REPORT 1

Import the Training Data

```
[1] "Training data"
# A tibble: 100 × 97
      X1    X2    X3    X4    X5     X6     X7      X8     X9     X10     X11
   <dbl> <dbl> <dbl> <dbl> <dbl>  <dbl>  <dbl>   <dbl>  <dbl>   <dbl>   <dbl>
 1    -1 0.502 0.542 0.722 1.43  2.14    2.28   1.94    1.47   1.01    0.380
 2     1 0.148 0.805 0.368 0.244 0.0266 -0.274  0.0967 -0.748 -1.61   -1.18
 3    -1 0.317 0.243 0.370 1.06  1.68    1.76   1.70    1.61   1.17    0.500
 4    -1 1.17  2.08  1.76  1.61  1.95    1.30   0.459   0.516  0.852   0.989
 5     1 0.649 0.752 2.64  3.46  2.12    0.521 -0.189   0.781  0.934   0.701
 6     1 0.405 1.28  2.52  1.30  1.45    0.474 -1.40   -0.647  0.432   0.132
 7    -1 1.21  2.03  2.45  2.74  2.75    2.28   1.53    0.761  0.188  -0.0291
 8    -1 0.598 1.10  1.68  2.48  2.80    2.44   1.72    1.01   0.257  -0.222
 9     1 0.328 1.21  2.60  2.21  1.62   -0.239 -1.60   -0.602 -0.0866  0.0266
10     1 1.67  2.85  2.52  2.17  0.720   0.725  1.64    1.29   1.61    1.40
# … with 90 more rows, and 86 more variables: X12 <dbl>, X13 <dbl>, X14 <dbl>,
#   X15 <dbl>, X16 <dbl>, X17 <dbl>, X18 <dbl>, X19 <dbl>, X20 <dbl>,
#   X21 <dbl>, X22 <dbl>, X23 <dbl>, X24 <dbl>, X25 <dbl>, X26 <dbl>,
#   X27 <dbl>, X28 <dbl>, X29 <dbl>, X30 <dbl>, X31 <dbl>, X32 <dbl>,
#   X33 <dbl>, X34 <dbl>, X35 <dbl>, X36 <dbl>, X37 <dbl>, X38 <dbl>,
#   X39 <dbl>, X40 <dbl>, X41 <dbl>, X42 <dbl>, X43 <dbl>, X44 <dbl>,
#   X45 <dbl>, X46 <dbl>, X47 <dbl>, X48 <dbl>, X49 <dbl>, X50 <dbl>, …
```

Import the Testing Data

```
[1] "Testing data"
# A tibble: 100 × 97
      X1    X2    X3    X4    X5      X6     X7     X8     X9      X10     X11
   <dbl> <dbl> <dbl> <dbl> <dbl>   <dbl>  <dbl>  <dbl>  <dbl>    <dbl>   <dbl>
 1     1 0.425 1.42  2.67   3.30  2.26    0.165 -0.960  0.283  0.843    0.683
 2     1 0.654 2.18  3.64   2.28  0.978  -0.388 -0.912 -0.148  0.305   -0.230
 3     1 0.405 0.554 0.724  1.45  2.01    1.62   1.20   1.12   0.562   -0.0116
 4     1 1.09  2.01  2.30   1.63  0.637  -0.141  0.548  1.08   0.897    1.14
 5    -1 0.444 0.947 1.92   2.16  1.50    0.965  0.223 -0.425  0.121    0.830
 6     1 0.209 1.27  2.82   3.59  2.22    0.570 -0.939 -0.813 -0.00936 -0.266
 7     1 1.09  1.85  1.83   1.55  1.38    1.00   0.255 -0.333 -0.444   -0.138
 8     1 1.71  2.75  1.68   1.24 -0.0380 -0.218  0.790  0.547  0.302    0.339
 9     1 1.62  2.95  2.70   2.70  1.07    0.210  1.16   1.38   0.995    0.948
10    -1 0.796 0.950 1.15   1.75  2.43    2.67   2.46   2.07   1.62     1.09
# … with 90 more rows, and 86 more variables: X12 <dbl>, X13 <dbl>, X14 <dbl>,
#   X15 <dbl>, X16 <dbl>, X17 <dbl>, X18 <dbl>, X19 <dbl>, X20 <dbl>,
#   X21 <dbl>, X22 <dbl>, X23 <dbl>, X24 <dbl>, X25 <dbl>, X26 <dbl>,
#   X27 <dbl>, X28 <dbl>, X29 <dbl>, X30 <dbl>, X31 <dbl>, X32 <dbl>,
#   X33 <dbl>, X34 <dbl>, X35 <dbl>, X36 <dbl>, X37 <dbl>, X38 <dbl>,
#   X39 <dbl>, X40 <dbl>, X41 <dbl>, X42 <dbl>, X43 <dbl>, X44 <dbl>,
#   X45 <dbl>, X46 <dbl>, X47 <dbl>, X48 <dbl>, X49 <dbl>, X50 <dbl>, …
```

