

R version 3.3.3 (2017-03-06) -- "Another Canoe"
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Platform: x86_64-apple-darwin13.4.0 (64-bit)

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[R.app GUI 1.69 (7328) x86_64-apple-darwin13.4.0]

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```
> library(klaR)
Loading required package: MASS
> library(openxlsx)
> training <- read.xlsx("snp_train.xlsx", sheet=1, na.strings=c("NN", ""))
> test <- read.xlsx("snp_test.xlsx", sheet=1, na.strings=c("NN", ""))
> training[] <- lapply( training, factor) #convert training in factor
> test[] <- lapply( test, factor) #convert test in factor
> nb_mod <- NaiveBayes(Population ~., data=training, fL=1, usekernel = T) # with kernel and laplace correction = 1
> pred <- suppressWarnings(predict(nb_mod, test))
> nb_mod
$apriori
grouping
      POPA      POPB      POPC
0.44670051 0.46192893 0.09137056

$tables
$tables$Locus01
      var
grouping      AA      AG      GG
      POPA 0.97802198 0.01098901 0.01098901
      POPB 0.14893617 0.41489362 0.43617021
      POPC 0.04761905 0.23809524 0.71428571

$tables$Locus02
      var
grouping      AA      AC      CC
      POPA 0.9120879 0.07692308 0.01098901
      POPB 0.2234043 0.41489362 0.36170213
      POPC 0.2380952 0.38095238 0.38095238

$tables$Locus03
      var
grouping      AA      AC      CC
      POPA 0.2087912 0.4945055 0.29670330
      POPB 0.7872340 0.1702128 0.04255319
      POPC 0.6190476 0.3333333 0.04761905

$tables$Locus04
      var
grouping      AA      AG      GG
      POPA 0.01098901 0.1868132 0.8021978
      POPB 0.56382979 0.3297872 0.1063830
      POPC 0.47619048 0.3809524 0.1428571

$tables$Locus05
      var
grouping      AA      AG      GG
      POPA 0.7912088 0.1758242 0.03296703
      POPB 0.2765957 0.5000000 0.22340426
      POPC 0.1904762 0.5238095 0.28571429

$tables$Locus06
      var
grouping      GG      GT      TT
      POPA 0.01098901 0.1318681 0.8571429
      POPB 0.02127660 0.1808511 0.7978723
      POPC 0.04761905 0.0952381 0.8571429
```

```
$tables$Locus07
var
grouping      CC      CT      TT
POPA 0.01098901 0.05494505 0.93406593
POPB 0.71276596 0.24468085 0.04255319
POPC 0.76190476 0.19047619 0.04761905
```

```
$tables$Locus08
var
grouping      CC      CT      TT
POPA 0.02197802 0.25274725 0.7252747
POPB 0.01063830 0.09574468 0.8936170
POPC 0.04761905 0.14285714 0.8095238
```

```
$tables$Locus09
var
grouping      AA      AG      GG
POPA 0.04395604 0.3516484 0.6043956
POPB 0.07446809 0.2021277 0.7234043
POPC 0.04761905 0.1904762 0.7619048
```

```
$tables$Locus10
var
grouping      CC      CT      TT
POPA 0.01098901 0.01098901 0.9780220
POPB 0.02127660 0.11702128 0.8617021
POPC 0.04761905 0.28571429 0.6666667
```

```
$tables$Locus11
var
grouping      CC      CT
POPA 0.7222222 0.2777778
POPB 0.5000000 0.5000000
POPC 0.7000000 0.3000000
```

```
$tables$Locus12
var
grouping      CC      CT      TT
POPA 0.9340659 0.05494505 0.01098901
POPB 0.2234043 0.46808511 0.30851064
POPC 0.2380952 0.52380952 0.23809524
```

