SY19 - TP3 Rapport

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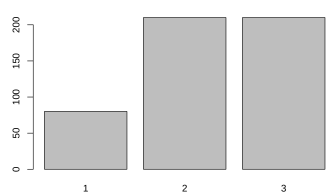
1 Classifieur

1.1 Preparation : Partitioning raw data to train & test

```
set.seed(69)
clas.test.id <- createDataPartition(TPN1_a22_clas_app$y,
                                    p = 1/5,
                                    list = TRUE)

clas.data.test  <- TPN1_a22_clas_app[ clas.test.id[[1]],]
clas.data.train <- TPN1_a22_clas_app[-clas.test.id[[1]],]
clas.levels <- levels(TPN1_a22_clas_app$y)
```

1.2 Data exploration



```
## [1] 0.58
```

First we explore the data a little, there is barplot can be seen: Y consists of three classes, the number of class1 is significantly smaller than the number of class2, 3. So if we do not do machine learning and choose the class with the largest proportion each time, our error rate will be 0.58, which will be the highest error rate we can accept

1.3 Nonparametric method kNN

The first method we choose is the non-parametric one, the knn method. Firstly we apply KNN with an arbitrary k = 10 to have a look at general result.

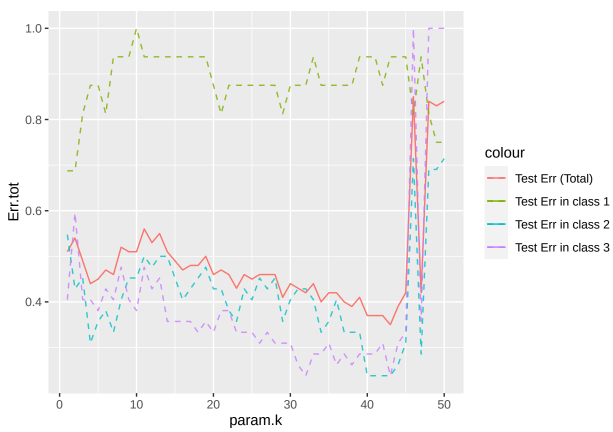
```
## [1] "Contingency matrix:"
```

```
##    clas.knn.fit
##      1  2  3
##   1  0  5 11
##   2  0 23 19
##   3  2 14 26

## [1] "Error total:"

## [1] 0.51

## [1] "Error within each class"

##         1         2         3
## 1.0000000 0.4523810 0.3809524
```

