```
DatosCortosStar.Properties.VariableNames
```

```
ans = 1×37 cell
'art'       'EW5876G'    'EW4541G'    'EW4471G'    'EW5411G'    'EW4481G'    'EW ···
```

```
DatosCortosStar = DatosCortosStar(randperm(size(DatosCortosStar, 1)), :)
```

```
DatosCortosStar = 751×37 table
```

...

	art	EW5876G	EW4541G	EW4471G	EW5411G	EW4481G	EW5592G	EW4686G
1	O	437.3800	234.6100	265.0300	1.3120e+03	9.2500	635.4800	0
2	O	1.2097e+03	394.6400	770.1700	568.4800	85.9400	329.9700	372.3600
3	B	189.5100	0	292.7300	2.9800	359.3300	0	0
4	O	1.1825e+03	140.7800	804.9500	184.9700	93.3100	141.7200	166.5100
5	B	1.0703e+03	103.1700	743.3200	144.9400	119.9900	112.5300	174.5100
6	O	678.2800	685.4800	432.4100	889.7300	51.7100	224.8300	831.7300
7	B	261.3300	0	437.8600	0	323.4700	0	0
8	O	1.6692e+03	763.4000	941.7300	1.1804e+03	0	263.3200	785.2800
9	O	1.2946e+03	183.4000	877.7000	333.3400	90.5500	160.7100	0
10	O	552.9300	635.9700	202.8500	823.1700	0	206.3400	0
11	O	531.7700	581.0900	221.2700	785.2100	24.8700	159.2600	0
12	O	1.0523e+03	282.3500	682.4700	563.4900	0	267.3100	336.5300
13	O	931.9400	144.8900	803.0200	263.1600	43.5200	187.0300	0
14	O	510.3000	630.0700	226.2900	830.9300	36.6800	150.2300	90.6000

⋮

```
label=DatosCortosStar(:,1);
labelB=label.art(1:216);
labelO=label.art(217:432);
datos=DatosCortosStar(:,2:end);
datosB=datos(1:216,:);
datosO=datos(217:432,:);
```

```
mdl=fitcauto(DatosCortosStar(1:432,:),"art")
```

```
Warning: It is recommended that you first standardize all numeric predictors when optimizing the
 Naive Bayes 'Width' parameter. Ignore this warning if you have done that.
Learner types to explore: ensemble, knn, nb, svm, tree
Total iterations (MaxObjectiveEvaluations): 150
Total time (MaxTime): Inf

|=====================================================================================================
| Iter | Eval   | Validation | Time for training | Observed min    | Estimated min   | Learner      | Hype
|      | result | loss       | & validation (sec)| validation loss | validation loss |              |
```

Iter	Eval result	Validation loss	Time for training & validation (sec)	Observed min validation loss	Estimated min validation loss	Learner	Hype
1	Best	0.046296	1.2148	0.046296	0.046296	tree	MinL
2	Accept	0.28472	13.758	0.046296	0.046296	ensemble	Meth NumL MinL
3	Accept	0.28472	0.6695	0.046296	0.046296	svm	BoxC Kern
4	Accept	0.28472	19.264	0.046296	0.046296	svm	BoxC Kern
5	Best	0.030093	0.27964	0.030093	0.030093	nb	Dist Widt
6	Best	0.016204	12.252	0.016204	0.030093	ensemble	Meth NumL MinL
7	Accept	0.030093	0.2124	0.016204	0.030093	knn	NumN
8	Accept	0.28472	0.084493	0.016204	0.030093	knn	NumN
9	Accept	0.28472	0.13787	0.016204	0.030093	svm	BoxC Kern
10	Accept	0.018519	12.578	0.016204	0.030093	ensemble	Meth NumL MinL

