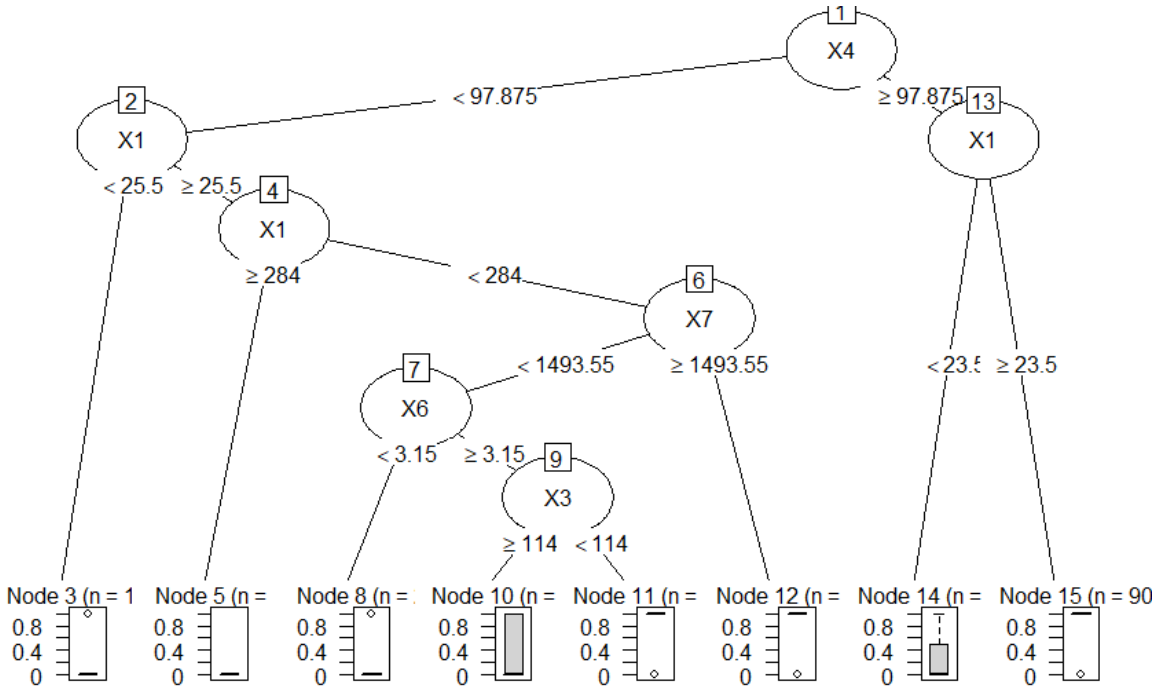
Project Report for CA 2

By Arambakam Mukesh – 19301497

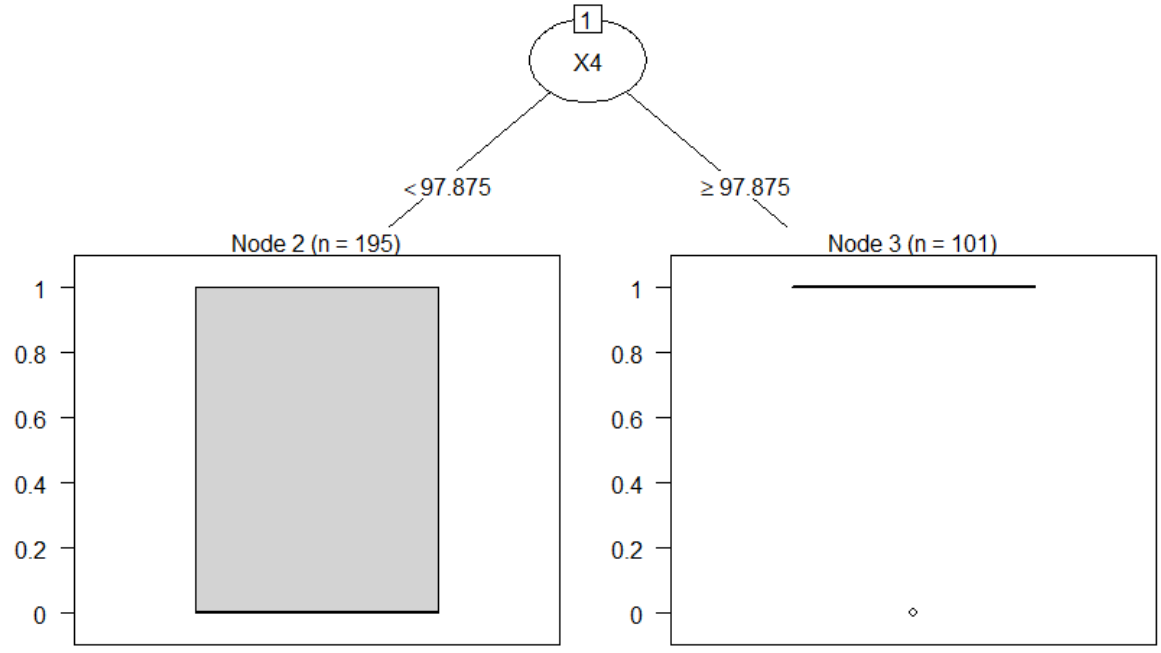
The code for this can be found on my GitHub, please find the link to the repo below.

https://github.com/mukeshmk/r-project

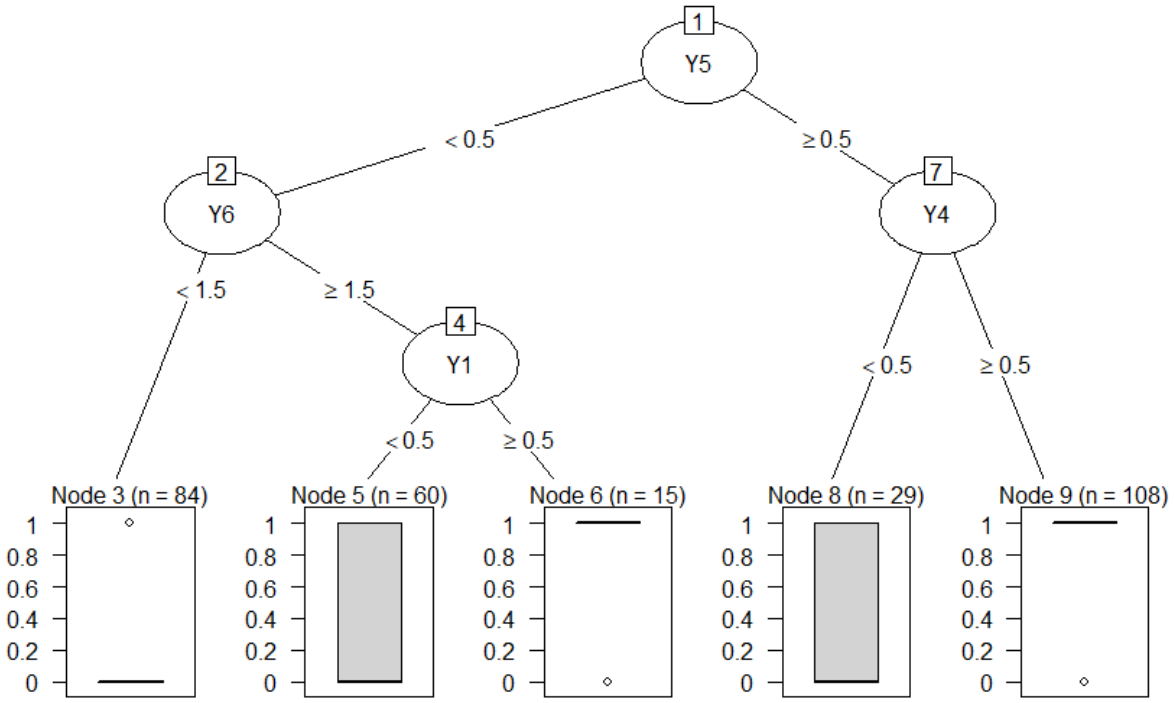
Decision tree using X data without pruning