The error rate reaches 0.51

1.3.1 KNN with an arbitrary k

Next we try to iterate over k to see if we can optimize the error rate



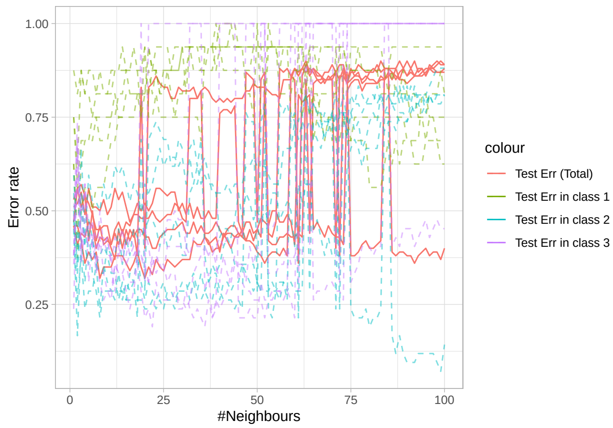

```
## [1] "Error minimal:"
```

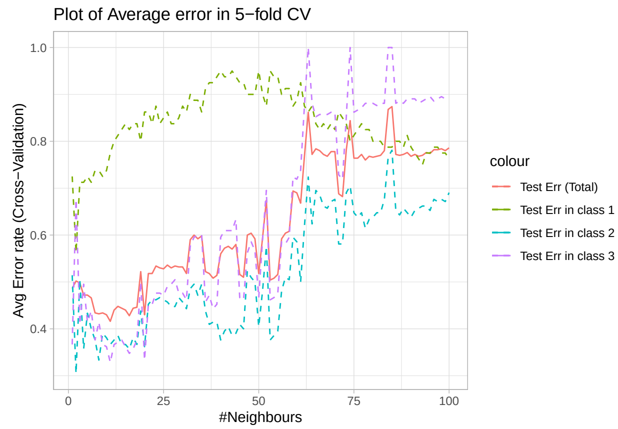
	Err.tot	Err.1	Err.2	Err.3	param.k
43	0.35	0.9375	0.2380952	0.2380952	43

Observing the plot, we see that class1 has an error rate of 1 when the value of k exceeds 10, most likely because class1 is a smaller class and is therefore divided into other classes when the value of k increases. But at k = 43 we observed a minimum error rate of 0.35, which is unlikily and next we applied cross comparisons to confirm the results. ### k_f-fold validation with k=5 In the k-fold validation, firtly we choose k = 5

```
## [1] "result"
## [1] "best parameter k : "
```

param.k	avg.Err.tot
11	0.416



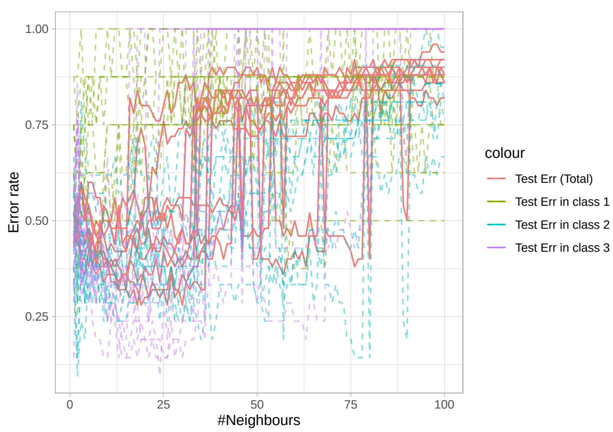


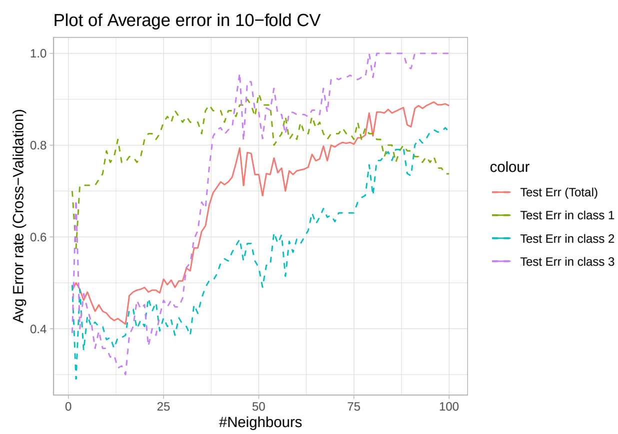
After k-fold =5, we obtained optimal results at KNN k=11 with an error rate of 0.41.

1.3.2 k_f-fold validation with k=10

```
## [1] "result"
## [1] "best parameter k : "
```

param.k	avg.Err.tot
15	0.41





After k-fold =10, we obtained optimal results at KNN k=15 with an error rate of 0.41, The results are similar

1.4 QDA

```
## $contingency.matrix
##            pred_class
## test_class  1  2  3
```

```
##           1  0  5 11
##           2  0 36  6
##           3  0  8 34
##
## $test.error.total
## [1] 0.3
##
## $test.error.within_class
##         1         2         3
## 1.0000000 0.1428571 0.1904762
```

After one QDA, we obtained an error rate of 0.38, which is already better than the optimal KNN result.