Merge the Data

```
[1] "Merged data"
# A tibble: 200 × 97
      X1    X2    X3    X4    X5     X6     X7      X8     X9     X10     X11
   <dbl> <dbl> <dbl> <dbl> <dbl>  <dbl>  <dbl>   <dbl>  <dbl>   <dbl>   <dbl>
 1    -1 0.502 0.542 0.722 1.43  2.14    2.28   1.94    1.47   1.01    0.380
 2     1 0.148 0.805 0.368 0.244 0.0266 -0.274  0.0967 -0.748 -1.61   -1.18
 3    -1 0.317 0.243 0.370 1.06  1.68    1.76   1.70    1.61   1.17    0.500
 4    -1 1.17  2.08  1.76  1.61  1.95    1.30   0.459   0.516  0.852   0.989
 5     1 0.649 0.752 2.64  3.46  2.12    0.521 -0.189   0.781  0.934   0.701
 6     1 0.405 1.28  2.52  1.30  1.45    0.474 -1.40   -0.647  0.432   0.132
 7    -1 1.21  2.03  2.45  2.74  2.75    2.28   1.53    0.761  0.188  -0.0291
 8    -1 0.598 1.10  1.68  2.48  2.80    2.44   1.72    1.01   0.257  -0.222
 9     1 0.328 1.21  2.60  2.21  1.62   -0.239 -1.60   -0.602 -0.0866  0.0266
10     1 1.67  2.85  2.52  2.17  0.720   0.725  1.64    1.29   1.61    1.40
# … with 190 more rows, and 86 more variables: X12 <dbl>, X13 <dbl>, X14 <dbl>,
#   X15 <dbl>, X16 <dbl>, X17 <dbl>, X18 <dbl>, X19 <dbl>, X20 <dbl>,
#   X21 <dbl>, X22 <dbl>, X23 <dbl>, X24 <dbl>, X25 <dbl>, X26 <dbl>,
#   X27 <dbl>, X28 <dbl>, X29 <dbl>, X30 <dbl>, X31 <dbl>, X32 <dbl>,
#   X33 <dbl>, X34 <dbl>, X35 <dbl>, X36 <dbl>, X37 <dbl>, X38 <dbl>,
#   X39 <dbl>, X40 <dbl>, X41 <dbl>, X42 <dbl>, X43 <dbl>, X44 <dbl>,
#   X45 <dbl>, X46 <dbl>, X47 <dbl>, X48 <dbl>, X49 <dbl>, X50 <dbl>, …
```

The dataset was present as two TSV (tab-separated) files. In order to combine the data from both files, they were first imported using the library “Tidyverse” and the function it provides “read_tsv”. The function returns a dataframe with the data laid out in rows and columns. The “rbind” function was used to combine both dataframes into a single dataframe.