```
$levels
[1] "POPA" "POPB" "POPC"
```

```
$call
NaiveBayes.default(x = X, grouping = Y, usekernel = ..2, fL = 1)
```

```
$x
      Locus01 Locus02 Locus03 Locus04 Locus05 Locus06 Locus07 Locus08 Locus09 Locus10 Locus11 Locus12
1         AA        AA        AC        GG        AA        TT        TT        TT        AG        TT        CC        CC
2         AA        AA        CC        GG        AA        TT        TT        TT        GG        TT        CC        CC
3         AA        AA        AC        AG        AA        TT        TT        CT        GG        TT        CC        CC
4         AA        AA        CC        GG        AA        GT        TT        TT        GG        TT        CC        CC
5         AA        AA        CC        GG        AA        TT        TT        CT        AG        TT        CC        CC
6         AA        AA        CC        AG        AA        TT        TT        CT        GG        TT        CC        CC
7         AA        AA        AC        AG        AA        TT        TT        TT        AA        TT        CC        CC
8         AA        AA        AA        GG        AA        GT        TT        TT        GG        TT        CC        CC
9         AA        AA        CC        GG        AA        TT        TT        TT        GG        TT        CC        CC
10        AA        AA        AC        GG        AA        TT        TT        TT        AG        TT        CC        CC
11        AA        AA        AA        GG        AA        TT        TT        CT        AG        TT        CC        CC
12        AA        AA        AC        GG        AA        TT        TT        TT        GG        TT        CC        CC
13        AA        AC        AC        GG        AA        TT        TT        TT        GG        TT        CT        CC
14        AA        AA        AC        GG        AA        TT        TT        CT        AG        TT        CC        CC
15        AA        AA        AA        GG        AA        GT        TT        CT        GG        TT        CC        CC
16        AA        AA        CC        GG        AG        TT        TT        TT        GG        TT        CC        CC
17        AA        AA        AC        AG        AA        TT        TT        CT        AG        TT        CC        CC
18        AA        AA        AC        GG        AA        TT        TT        TT        AG        TT        CC        CC
19        AA        AA        CC        GG        AA        TT        TT        TT        GG        TT        CC        CC