1.5 QDA with K-fold validation

1.5.1 k =5, repeats 10

```
##     Err.tot           Err.1            Err.2             Err.3
##  Min.   :0.2400   Min.   :0.9375   Min.   :0.09524   Min.   :0.02381
##  1st Qu.:0.3100   1st Qu.:1.0000   1st Qu.:0.21429   1st Qu.:0.11905
##  Median :0.3400   Median :1.0000   Median :0.23810   Median :0.16667
##  Mean   :0.3294   Mean   :0.9962   Mean   :0.24381   Mean   :0.16095
##  3rd Qu.:0.3500   3rd Qu.:1.0000   3rd Qu.:0.28571   3rd Qu.:0.19048
##  Max.   :0.4000   Max.   :1.0000   Max.   :0.38095   Max.   :0.28571
```

1.5.2 k =10, repeats 10

```
##     Err.tot           Err.1            Err.2             Err.3
##  Min.   :0.2200   Min.   :0.7500   Min.   :0.09524   Min.   :0.00000
##  1st Qu.:0.2800   1st Qu.:1.0000   1st Qu.:0.17857   1st Qu.:0.09524
##  Median :0.3200   Median :1.0000   Median :0.23810   Median :0.14286
##  Mean   :0.3234   Mean   :0.9788   Mean   :0.22810   Mean   :0.16905
##  3rd Qu.:0.3600   3rd Qu.:1.0000   3rd Qu.:0.28571   3rd Qu.:0.23810
##  Max.   :0.4600   Max.   :1.0000   Max.   :0.42857   Max.   :0.38095
```

1.6 LDA

```
## $contingency.matrix
##            pred_class
## test_class  1  2  3
##           1  7  2  7
##           2  2 23 17
##           3  5 11 26
##
## $test.error.total
## [1] 0.44
##
## $test.error.within_class
##         1         2         3
## 0.5625000 0.4523810 0.3809524
```

1.7 LDA with K-fold validation

1.7.1 k =5, repeats 10

```
##     Err.tot          Err.1            Err.2            Err.3       
##  Min.   :0.330   Min.   :0.2500   Min.   :0.1667   Min.   :0.3571  
##  1st Qu.:0.380   1st Qu.:0.4375   1st Qu.:0.2679   1st Qu.:0.4524  
##  Median :0.420   Median :0.5312   Median :0.3214   Median :0.4881  
##  Mean   :0.429   Mean   :0.5300   Mean   :0.3219   Mean   :0.4976  
##  3rd Qu.:0.470   3rd Qu.:0.6094   3rd Qu.:0.3750   3rd Qu.:0.5476  
##  Max.   :0.530   Max.   :0.8125   Max.   :0.5000   Max.   :0.7619  
```

1.7.2 k =10, repeats 10

```
##     Err.tot           Err.1             Err.2              Err.3        
##  Min.   :0.2200   Min.   :0.8750   Min.   :0.09524   Min.   :0.00000  
##  1st Qu.:0.3000   1st Qu.:1.0000   1st Qu.:0.14286   1st Qu.:0.09524  
##  Median :0.3200   Median :1.0000   Median :0.23810   Median :0.14286  
##  Mean   :0.3248   Mean   :0.9788   Mean   :0.23429   Mean   :0.16619  
##  3rd Qu.:0.3600   3rd Qu.:1.0000   3rd Qu.:0.28571   3rd Qu.:0.23810  
##  Max.   :0.4800   Max.   :1.0000   Max.   :0.52381   Max.   :0.42857  
```

1.8 Naive Bayes

```
## $contingency.matrix
##           pred_class
## test_class  1  2  3
##          1 10  1  5
##          2  1 33  8
##          3  4 14 24
## 
## $test.error.total
## [1] 0.33
## 
## $test.error.within_class
##         1         2         3 
## 0.3750000 0.2142857 0.4285714 
```