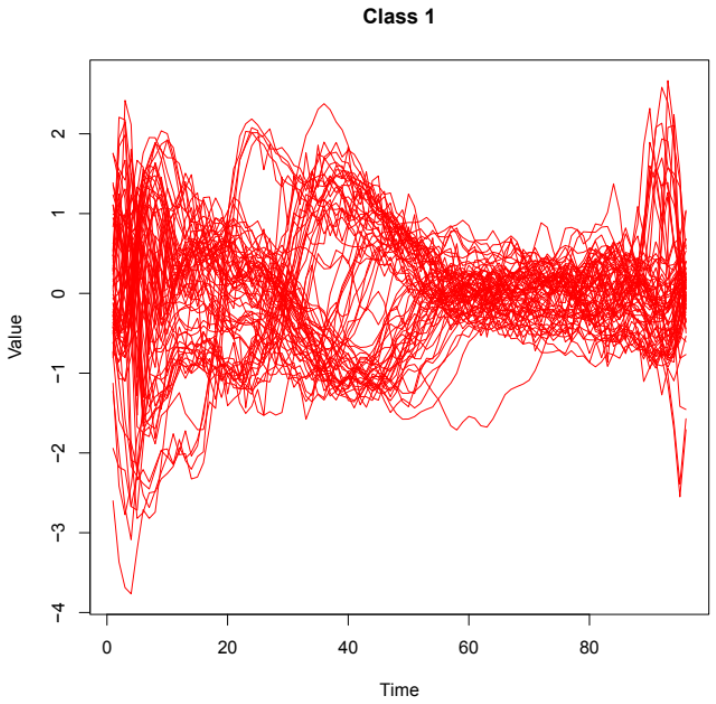
Extract Class 1

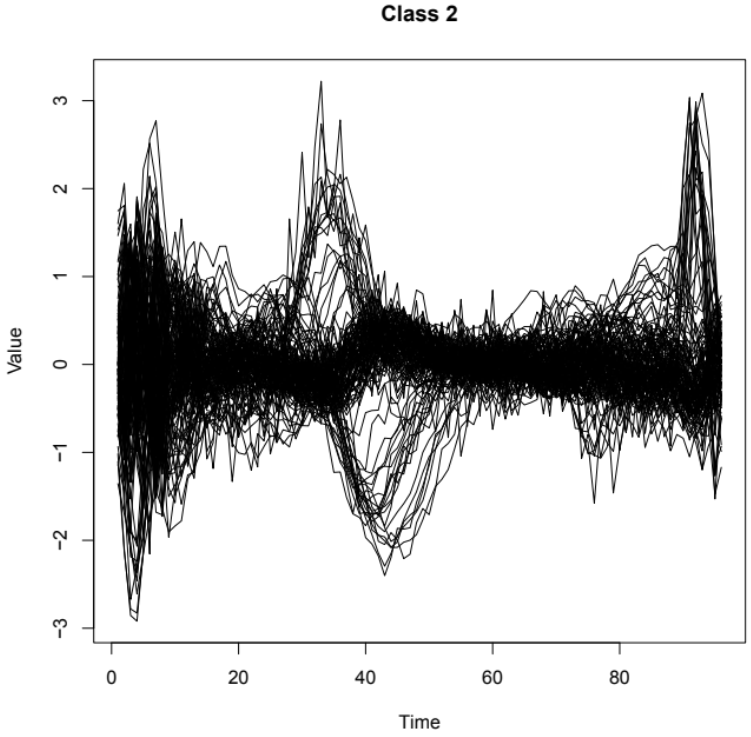
```
[1] "Class 1"
# A tibble: 67 × 97
      X1    X2    X3    X4    X5      X6    X7    X8    X9    X10     X11
   <dbl> <dbl> <dbl> <dbl> <dbl>   <dbl> <dbl> <dbl> <dbl>  <dbl>   <dbl>
 1    -1 0.502 0.542 0.722 1.43   2.14   2.28  1.94  1.47   1.01   0.380
 2    -1 0.317 0.243 0.370 1.06   1.68   1.76  1.70  1.61   1.17   0.500
 3    -1 1.17  2.08  1.76  1.61   1.95   1.30  0.459 0.516  0.852  0.989
 4    -1 1.21  2.03  2.45  2.74   2.75   2.28  1.53  0.761  0.188 -0.0291
 5    -1 0.598 1.10  1.68  2.48   2.80   2.44  1.72  1.01   0.257 -0.222
 6    -1 0.501 0.729 0.834 1.26   2.00   2.50  2.45  2.22   2.12   1.92
 7    -1 1.09  1.56  1.37  1.25   1.49   1.68  1.23  0.344 -0.335 -0.729
 8    -1 0.526 1.01  1.79  2.36   2.30   2.09  1.97  1.51   0.750  0.115
 9    -1 1.35  2.83  2.64  1.22  -0.0567 1.20  0.725 0.967  0.550 -0.989
10    -1 0.203 0.462 0.748 0.997  0.999  0.849 0.876 1.01   0.808  0.161
# … with 57 more rows, and 86 more variables: X12 <dbl>, X13 <dbl>, X14 <dbl>,
#   X15 <dbl>, X16 <dbl>, X17 <dbl>, X18 <dbl>, X19 <dbl>, X20 <dbl>,
#   X21 <dbl>, X22 <dbl>, X23 <dbl>, X24 <dbl>, X25 <dbl>, X26 <dbl>,
#   X27 <dbl>, X28 <dbl>, X29 <dbl>, X30 <dbl>, X31 <dbl>, X32 <dbl>,
#   X33 <dbl>, X34 <dbl>, X35 <dbl>, X36 <dbl>, X37 <dbl>, X38 <dbl>,
#   X39 <dbl>, X40 <dbl>, X41 <dbl>, X42 <dbl>, X43 <dbl>, X44 <dbl>,
#   X45 <dbl>, X46 <dbl>, X47 <dbl>, X48 <dbl>, X49 <dbl>, X50 <dbl>, …
```

