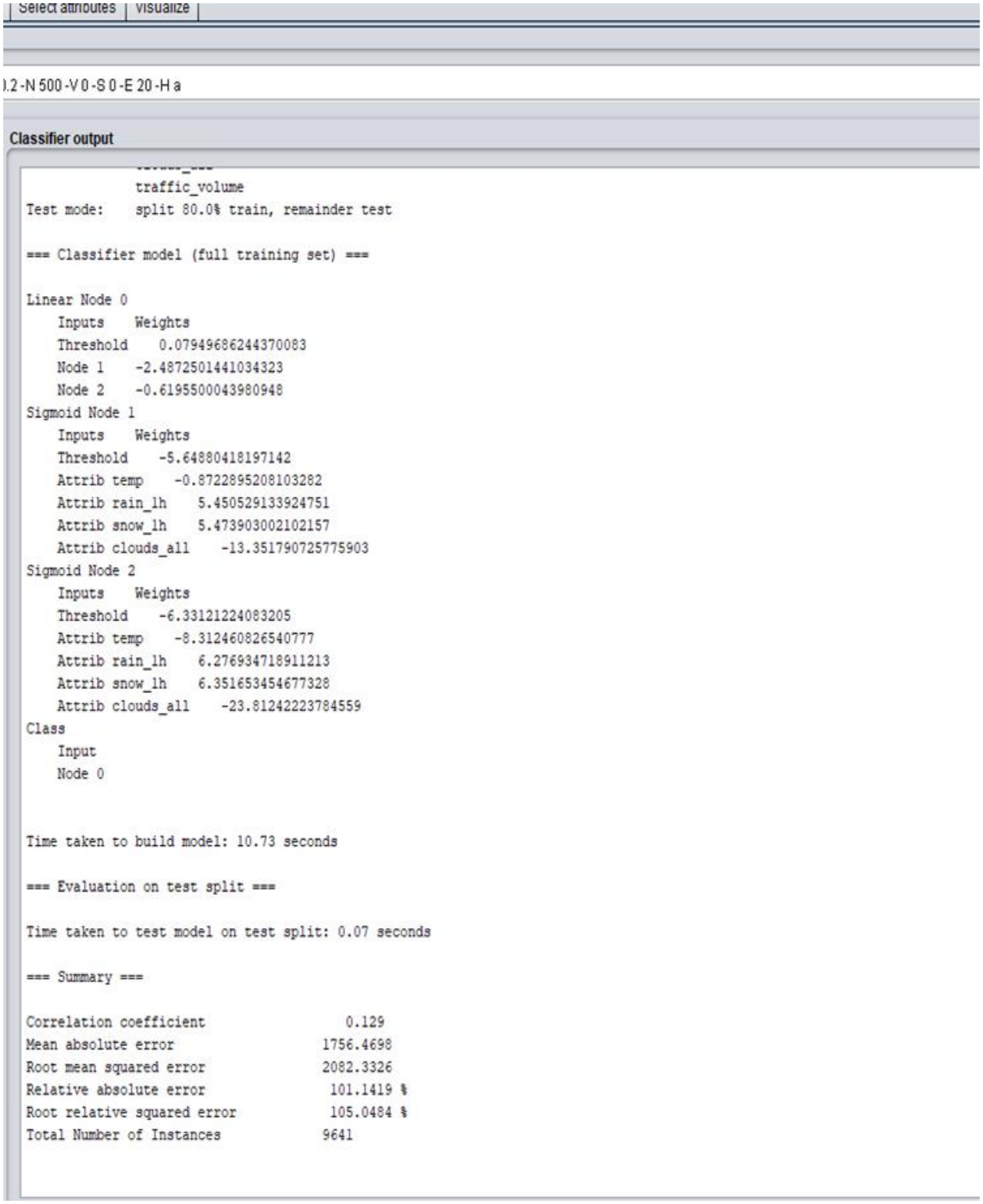
2- Split validation for **Multilayer Perceptron:**

