S3. Data Mining

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Problem Description

- A complex modern **semi-conductor manufacturing process** is normally under consistent surveillance via the monitoring of signals/variables collected from sensors and or process measurement points.

- However, not all of these signals are equally valuable in a specific monitoring system. The measured signals contain **a combination of useful information, irrelevant information as well as noise**.

Problem Description

- Engineers typically have a much larger number of signals than are actually required. **If we consider each type of signal as a feature**, then feature selection may be applied to identify the **most relevant signals**.

- The Process Engineers may then use these signals to determine key factors contributing to yield excursions downstream in the process. This will enable an increase in process throughput, decreased time to learning and reduce the per unit production costs.

SECOM Dataset

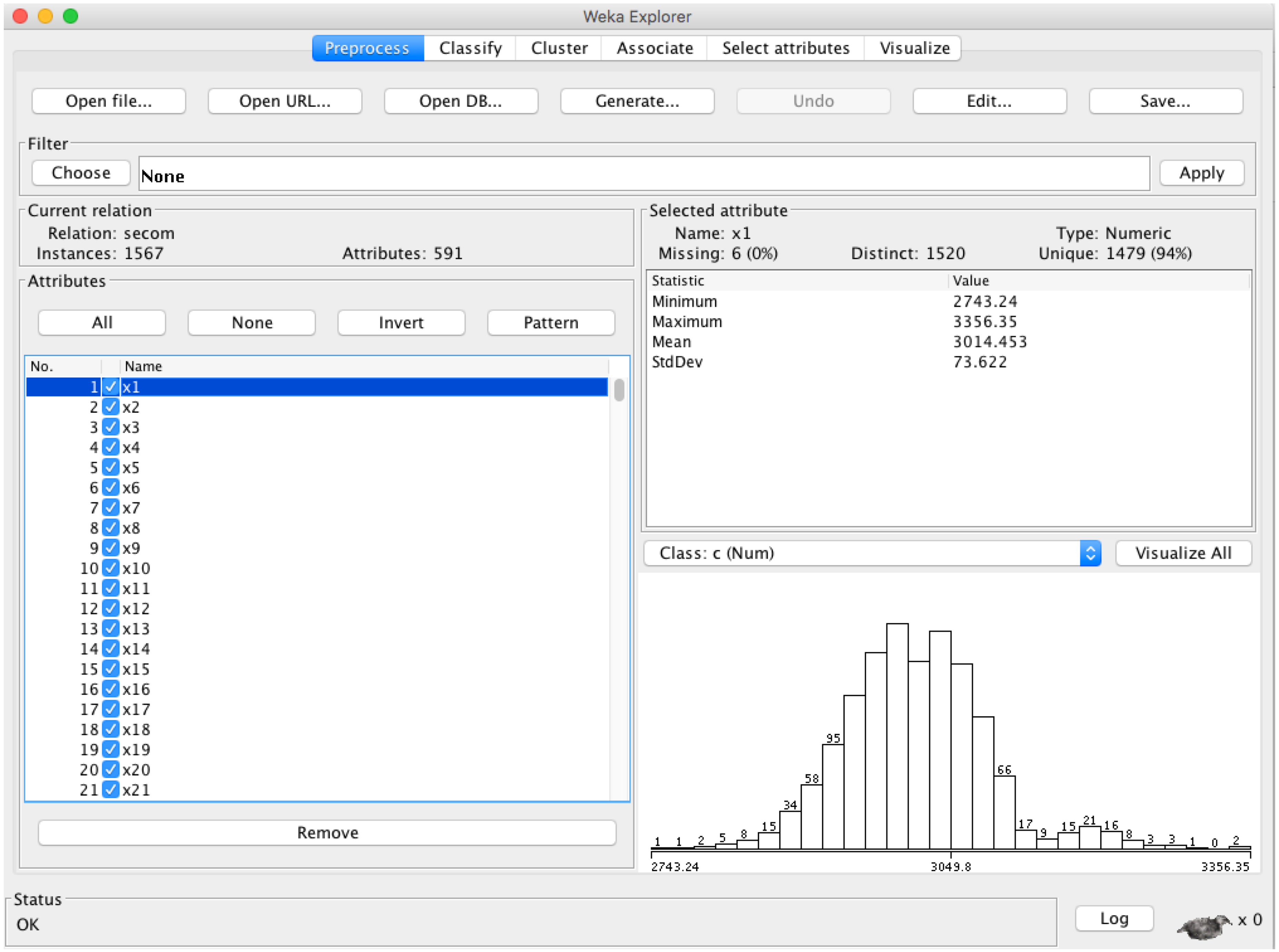
- SECOM Dataset: 1567 examples 591 features, 104 fails

