

Practical Machine Learning Tools and Techniques

Examples Illustrating Testing and Evaluation Concepts (Sections 5.1-5.4, and 5.7)

Viewer

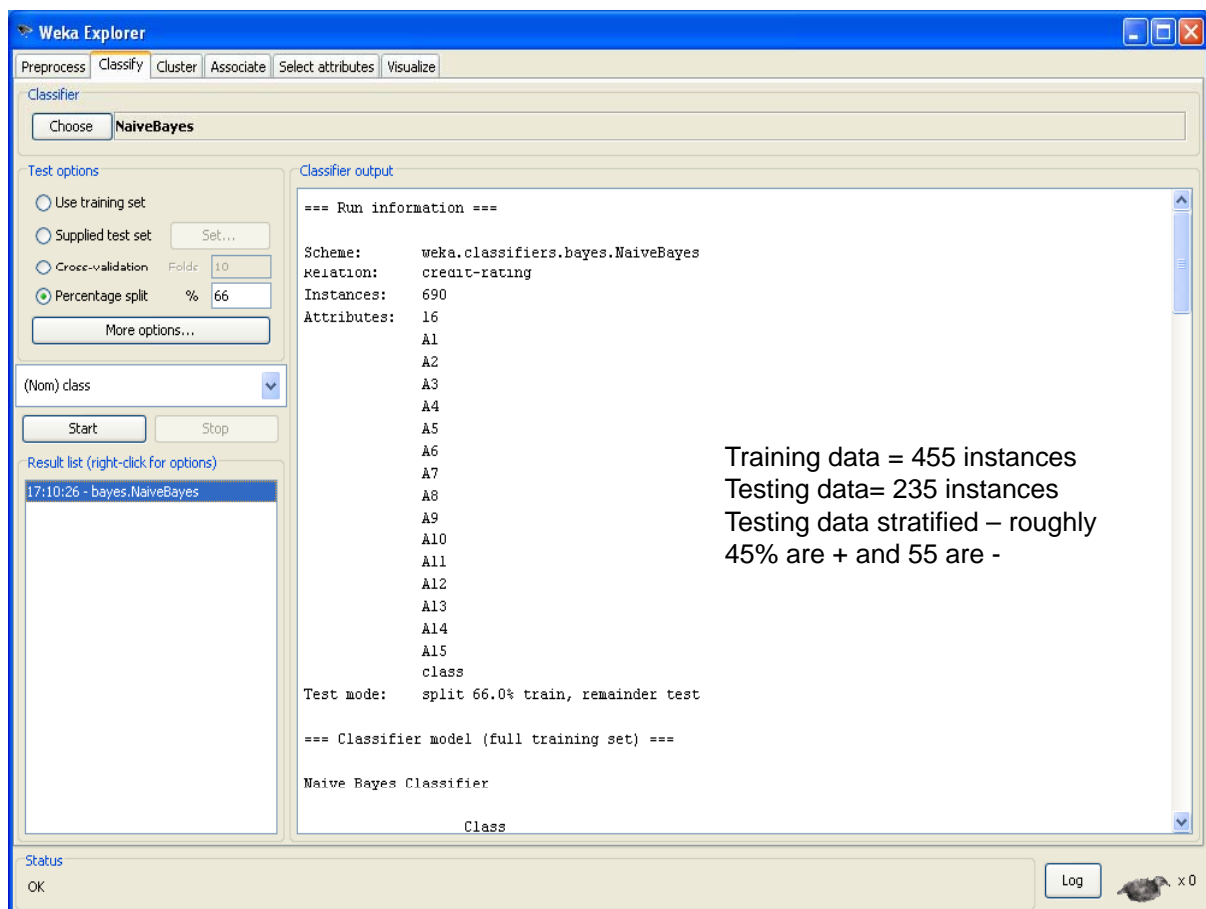
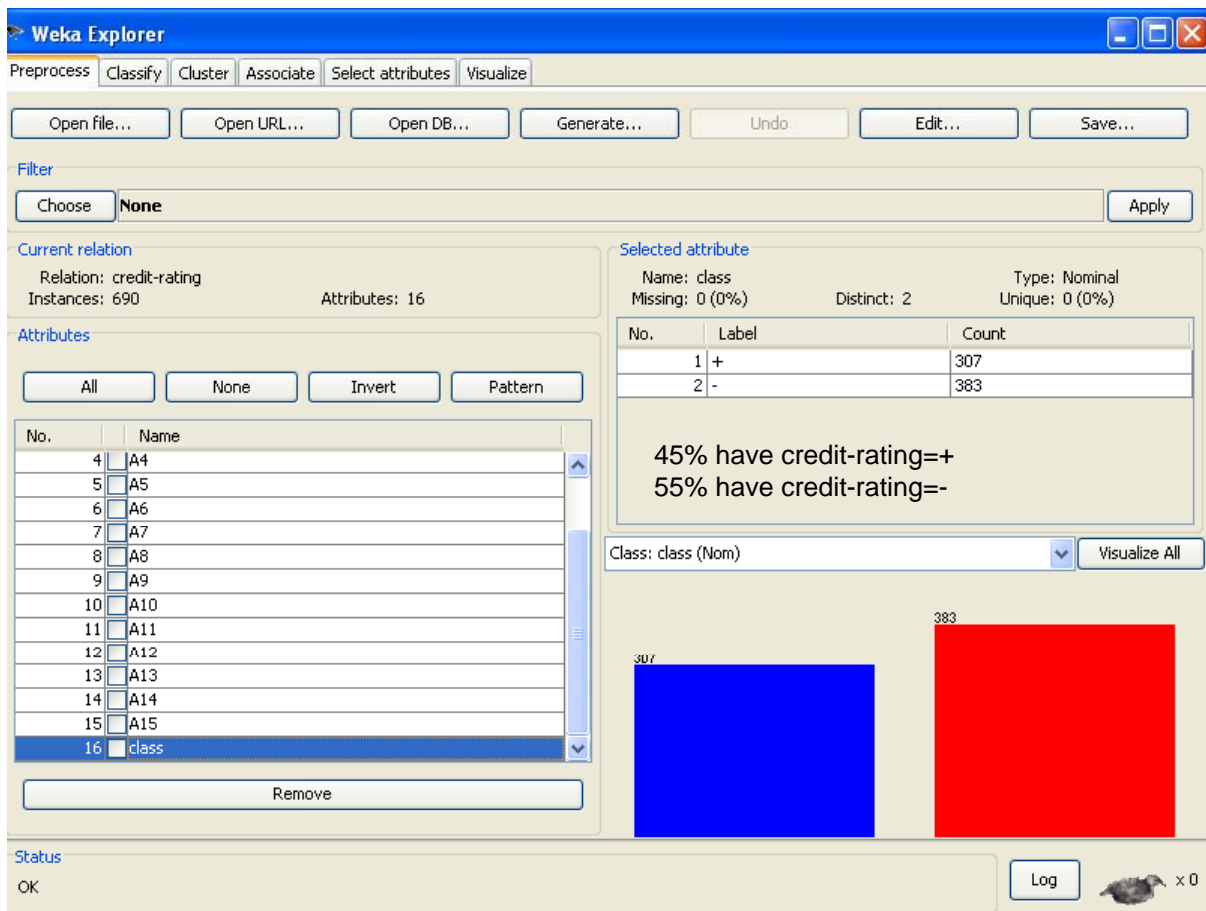
Relation: credit-rating