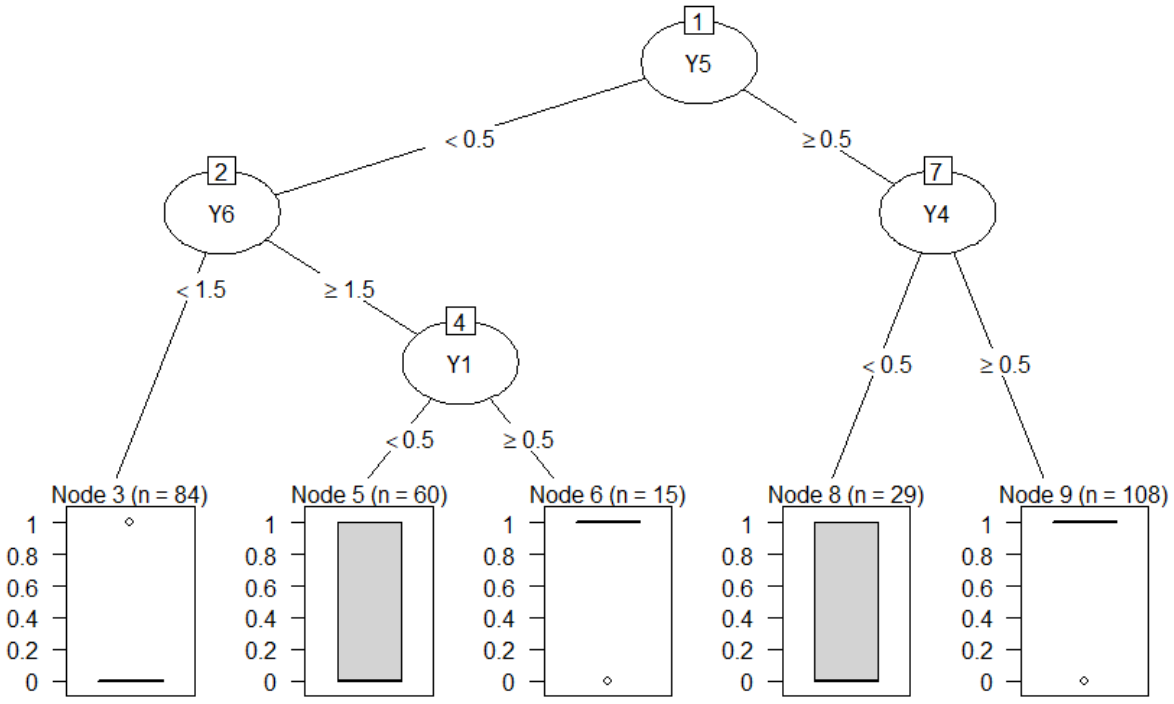
Decision tree using X data with pruning



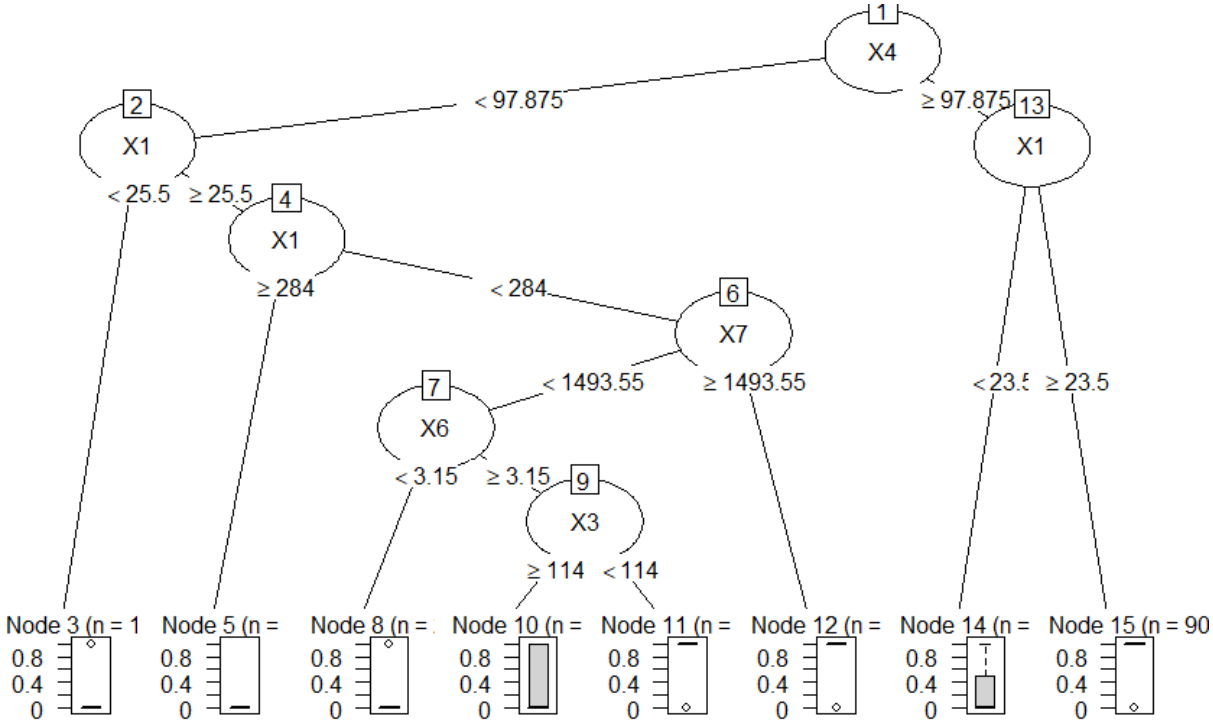
Decision tree using Y data without pruning



