



American International University-Bangladesh

Data Warehousing and Data Mining

Section: A

Supervised Learning

Project Title : Teaching Assistant Evaluation

Submitted By,

Name : Mahmudur Rahman Pranto

ID: 16-32548-2

Submitted To,

Course Teacher : A.G.M. Zaman

Department of Computer Science

American International University-Bangladesh

Teaching Assistant Evaluation Data Set:

The data set consist of evaluations of teaching performance with class attributes "1=low", "2=medium", or "3=high". The main purpose of this project is to categorize the teaching performance with these class attributes.

Data Set Information:

The data consist of evaluations of teaching performance over three regular semesters and two summer semesters of 151 teaching assistant (TA) assignments at the Statistics Department of the University of Wisconsin-Madison. The scores were divided into 3 roughly equal-sized categories ("low", "medium", and "high") to form the class variable.

Attribute Information:

Whether or not the TA is a native English speaker (binary);

- 1=English speaker, 2=non-English speaker
2. Course instructor (categorical, 25 categories)
3. Course (categorical, 26 categories)
4. Summer or regular semester (binary) 1=Summer, 2=Regular
5. Class size (numerical)
6. Class attribute (categorical) 1=Low, 2=Medium, 3=High

Solution:

For the solution, 5 classifiers have been used. They are:

- 1) Naive Bayes
- 2) IBk (Nearest Neighbor)
- 3) KStar
- 4) Random tree
- 5) ZeroR

1. Naïve Bayes

The screenshot shows the Weka Explorer interface with the Naïve Bayes classifier selected. The 'Classifier output' pane displays the following results:

```
precision      1      1      1

Class size
mean           28.2154  25.616  29.3714
std. dev.      13.3967  11.7335  12.9042
weight sum     52      50      49
precision      1.4      1.4      1.4

Class attribute
mean           3         2         1
std. dev.      0.1667  0.1667  0.1667
weight sum     52      50      49
precision      1         1         1

Time taken to build model: 0 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances      151          100 %
Incorrectly Classified Instances      0           0 %
Mappa statistic                     1
Mean absolute error                  0.0022
Root mean squared error              0.0081
Relative absolute error              0.4967 %
Root relative squared error          1.7134 %
Total Number of Instances           151

=== Detailed Accuracy By Class ===

      TP Rate  FP Rate  Precision  Recall  F-Measure  MCC  ROC Area  FRC Area  Class
1.000  0.000  1.000  1.000  1.000  1.000  1.000  1.000  high
1.000  0.000  1.000  1.000  1.000  1.000  1.000  1.000  medium
1.000  0.000  1.000  1.000  1.000  1.000  1.000  1.000  low
Weighted Avg.  1.000  0.000  1.000  1.000  1.000  1.000  1.000  1.000

=== Confusion Matrix ===
 a b c <-- classified as
52 0 0 | a = high
0 50 0 | b = medium
0 0 49 | c = low
```

=== Summary ===

Correctly Classified Instances 151 100 %

Incorrectly Classified Instances 0 0 %

True Positive Rate = 1.000

False Positive Rate = 0.000

=== Confusion Matrix ===

a b c <-- classified as

52 0 0 | a = high

0 50 0 | b = medium

0 0 49 | c = low

Now considering 'a', 'b' as our positive interest and 'c' as our negative interest,