No.	A1 Nominal	A2 Numeric	A3 Numeric	A4 Nominal	A5 Nominal	A6 Nominal	A7 Nominal	A8 Numeric	A9 Nominal	A10 Nominal	A11 Numeric	A12 Nominal	A13 Nominal	A14 Numeric	A15 Numeric	class Nominal
50	b	23.92	0.665	u	q	c	v	0.165	f	f	0.0	f	g	100.0	0.0	+
51	a	25.75	0.5	u	g	c	h	0.875	t	f	0.0	t	g	491.0	0.0	+
52	b	26.0	1.0	u	g	q	v	1.75	t	f	0.0	t	g	280.0	0.0	+
53	b	37.42	2.04	u	g	w	v	0.04	t	f	0.0	t	g	400.0	5800.0	+
54	b	34.92	2.5	u	g	w	v	0.0	t	f	0.0	t	g	239.0	200.0	+
55	b	34.25	3.0	u	g	cc	h	7.415	t	f	0.0	t	g	0.0	0.0	+
56	b	23.33	11.625	y	p	w	v	0.035	t	f	0.0	t	g	160.0	300.0	+
57	b	23.17	0.0	u	g	cc	v	0.085	t	f	0.0	f	g	0.0	0.0	+
58	b	44.33	0.5	u	g	i	h	5.0	t	f	0.0	t	g	320.0	0.0	+
59	b	35.17	4.5	u	g	x	h	5.75	f	f	0.0	t	s	711.0	0.0	+
50	b	43.25	3.0	u	g	q	h	6.0	t	t	11.0	f	g	80.0	0.0	+
51	b	56.75	12.25	u	g	m	v	1.25	t	t	4.0	t	g	200.0	0.0	+
52	b	31.67	16.165	u	g	d	v	3.0	t	t	9.0	f	g	250.0	730.0	+
53	a	23.42	0.79	y	p	q	v	1.5	t	t	2.0	t	g	80.0	400.0	+
54	a	20.42	0.835	u	g	q	v	1.585	t	t	1.0	f	g	0.0	0.0	+
55	b	26.67	4.25	u	g	cc	v	4.29	t	t	1.0	t	g	120.0	0.0	+
56	b	34.17	1.54	u	g	cc	v	1.54	t	t	1.0	t	g	520.0	5000.0	+
57	a	36.0	1.0	u	g	c	v	2.0	t	t	11.0	f	g	0.0	456.0	+
58	b	29.5	0.375	u	g	m	v	0.25	t	t	3.0	f	g	280.0	15108.0	+
59	b	19.42	6.5	u	g	w	h	1.46	t	t	7.0	f	g	80.0	2954.0	+
70	b	35.17	25.125	u	g	x	h	1.625	t	t	1.0	t	g	515.0	500.0	+
71	b	32.33	7.5	u	g	e	bb	1.585	t	f	0.0	t	s	420.0	0.0	-
72	b	34.83	4.0	u	g	d	bb	12.5	t	f	0.0	t	g		0.0	-
73	a	38.58	5.0	u	g	cc	v	13.5	t	f	0.0	t	g	980.0	0.0	-
74	b	44.25	0.5	u	g	m	v	10.75	t	f	0.0	f	s	400.0	0.0	-
75	b	44.83	7.0	y	p	c	v	1.625	f	f	0.0	f	g	160.0	2.0	-
76	b	20.67	5.29	u	g	q	v	0.375	t	t	1.0	f	g	160.0	0.0	-
77	b	34.08	6.5	u	g	aa	v	0.125	t	f	0.0	t	g	443.0	0.0	-
78	a	19.17	0.585	y	p	aa	v	0.585	t	f	0.0	t	g	160.0	0.0	-
79	b	21.67	1.165	y	p	k	v	2.5	t	t	1.0	f	g	180.0	20.0	-
80	b	21.5	9.75	u	g	c	v	0.25	t	f	0.0	f	g	140.0	0.0	-
81	b	49.58	19.0	u	g	ff	ff	0.0	t	t	1.0	f	g	94.0	0.0	-
82	a	27.67	1.5	u	g	m	v	2.0	t	f	0.0	f	s	368.0	0.0	-
83	b	39.83	0.5	u	g	m	v	0.25	t	f	0.0	f	s	288.0	0.0	-