20        AA        AA        AC        AG        AA        TT        TT        TT        GG        TT        CC        CC
21        AA        AA        AC        GG        AA        TT        TT        TT        GG        TT        CC        CC
22        AA        AA        AC        GG        AG        TT        TT        TT        AG        TT        CC        CC
23        AA        AA        CC        GG        AA        GT        TT        TT        GG        TT        CC        CC
24        AA        AA        CC        GG        AA        TT        TT        TT        GG        TT        CC        CC
25        AA        AA        AA        GG        AA        TT        TT        TT        AA        TT        CT        CC
26        AA        AA        AC        AG        AA        TT        TT        TT        AG        TT        CT        CC
27        AA        AA        AA        GG        AA        TT        CT        TT        AG        TT        CC        CC
28        AA        AA        AA        GG        AA        TT        TT        CT        GG        TT        CC        CC
```

29	AA	AA	AA	GG	AG	TT	TT	TT	GG	TT	CT	CC
30	AA	AA	AC	GG	AA	TT	TT	TT	AG	TT	CC	CC
31	AA	AA	CC	AG	AA	TT	TT	CT	GG	TT	CC	CT
32	AA	AA	AC	GG	AG	TT	TT	TT	AG	TT	CC	CC
33	AA	AA	CC	GG	AA	GT	TT	TT	GG	TT	CT	CC
34	AA	AA	AC	AG	AA	TT	TT	CC	AG	TT	CT	CT
35	AA	AA	AC	GG	AA	TT	TT	TT	GG	TT	CC	CT
36	AA	AA	CC	GG	AA	TT	TT	TT	GG	TT	CT	CC
37	AA	AA	CC	GG	AA	TT	TT	TT	AG	TT	CT	CC
38	AA	AA	AC	GG	AA	TT	TT	TT	GG	TT	CT	CC
39	AA	AA	AC	GG	AA	TT	TT	TT	GG	TT	CT	CC
40	AA	AA	CC	GG	AA	TT	TT	TT	GG	TT	CC	CC
41	AA	AA	AA	GG	AA	TT	TT	TT	GG	TT	CC	CC
42	AA	AA	AC	GG	AA	TT	TT	TT	GG	TT	CT	CC
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45	AA	AA	AC	GG	GG	TT	TT	TT	GG	TT	CC	CC
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47	AA	AC	CC	GG	AA	TT	TT	TT	GG	TT	CC	CC
48	AA	AA	AC	GG	AA	TT	TT	TT	GG	TT	CC	CC
49	AA	AA	CC	GG	AA	TT	TT	TT	GG	TT	CC	CC
50	AA	AA	AC	GG	AA	GT	TT	TT	AG	TT	CC	CC
51	AA	AA	AA	GG	AG	TT	TT	CT	GG	TT	CC	CC
52	AA	AA	AC	GG	AA	GT	TT	TT	GG	TT	CC	CC
53	AA	AA	AC	GG	AA	TT	TT	TT	AG	TT	CC	CC
54	AA	AA	AC	GG	AA	GT	TT	TT	GG	TT	CT	CC
55	AA	AA	AC	GG	AG	TT	TT	TT	GG	TT	CT	CC
56	AA	AA	AC	GG	AA	TT	TT	CT	GG	TT	CT	CC
57	AA	AC	CC	GG	AG	TT	TT	TT	GG	TT	CC	CC
58	AA	AA	AA	GG	AG	TT	TT	TT	AG	TT	CC	CC
59	AA	AA	AC	GG	AA	TT	TT	CT	GG	TT	CT	CC
60	AA	AA	AC	GG	AA	TT	TT	CT	AA	TT	CC	CC
61	AA	AA	CC	GG	AA	TT	TT	TT	GG	TT	CC	CC
62	AA	AA	AC	GG	AA	TT	TT	TT	AG	TT	CC	CC
63	AA	AA	AC	GG	AA	TT	TT	CT	GG	TT	CC	CC
64	AA	AA	AA	GG	AA	TT	TT	TT	GG	TT	CC	CC