- There are missing values;

- Where –1 corresponds to a pass and 1 corresponds to a fail and the data time stamp is for that specific test point.

- https://archive.ics.uci.edu/ml/datasets/SECOM

Features (variables)



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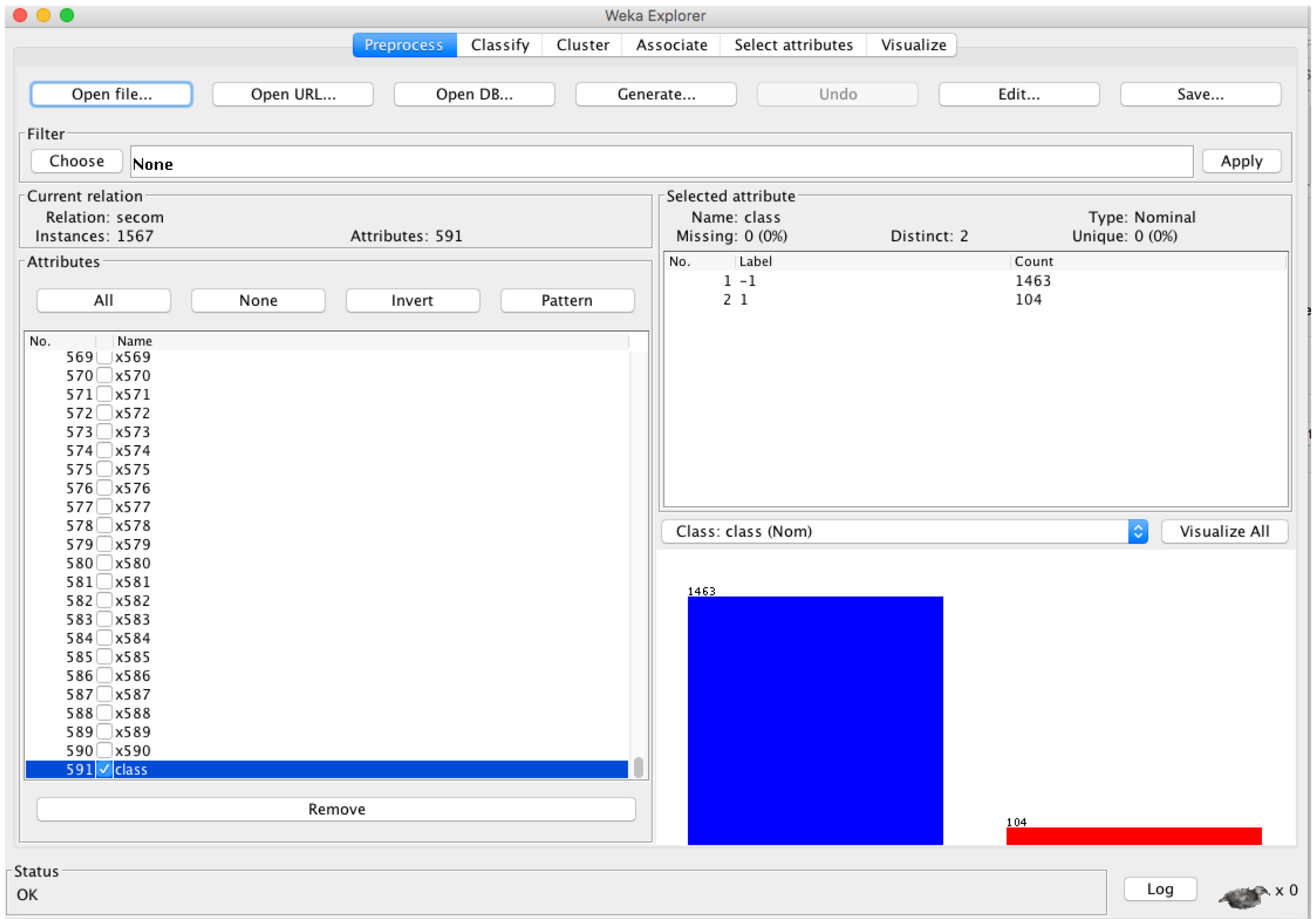
ARFF File