Iter	Eval result	Validation loss	Time for training & validation (sec)	Observed min validation loss	Estimated min validation loss	Learner	Hype
11	Accept	0.018519	13.374	0.016204	0.030093	ensemble	Meth NumL MinL
12	Accept	0.032407	0.19243	0.016204	0.030093	tree	MinL
13	Accept	0.28472	15.971	0.016204	0.030093	svm	BoxC Kern
14	Accept	0.28472	0.13822	0.016204	0.030093	svm	BoxC Kern
15	Accept	0.030093	0.099933	0.016204	0.030093	nb	Dist Widt
16	Accept	0.034722	0.13962	0.016204	0.030093	tree	MinL
17	Accept	0.074074	0.11794	0.016204	0.030093	svm	BoxC Kern
18	Best	0.011574	9.4169	0.011574	0.030093	ensemble	Meth NumL MinL
19	Accept	0.030093	0.10393	0.011574	0.030093	nb	Dist Widt
20	Accept	0.030093	0.10097	0.011574	0.030093	nb	Dist Widt

Iter	Eval result	Validation loss	Time for training & validation (sec)	Observed min validation loss	Estimated min validation loss	Learner	Hype
21	Accept	0.020833	0.084166	0.011574	0.030093	knn	NumN
22	Accept	0.027778	12.805	0.011574	0.024985	ensemble	Meth NumL MinL
23	Accept	0.032407	0.13578	0.011574	0.024985	tree	MinL
24	Accept	0.030093	0.097914	0.011574	0.024985	nb	Dist Widt
25	Accept	0.030093	0.098994	0.011574	0.024985	nb	Dist Widt
26	Accept	0.023148	0.081999	0.011574	0.024985	knn	NumN
27	Accept	0.11574	0.093617	0.011574	0.024985	knn	NumN
28	Accept	0.041667	0.07638	0.011574	0.024985	knn	NumN
29	Accept	0.17361	0.097161	0.011574	0.024985	knn	NumN
30	Accept	0.034722	0.13176	0.011574	0.024985	tree	MinL

Iter	Eval	Validation	Time for training	Observed min	Estimated min	Learner	Hype

	result	loss	& validation (sec)	validation loss	validation loss		
31	Accept	0.17361	0.079974	0.011574	0.024985	knn	NumN
32	Accept	0.023148	0.077467	0.011574	0.024985	knn	NumN
33	Accept	0.016204	13.751	0.011574	0.023075	ensemble	Meth
							NumL
							MinL
34	Accept	0.027778	0.075071	0.011574	0.023075	knn	NumN
35	Accept	0.046296	0.10883	0.011574	0.023075	tree	MinL
36	Accept	0.030093	0.085552	0.011574	0.023075	nb	Dist
							Widt
37	Accept	0.19907	0.11965	0.011574	0.023075	tree	MinL
38	Accept	0.043981	0.10908	0.011574	0.023075	tree	MinL
39	Accept	0.28472	0.12636	0.011574	0.023075	svm	BoxC
							Kern
40	Accept	0.011574	9.6922	0.011574	0.029668	ensemble	Meth
							NumL
							MinL

Iter	Eval result	Validation loss	Time for training & validation (sec)	Observed min validation loss	Estimated min validation loss	Learner	Hype
41	Accept	0.030093	0.087186	0.011574	0.029668	nb	Dist
							Widt
42	Accept	0.030093	0.085412	0.011574	0.029668	nb	Dist
							Widt
43	Accept	0.28472	0.12562	0.011574	0.029668	svm	BoxC
							Kern
44	Accept	0.11574	0.087063	0.011574	0.028275	knn	NumN
45	Accept	0.081019	1.6321	0.011574	0.028275	nb	Dist
							Widt
46	Accept	0.037037	0.091473	0.011574	0.027969	knn	NumN
47	Accept	0.020833	0.097881	0.011574	0.024926	knn	NumN
48	Accept	0.027778	10.153	0.011574	0.024926	ensemble	Meth
							NumL
							MinL
49	Accept	0.046296	0.096568	0.011574	0.024926	tree	MinL
50	Accept	0.043981	0.10357	0.011574	0.024926	tree	MinL