2/2 confusion matrix

+ -
+ 102 0
- 0 49

2. IBK (K-Nearest Neighbor)

The screenshot shows the Weka Explorer interface with the IBK classifier selected. The 'Test options' tab is active, showing 'Cross-validation' with 'Folds' set to 10. The 'Classifier output' pane displays the following results:

```
Attributes: 7
English Speaker
Course Instructor
Course
semester
Class size
Class attribute
Score
Test mode: 10-fold cross-validation

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

IBK instance-based classifier
using 1 nearest neighbour(s) for classification

Time taken to build model: 0 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances      148          98.0132 %
Incorrectly Classified Instances     3           1.9868 %
Kappa statistic                    0.9702
Mean absolute error                 0.0214
Root mean squared error             0.1144
Relative absolute error             4.8536 %
Root relative squared error        24.2726 %
Total Number of Instances         151

=== Detailed Accuracy By Class ===
+-----+-----+-----+-----+-----+-----+-----+-----+
TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
+-----+-----+-----+-----+-----+-----+-----+-----+
0.942    0.010    0.980     0.942    0.971     0.956    0.975    0.961    high
0.980    0.020    0.961     0.980    0.970     0.955    0.976    0.952    medium
1.000    0.000    1.000     1.000    1.000     1.000    1.000    1.000    low
Weighted Avg.  0.980    0.010    0.980     0.980    0.980    0.970    0.983    0.971

=== Confusion Matrix ===
a b c <-- classified as
50 2 0 | a = high
1 49 0 | b = medium
0 0 49 | c = low
```

=== Summary ===

Correctly Classified Instances 148 98.0132 %

Incorrectly Classified Instances 3 1.9868 %

True Positive Rate = 0.980

False Positive Rate = 0.010

=== Confusion Matrix ===

a b c <-- classified as

50 2 0 | a = high

1 49 0 | b = medium

0 0 49 | c = low

Now considering 'a', 'b' as our positive interest and 'c' as our negative interest,

2/2 confusion matrix

+ -
+ 104 0
- 0 49

3. KStar

The screenshot shows the Weka Explorer interface with the KStar classifier selected. The 'Test options' panel on the left shows 'Cross-validation' with 'Folds' set to 10. The 'Classifier output' panel on the right displays the following text:

```
Course Instructor
Course
semester
Class size
Class attribute
Score
Test mode: 10-fold cross-validation
=== Classifier model (full training set) ===
KStar Beta Version (0.1b).
Copyright (c) 1995-97 by Ian Trigg (trigg@cs.waikato.ac.nz).
Java port to Weka by Abdelaziz Mehoui (amei@cs.waikato.ac.nz).
KStar options : -B 20 -M a
Time taken to build model: 0 seconds
=== Stratified cross-validation ===
=== Summary ===
Correctly Classified Instances      128      84.7602 %
Incorrectly Classified Instances     23      15.2398 %
Kappa statistic                    0.7714
Mean absolute error                 0.1214
Root mean squared error             0.2529
Relative absolute error             27.3195 %
Root relative squared error        53.6385 %
Total Number of Instances          151

=== Detailed Accuracy By Class ===
      TP Rate  FP Rate  Precision  Recall  F-Measure  MCC  ROC Area  PRC Area  Class
      0.855    0.071    0.820    0.835    0.826    0.810    0.978    0.966    high
      0.780    0.099    0.794    0.780    0.788    0.685    0.953    0.925    medium
      0.878    0.059    0.878    0.878    0.878    0.819    0.977    0.958    low
Weighted Avg.   0.848    0.076    0.847    0.848    0.847    0.771    0.969    0.950

=== Confusion Matrix ===
 a b c <-- classified as
46 6 0 | a = high
 5 39 6 | b = medium
 2 4 43 | c = low
```

The 'Result list' on the left shows the following entries:

- 14:06:10 - bayes.NaiveBayes
- 16:29:16 - lazy.IBK
- 16:30:56 - lazy.KStar
- 17:18:12 - trees.RandomTree
- 18:17:33 - rules.ZeroR

The 'Status' bar at the bottom shows 'OK'.