The variable **class** is the binary.

@attribute class {-1,1}

-1 = Pass

1 = Fail

```
@attribute x588 numeric
@attribute x589 numeric
@attribute x590 numeric
@attribute class {-1,1}

@data
3030.93,2564,2187.7333,1411.1265,1.3602,100,97.61
455,202.4396,0,7.9558,414871,10.0433,968,192.396
```

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Algorithms used

- Naive Bayes
- TAN
- IB1
- Idk
- RIPPER
- ID3
- C4.5 (J48)
- Logistic

Measures

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

Correctly Classified Instances        1012               64.582  %
Incorrectly Classified Instances       555               35.418  %
Kappa statistic                          0.0077
Mean absolute error                      0.3534
Root mean squared error                  0.59
Relative absolute error                283.9367 %
Root relative squared error            237.0124 %
Total Number of Instances             1567

=== Detailed Accuracy By Class ===

               TP Rate   FP Rate   Precision   Recall  F-Measure   ROC Area  Class
                 0.666     0.644      0.936     0.666     0.778      0.505    -1
                 0.356     0.334      0.07      0.356     0.118      0.497     1
Weighted Avg.    0.646     0.624      0.878     0.646     0.735      0.505

=== Confusion Matrix ===

   a   b   <-- classified as
 975 488 |   a = -1
  67  37 |   b = 1
```

		prediction outcome		
		p	***n***	**total**
actual value	***p'***	True Positive	False Negative	P'
	n'	False Positive	True Negative	N'
	total	P	N	

It is possible to see that 975 are True Positive, 488 False Negative, 67 False Positive and 37 True Negative and that 64.58% of correctly classified instances.

Naive Bayes with all variables.