In Weka With 0.7 split



2- Split validation for **Multilayer Perceptron:**

In Weka With 0.8 split



Select attributes | Visualize

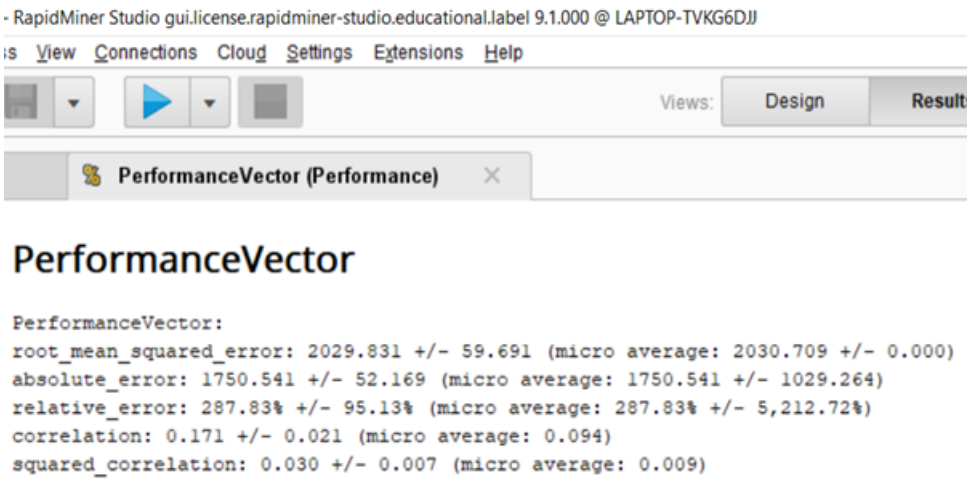
).2 -N 500 -V 0 -S 0 -E 20 -H a

Classifier output

```
              traffic_volume
Test mode:    split 80.0% train, remainder test

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

Linear Node 0
    Inputs    Weights
    Threshold    0.07949686244370083
    Node 1    -2.4872501441034323
    Node 2    -0.6195500043980948
Sigmoid Node 1
    Inputs    Weights
    Threshold    -5.64880418197142
    Attrib temp    -0.8722895208103282
    Attrib rain_1h    5.450529133924751
    Attrib snow_1h    5.473903002102157
    Attrib clouds_all    -13.351790725775903
Sigmoid Node 2
    Inputs    Weights
    Threshold    -6.33121224083205
    Attrib temp    -8.312460826540777
    Attrib rain_1h    6.276934718911213
    Attrib snow_1h    6.351653454677328
    Attrib clouds_all    -23.81242223784559
Class
    Input
    Node 0


Time taken to build model: 10.73 seconds

=== Evaluation on test split ===

Time taken to test model on test split: 0.07 seconds

=== Summary ===

Correlation coefficient                  0.129
Mean absolute error                1756.4698
Root mean squared error            2082.3326
Relative absolute error             101.1419 %
Root relative squared error         105.0484 %
Total Number of Instances           9641
```

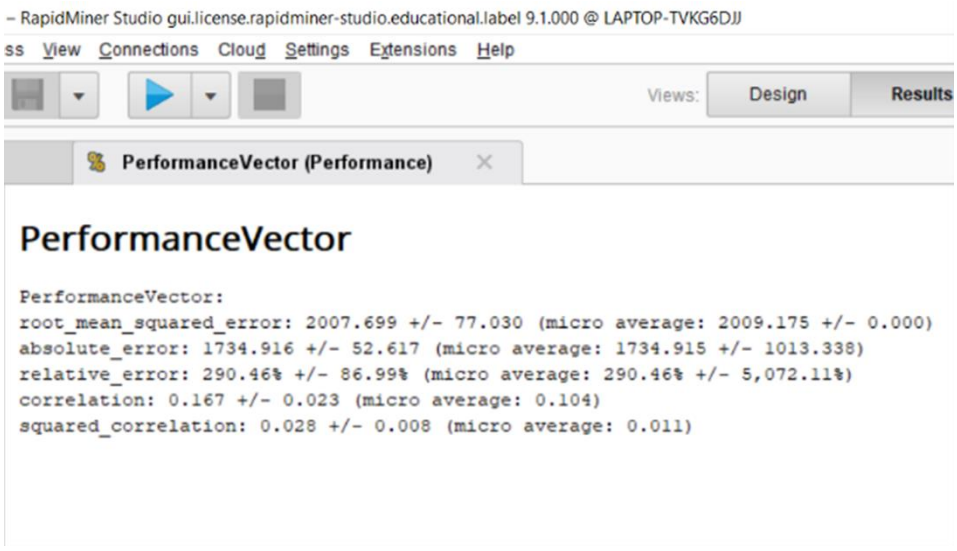
1- Cross validation for **Multilayer Perceptron:**