Correctly Classified Instances 128 84.7682 %

Incorrectly Classified Instances 23 15.2318 %

True Positive Rate = 0.848

False Positive Rate = 0.076

=== Confusion Matrix ===

a b c <-- classified as

46 6 0 | a = high

5 39 6 | b = medium

2 4 43 | c = low

Now considering 'a', 'b' as our positive interest and 'c' as our negative interest,

2/2 confusion matrix

+ -

+ 96 6

- 6 43

4. Random Tree

The screenshot shows the Weka Explorer interface with the Random Tree classifier selected. The 'Classify' tab is active, and the 'Test options' are set to 'Cross-validation Folds 10'. The 'Result list' on the left shows the '17:16:12 - weka.RandomTree' model selected. The 'Classifier output' pane displays the following information:

```
Size of the tree : 19
Time taken to build model: 0 seconds

=== Stratified cross-validation ===
=== Summary ===
Correctly Classified Instances      149      98.6755 %
Incorrectly Classified Instances      2      1.3245 %
Kappa statistic                    0.9801
Mean absolute error                 0.0089
Root mean squared error             0.094
Relative absolute error             1.987 %
Root relative squared error        19.9334 %
Total Number of Instances         151

=== Detailed Accuracy By Class ===

```

	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	FRC Area	Class
	1.000	0.010	0.981	1.000	0.990	0.986	0.995	0.981	high
	0.980	0.010	0.980	0.980	0.980	0.970	0.985	0.967	medium
	0.980	0.000	1.000	0.960	0.980	0.965	0.990	0.966	low
Weighted Avg.	0.987	0.007	0.987	0.987	0.987	0.980	0.990	0.978	

```

=== Confusion Matrix ===
 a b c <-- classified as
52 0 0 | a = high
1 49 0 | b = medium
0 1 48 | c = low

```

Correctly Classified Instances 149 98.6755 %

Incorrectly Classified Instances 2 1.3245 %

True Positive Rate = 0.987

False Positive Rate = 0.007

=== Confusion Matrix ===

a b c <-- classified as

52 0 0 | a = high

1 49 0 | b = medium

0 1 48 | c = low

Now considering 'a', 'b' as our positive interest and 'c' as our negative interest,

2/2 confusion matrix

+ -
+ 102 0
- 1 48

5. ZeroR

The screenshot shows the Weka Explorer interface with the ZeroR classifier selected. The 'Classify' tab is active, and the 'Test options' section shows 'Cross-validation' with 'Folds' set to 10. The 'Result list' on the left shows '16:17:33 - rules.ZeroR' selected. The 'Classifier output' pane displays the following information:

Relation: Book1
Instances: 151
Attributes: 7
English Speaker
Course Instructor
Course
Semester
Class size
Class attribute
Score

Test mode: 10-fold cross-validation

=== Classifier model (full training set) ===
ZeroR predicts class value: high
Time taken to build model: 0 seconds

=== Stratified cross-validation ===
=== Summary ===

Metric	Value	Percentage
Correctly Classified Instances	52	34.4371 %
Incorrectly Classified Instances	99	65.5629 %
Kappa statistic	0	
Mean absolute error	0.4444	
Root mean squared error	0.4714	
Relative absolute error	100 %	
Root relative squared error	100 %	
Total Number of Instances	151	

=== Detailed Accuracy By Class ===

	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
1.000	1.000	0.344	1.000	0.512	?	0.480	0.335	high	
0.000	0.000	?	0.000	?	?	0.496	0.325	medium	
0.000	0.000	?	0.000	?	?	0.483	0.316	low	
Weighted Avg.	0.344	0.344	?	0.344	?	?	0.486	0.327	

=== Confusion Matrix ===

	a	b	c	<-- classified as
52	0	0	1	a = high
50	0	0	1	b = medium
49	0	0	1	c = low

Correctly Classified Instances 52 34.4371 %

Incorrectly Classified Instances 99 65.5629 %

True Positive Rate = 0.344

False Positive Rate = 0.344

=== Confusion Matrix ===

a b c <-- classified as

52 0 0 | a = high

50 0 0 | b = medium

49 0 0 | c = low

Now considering 'a', 'b' as our positive interest and 'c' as our negative interest,