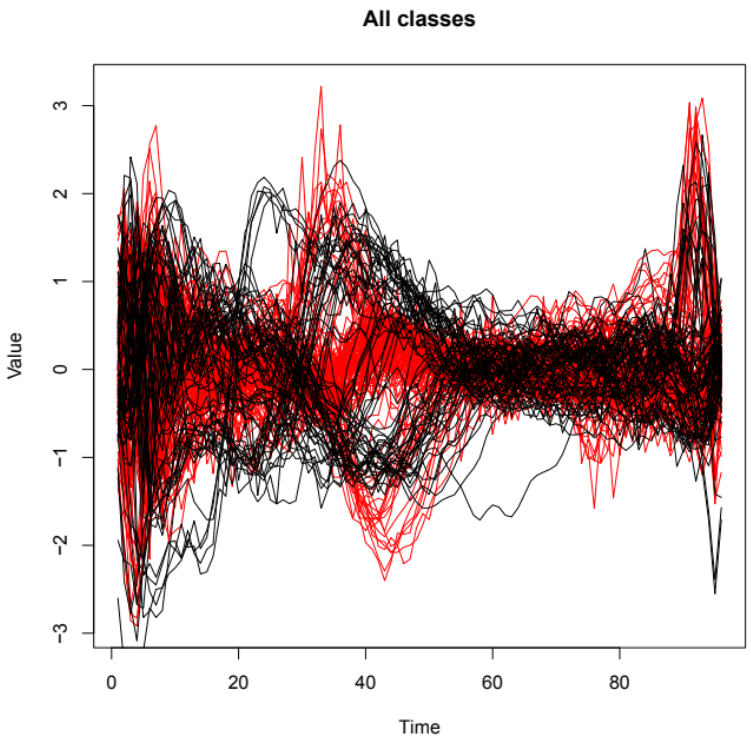
Extract Class 2

```
[1] "Class 2"
# A tibble: 133 × 97
      X1     X2     X3    X4     X5      X6      X7      X8     X9     X10
   <dbl>  <dbl>  <dbl> <dbl>  <dbl>   <dbl>   <dbl>   <dbl>  <dbl>   <dbl>
 1     1  0.148  0.805 0.368  0.244  0.0266 -0.274   0.0967 -0.748 -1.61
 2     1  0.649  0.752 2.64   3.46   2.12    0.521  -0.189   0.781  0.934
 3     1  0.405  1.28  2.52   1.30   1.45    0.474  -1.40   -0.647  0.432
 4     1  0.328  1.21  2.60   2.21   1.62   -0.239  -1.60   -0.602 -0.0866
 5     1  1.67   2.85  2.52   2.17   0.720   0.725   1.64    1.29   1.61
 6     1  0.482  0.987 1.44   2.19   2.52    1.88    1.09    0.353 -0.294
 7     1  0.275  0.481 0.919  1.54   2.05    2.25    1.88    1.22   0.581
 8     1 -0.706 -0.226 0.216 -0.318 -0.649  -1.22   -1.52   -1.51  -1.55
 9     1  0.988  2.81  3.85   2.38   1.70    0.0786 -0.597   0.827  0.871
10     1  2.25   3.54  2.89   2.72   0.862   0.376   1.64    1.28   1.16
# … with 123 more rows, and 87 more variables: X11 <dbl>, X12 <dbl>, X13 <dbl>,
#   X14 <dbl>, X15 <dbl>, X16 <dbl>, X17 <dbl>, X18 <dbl>, X19 <dbl>,
#   X20 <dbl>, X21 <dbl>, X22 <dbl>, X23 <dbl>, X24 <dbl>, X25 <dbl>,
#   X26 <dbl>, X27 <dbl>, X28 <dbl>, X29 <dbl>, X30 <dbl>, X31 <dbl>,
#   X32 <dbl>, X33 <dbl>, X34 <dbl>, X35 <dbl>, X36 <dbl>, X37 <dbl>,
#   X38 <dbl>, X39 <dbl>, X40 <dbl>, X41 <dbl>, X42 <dbl>, X43 <dbl>,
#   X44 <dbl>, X45 <dbl>, X46 <dbl>, X47 <dbl>, X48 <dbl>, X49 <dbl>, …
```