65	AA	AA	AC	GG	AA	GT	TT	TT	AG	TT	CT	CC
66	AA	AA	CC	GG	AA	TT	TT	CT	AG	TT	CC	CC
67	AA	AA	CC	GG	AG	TT	CT	TT	AG	TT	CC	CC
68	AA	AA	AA	GG	AA	TT	TT	TT	AG	TT	CC	CC
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73	AA	AA	CC	GG	AA	TT	TT	TT	AG	TT	CC	CT
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75	AA	AA	AA	AG	AA	TT	TT	TT	AG	TT	CC	CC
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78	AA	AA	AC	AG	AA	TT	TT	TT	GG	TT	CC	CC
79	AA	AA	CC	GG	AA	TT	TT	TT	AG	TT	CC	CC
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86	AA	AA	AA	AG	AA	TT	TT	TT	GG	TT	CT	CC
87	AA	AA	CC	AG	AA	TT	TT	TT	GG	TT	CC	CC
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89	AA	AC	AA	AA	AA	TT	CT	TT	GG	TT	<NA>	CC
90	AG	AA	AC	AA	AG	TT	CT	TT	GG	CT	<NA>	CT
91	AA	AC	AA	GG	AG	TT	CT	CT	GG	TT	<NA>	CC
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95	AG	AA	AA	AG	AG	TT	CC	TT	AG	TT	<NA>	CT
96	AA	AA	AC	GG	AA	TT	CC	TT	GG	TT	<NA>	CT
97	AG	CC	AC	AA	AA	GT	CC	TT	GG	TT	<NA>	CC
98	GG	AA	CC	AA	AG	TT	CC	TT	GG	TT	<NA>	TT
99	AG	AA	AC	GG	AG	TT	CT	TT	AG	TT	<NA>	CC
100	AA	AA	AA	AG	AA	TT	CC	TT	GG	TT	<NA>	CT
101	AA	AC	AA	GG	AG	TT	CT	TT	GG	TT	<NA>	CC
102	AG	AA	AA	AA	AG	TT	TT	TT	GG	TT	<NA>	CC
103	AG	CC	AC	AA	GG	TT	CC	TT	AA	TT	<NA>	CT
104	AG	AA	AA	AA	GG	TT	CC	TT	GG	TT	<NA>	TT
105	AA	AC	AA	AG	AG	TT	TT	TT	AG	TT	<NA>	CC
106	AG	CC	AC	AG	AG	TT	CC	TT	GG	TT	<NA>	TT
107	AA	CC	AA	AG	AA	TT	CC	TT	GG	TT	<NA>	CC

108	AG	AC	AC	AG	AG	TT	CT	TT	AG	TT	<NA>	CT
109	AG	AC	AA	AA	AA	GT	CC	CT	GG	TT	<NA>	CC
110	GG	CC	AA	AA	GG	TT	CC	TT	AG	TT	<NA>	CT
111	GG	AA	AA	AG	AG	TT	CC	TT	GG	TT	<NA>	TT
112	GG	CC	AA	AG	AG	TT	CC	TT	GG	TT	<NA>	TT
113	GG	AC	AA	AA	AG	TT	CC	CT	GG	TT	<NA>	CT
114	GG	CC	AA	AA	GG	TT	CC	TT	GG	TT	<NA>	CT
115	GG	AA	AA	AA	AA	TT	CT	TT	GG	TT	<NA>	CT
116	AG	CC	AA	AA	GG	TT	CT	TT	GG	TT	<NA>	CT
117	AG	AC	AA	AA	AA	TT	CC	TT	GG	TT	<NA>	CT
118	AG	CC	AA	AA	AA	TT	CC	TT	GG	TT	<NA>	CC
119	GG	CC	AA	AA	AG	TT	CC	TT	AG	TT	<NA>	TT
120	AG	AA	AC	AG	GG	TT	CC	TT	GG	TT	<NA>	CT
121	GG	AC	AA	AA	AG	TT	CC	TT	GG	TT	<NA>	TT
122	GG	AC	AA	AA	AG	GT	CC	TT	GG	TT	<NA>	CT
123	AA	CC	AA	AG	AG	TT	CC	TT	AA	TT	<NA>	TT
124	AG	AC	AA	AA	GG	GT	CC	TT	GG	CT	<NA>	CT
125	GG	CC	AA	AA	AG	TT	CC	TT	GG	CT	<NA>	TT
126	AG	AC	AA	AA	AA	TT	CC	CT	GG	TT	<NA>	CC
127	AG	CC	AA	AA	AG	TT	CC	TT	GG	TT	<NA>	CT
128	AG	CC	AA	AG	AA	TT	CT	TT	GG	TT	<NA>	CT
129	AG	AC	AA	AA	AG	TT	CC	TT	GG	CT	<NA>	CC
130	GG	AC	AA	AA	AG	TT	CT	TT	AG	TT	<NA>	TT
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133	GG	AC	AA	AG	AA	TT	CC	TT	GG	TT	<NA>	TT
134	AG	AC	AA	AA	AG	TT	CC	TT	GG	TT	<NA>	CT
135	GG	CC	AA	AA	AG	TT	CC	TT	GG	CT	<NA>	CT
136	GG	CC	AA	AG	AA	TT	CC	TT	AG	TT	<NA>	CT