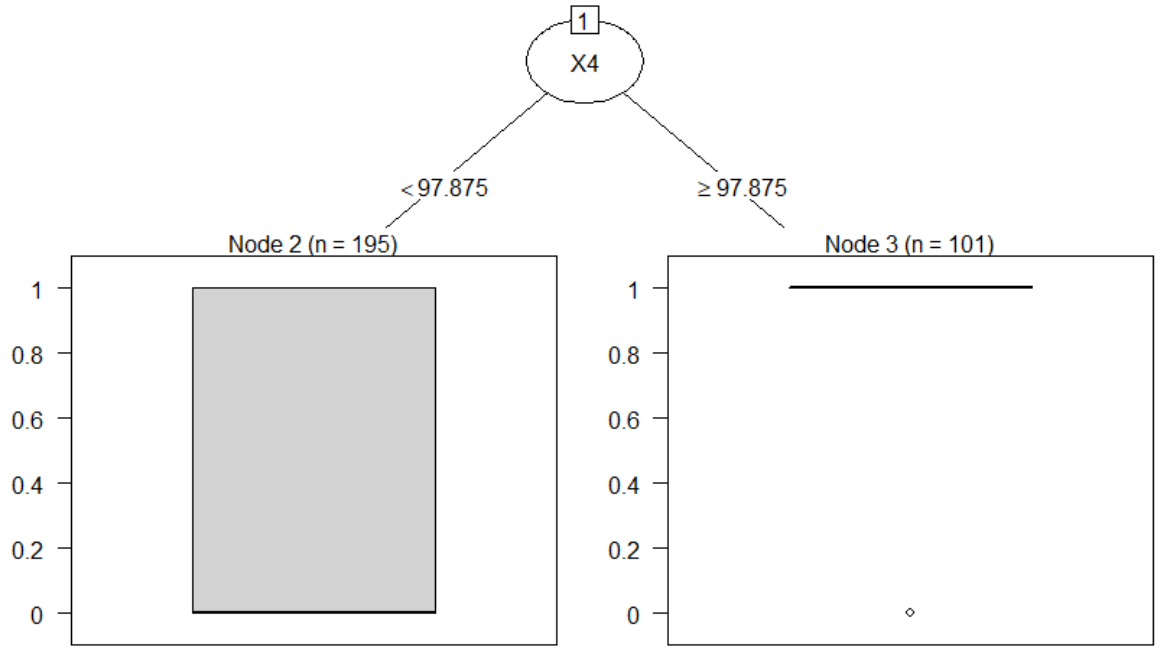
Decision tree using Y data with pruning



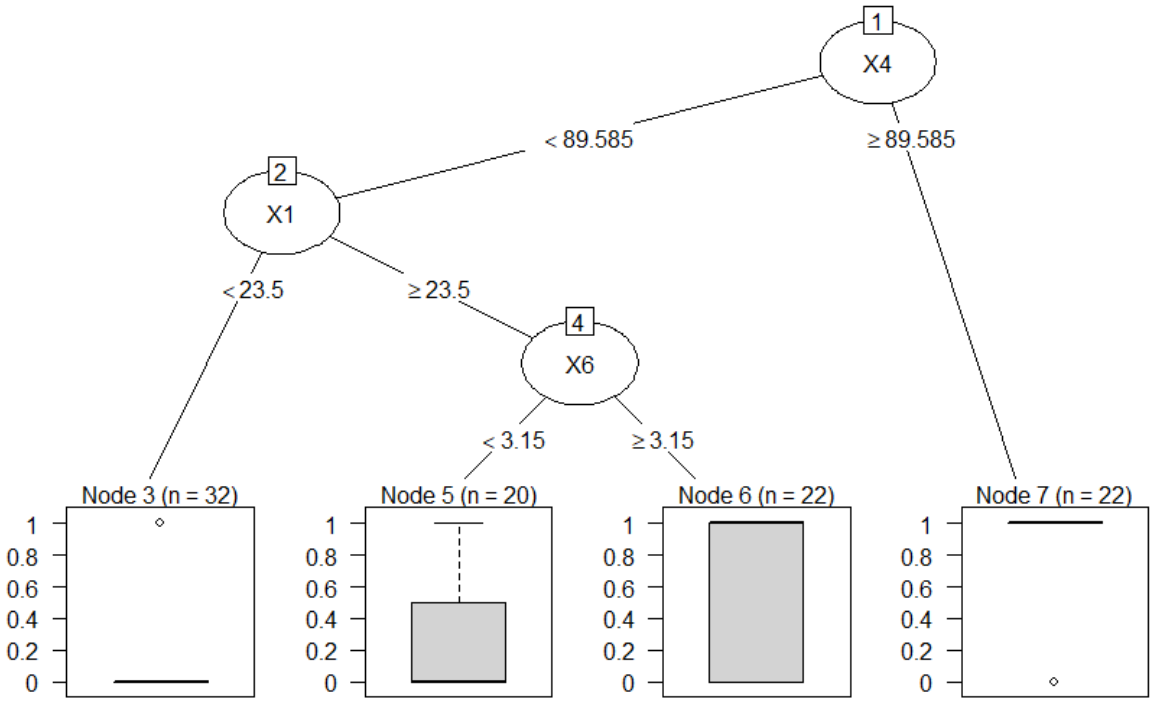
Decision tree using X & Y data without pruning



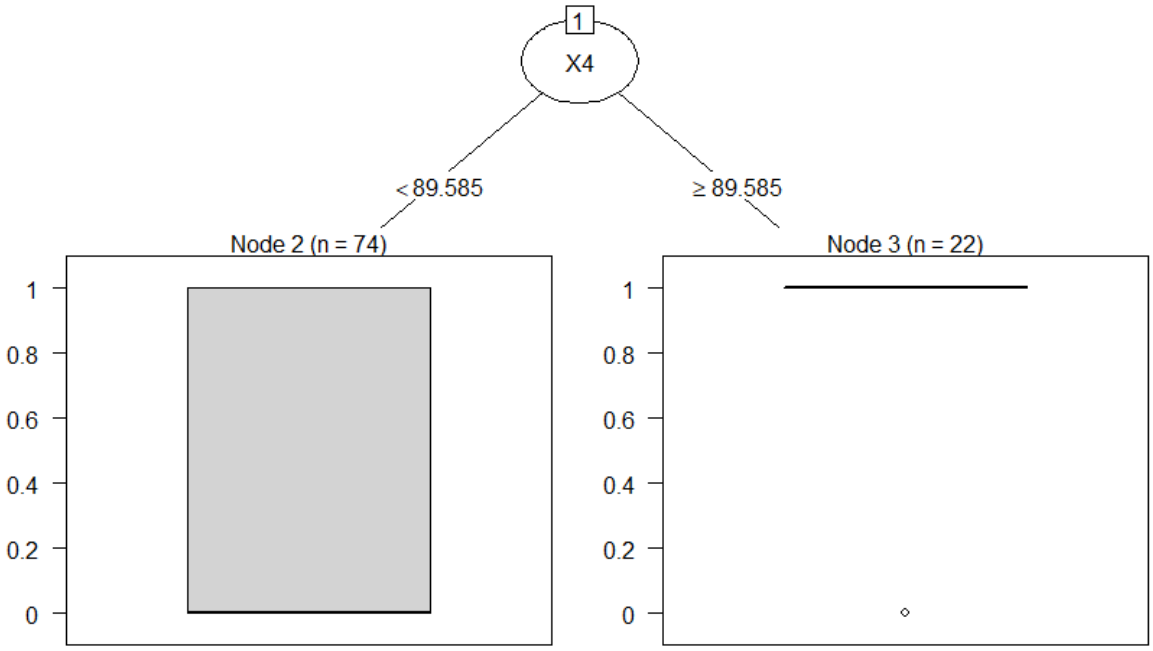
Decision tree using X & Y data with pruning