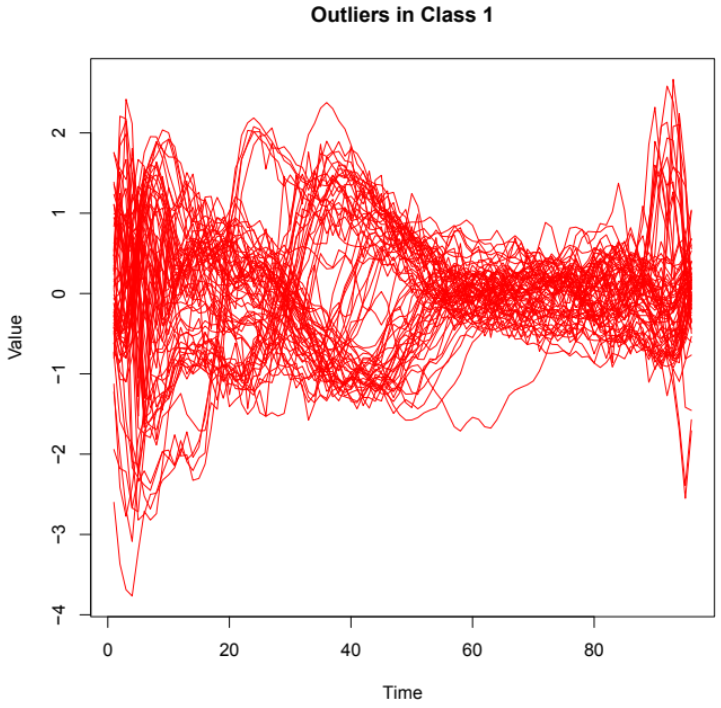
The data of category "-1" were taken as the first class "Class 1" and the data with category "1" were taken as "Class 2". The data belonging to the different categories were extracted to separate dataframes. These data were then plotted after converting them to functional data using the library "fda" and the function it provides "fdata.cen()".

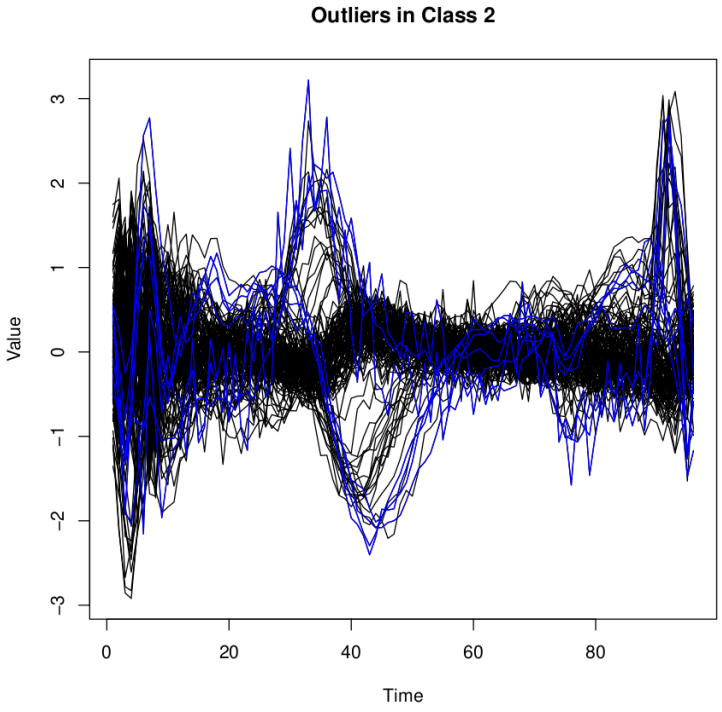



Class 2
Value
Time
3
2
1
0
−1
−2
−3
0
20
40
60
80


All classes
Value
Time
3
2
1
0
−1
−2
−3
0
20
40
60
80

Extract Outliers from both Classes





The outliers from both classes are extracted using the “outliers.depth.trim()” function from the “fda.usc” library. The outliers along with the classes are plotted. The outliers are shown as the blue lines in the plots. An interesting observation is that one of the classes (Class 1) does not seem to have outliers present. All the outliers in the entire dataset seem to be present in “Class 2”.