Iter	Eval result	Validation loss	Time for training & validation (sec)	Observed min validation loss	Estimated min validation loss	Learner	Hype
51	Accept	0.071759	1.1178	0.011574	0.024926	nb	Dist
							Widt
52	Accept	0.28472	0.12828	0.011574	0.024926	svm	BoxC
							Kern
53	Accept	0.1713	0.087312	0.011574	0.025119	knn	NumN
54	Accept	0.16204	0.10589	0.011574	0.025119	svm	BoxC
							Kern
55	Accept	0.28472	0.10922	0.011574	0.025119	svm	BoxC
							Kern
56	Accept	0.041667	0.086445	0.011574	0.024234	knn	NumN
57	Accept	0.28472	0.13718	0.011574	0.024234	svm	BoxC
							Kern
58	Accept	0.043981	0.11692	0.011574	0.024234	tree	MinL
59	Accept	0.016204	13.044	0.011574	0.017012	ensemble	Meth
							NumL
							MinL
60	Accept	0.011574	9.6705	0.011574	0.016121	ensemble	Meth
							NumL
							MinL

Iter	Eval result	Validation loss	Time for training & validation (sec)	Observed min validation loss	Estimated min validation loss	Learner	Hype

| 61 | Accept | 0.034722 | 0.14009 | 0.011574 | 0.016121 | tree | MinL
| 62 | Accept | 0.030093 | 0.084108 | 0.011574 | 0.016121 | nb | Dist
| | | | | | | | Widt
| 63 | Accept | 0.037037 | 0.11799 | 0.011574 | 0.016121 | tree | MinL
| 64 | Accept | 0.030093 | 0.0859 | 0.011574 | 0.016121 | nb | Dist
| | | | | | | | Widt
| 65 | Accept | 0.28472 | 0.11034 | 0.011574 | 0.016121 | svm | BoxC
| | | | | | | | Kern
| 66 | Accept | 0.018519 | 12.044 | 0.011574 | 0.016345 | ensemble | Meth
| | | | | | | | NumL
| | | | | | | | MinL
| 67 | Accept | 0.28472 | 1.1548 | 0.011574 | 0.016345 | nb | Dist
| | | | | | | | Widt
| 68 | Accept | 0.62731 | 0.16855 | 0.011574 | 0.016345 | svm | BoxC
| | | | | | | | Kern
| 69 | Accept | 0.018519 | 13.626 | 0.011574 | 0.016093 | ensemble | Meth
| | | | | | | | NumL
| | | | | | | | MinL
| 70 | Accept | 0.043981 | 0.13706 | 0.011574 | 0.016093 | tree | MinL
|======|========|============|==================|================|================|==============|=====
| Iter | Eval | Validation | Time for training | Observed min | Estimated min | Learner | Hype
| | result | loss | & validation (sec)| validation loss | validation loss | |
|======|========|============|==================|================|================|==============|=====
| 71 | Accept | 0.011574 | 10.156 | 0.011574 | 0.013903 | ensemble | Meth
| | | | | | | | NumL
| | | | | | | | MinL
| 72 | Accept | 0.020833 | 10.49 | 0.011574 | 0.013675 | ensemble | Meth
| | | | | | | | NumL
| | | | | | | | MinL
| 73 | Accept | 0.28472 | 0.11549 | 0.011574 | 0.013675 | svm | BoxC
| | | | | | | | Kern
| 74 | Accept | 0.043981 | 0.11557 | 0.011574 | 0.013675 | tree | MinL
| 75 | Accept | 0.030093 | 0.091232 | 0.011574 | 0.013675 | nb | Dist
| | | | | | | | Widt
| 76 | Accept | 0.011574 | 9.4301 | 0.011574 | 0.012951 | ensemble | Meth
| | | | | | | | NumL
| | | | | | | | MinL
| 77 | Accept | 0.011574 | 9.4267 | 0.011574 | 0.013528 | ensemble | Meth
| | | | | | | | NumL
| | | | | | | | MinL
| 78 | Accept | 0.011574 | 9.6403 | 0.011574 | 0.014873 | ensemble | Meth
| | | | | | | | NumL
| | | | | | | | MinL
| 79 | Accept | 0.011574 | 10.06 | 0.011574 | 0.011867 | ensemble | Meth
| | | | | | | | NumL
| | | | | | | | MinL
| 80 | Accept | 0.011574 | 9.5415 | 0.011574 | 0.011903 | ensemble | Meth
| | | | | | | | NumL
| | | | | | | | MinL
|======|========|============|==================|================|================|==============|=====
| Iter | Eval | Validation | Time for training | Observed min | Estimated min | Learner | Hype
| | result | loss | & validation (sec)| validation loss | validation loss | |
|======|========|============|==================|================|================|==============|=====
| 81 | Accept | 0.011574 | 9.8339 | 0.011574 | 0.011574 | ensemble | Meth
| | | | | | | | NumL
| | | | | | | | MinL
| 82 | Accept | 0.018519 | 11.937 | 0.011574 | 0.011574 | ensemble | Meth
| | | | | | | | NumL
| | | | | | | | MinL
| 83 | Accept | 0.020833 | 9.922 | 0.011574 | 0.011651 | ensemble | Meth
| | | | | | | | NumL
| | | | | | | | MinL
| 84 | Accept | 0.011574 | 9.4719 | 0.011574 | 0.011602 | ensemble | Meth
| | | | | | | | NumL
| | | | | | | | MinL