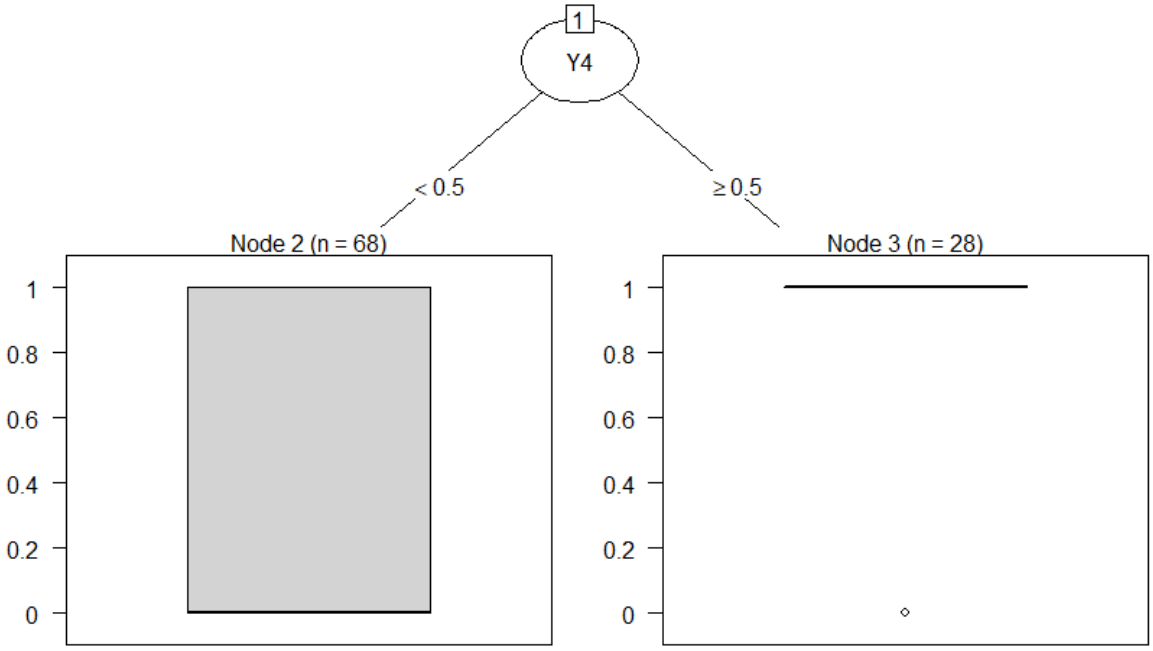
Decision tree using X data for group 0 without pruning



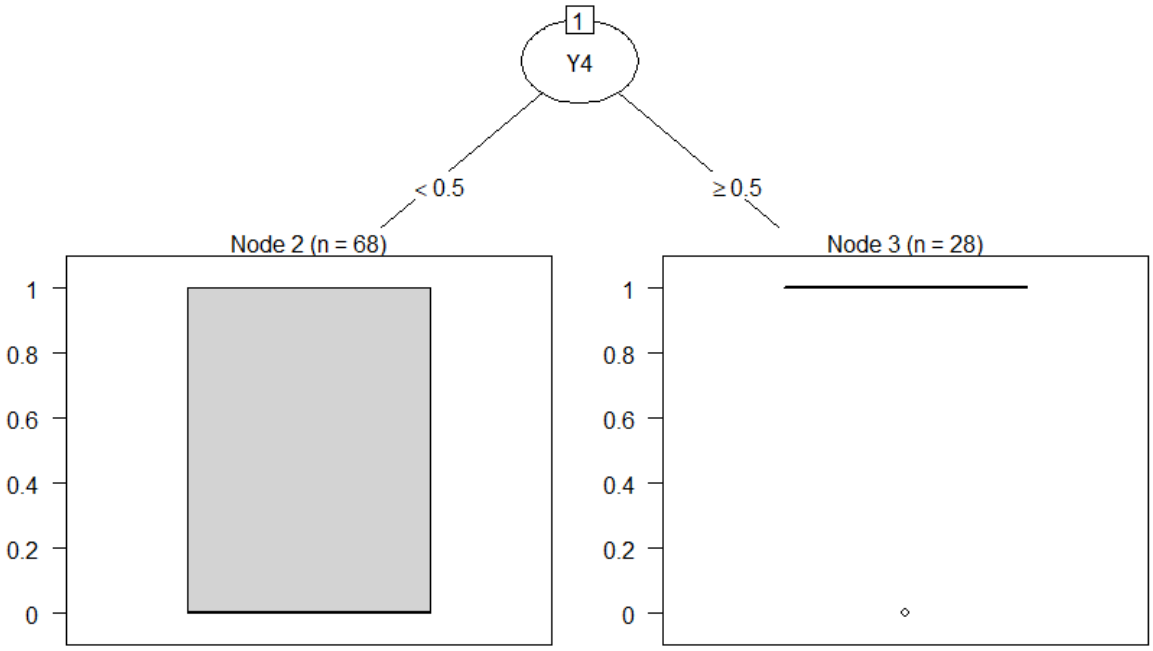
Decision tree using X data for group 0 with pruning