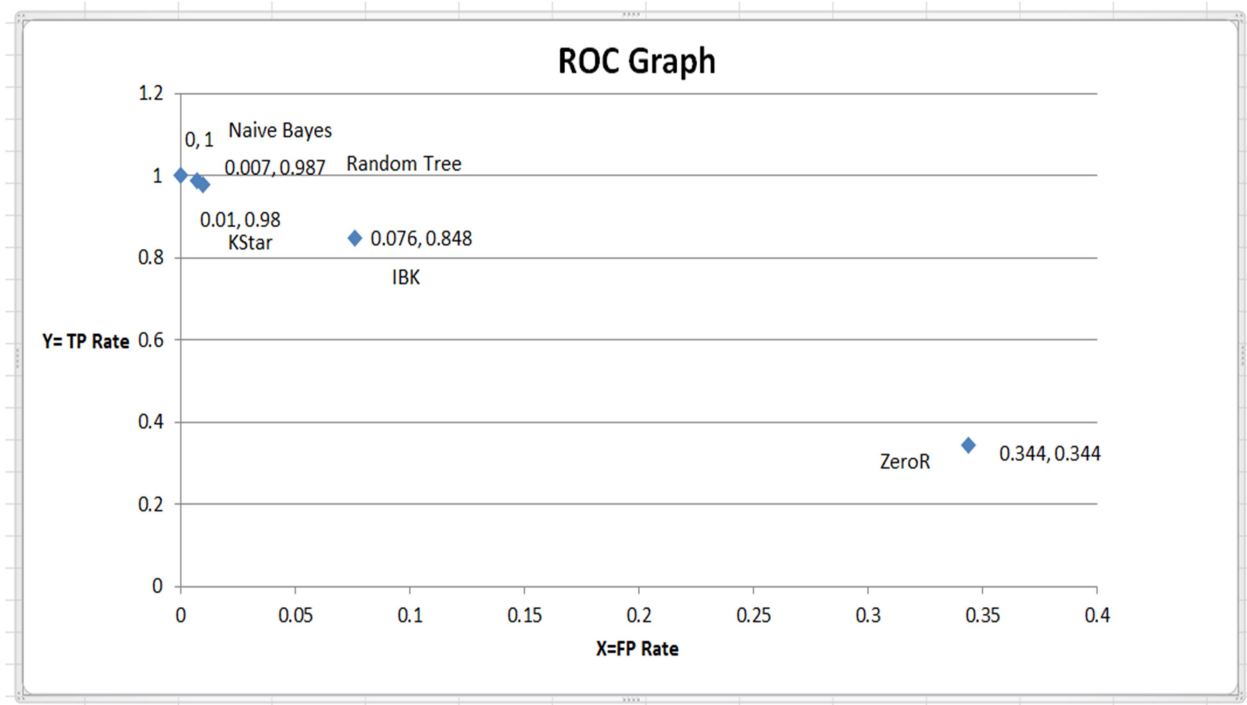
2/2 confusion matrix

+ -
+ 102 0
- 49 0

Results:

Classifier Name:	True Positive Rate	False Positive Rate
Naive Bayes	1.000	0.000
IBK (k-NN)	0.980	0.010
KStar	0.848	0.076
Random tree	0.987	0.007
ZeroR	0.344	0.344

Receiver Operational characteristic (ROC):



Analysis:

For this data set 5 algorithms are applied (Naive Bayes, IBK, KStar, Random tress & ZeroR). I have plotted this ROC graph by using FPR and TPR values. From this ROC graph, we can see that Naïve Bayes (0, 1) have the best value among all the others. And it can correctly classify all the instances with the percentage of 100 %. Random Tree (0.007, 0.987) and KStar (0.01, 0.98) classifier can classify 149 and 148 instances correctly. They are very close to Naïve Bayes and both have percentage of 98 %. On the other hand IBK (0.076, 0.848) can classify 128 instances with percentage rate of 84 %. At last we can see ZeroR (0.344, 0.344) can classify only 52 instances and percentage is very low of 34 %. So we can not consider this classifier as a best solution.

So according to the classifiers we can say Naïve Bayes gives the best solution for this evaluation. But we can also choose KStar or Random Tree.

Reference:

- <http://archive.ics.uci.edu/ml/datasets/Teaching+Assistant+Evaluation>