```
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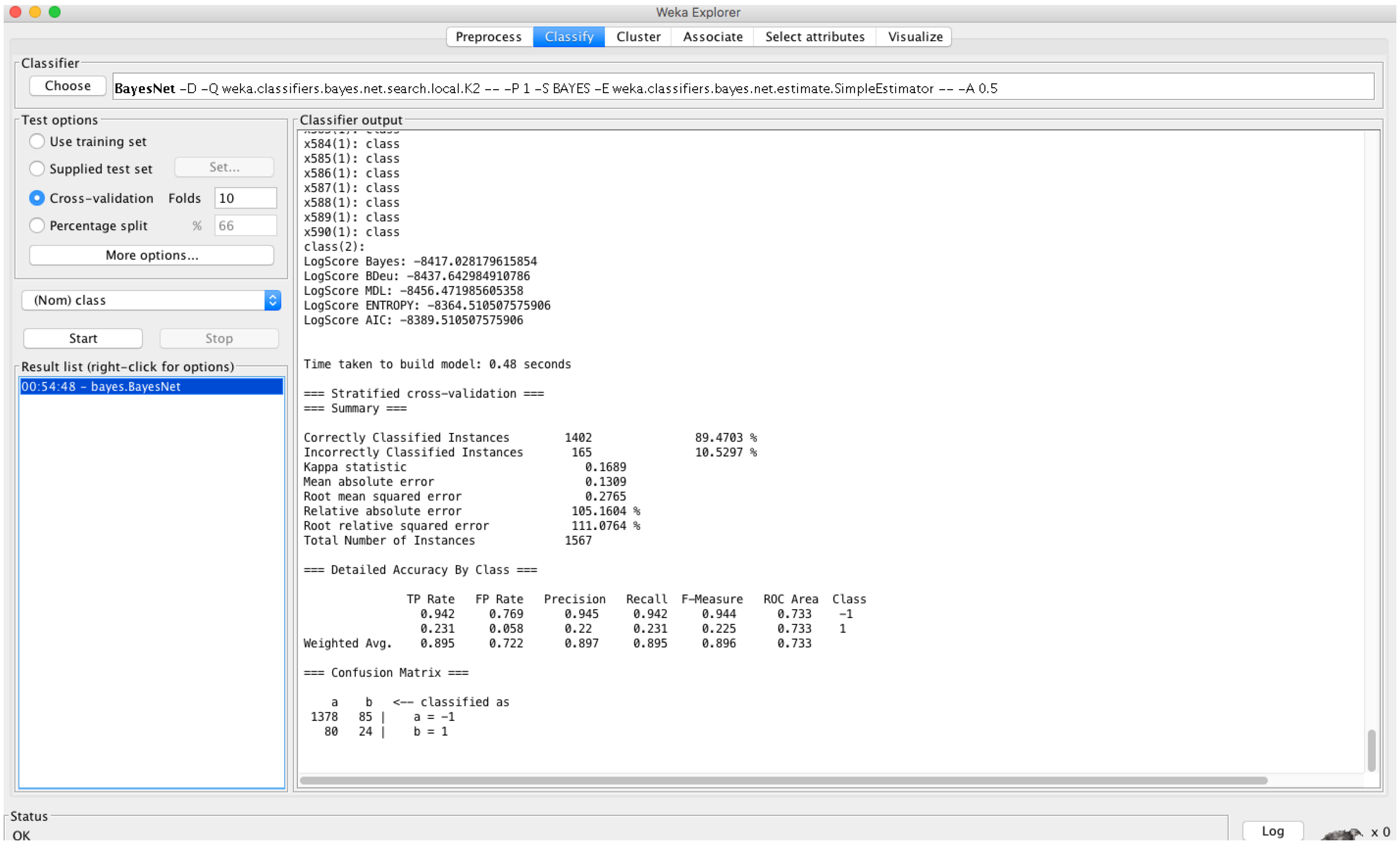
Try all algorithms

Using Weka I will try different algorithms using different techniques and compare the results in a table.

	All variables	FSS1	FSS2	Wrapper
Naive Bayes				
TAN				
IB1				
IBK				
RIPPER				
ID3				
C4.5 (J48)				
Logistic				