1.9 Naive Bayes with K-fold validation

1.9.1 k =5, repeats 10

```
##     Err.tot           Err.1             Err.2              Err.3       
##  Min.   :0.2500   Min.   :0.1875   Min.   :0.07143   Min.   :0.2857  
##  1st Qu.:0.3300   1st Qu.:0.3750   1st Qu.:0.16667   1st Qu.:0.4107  
##  Median :0.3600   Median :0.4375   Median :0.21429   Median :0.4762  
##  Mean   :0.3588   Mean   :0.4437   Mean   :0.21619   Mean   :0.4690  
##  3rd Qu.:0.3900   3rd Qu.:0.5000   3rd Qu.:0.26190   3rd Qu.:0.5238  
##  Max.   :0.4400   Max.   :0.6875   Max.   :0.35714   Max.   :0.6190  
```

1.9.2 k =10, repeats 10

```
##     Err.tot           Err.1            Err.2            Err.3
##  Min.   :0.2400   Min.   :0.0000   Min.   :0.0000   Min.   :0.2381
##  1st Qu.:0.3000   1st Qu.:0.3438   1st Qu.:0.1429   1st Qu.:0.4286
##  Median :0.3400   Median :0.3750   Median :0.1905   Median :0.4762
##  Mean   :0.3526   Mean   :0.4375   Mean   :0.2014   Mean   :0.4714
##  3rd Qu.:0.4000   3rd Qu.:0.6250   3rd Qu.:0.2381   3rd Qu.:0.5714
##  Max.   :0.5400   Max.   :0.8750   Max.   :0.4286   Max.   :0.6667
```

1.10 Multinomial logistic regression

Here, our data have the classes c > 2, so we used the "Multinomial logistic regression" method

```
## # weights:  156 (102 variable)
## initial  value 439.444915
## iter  10 value 287.826765
## iter  20 value 281.332153
## iter  30 value 272.637048
## iter  40 value 265.495269
## iter  50 value 259.341441
## iter  60 value 253.535272
## iter  70 value 246.931670
## iter  80 value 244.580896
## iter  90 value 242.577689
## iter 100 value 241.311703
## final  value 241.311703
## stopped after 100 iterations
```

```
## $contingency.matrix
##           pred_class
## test_class  1  2  3
##          1  6  0 10
##          2  2 22 18
##          3  5  9 28
##
## $test.error.total
## [1] 0.44
##
## $test.error.within_class
##         1         2         3
## 0.6250000 0.4761905 0.3333333
```

1.11 Naive Bayes with K-fold validation

1.11.1 k =5, repeats 10

```
##     Err.tot           Err.1            Err.2            Err.3
##  Min.   :0.3300   Min.   :0.1875   Min.   :0.1190   Min.   :0.3095
##  1st Qu.:0.4000   1st Qu.:0.4375   1st Qu.:0.2857   1st Qu.:0.4286
##  Median :0.4250   Median :0.5000   Median :0.3333   Median :0.4762
##  Mean   :0.4288   Mean   :0.5337   Mean   :0.3424   Mean   :0.4752
```

```
##  3rd Qu.:0.4600   3rd Qu.:0.6094   3rd Qu.:0.4048   3rd Qu.:0.5238
##  Max.   :0.5900   Max.   :0.9375   Max.   :0.5000   Max.   :0.5952
```

1.11.2 k =10, repeats 10

```
##     Err.tot           Err.1            Err.2              Err.3
##  Min.   :0.2800   Min.   :0.1250   Min.   :0.04762   Min.   :0.2381
##  1st Qu.:0.3800   1st Qu.:0.3750   1st Qu.:0.23810   1st Qu.:0.3810
##  Median :0.4200   Median :0.5000   Median :0.33333   Median :0.4524
##  Mean   :0.4172   Mean   :0.5112   Mean   :0.33524   Mean   :0.4633
##  3rd Qu.:0.4600   3rd Qu.:0.6250   3rd Qu.:0.39286   3rd Qu.:0.5238
##  Max.   :0.5800   Max.   :0.8750   Max.   :0.57143   Max.   :0.7619
```

2 Principal component analysis