Iter	Eval result	Validation loss	Time for training & validation (sec)	Observed min validation loss	Estimated min validation loss	Learner	Hype
85	Accept	0.018519	12.458	0.011574	0.011574	ensemble	Meth NumL MinL
86	Accept	0.025463	9.2872	0.011574	0.01162	ensemble	Meth NumL MinL
87	Accept	0.011574	9.6942	0.011574	0.011782	ensemble	Meth NumL MinL
88	Accept	0.011574	10.131	0.011574	0.011713	ensemble	Meth NumL MinL
89	Accept	0.018519	13.728	0.011574	0.011713	ensemble	Meth NumL MinL
90	Accept	0.018519	12.374	0.011574	0.011574	ensemble	Meth NumL MinL

Iter	Eval result	Validation loss	Time for training & validation (sec)	Observed min validation loss	Estimated min validation loss	Learner	Hype
91	Accept	0.018519	12.329	0.011574	0.011574	ensemble	Meth NumL MinL
92	Accept	0.28472	8.7902	0.011574	0.011667	ensemble	Meth NumL MinL
93	Accept	0.011574	9.563	0.011574	0.01169	ensemble	Meth NumL MinL
94	Accept	0.011574	9.5023	0.011574	0.011682	ensemble	Meth NumL MinL
95	Accept	0.28472	8.903	0.011574	0.011574	ensemble	Meth NumL MinL
96	Accept	0.011574	9.3159	0.011574	0.011574	ensemble	Meth NumL MinL
97	Accept	0.011574	10.162	0.011574	0.011574	ensemble	Meth NumL MinL
98	Accept	0.011574	9.9658	0.011574	0.011636	ensemble	Meth NumL MinL
99	Accept	0.016204	9.8103	0.011574	0.011574	ensemble	Meth NumL MinL
100	Accept	0.011574	9.8818	0.011574	0.011574	ensemble	Meth NumL MinL

Iter	Eval result	Validation loss	Time for training & validation (sec)	Observed min validation loss	Estimated min validation loss	Learner	Hype
101	Accept	0.013889	9.5599	0.011574	0.011574	ensemble	Meth NumL MinL
102	Accept	0.011574	9.4874	0.011574	0.011574	ensemble	Meth NumL MinL
103	Accept	0.025463	9.752	0.011574	0.011574	ensemble	Meth NumL MinL

Iter	Eval result	Validation loss	Time for training & validation (sec)	Observed min validation loss	Estimated min validation loss	Learner	Hype
104	Accept	0.013889	9.7242	0.011574	0.011574	ensemble	Meth NumL MinL
105	Accept	0.016204	9.4718	0.011574	0.011574	ensemble	Meth NumL MinL
106	Accept	0.011574	9.4098	0.011574	0.011574	ensemble	Meth NumL MinL
107	Accept	0.011574	9.7002	0.011574	0.011574	ensemble	Meth NumL MinL
108	Accept	0.013889	9.4258	0.011574	0.011574	ensemble	Meth NumL MinL
109	Accept	0.016204	12.778	0.011574	0.011574	ensemble	Meth NumL MinL
110	Accept	0.011574	9.5631	0.011574	0.011574	ensemble	Meth NumL MinL