Undo

OK

Cancel



Weka Explorer

Preprocess Classify Cluster Associate Select attributes Visualize

Classifier: Choose **NaiveBayes**

Test options:

- ☐ Use training set
- ☐ Supplied test set (Set...)
- ☐ Cross-validation (Folds: 10)
- ☒ Percentage split (%: 66)

More options...

(Nom) class: [v]

Start Stop

Result list (right-click for options):

17:10:26 - bayes.NaiveBayes

Classifier output:

Attribute	Class	
	+	-
	(0.45)	(0.55)
=====		
A1		
b	207.0	263.0
a	99.0	113.0
[total]	306.0	376.0
A2		
mean	33.723	29.8068
std. dev.	12.7816	10.9057
weight sum	305	373
precision	0.1911	0.1911
A3		
mean	5.9075	3.8409
std. dev.	5.4649	4.3316
weight sum	307	383
precision	0.1308	0.1308
A4		
u	257.0	264.0
y	46.0	119.0
l	3.0	1.0
t	1.0	1.0
[total]	307.0	385.0

$P[A1=b|Class=+] = 207/306 = .67$
 $P[A1=a|Class=+] = 99/306 = .32$

**A2 is Gaussian with mean 33.723
 And standard deviation 12.7816**

Status: OK Log x 0

Weka Explorer

Preprocess Classify Cluster Associate Select attributes Visualize

Classifier: Choose **NaiveBayes**

Test options:

- ☐ Use training set
- ☐ Supplied test set (Set...)
- ☐ Cross-validation (Folds: 10)
- ☒ Percentage split (%: 66)

More options...

(Nom) class: [v]

Start Stop

Result list (right-click for options):

17:10:26 - bayes.NaiveBayes

Classifier output:

Time taken to build model: 0.02 seconds

=== Evaluation on test split ===

=== Summary ===

Correctly Classified Instances	177	75.3191 %
Incorrectly Classified Instances	58	24.6809 %
Kappa statistic	0.4918	
Mean absolute error	0.256	
Root mean squared error	0.4741	
Relative absolute error	51.6877 %	
Root relative squared error	94.9111 %	
Total Number of Instances	235	

Justify table from Confusion Matrix- in class

--- Detailed Accuracy By Class ---

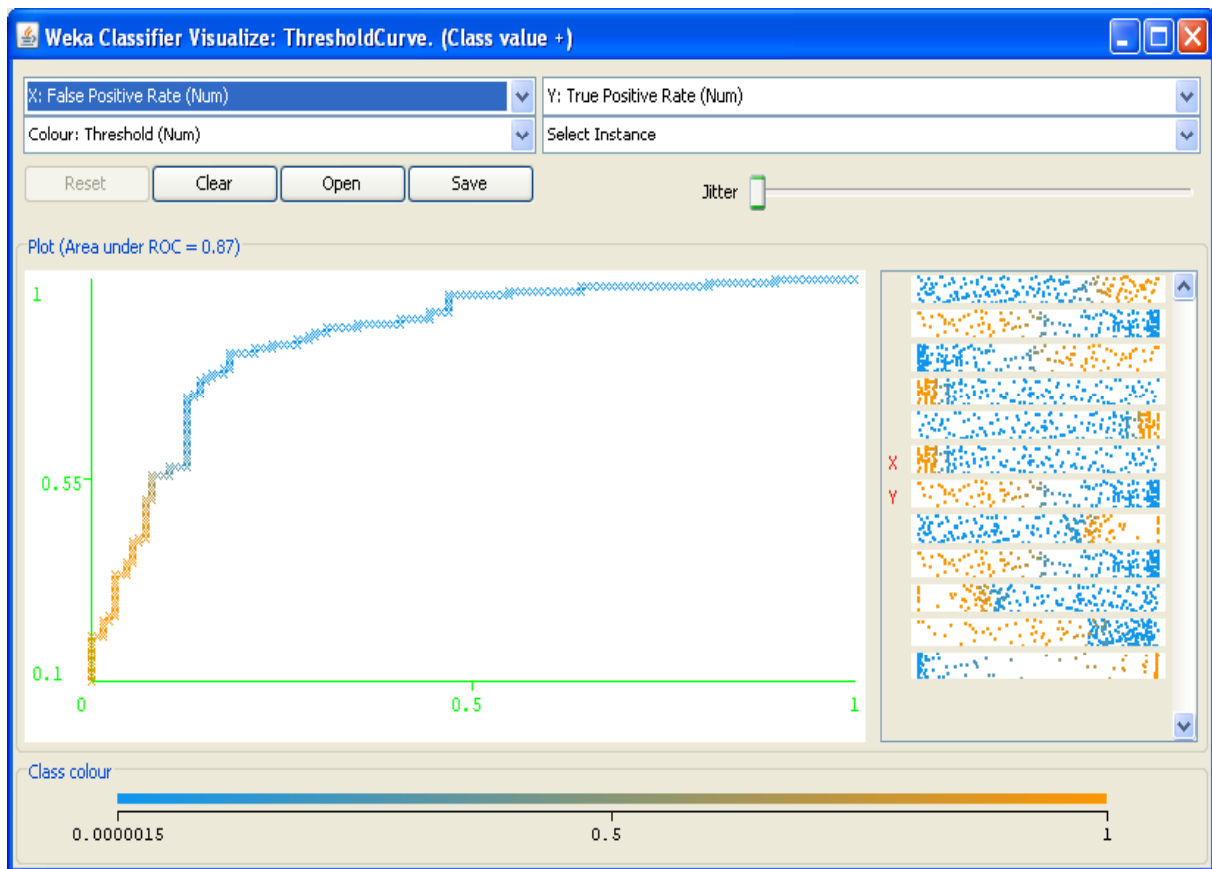
	TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
	0.56	0.079	0.859	0.56	0.678	0.87	+
	0.921	0.44	0.707	0.921	0.8	0.87	-
Weighted Avg.	0.753	0.273	0.778	0.753	0.743	0.87	

