Does NFL Combine Data Predict Rushing Performance

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For this project we used Decision Trees to see how a player's NFL combine results effect the player's rushing production. We cleaned the data by gathering the information from the NFL combine statistics with the rushing data from 2017 season of the 50 players.

For Scenario One we used all the data points from the NFL combine; Height, Weight, 40 Yard, Bench Press, Veritical Leap, Broad Jump, Shuttle and 3 Cone Drill. We then determined the two best "Y variables" from the rushing data to compare to the 8 "X variables" stated above. We determined the best "Y variables" were combinations of the varibales from the rushing data.

```
installed.packages("tree")
```

```
##      Package LibPath Version Priority Depends Imports LinkingTo Suggests
##      Enhances License License_is_FOSS License_restricts_use OS_type Archs
##      MD5sum NeedsCompilation Built
```

```
library(tree)
nfl_data <-read.csv("/home/students/kadoshn/GitHub/Sports Analytics/CombineData.csv")
str(nfl_data)
```

```
## 'data.frame':    50 obs. of  18 variables:
##  $ X         : Factor w/ 50 levels "Aaron Jones",..: 29 48 34 37 38 28 41 36 8 18 ...
##  $ College   : Factor w/ 34 levels "","Alabama","Alabama State",..: 31 12 18 1 2 14 34 15 7 22 ...
##  $ POS       : Factor w/ 4 levels "","ILB","QB",..: 4 4 4 1 4 4 4 4 4 4 ...
##  $ Height    : num  70.5 72.6 73.4 NA 69.1 ...
##  $ Weight    : int  216 222 230 NA 215 230 215 240 224 225 ...
##  $ X40Yard   : num  4.62 4.52 4.6 NA 4.62 NA 4.52 4.51 4.6 4.47 ...
##  $ BenchPress: int  18 17 24 NA 21 16 19 NA 17 NA ...
##  $ VertLeap  : num  36.5 NA 31.5 NA 31.5 34 35 28.5 32 32.5 ...
##  $ BroadJump : int  119 NA 118 NA 113 122 126 NA 119 118 ...
##  $ Shuttle   : num  NA NA 4.24 NA 4.62 NA 4.07 NA 4.12 NA ...
##  $ X3Cone    : num  NA NA 6.75 NA 7.13 NA 7.04 NA 7.15 NA ...
##  $ Gms       : int  16 15 15 16 16 16 16 13 16 10 ...
##  $ Att       : int  272 279 321 287 230 276 284 268 245 242 ...
##  $ Yds       : Factor w/ 50 levels "1,007","1,040",..: 9 8 7 6 5 4 3 2 1 50 ...
##  $ Avg       : num  4.88 4.68 4.02 3.97 4.89 4.07 3.89 3.88 4.11 4.06 ...
##  $ YPG       : num  82.9 87 86.1 71.1 70.2 70.1 69.1 80 62.9 98.3 ...
##  $ Lg        : int  69 57 27 48 72 53 87 90 40 30 ...
##  $ TD        : int  8 13 9 6 12 9 8 9 3 7 ...
```

```
names(nfl_data)
```

```
##  [1] "X"          "College"    "POS"        "Height"     "Weight"
##  [6] "X40Yard"    "BenchPress" "VertLeap"   "BroadJump"  "Shuttle"
## [11] "X3Cone"     "Gms"        "Att"        "Yds"        "Avg"
## [16] "YPG"        "Lg"         "TD"
```

```
nrow(nfl_data)
```

```
## [1] 50
```

```
ncol(nfl_data)
```

```
## [1] 18
```