In RapidMiner With 10 Folds



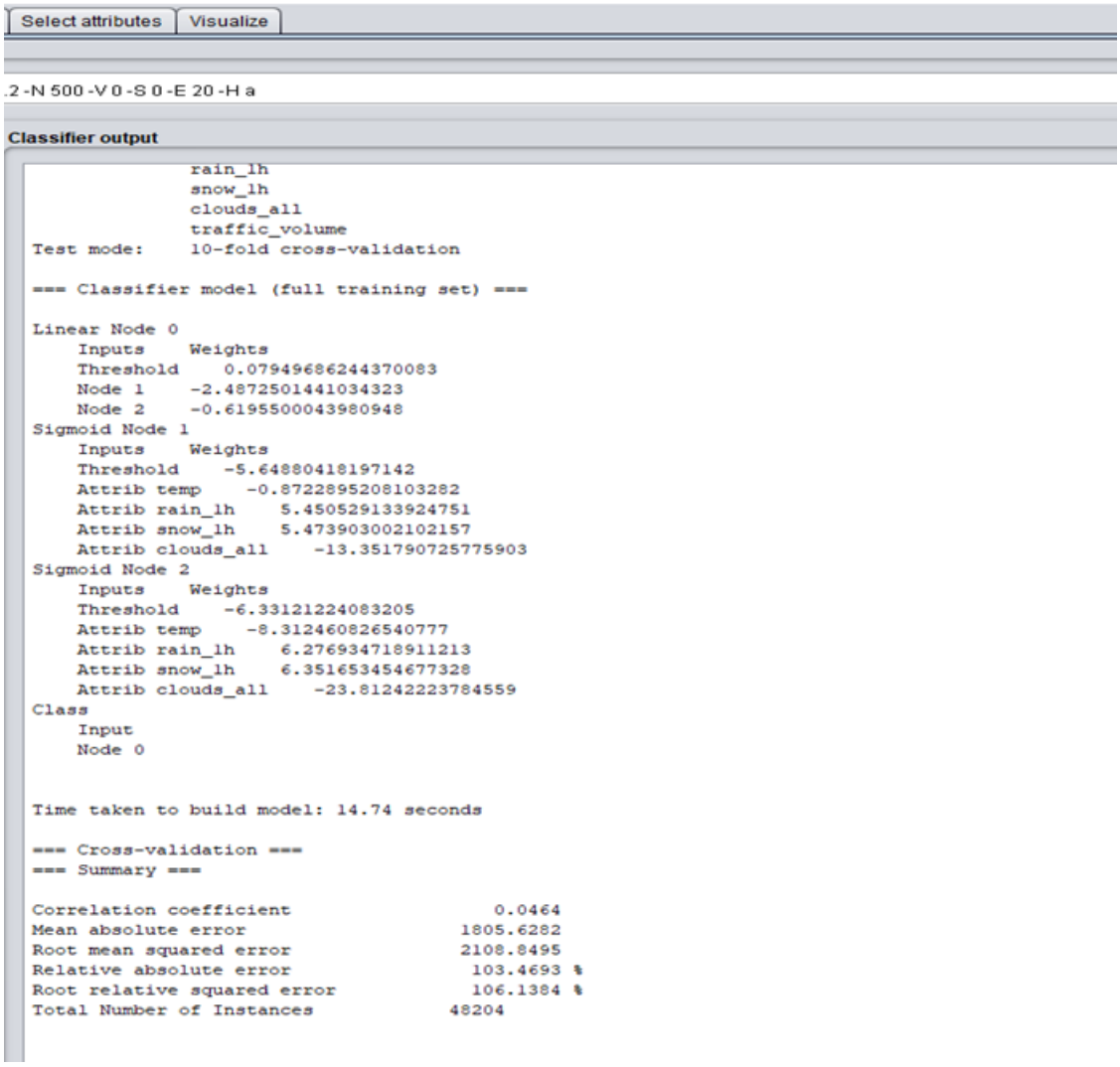
1- Cross validation for **Multilayer Perceptron:**

In RapidMiner With 20 Folds



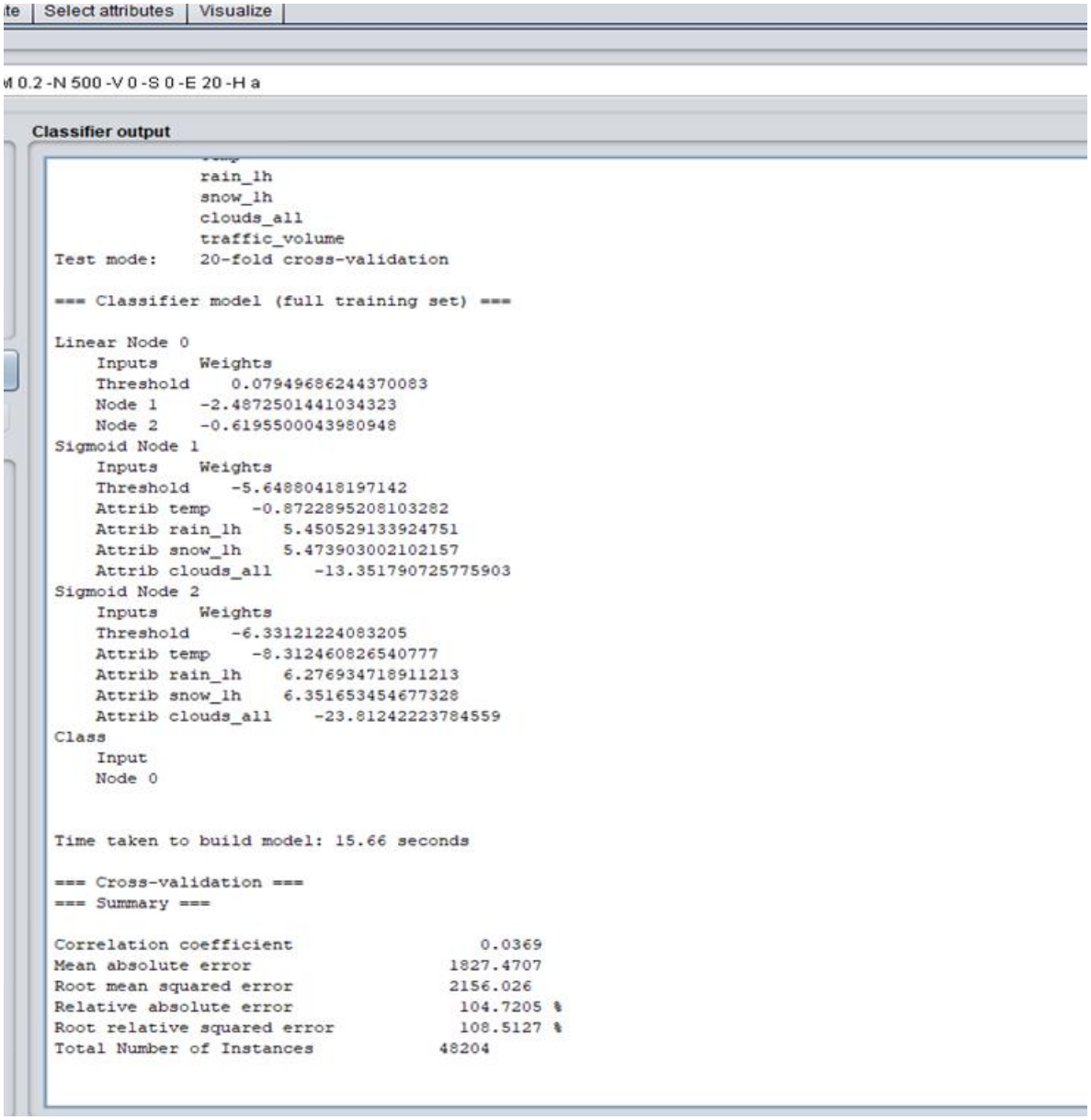
2-Cross validation for **Multilayer Perceptron:**