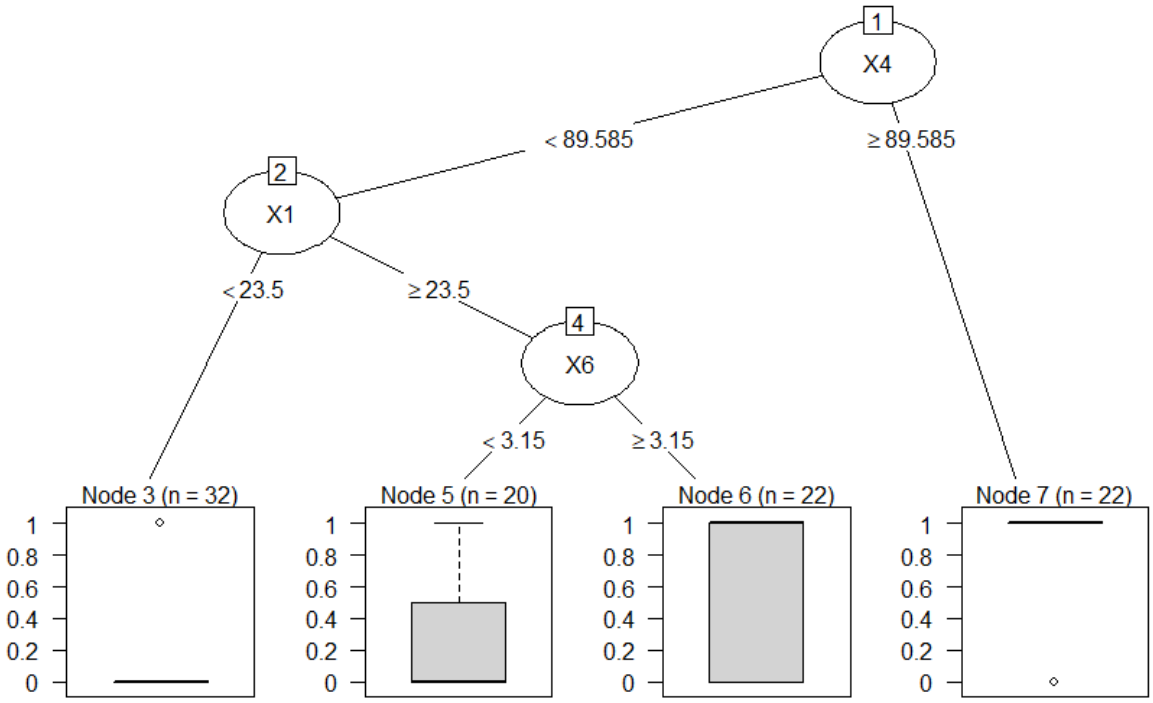
Decision tree using Y data for group 0 without pruning



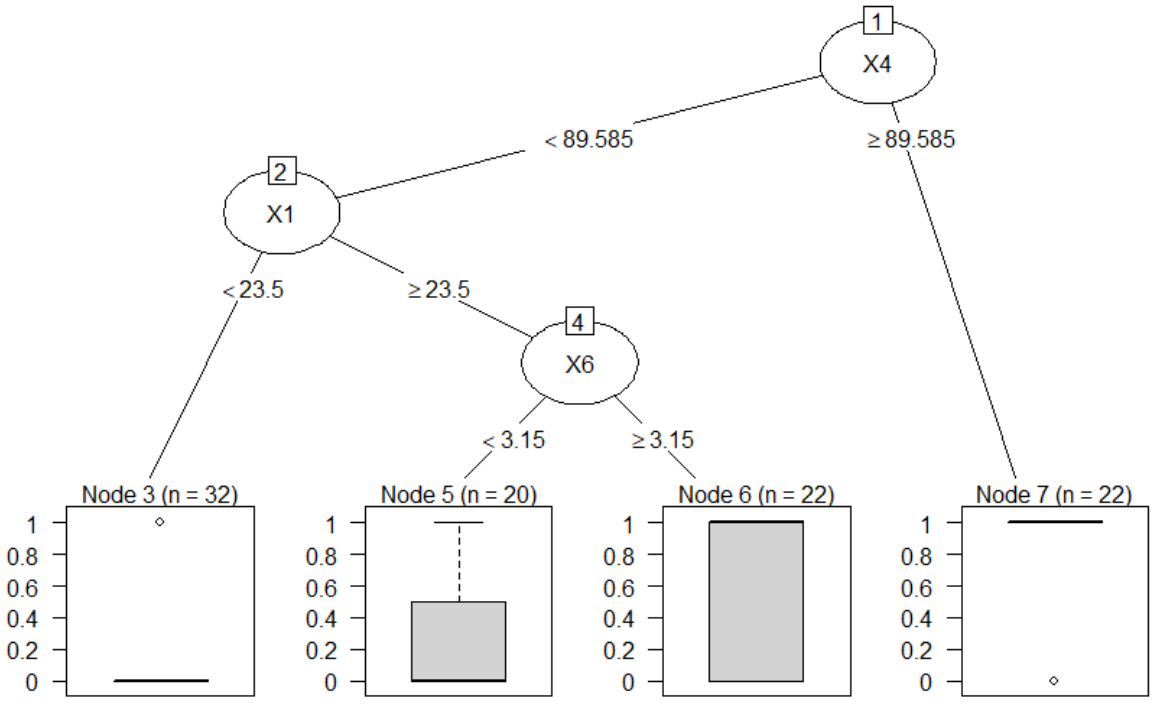
Decision tree using Y data for group 0 with pruning



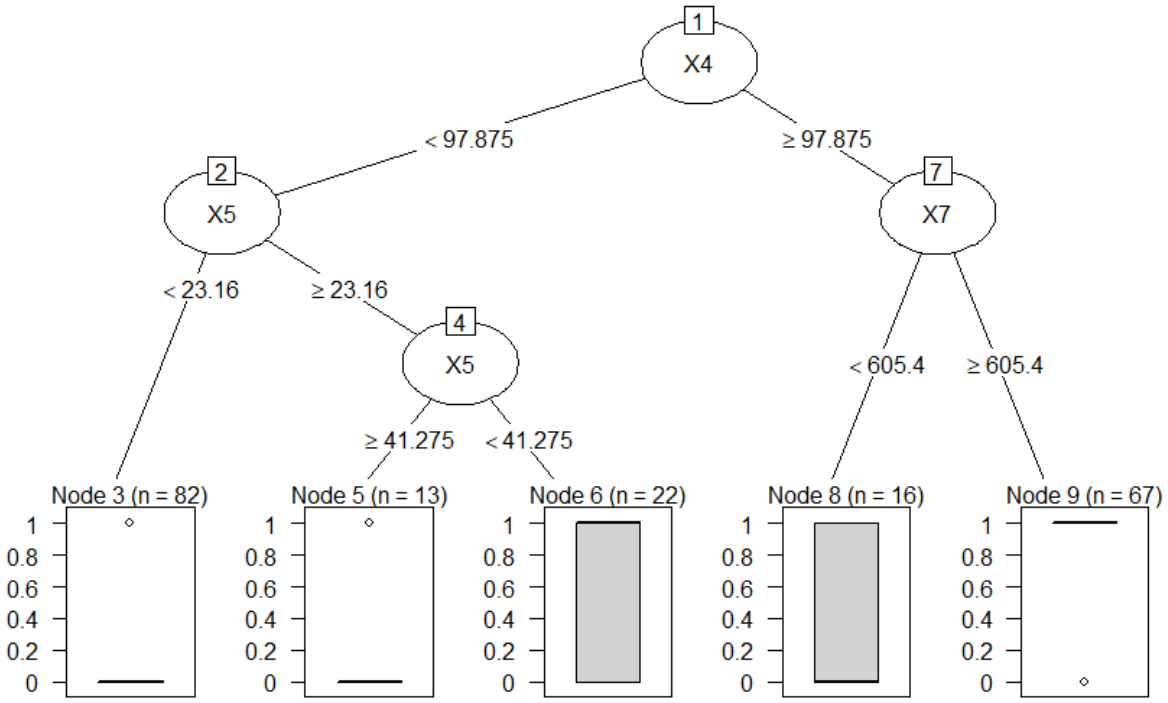
Decision tree using X & Y data for group 0 without Pruning