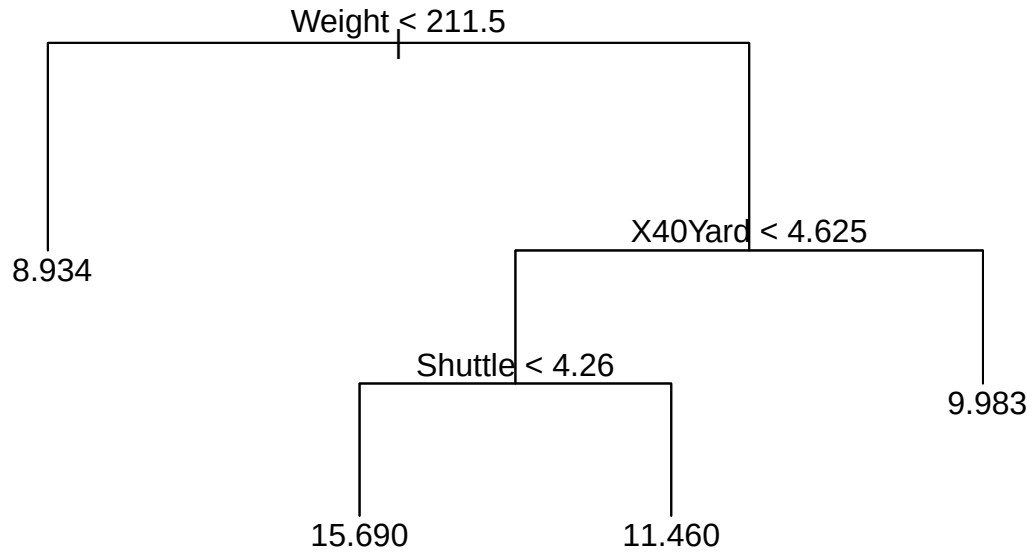
```
set.seed(3)
select_rows <- sample(1:nrow(nfl_data),round(0.3*nrow(nfl_data)),replace=F)
select_rows
```

```
##  [1]  9 40 19 16 28 46  6 13 25 26 21 20 49 38 32
```

```
test <- nfl_data[select_rows,]
train <- nfl_data[-(select_rows),]
nfl_data$new_column2 <- nfl_data$Att/nfl_data$Gms
nfl_data$new_column3 <- nfl_data$Yds/nfl_data$Att #no
```

```
## Warning in Ops.factor(nfl_data$Yds, nfl_data$Att): '/' not meaningful for
## factors
```

```
model_tree <-tree(nfl_data$new_column2~Height+Weight+X40Yard+BenchPress+VertLeap+BroadJump+Shuttle+X3Co
plot(model_tree)
text(model_tree)
```




```
pred <- predict(model_tree,newdata = test)
pred
```

```
##         9        40        19        16        28        46         6
## 15.688627 11.455192 13.764339 13.764339 15.688627  8.933752 12.582626
##        13        25        26        21        20        49        38
## 13.764339 11.455192 11.455192  8.933752 11.269031 15.688627  9.982857
##        32
##  9.982857
```

For this Decision Tree the "Y variavble" we chose was attempts per game. We made this variable by inserting a new column into the data set that incorporated attempts and games played per person from the rushing data. We did this because it allowed for more consistency since not all the players have played the same amount of games. The Decision Tree above shows that from the combine data weight is the first divisor making it of most importance and so on down the splits of the tree. If a player weighs more than 211.5 lbs then that player will have the lowest amount of attempts per game of 8.9. However, if a player weighs less than 211.5 lbs then the next divisor is the 40 Yard Dash. Now if the player runs less than a 4.6 second 40

Yard Dash, then the player will have the next lowest attempts per game, 9.98. If the player runs the 40 Yard Dash in more than 4.6 seconds making them slower then the next divisor occurs, the shuttle. If the player's shuttle run is less than 4.3 seconds then the attempts per game is 11.5. Finally, If the players shuttle is more than 4.3 seconds then the player's attempts per game is 15.7.