=== Confusion Matrix ===

a	b	<-- classified as
61	48	a = +
10	116	b = -

Test data contains 109 instances +
 61 classified correctly (TP)
 10 classified as + incorrectly (FP)

Status: OK Log x 0



Weka Explorer

Preprocess Classify Cluster Associate Select attributes Visualize

Classifier

Choose **OneR -B 6**

Test options

☐ Use training set

☐ Supplied test set Set...

☐ Cross-validation Folds 10

☒ Percentage split % 66

More options...

(Nom) class

Start Stop

Result list (right-click for options)

17:10:26 - bayes.NaiveBayes

17:16:55 - rules.OneR

Classifier output

```
=== Run information ===

Scheme:      weka.classifiers.rules.OneR -B 6
Relation:    credit-rating
Instances:   690
Attributes:  16
             A1
             A2
             A3
             A4
             A5
             A6
             A7
             A8
             A9
             A10
             A11
             A12
             A13
             A14
             A15
             class
Test mode:   split 66.0% train, remainder test

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

A9:
      t    -> +
      f    -> -
```

Status

OK Log

Weka Explorer

Preprocess **Classify** Cluster Associate Select attributes Visualize

Classifier: Choose **OneR -B 6**

Test options:

- ☐ Use training set
- ☐ Supplied test set
- ☐ Cross-validation Folds: 10
- ☒ Percentage split % 66

More options...

(Nom) class

Start Stop

Result list (right-click for options):

- 17:10:26 - bayes.NaiveBayes
- 17:16:55 - rules.OneR

Classifier output:

Time taken to build model: 0 seconds

=== Evaluation on test split ===

=== Summary ===

Correctly Classified Instances	201	85.5319 %
Incorrectly Classified Instances	34	14.4681 %
Kappa statistic	0.7116	
Mean absolute error	0.1447	
Root mean squared error	0.3804	
Relative absolute error	29.209 %	
Root relative squared error	76.1505 %	
Total Number of Instances	235	

=== Detailed Accuracy By Class ===

	TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
	0.908	0.19	0.805	0.908	0.853	0.859	+
	0.81	0.092	0.911	0.81	0.857	0.859	-
Weighted Avg.	0.855	0.138	0.862	0.855	0.855	0.859	

=== Confusion Matrix ===

```

a  b  <-- classified as
99 10 | a = +
24 102 | b = -

```

TP=99 higher than before (vs 61)
FP=24 higher than before (vs 10)

Status: OK

Log

Weka Explorer

Preprocess **Classify** Cluster Associate Select attributes Visualize

Classifier: Choose **J48graft -C 0.25 -M 2**

Test options:

- ☐ Use training set
- ☐ Supplied test set
- ☐ Cross-validation Folds: 10
- ☒ Percentage split % 66

More options...