Iter	Eval result	Validation loss	Time for training & validation (sec)	Observed min validation loss	Estimated min validation loss	Learner	Hype
111	Accept	0.023148	9.6844	0.011574	0.011574	ensemble	Meth NumL MinL
112	Accept	0.023148	11.037	0.011574	0.011574	ensemble	Meth NumL MinL
113	Accept	0.011574	9.6552	0.011574	0.011651	ensemble	Meth NumL MinL
114	Accept	0.018519	12.334	0.011574	0.01162	ensemble	Meth NumL MinL
115	Accept	0.032407	9.5021	0.011574	0.011574	ensemble	Meth NumL MinL
116	Accept	0.018519	12.808	0.011574	0.011574	ensemble	Meth NumL MinL
117	Accept	0.13426	12.996	0.011574	0.011574	ensemble	Meth NumL MinL
118	Accept	0.013889	12.474	0.011574	0.011574	ensemble	Meth NumL MinL
119	Accept	0.013889	12.465	0.011574	0.011574	ensemble	Meth NumL MinL
120	Accept	0.025463	9.3865	0.011574	0.011574	ensemble	Meth NumL MinL

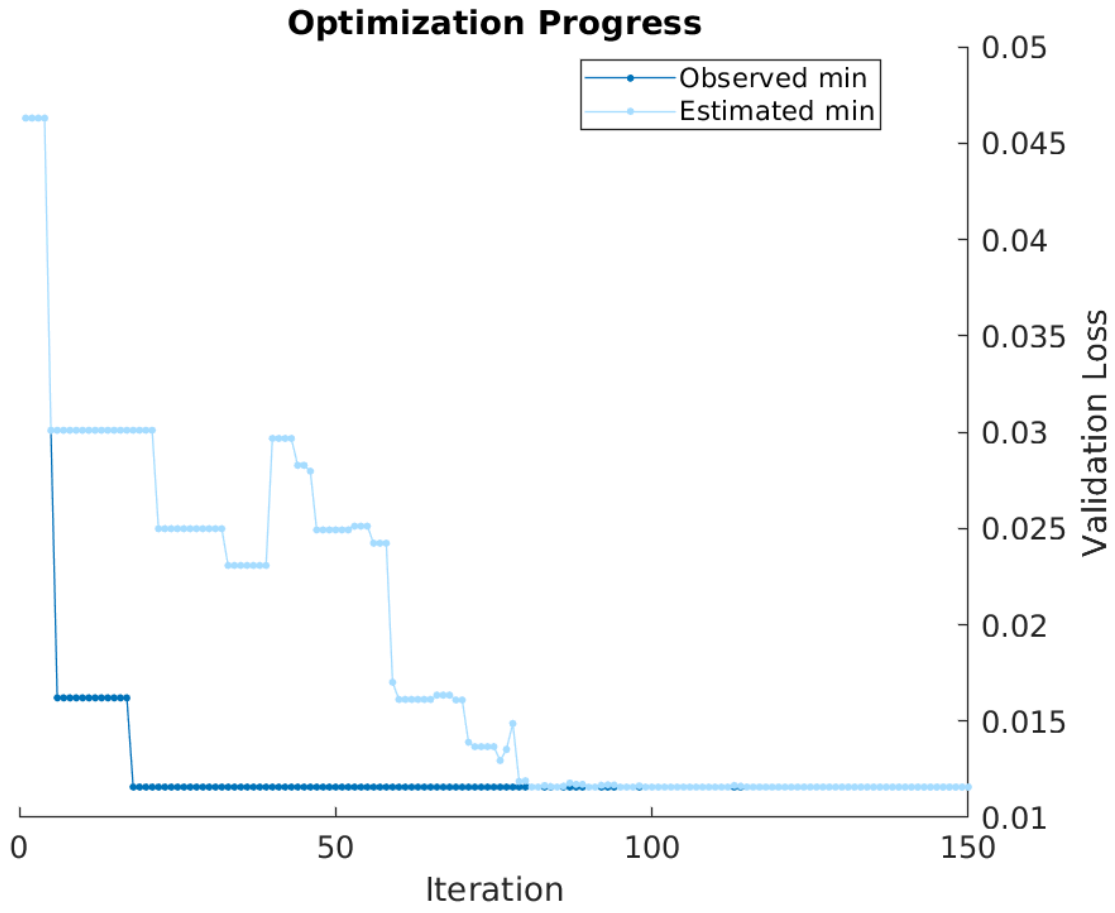
Iter	Eval result	Validation loss	Time for training & validation (sec)	Observed min validation loss	Estimated min validation loss	Learner	Hype
121	Accept	0.030093	9.0354	0.011574	0.011574	ensemble	Meth NumL MinL
122	Accept	0.011574	9.2223	0.011574	0.011574	ensemble	Meth NumL MinL