The best scenario for this tree is if the player weighs less than 211.5lbs, runs the 40 yard dash in more than 4.6 seconds and runs the shuttle in more than 4.3 seconds, as it gives you the highest attempts per game, 15.7. This does not makes sense as it is showing that the players who are slower and less agile, while having a lower weight, have a higher attempts per game.

```
installed.packages("tree")
```

```
##      Package LibPath Version Priority Depends Imports LinkingTo Suggests
##      Enhances License License_is_FOSS License_restricts_use OS_type Archs
##      MD5sum NeedsCompilation Built
```

```
library(tree)
nfl_data <-read.csv("/home/students/kadoshn/GitHub/Sports Analytics/CombineData.csv")
str(nfl_data)
```

```
## 'data.frame':    50 obs. of  18 variables:
##  $ X         : Factor w/ 50 levels "Aaron Jones",..: 29 48 34 37 38 28 41 36 8 18 ...
##  $ College   : Factor w/ 34 levels "","Alabama","Alabama State",..: 31 12 18 1 2 14 34 15 7 22 ...
##  $ POS       : Factor w/ 4 levels "","ILB","QB",..: 4 4 4 1 4 4 4 4 4 4 ...
##  $ Height    : num  70.5 72.6 73.4 NA 69.1 ...
##  $ Weight    : int  216 222 230 NA 215 230 215 240 224 225 ...
##  $ X40Yard   : num  4.62 4.52 4.6 NA 4.62 NA 4.52 4.51 4.6 4.47 ...
##  $ BenchPress: int  18 17 24 NA 21 16 19 NA 17 NA ...
##  $ VertLeap  : num  36.5 NA 31.5 NA 31.5 34 35 28.5 32 32.5 ...
##  $ BroadJump : int  119 NA 118 NA 113 122 126 NA 119 118 ...
##  $ Shuttle   : num  NA NA 4.24 NA 4.62 NA 4.07 NA 4.12 NA ...
##  $ X3Cone    : num  NA NA 6.75 NA 7.13 NA 7.04 NA 7.15 NA ...
##  $ Gms       : int  16 15 15 16 16 16 16 13 16 10 ...
##  $ Att       : int  272 279 321 287 230 276 284 268 245 242 ...
##  $ Yds       : Factor w/ 50 levels "1,007","1,040",..: 9 8 7 6 5 4 3 2 1 50 ...
##  $ Avg       : num  4.88 4.68 4.02 3.97 4.89 4.07 3.89 3.88 4.11 4.06 ...
##  $ YPG       : num  82.9 87 86.1 71.1 70.2 70.1 69.1 80 62.9 98.3 ...
##  $ Lg        : int  69 57 27 48 72 53 87 90 40 30 ...
##  $ TD        : int  8 13 9 6 12 9 8 9 3 7 ...
```

```
names(nfl_data)
```

```
##  [1] "X"          "College"    "POS"        "Height"     "Weight"
##  [6] "X40Yard"    "BenchPress" "VertLeap"   "BroadJump"  "Shuttle"
## [11] "X3Cone"     "Gms"        "Att"        "Yds"        "Avg"
## [16] "YPG"        "Lg"         "TD"
```

```
nrow(nfl_data)
```

```
## [1] 50
```

```
ncol(nfl_data)
```

```
## [1] 18
```

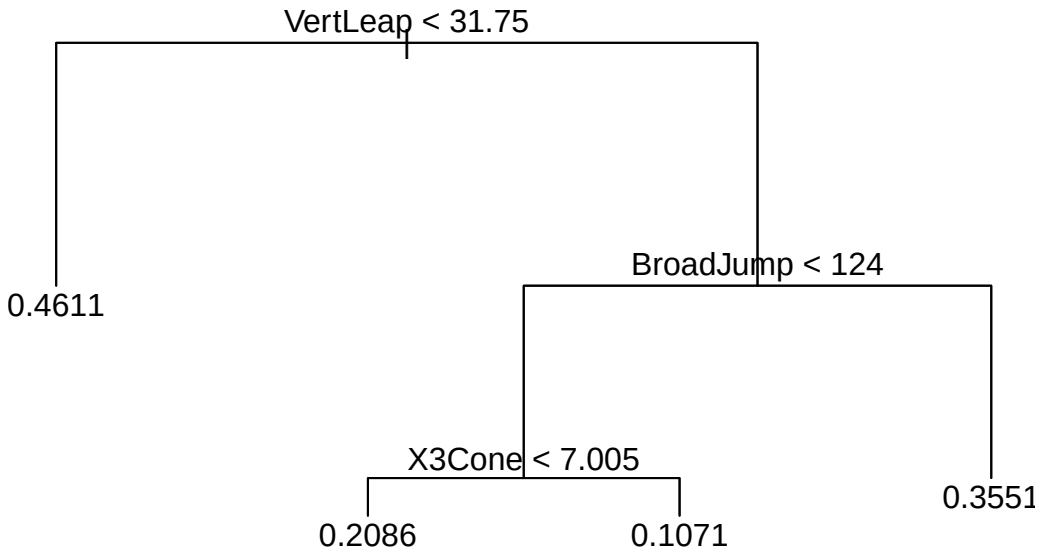
```
set.seed(2)
select_rows <- sample(1:nrow(nfl_data),round(0.3*nrow(nfl_data)),replace=F)
select_rows
```

```
##  [1] 10 35 28  8 44 43  6 36 20 23 41 50 29  7 15
```

```
test <- nfl_data[select_rows,]
train <- nfl_data[-(select_rows),]
nfl_data$new_column <- nfl_data$TD / nfl_data$Gms
nfl_data$new_column4 <- (nfl_data$TD + nfl_data$Yds) /nfl_data$Gms #doesn't work
```

```
## Warning in Ops.factor(nfl_data$TD, nfl_data$Yds): '+' not meaningful for
## factors
```

```
model_tree <-tree(nfl_data$new_column~Height+Weight+X40Yard+BenchPress+VertLeap+BroadJump+Shuttle+X3Cone
plot(model_tree)
text(model_tree)
```




```
pred <- predict(model_tree,newdata = test)
pred
```

```
##        10        35        28         8        44        43         6
## 0.1617757 0.3551020 0.3551020 0.4611111 0.2086039 0.3551020 0.1617757
##        36        20        23        41        50        29         7
## 0.2757742 0.2757742 0.3551020 0.2757742 0.4611111 0.1071429 0.3551020
##        15
## 0.3551020
```