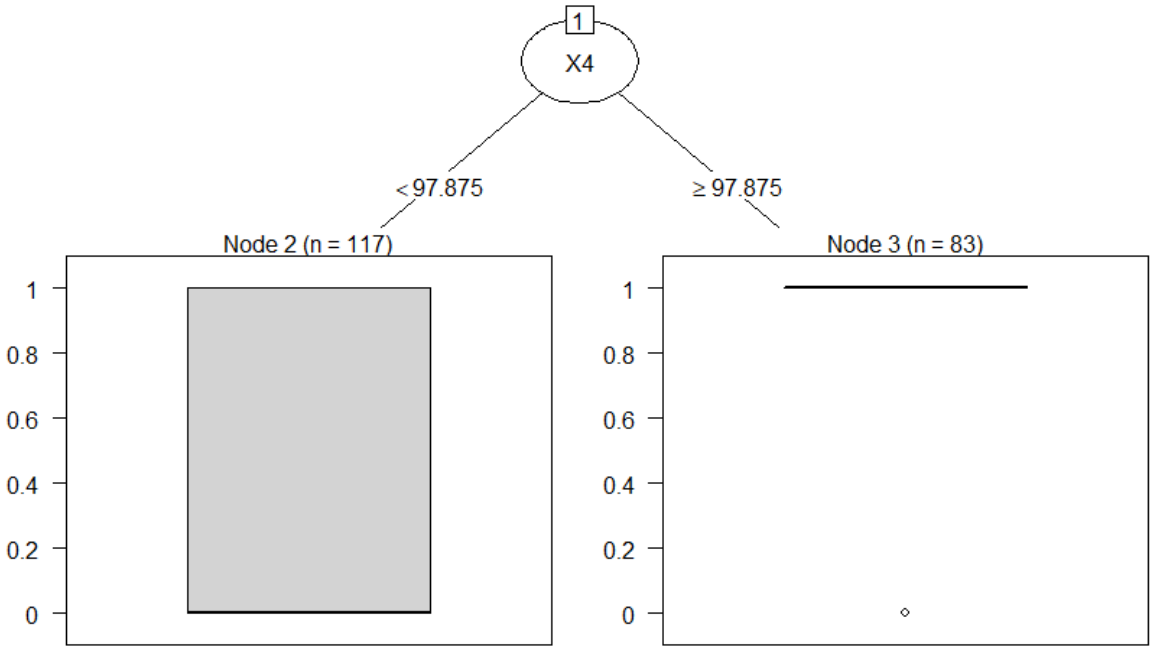
Decision tree using X & Y data for group 0 with Pruning



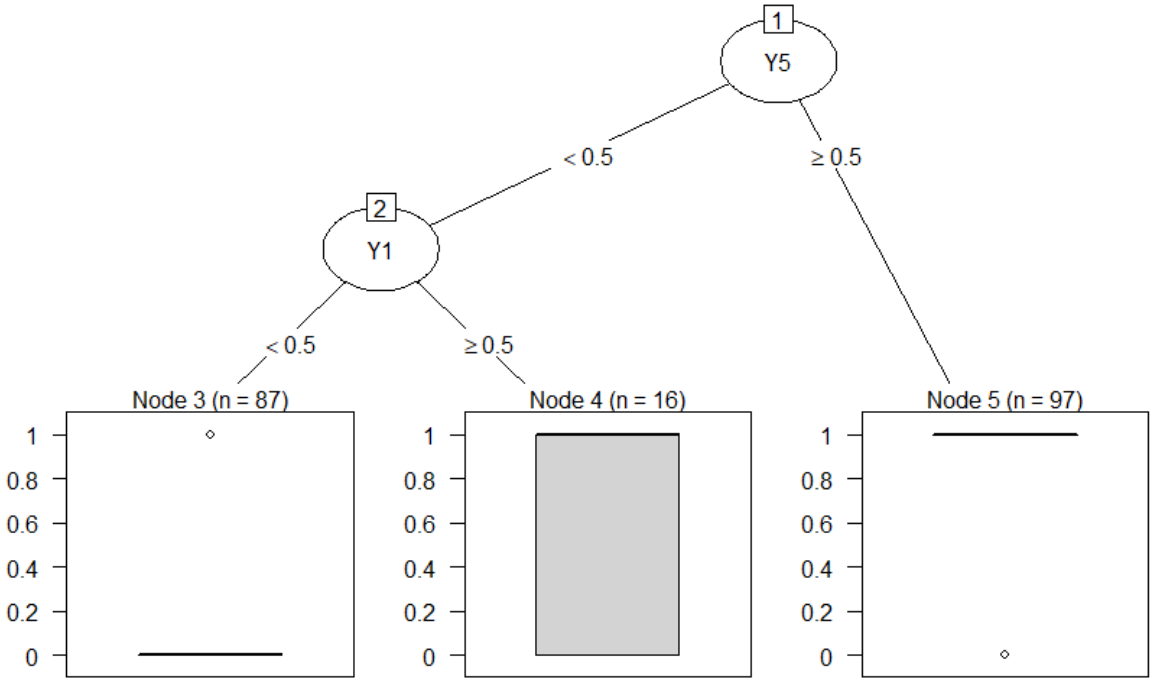
Decision tree using X data for group 1 without Pruning