In Weka With 10 Folds



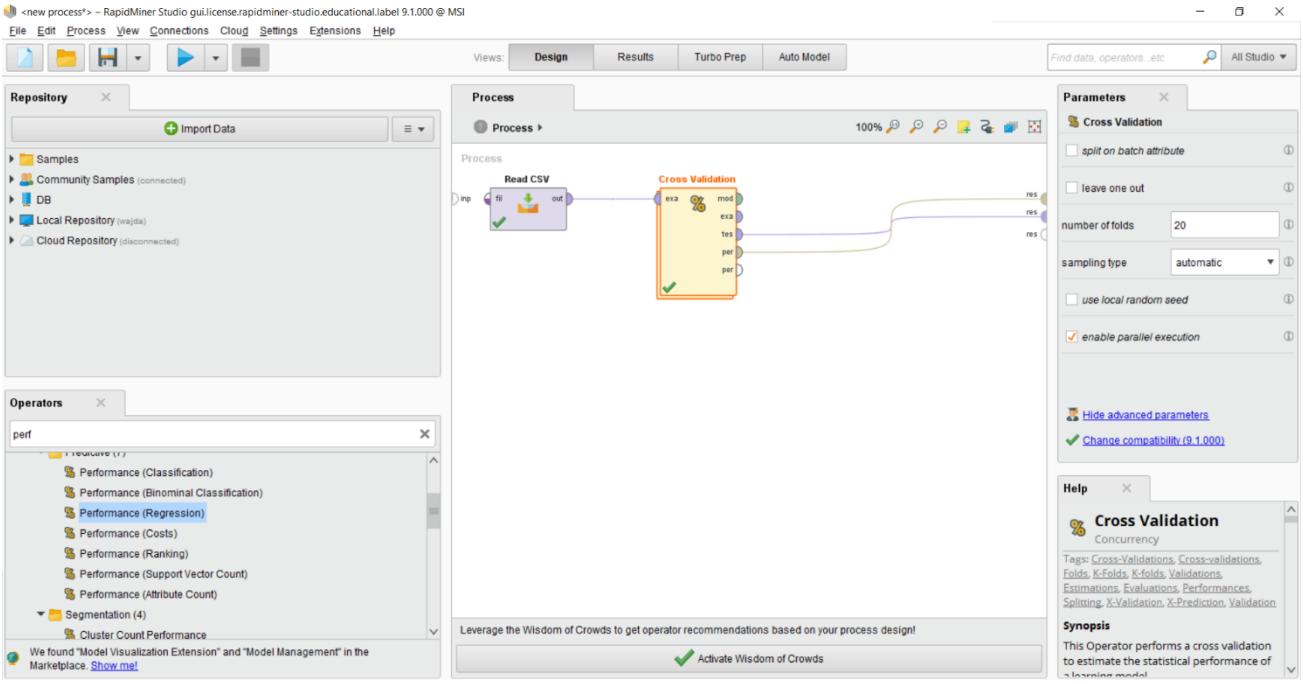
2- Cross validation for **Multilayer Perceptron:**