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138	AG	AC	AA	GG	AG	GT	CC	TT	GG	TT	<NA>	TT
139	GG	AC	AA	AA	AA	GT	CC	TT	AA	CT	<NA>	TT
140	GG	CC	AA	AA	AA	GG	CC	TT	GG	CT	<NA>	CT
141	GG	AA	AA	AA	AG	GT	CC	TT	AG	TT	<NA>	CC
142	AG	AA	AA	AA	AA	TT	CC	TT	GG	TT	<NA>	CT
143	GG	AC	AA	AG	AG	TT	CC	TT	GG	TT	<NA>	TT
144	AG	CC	AA	AA	AG	TT	CT	TT	AG	TT	<NA>	CT
145	AG	CC	AA	AA	GG	TT	CT	CT	GG	TT	<NA>	CT
146	GG	AC	AA	AA	AA	TT	CC	TT	GG	TT	<NA>	CT
147	AA	AA	AA	AG	GG	TT	CT	TT	GG	CT	<NA>	CT
148	AG	CC	AA	AA	AG	TT	CC	TT	GG	TT	<NA>	CT
149	AA	CC	AA	AA	AG	TT	CC	TT	GG	TT	<NA>	CC
150	GG	CC	AA	AG	AG	TT	CC	TT	GG	CT	<NA>	CT
151	GG	CC	AA	AG	AG	TT	CC	TT	AG	CT	<NA>	TT
152	GG	CC	AA	AG	GG	TT	CC	TT	AA	TT	<NA>	CT
153	GG	AC	AC	AG	GG	TT	CT	TT	AG	TT	<NA>	CC
154	GG	AC	AA	AG	AG	TT	CT	TT	GG	TT	<NA>	CT
155	AG	CC	AA	AA	AG	TT	CC	TT	AG	TT	<NA>	CT
156	GG	CC	AA	GG	GG	GT	CT	TT	AG	TT	<NA>	CC
157	GG	AA	CC	AA	AA	TT	CC	TT	GG	TT	<NA>	CC
158	AG	AC	AA	AA	AG	GT	CC	TT	GG	TT	<NA>	CT
159	AG	AC	AA	AA	AG	TT	CC	TT	GG	TT	<NA>	TT
160	GG	AC	AA	AA	AA	TT	CC	TT	GG	CC	<NA>	CC
161	AG	AC	AA	AA	GG	TT	CC	TT	AA	TT	<NA>	TT
162	AA	AC	AA	AG	GG	TT	CT	TT	GG	TT	<NA>	CT
163	GG	AC	AC	AG	AA	TT	CC	TT	GG	TT	<NA>	TT
164	AG	AC	AA	AA	AG	TT	CC	TT	GG	TT	<NA>	CT
165	GG	CC	AA	AG	AG	TT	CC	TT	GG	TT	<NA>	TT
166	GG	AC	AA	GG	GG	TT	CT	TT	GG	TT	<NA>	CT
167	AG	CC	AC	AA	AG	TT	CC	TT	AG	TT	<NA>	CC
168	AA	AC	AA	AG	AG	TT	CC	TT	AG	TT	<NA>	CT
169	AG	CC	AA	AA	AG	TT	CC	CT	GG	TT	<NA>	TT
170	GG	AA	AA	AA	AG	GT	CC	TT	GG	TT	<NA>	CT
171	AG	AA	AA	AA	AA	GT	CC	TT	GG	TT	<NA>	TT
172	AA	CC	AA	AA	AG	TT	CC	TT	GG	TT	<NA>	CT
173	AG	AC	AC	GG	AG	TT	CC	TT	GG	TT	<NA>	TT
174	GG	CC	AA	AA	GG	GT	TT	TT	GG	TT	<NA>	CT
175	GG	AC	AC	AG	AA	TT	CT	TT	AA	TT	<NA>	TT
176	GG	AC	CC	AA	GG	TT	CC	TT	GG	TT	<NA>	CT
177	AG	AC	AA	AG	AG	GT	CT	CT	AG	TT	<NA>	CT
178	GG	AC	AC	AA	AA	GT	CC	CT	GG	TT	<NA>	TT
179	GG	AA	AA	AG	GG	TT	CC	TT	GG	TT	<NA>	CC
180	GG	AA	AC	AA	AG	TT	CT	TT	GG	TT	CC	CT
181	AG	AA	AA	AA	AG	TT	CC	TT	GG	TT	CC	CT
182	GG	AC	AA	AA	AG	TT	CC	TT	GG	TT	CC	CT
183	GG	AA	AA	AG	AG	TT	CC	TT	GG	TT	CT	CT
184	GG	CC	AA	AA	AG	TT	CC	TT	GG	TT	CC	CT
185	AG	CC	AC	AA	GG	TT	CC	TT	GG	TT	CT	TT
186	GG	AA	AC	AA	AG	TT	CT	TT	GG	TT	CC	CT

187	GG	CC	AA	AG	GG	TT	CC	TT	GG	TT	CC	CC
188	GG	CC	AA	GG	AG	TT	CC	TT	GG	CT	CT	CT
189	AG	CC	AA	AA	AG	TT	CC	CT	GG	TT	CT	CC
190	GG	CC	AA	AA	AG	TT	CC	TT	GG	CT	CC	TT
191	GG	AC	AA	AG	GG	TT	CC	TT	GG	CT	CC	TT
192	GG	AC	AC	AG	AA	TT	CC	TT	AG	CT	CC	CC
193	GG	AC	AC	AG	AA	TT	CC	TT	GG	TT	CC	TT
194	GG	AC	AA	GG	AA	TT	CT	CT	AG	TT	CC	CT
195	AG	CC	AA	AG	GG	GT	CC	TT	GG	TT	CC	CT
196	GG	AC	AC	AG	GG	TT	CC	TT	GG	CT	CC	CT
197	GG	AC	AA	AA	AG	TT	CC	TT	AG	TT	CT	CC