Iter	Eval result	Validation loss	Time for training & validation (sec)	Observed min validation loss	Estimated min validation loss	Learner	Hype
123	Accept	0.011574	9.8339	0.011574	0.011574	ensemble	Meth NumL MinL
124	Accept	0.018519	12.407	0.011574	0.011574	ensemble	Meth NumL MinL
125	Accept	0.011574	9.6117	0.011574	0.011574	ensemble	Meth NumL MinL
126	Accept	0.016204	12.634	0.011574	0.011574	ensemble	Meth NumL MinL
127	Accept	0.011574	9.3649	0.011574	0.011574	ensemble	Meth NumL MinL
128	Accept	0.018519	13.682	0.011574	0.011574	ensemble	Meth NumL MinL
129	Accept	0.018519	12.27	0.011574	0.011574	ensemble	Meth NumL MinL
130	Accept	0.011574	9.7681	0.011574	0.011574	ensemble	Meth NumL MinL

Iter	Eval result	Validation loss	Time for training & validation (sec)	Observed min validation loss	Estimated min validation loss	Learner	Hype
131	Accept	0.023148	9.0814	0.011574	0.011574	ensemble	Meth NumL MinL
132	Accept	0.027778	11.771	0.011574	0.011574	ensemble	Meth NumL MinL
133	Accept	0.13194	10.926	0.011574	0.011574	ensemble	Meth NumL MinL
134	Accept	0.013889	12.362	0.011574	0.011574	ensemble	Meth NumL MinL
135	Accept	0.027778	9.18	0.011574	0.011574	ensemble	Meth NumL MinL
136	Accept	0.28472	0.97945	0.011574	0.011574	nb	Dist Widt
137	Accept	0.013889	14.351	0.011574	0.011574	ensemble	Meth NumL MinL
138	Accept	0.032407	13.632	0.011574	0.011574	ensemble	Meth NumL MinL
139	Accept	0.016204	9.7887	0.011574	0.011574	ensemble	Meth NumL MinL
140	Accept	0.011574	9.6904	0.011574	0.011574	ensemble	Meth NumL MinL

Iter	Eval result	Validation loss	Time for training & validation (sec)	Observed min validation loss	Estimated min validation loss	Learner	Hype
141	Accept	0.034722	13.806	0.011574	0.011574	ensemble	Meth NumL MinL
142	Accept	0.011574	9.6689	0.011574	0.011574	ensemble	Meth

143	Accept	0.018519	12.274	0.011574	0.011574	ensemble	Meth NumL MinL
144	Accept	0.011574	9.7301	0.011574	0.011574	ensemble	Meth NumL MinL
145	Accept	0.016204	14.3	0.011574	0.011574	ensemble	Meth NumL MinL
146	Accept	0.016204	14.247	0.011574	0.011574	ensemble	Meth NumL MinL
147	Accept	0.013889	14.139	0.011574	0.011574	ensemble	Meth NumL MinL
148	Accept	0.011574	9.453	0.011574	0.011574	ensemble	Meth NumL MinL
149	Accept	0.018519	13.849	0.011574	0.011574	ensemble	Meth NumL MinL
150	Accept	0.13889	0.11262	0.011574	0.011574	svm	BoxC Kern



Optimization completed.
Total iterations: 150
Total elapsed time: 2268.6591 seconds
Total time for training and validation: 1011.3787 seconds