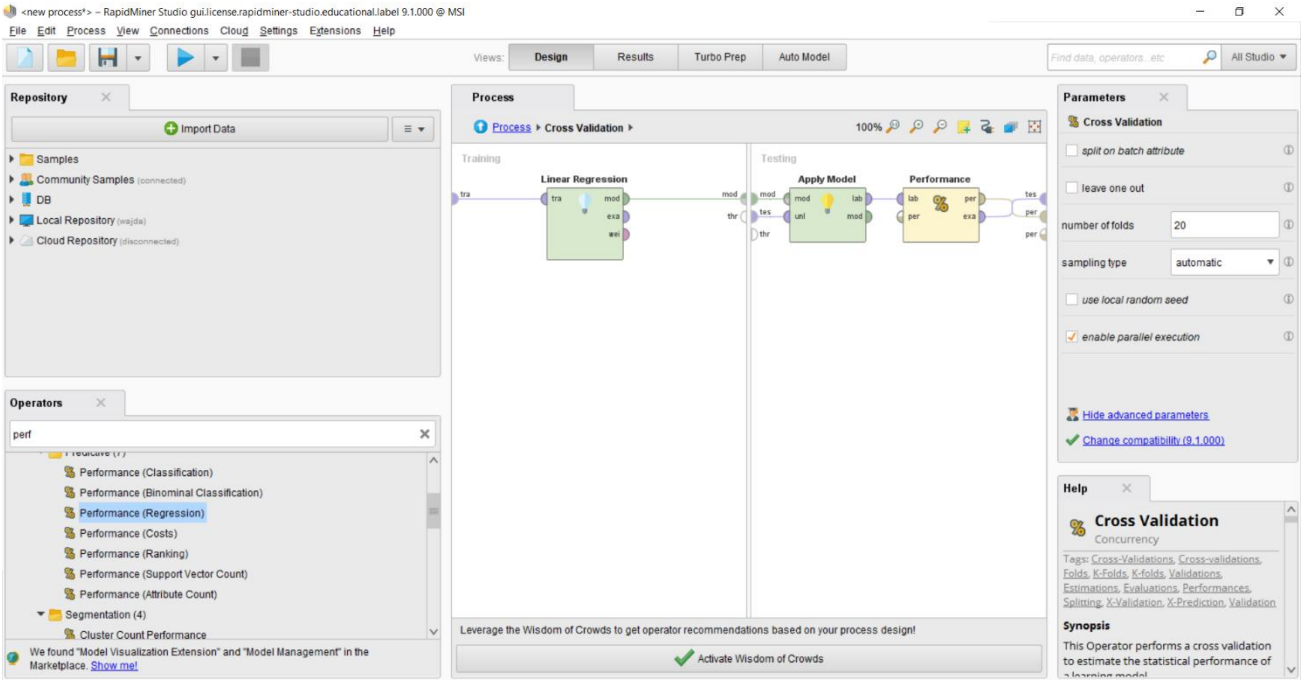
In Weka With 20 Folds



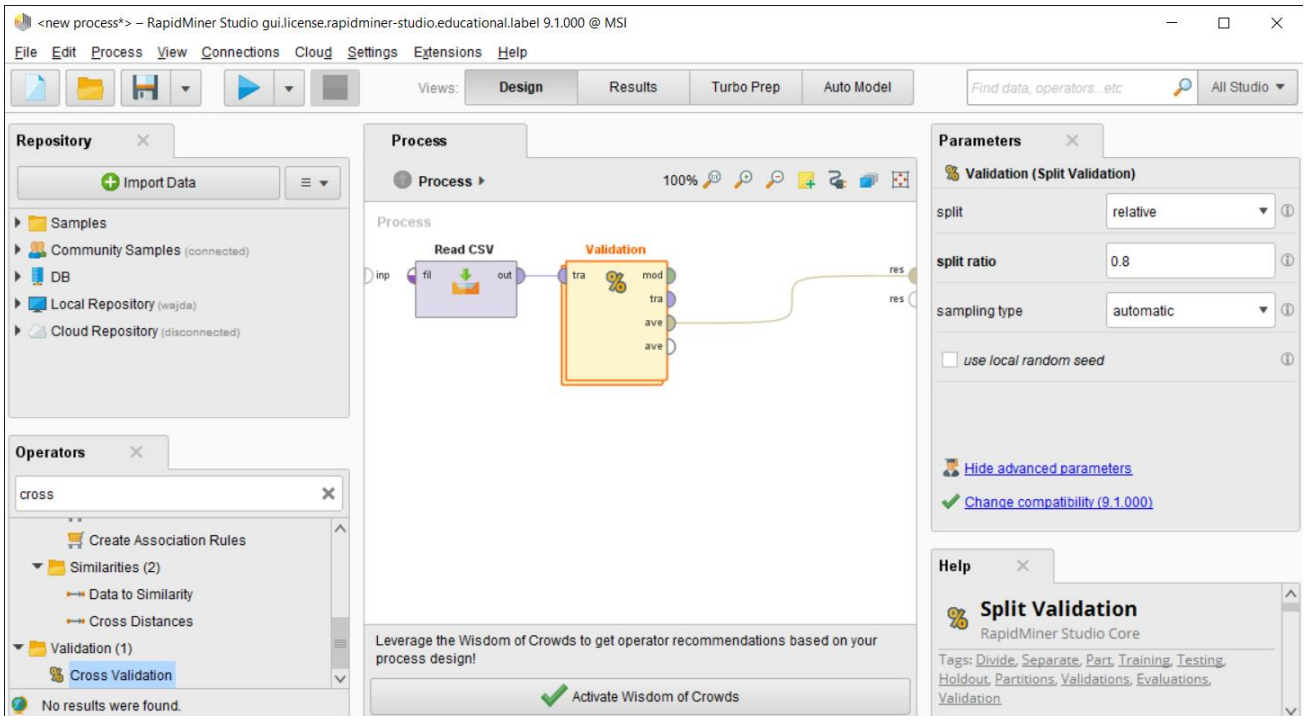
- **Designs and Steps**

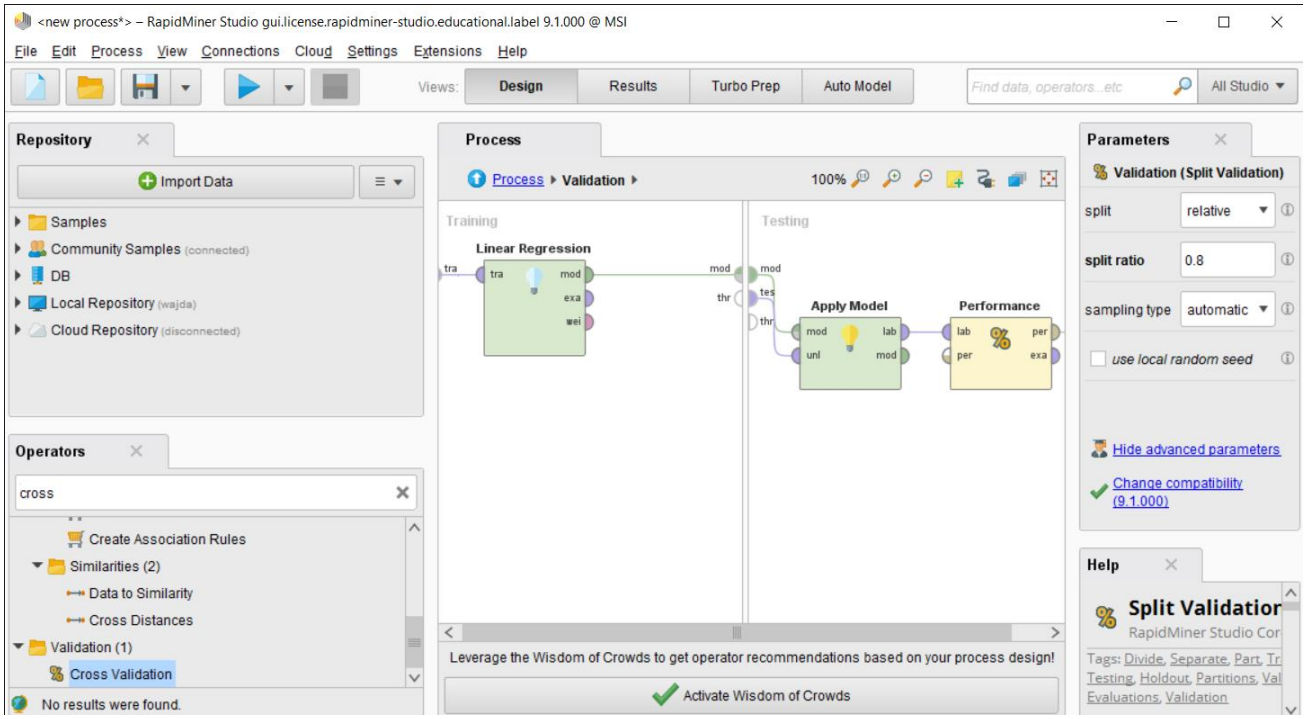