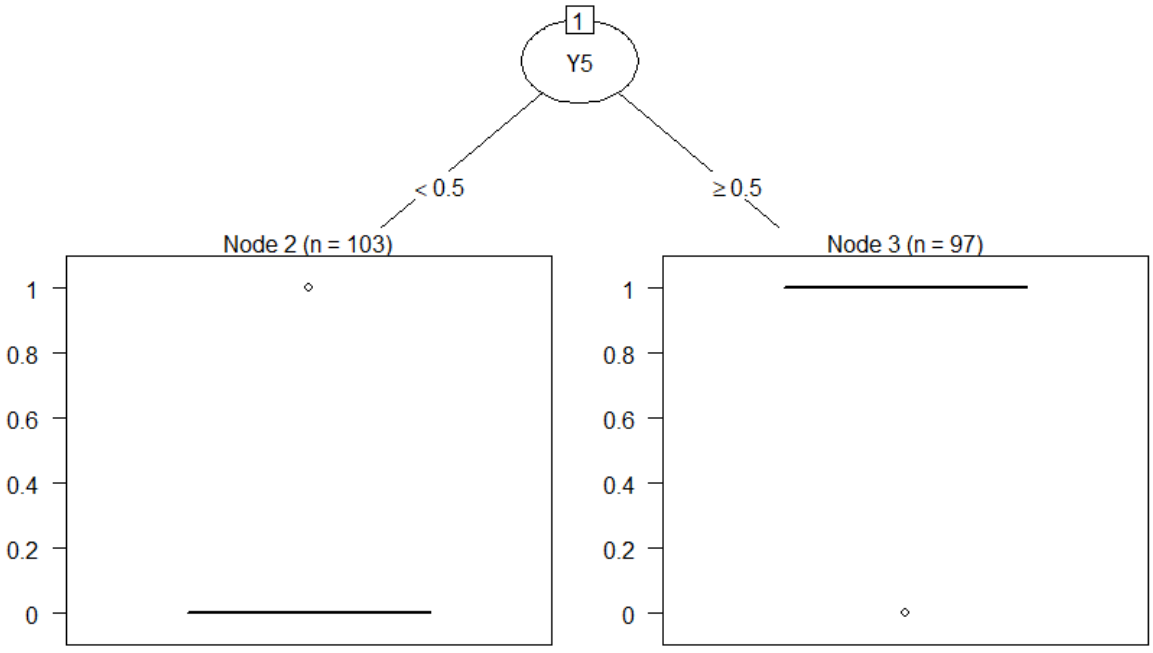
Decision tree using X data for group 1 with Pruning



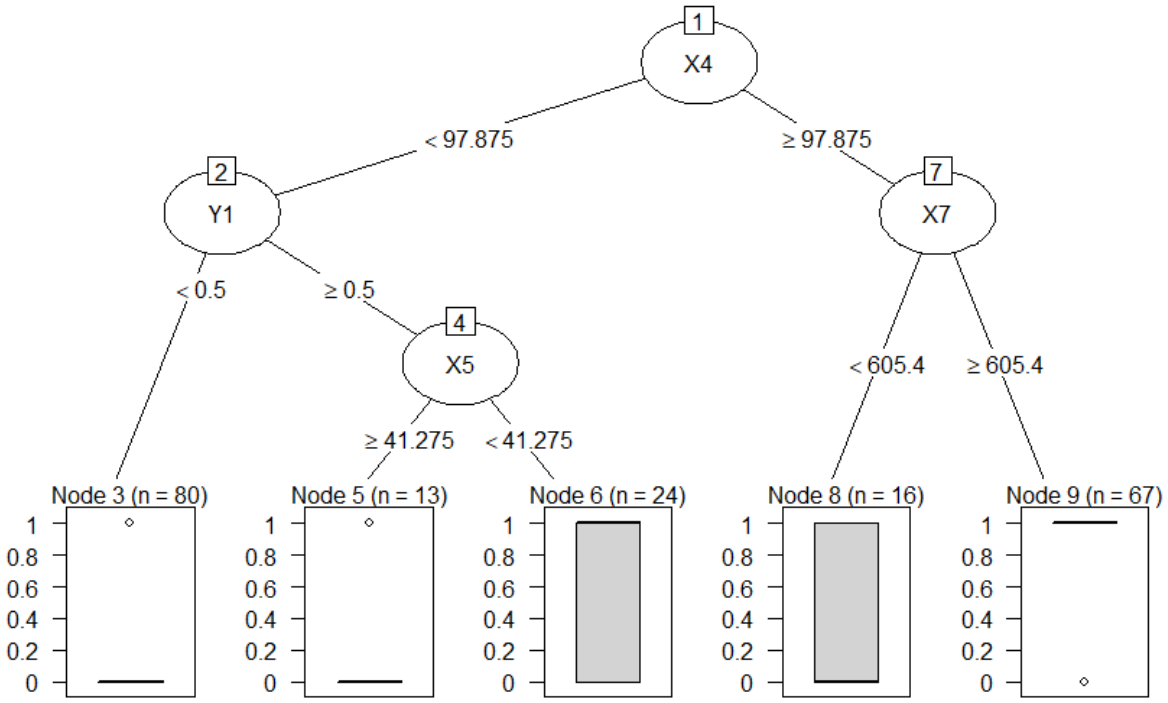
Decision tree using Y data for group 1 without Pruning



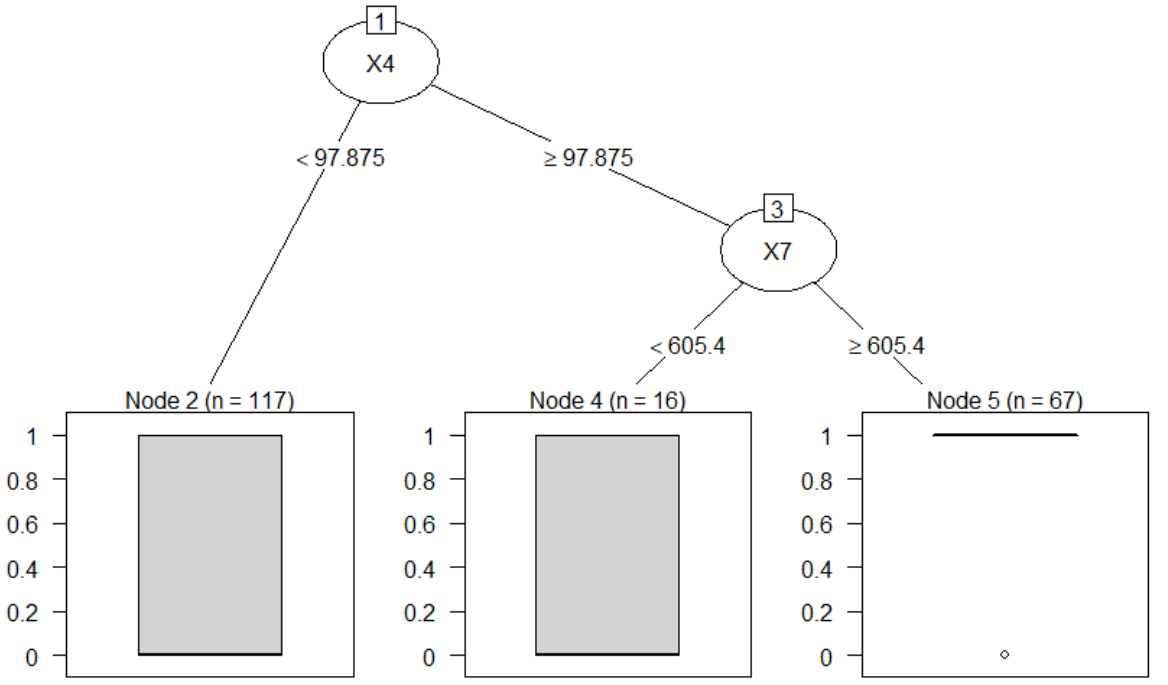
Decision tree using Y data for group 1 with Pruning