BayesNet



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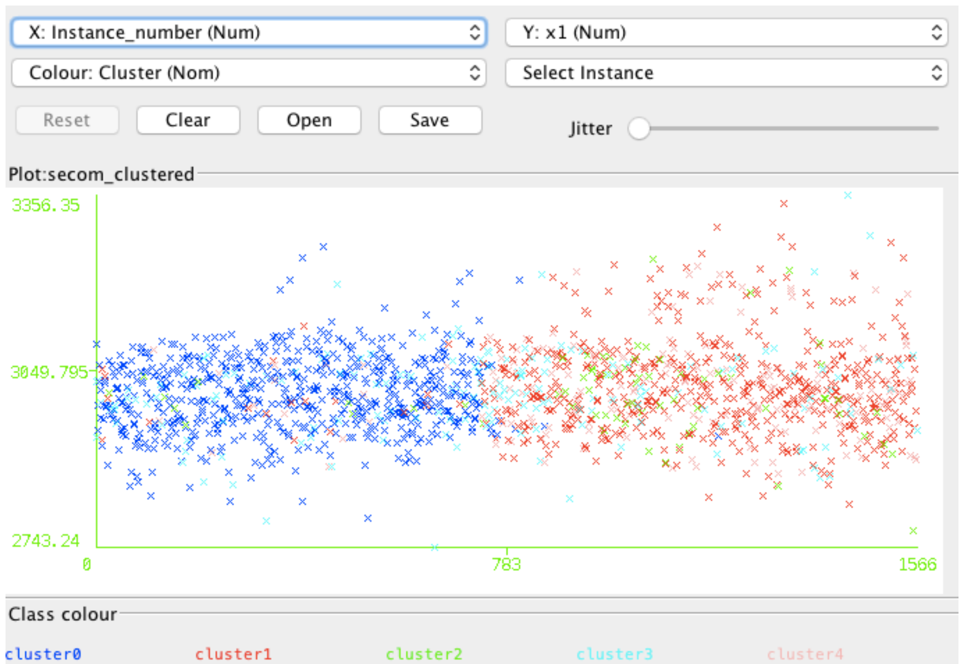
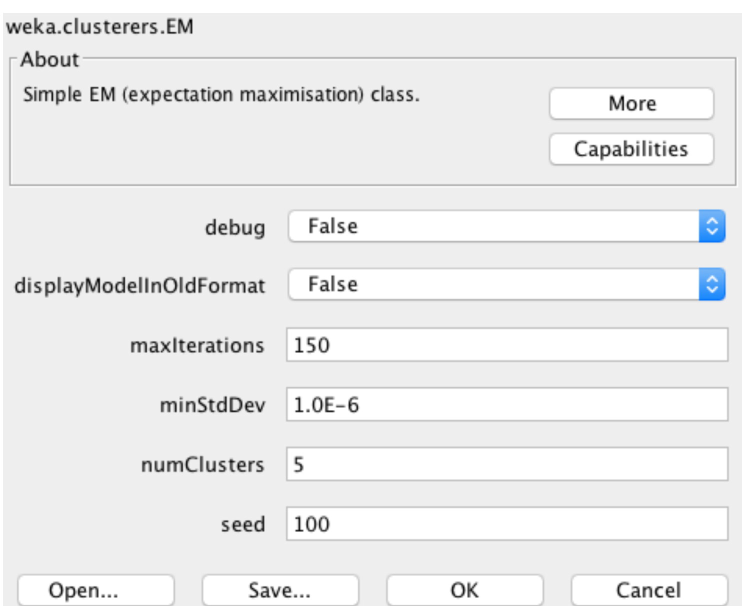
Clusters (EM)



Clustered Instances

0	620	(40%)
1	532	(34%)
2	73	(5%)
3	161	(10%)
4	181	(12%)



Number of clusters: 5

Attribute		Cluster 0 (0.25)	1 (0.36)	2 (0.11)	3 (0.1)	4 (0.18)
x1						
	mean	3008.3732	3017.0769	3017.2189	3007.9674	3019.6939
	std. dev.	65.0659	78.9663	69.7525	78.5341	71.4975
x2						
	mean	2495.3421	2495.192	2498.6908	2502.606	2492.1228
	std. dev.	90.1282	71.9495	78.5174	83.8471	79.7755
x3						
	mean	2202.0203	2201.1245	2201.2211	2198.8636	2197.8491
	std. dev.	28.7128	29.2509	28.7702	32.5015	28.7759
x4						
	mean	161408.8011	137357.8632	194804.6429	175739.5712	222154.6529
	std. dev.	442682.2112	422197.3147	520856.5946	492155.3222	524988.1034
x5						
	mean	146.0039	120.5253	128.7204	115.2781	97.4385
	std. dev.	418.5318	404.4045	425.4729	417.1137	365.567
x6						
	mean	100	100	100	100	100
	std. dev.	0	0	0	0	0
x7						
	mean	102.2575	100.0769	100.0893	101.651	101.9432
	std. dev.	3.3735	7.3454	6.0552	5.8141	6.6374

Performance

	All variables	FSS1	FSS2	Wrapper
Naive Bayes	64.58%	75.62%	90.04%	**93.36%**
TAN	**93.23%**	**93.23%**	**93.29%**	**93.36%**
IB1	82.76%	72.68%	88.70%	84.74%
IBK	82.76%	72.68%	88.70%	**93.36%**
RIPPER	93.10%	**93.23%**	**93.29%**	**93.36%**
ID3	61.07%	65.15%	70.83%	**93.36%**
C4.5 (J48)	90.42%	92.40%	92.53%	**93.36%**
Logistic	80.91%	93.17%	**93.29%**	**93.36%**

Thanks

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