```
$usekernel
```

```
[1] TRUE
```

```
$varnames
```

```
[1] "Locus01" "Locus02" "Locus03" "Locus04" "Locus05" "Locus06" "Locus07" "Locus08" "Locus09" "Locus10" "Locus11"
[12] "Locus12"
```

```
attr(,"class")
```

```
[1] "NaiveBayes"
```

```
> pred
```

```
$class
```

```
1 2 3 4 5 6 7 8
POPA POPA POPB POPB POPB POPB POPC POPC
Levels: POPA POPB POPC
```

```
$posterior
```

	POPA	POPB	POPC
1	9.999554e-01	2.953559e-05	1.506429e-05
2	9.922890e-01	5.256809e-03	2.454166e-03
3	1.975941e-07	7.664740e-01	2.335258e-01
4	1.153456e-04	8.215954e-01	1.782892e-01
5	2.323500e-06	7.583479e-01	2.416498e-01
6	1.985686e-09	6.300280e-01	3.699720e-01
7	5.489696e-09	4.877856e-01	5.122144e-01
8	4.342867e-09	3.584623e-01	6.415377e-01

```
> tab <- table(pred$class, test$Population)
```

```
> caret::confusionMatrix(tab)
```

```
Confusion Matrix and Statistics
```

	POPA	POPB	POPC
POPA	2	0	0
POPB	0	3	1
POPC	0	0	2

```
Overall Statistics
```

```
Accuracy : 0.875
95% CI : (0.4735, 0.9968)
No Information Rate : 0.375
P-Value [Acc > NIR] : 0.005605
```

```
Kappa : 0.8095
McNemar's Test P-Value : NA
```

```
Statistics by Class:
```

	Class: POPA	Class: POPB	Class: POPC
Sensitivity	1.00	1.000	0.6667
Specificity	1.00	0.800	1.0000
Pos Pred Value	1.00	0.750	1.0000
Neg Pred Value	1.00	1.000	0.8333
Prevalence	0.25	0.375	0.3750
Detection Rate	0.25	0.375	0.2500
Detection Prevalence	0.25	0.500	0.2500
Balanced Accuracy	1.00	0.900	0.8333

```
> library(ggplot2)
```

```
> test$pred <- pred$class
```

```
> ggplot(test, aes(Population, pred, color = Population)) + geom_jitter(width = 0.2, height = 0.1,
size=2)+labs(title="Confusion Matrix", subtitle="Predicted vs. Observed from SNP dataset", y="Predicted", x="Truth")
```

```
>
```

```
>
```