Decision tree using X & Y data for group 1 without Pruning



Decision tree using X & Y data for group 1 with Pruning



Accuracies for the above generated graphs:

```
> print(paste("Accuracy for Decision tree using X data: ",accuracy_Test_X))

[1] "Accuracy for Decision tree using X data:  0.753378378378378"

> print(paste("Accuracy for Decision tree using Y data: ",accuracy_Test_Y))

[1] "Accuracy for Decision tree using Y data:  0.766891891891892"

> print(paste("Accuracy for Decision tree using X & Y data:
",accuracy_Test_XY))

[1] "Accuracy for Decision tree using X & Y data:  0.753378378378378"

> print(paste("Accuracy for Decision tree using X data for group 0:
",accuracy_Test_X_G0))

[1] "Accuracy for Decision tree using X data for group 0:  0.736486486486487"

> print(paste("Accuracy for Decision tree using Y data for group 0:
",accuracy_Test_Y_G0))

[1] "Accuracy for Decision tree using Y data for group 0:  0.668918918918919"

> print(paste("Accuracy for Decision tree using X & Y data for group 0:
",accuracy_Test_XY_G0))

[1] "Accuracy for Decision tree using X & Y data for group 0:
0.72972972972973"

> print(paste("Accuracy for Decision tree using X data for group 1:
",accuracy_Test_X_G1))

[1] "Accuracy for Decision tree using X data for group 1:  0.753378378378378"

> print(paste("Accuracy for Decision tree using Y data for group 1:
",accuracy_Test_Y_G1))

[1] "Accuracy for Decision tree using Y data for group 1:  0.712837837837838"

> print(paste("Accuracy for Decision tree using X & Y data for group 1:
",accuracy_Test_XY_G1))

[1] "Accuracy for Decision tree using X & Y data for group 1:
0.760135135135135"
```

Conclusion:

The best Decision Tree generated is the DT generated over **Entire Dataset with the Predictors X1-X7 and Y1-Y7 over Group 1** as it has the highest **accuracy of 76%** - see **Plot 18** for the DT. The Decision Tree's summary, indicating the splits can be found in the next page.

Though the other DT's also have an accuracy of 75.6% - the DT in Plot 18 is better because it gives a consistent accuracy of 76% when tested with different `rpart` configurations like minsplit, minbucket and maxdepth, more over it has a **Low Variance** between different decision tree when run with different seed values for the data and different rpart configuration. We can also clearly say that X's are the features with **High Information Gain** compared to Y, and also splitting the data into Group's do not show a significant improvement accuracy.

The code for this can be found on my GitHub, please find the link to the repo below.

https://github.com/mukeshmk/r-project

```
> summary(DT_Model_XY_G1_pruned)
Call:
rpart(formula = Response ~ ., data = input_XY_G1, method = "class",
    control = rpart.control(minsplit = 30, minbucket = 10, maxdepth = 8))
  n= 200

          CP nsplit rel error    xerror       xstd
1 0.54081633      0 1.0000000 1.0612245 0.07209601
2 0.06122449      1 0.4591837 0.5102041 0.06248698
3 0.02040816      2 0.3979592 0.4897959 0.06163130

Variable importance
X4 X5 X7 X1 Y5 Y4 Y7
24 17 16 13 13 12  4

Node number 1: 200 observations,    complexity param=0.5408163
  predicted class=0  expected loss=0.49  P(node) =1
    class counts:   102    98
   probabilities: 0.510 0.490
  left son=2 (117 obs) right son=3 (83 obs)
  Primary splits:
      X4 < 97.875  to the left,  improve=30.76630, (0 missing)
      X5 < 32.39   to the left,  improve=30.29774, (0 missing)
      Y5 < 0.5     to the left,  improve=25.97221, (0 missing)
      Y1 < 0.5     to the left,  improve=24.09052, (0 missing)
      X1 < 33.5    to the left,  improve=23.23900, (0 missing)
  Surrogate splits:
      X5 < 44.545  to the left,  agree=0.855, adj=0.651, (0 split)
      Y4 < 0.5     to the left,  agree=0.795, adj=0.506, (0 split)
      X1 < 80      to the left,  agree=0.785, adj=0.482, (0 split)
      Y5 < 0.5     to the left,  agree=0.780, adj=0.470, (0 split)
      X7 < 1576.35 to the left,  agree=0.735, adj=0.361, (0 split)

Node number 2: 117 observations
  predicted class=0  expected loss=0.2564103  P(node) =0.585
    class counts:    87    30
   probabilities: 0.744 0.256

Node number 3: 83 observations,    complexity param=0.06122449
  predicted class=1  expected loss=0.1807229  P(node) =0.415
    class counts:    15    68
   probabilities: 0.181 0.819
  left son=6 (16 obs) right son=7 (67 obs)
  Primary splits:
      X7 < 605.4   to the left,  improve=10.180930, (0 missing)
      X5 < 32.39   to the left,  improve= 6.437137, (0 missing)
      X1 < 23.5    to the left,  improve= 6.131738, (0 missing)
      Y5 < 0.5     to the left,  improve= 4.552823, (0 missing)
      X4 < 183.75  to the left,  improve= 4.137415, (0 missing)
  Surrogate splits:
      Y7 < 0.5     to the left,  agree=0.904, adj=0.500, (0 split)
      X1 < 21      to the left,  agree=0.855, adj=0.250, (0 split)
      X5 < 25.895  to the left,  agree=0.855, adj=0.250, (0 split)
      Y5 < 0.5     to the left,  agree=0.843, adj=0.188, (0 split)
      X2 < 3.5     to the left,  agree=0.819, adj=0.062, (0 split)

Node number 6: 16 observations
  predicted class=0  expected loss=0.3125  P(node) =0.08
    class counts:    11     5
   probabilities: 0.688 0.312

Node number 7: 67 observations
  predicted class=1  expected loss=0.05970149  P(node) =0.335
    class counts:     4    63
   probabilities: 0.060 0.940
```