Cross Validation RapidMiner Design with regression performance:





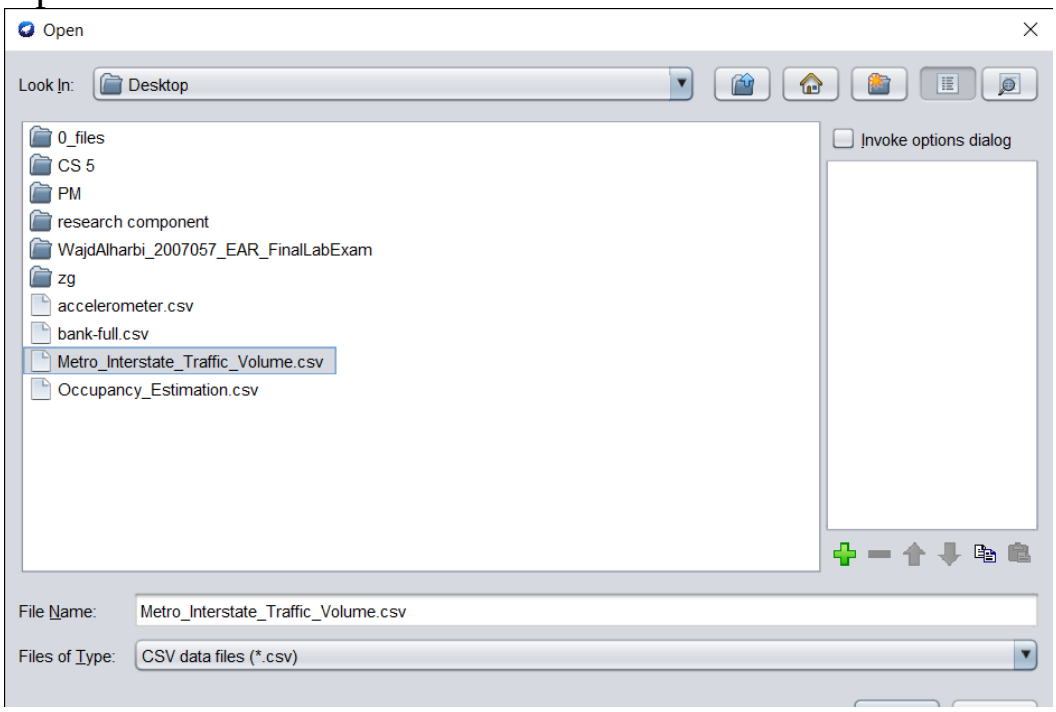
Split validation RapidMiner Design with regression performance:



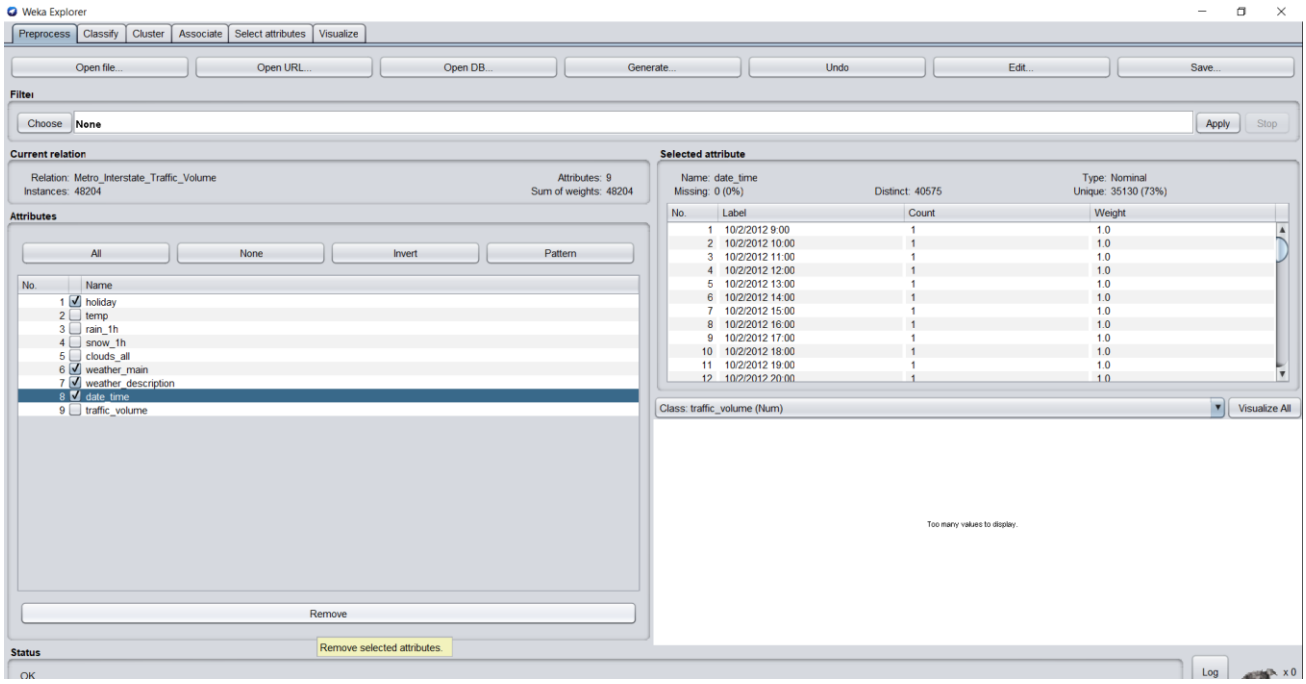


Weka Steps:

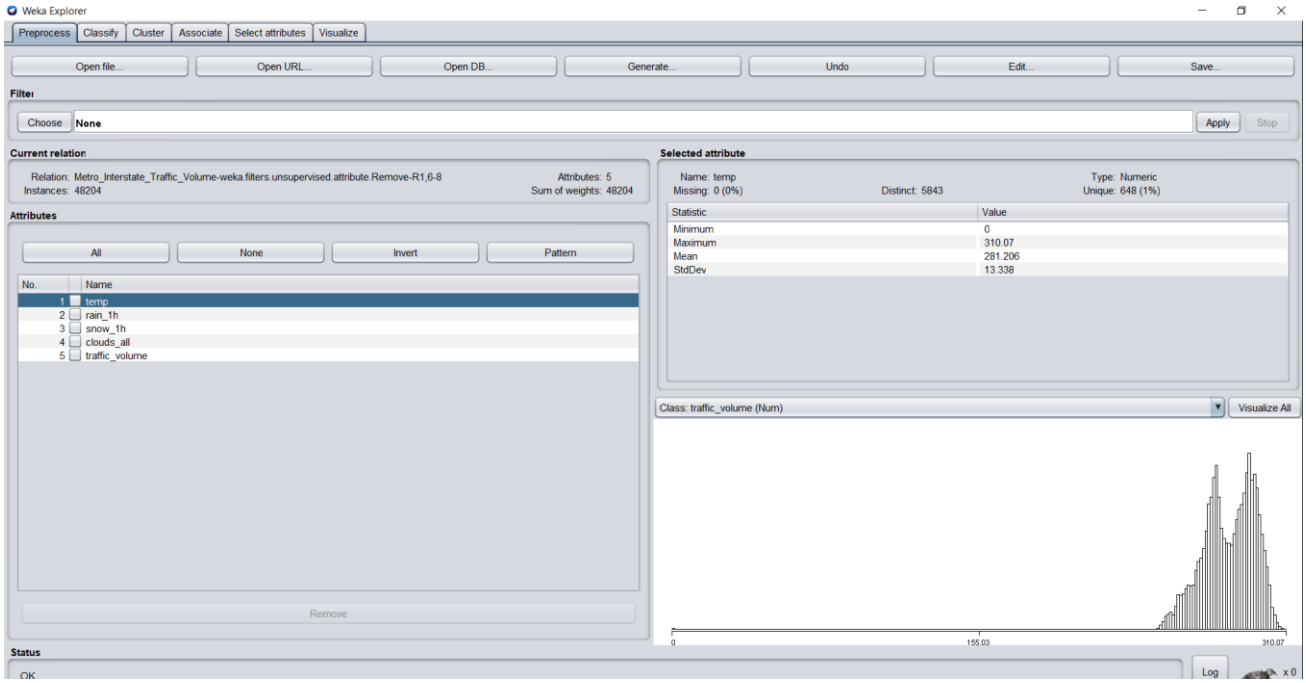
Open file



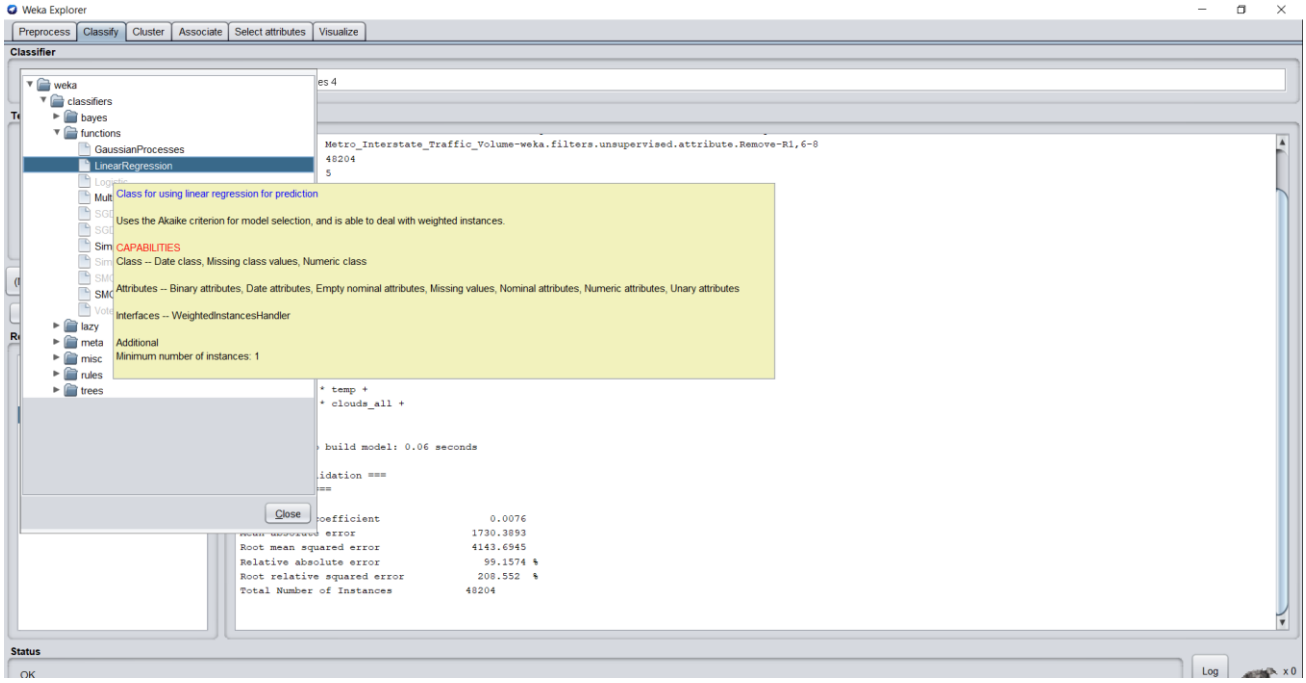
Remove Unwanted Attributes:



Attributes are removed:



Pick Algorithm (here I chose linear regression):



Pick Label (I Chose traffic volume):