Best observed learner is an ensemble model with:

```
 Method:          LogitBoost
 NumLearningCycles:      203
 MinLeafSize:            193
Observed validation loss: 0.011574
Time for training and validation: 9.4169 seconds

Best estimated learner (returned model) is an ensemble model with:
 Method:          LogitBoost
 NumLearningCycles:      203
 MinLeafSize:            193
Estimated validation loss: 0.011574
Estimated time for training and validation: 9.4229 seconds

Documentation for fitcauto display
mdl =
  CompactClassificationEnsemble
            PredictorNames: {1×36 cell}
              ResponseName: 'art'
    CategoricalPredictors: []
                ClassNames: [B    O]
            ScoreTransform: 'none'
                NumTrained: 203


  Properties, Methods
```

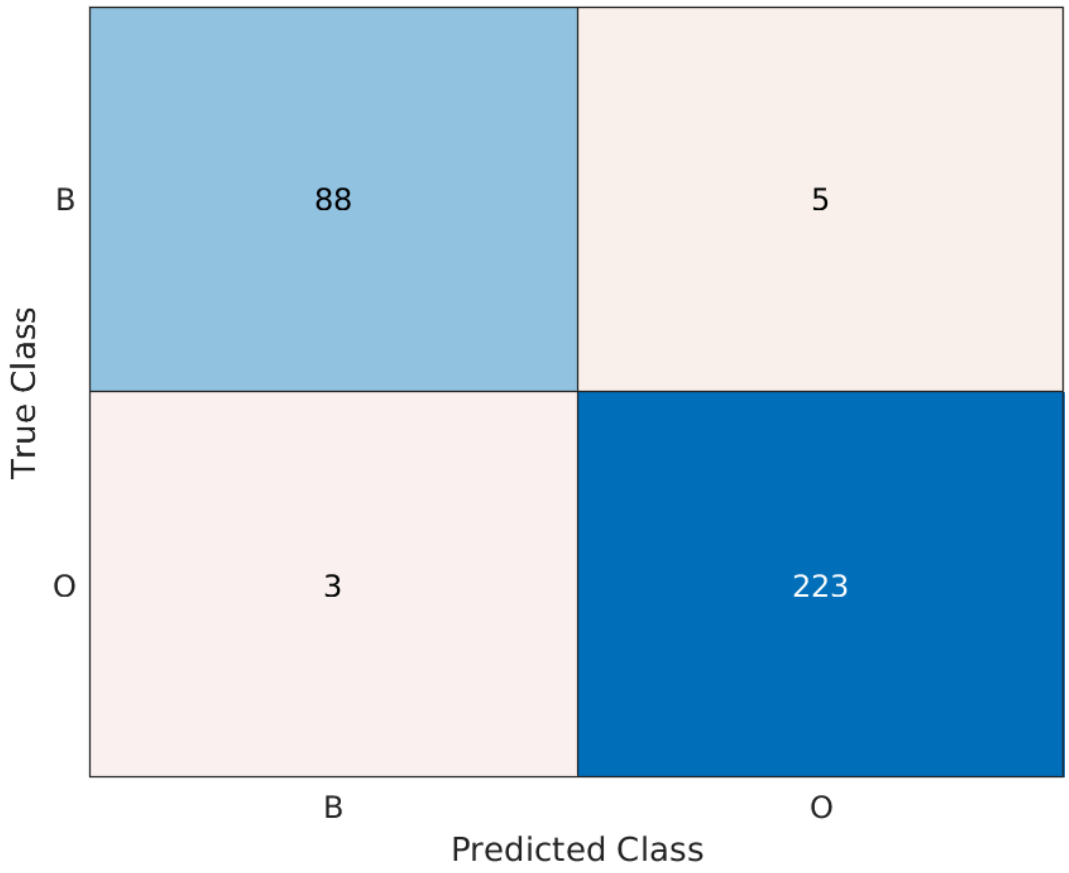
```
ars=predict(mdl,DatosCortosStar(433:end,2:end))
```

```
ars = 319×1 categorical
B
B
O
O
B
O
O
O
B
O
    ⋮
```

```

```

```
confusionchart(label.art(433:end),ars)
```


B
O
True Class
88
5
3
223
B
O
Predicted Class