(Nom) class

Start Stop

Result list (right-click for options):

- 17:10:26 - bayes.NaiveBayes
- 17:16:55 - rules.OneR
- 17:29:18 - trees.J48graft

Classifier output:

Time taken to build model: 0.09 seconds

=== Evaluation on test split ===

=== Summary ===

Correctly Classified Instances	198	84.2553 %
Incorrectly Classified Instances	37	15.7447 %
Kappa statistic	0.6801	
Mean absolute error	0.2032	
Root mean squared error	0.3418	
Relative absolute error	41.0193 %	
Root relative squared error	68.4314 %	
Total Number of Instances	235	

=== Detailed Accuracy By Class ===

	TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
	0.752	0.079	0.891	0.752	0.816	0.893	+
	0.921	0.248	0.811	0.921	0.862	0.893	-
Weighted Avg.	0.843	0.17	0.848	0.843	0.841	0.893	

=== Confusion Matrix ===

```

a  b  <-- classified as
82 27 | a = +
10 116 | b = -

```

TP= 82 better than Bayesian but not as good as 1R
FP= 10 as good as Bayesian

Status: OK

Log

Weka Explorer

Preprocess | **Classify** | Cluster | Associate | Select attributes | Visualize

Open file... Open URL... Open DB... Generate... Undo Edit... Save...

Filter: Choose **None** Apply

Current relation
 Relation: zoo
 Instances: 101
 Attributes: 18

Attributes
 All None Invert Pattern

No.	Name
2	hair
3	feathers
4	eggs
5	milk
6	airborne
7	aquatic
8	predator
9	toothed
10	backbone
11	breathes
12	venomous
13	fins
14	legs
15	tail
16	domestic
17	catsize
18	type

Remove

Selected attribute
 Name: type
 Missing: 0 (0%)
 Distinct: 7
 Type: Nominal
 Unique: 0 (0%)

No.	Label	Count
1	mammal	41
2	bird	20
3	reptile	5
4	fish	13
5	amphibian	4
6	insect	8
7	invertebrate	10

Class: type (Nom) Visualize All

Status
 OK Log x 0

Weka Explorer

Preprocess | Classify | **Cluster** | Associate | Select attributes | Visualize

Classifier
 Choose **NaiveBayes**

Test options
☐ Use training set
☐ Supplied test set Set...
☐ Cross-validation Folds 10
☒ Percentage split % 66
 More options...

(Nom) type Start Stop

Result list (right-click for options)
 17:33:40 - bayes.NaiveBayes

Classifier output

```

=== Evaluation on test split ===
=== Summary ===
Correctly Classified Instances      33      97.0588 %
Incorrectly Classified Instances    1      2.9412 %
Kappa statistic                    0.9617
Mean absolute error                 0.0221
Root mean squared error             0.1101
Relative absolute error             9.9605 %
Root relative squared error        32.8254 %
Total Number of Instances          34

=== Detailed Accuracy By Class ===

```

	TP	Rate	FP	Rate	Precision	Recall	F-Measure	ROC Area	Class
	0.923	0	1	0.923	0.96	1	1	1	mammal
	1	0	1	1	1	1	1	1	bird
	1	0	1	1	1	1	1	1	reptile
	1	0.034	0.833	1	0.909	1	1	1	fish
	0	0	0	0	0	0	?	?	amphibian
	1	0	1	1	1	1	1	1	insect
	1	0	1	1	1	1	1	1	invertebrate
Weighted Avg.	0.971	0.005	0.975	0.971	0.971	1	1	1	

```

=== Confusion Matrix ===
a b c d e f g <-- classified as
12 0 0 1 0 0 0 | a = mammal
0 6 0 0 0 0 0 | b = bird
0 0 1 0 0 0 0 | c = reptile
0 0 0 5 0 0 0 | d = fish
0 0 0 0 0 0 0 | e = amphibian
0 0 0 0 0 6 0 | f = insect
0 0 0 0 0 0 3 | g = invertebrate

```

Status
 OK Log x 0