For this Decision Tree the "Y variable" we chose was touchdowns per game. We made this variable by inserting a new column into the data set that incorportated touchdowns and games played per person from the rushing data. We did this because it allowed for more consistency since not all the players have played the same amount of games.

The best scenario from the decision tree above is that the player's vertical leap is more than 31.8 inches giving the player .46 touchdowns per game. This decision tree shows that touchdowns per game is a lesser indicator than attempt per game, shown in the previous tree.

This decision tree should show that the correlating tree to these varibles in Scenario Two will have a worse division rank than from the first tree's variables.

Prior to starting Scenario Two, we gathered the infromation of the divisions that each of the players went to. We entered this data as a new column into the data set (nfl_data) to use as the "Y variable" for this scenario. This then lead us to Scenario Two, which is taking the variables from the trees in Scenario One, "X variables", and compared them to that "Y variable" of the devision ranks. The goal is to determine what

variables correspond to different college devisions.

```
installed.packages("tree")
```

```
##      Package LibPath Version Priority Depends Imports LinkingTo Suggests
##      Enhances License License_is_FOSS License_restricts_use OS_type Archs
##      MD5sum NeedsCompilation Built
```

```
library(tree)
nfl_data <-read.csv("/home/students/kadoshn/GitHub/Sports Analytics/CombineData.csv")
str(nfl_data)
```

```
## 'data.frame':    50 obs. of  18 variables:
##  $ X         : Factor w/ 50 levels "Aaron Jones",..: 29 48 34 37 38 28 41 36 8 18 ...
##  $ College   : Factor w/ 34 levels "","Alabama","Alabama State",..: 31 12 18 1 2 14 34 15 7 22 ...
##  $ POS       : Factor w/ 4 levels "","ILB","QB",..: 4 4 4 1 4 4 4 4 4 4 ...
##  $ Height    : num  70.5 72.6 73.4 NA 69.1 ...
##  $ Weight    : int  216 222 230 NA 215 230 215 240 224 225 ...
##  $ X40Yard   : num  4.62 4.52 4.6 NA 4.62 NA 4.52 4.51 4.6 4.47 ...
##  $ BenchPress: int  18 17 24 NA 21 16 19 NA 17 NA ...
##  $ VertLeap  : num  36.5 NA 31.5 NA 31.5 34 35 28.5 32 32.5 ...
##  $ BroadJump : int  119 NA 118 NA 113 122 126 NA 119 118 ...
##  $ Shuttle   : num  NA NA 4.24 NA 4.62 NA 4.07 NA 4.12 NA ...
##  $ X3Cone    : num  NA NA 6.75 NA 7.13 NA 7.04 NA 7.15 NA ...
##  $ Gms       : int  16 15 15 16 16 16 16 13 16 10 ...
##  $ Att       : int  272 279 321 287 230 276 284 268 245 242 ...
##  $ Yds       : Factor w/ 50 levels "1,007","1,040",..: 9 8 7 6 5 4 3 2 1 50 ...
##  $ Avg       : num  4.88 4.68 4.02 3.97 4.89 4.07 3.89 3.88 4.11 4.06 ...
##  $ YPG       : num  82.9 87 86.1 71.1 70.2 70.1 69.1 80 62.9 98.3 ...
##  $ Lg        : int  69 57 27 48 72 53 87 90 40 30 ...
##  $ TD        : int  8 13 9 6 12 9 8 9 3 7 ...
```

```
names(nfl_data)
```

```
##  [1] "X"          "College"    "POS"        "Height"     "Weight"
##  [6] "X40Yard"    "BenchPress" "VertLeap"   "BroadJump"  "Shuttle"
## [11] "X3Cone"     "Gms"        "Att"        "Yds"        "Avg"
## [16] "YPG"        "Lg"         "TD"
```

```
nrow(nfl_data)
```

```
## [1] 50
```

```
ncol(nfl_data)
```

```
## [1] 18
```

```
set.seed(3)
select_rows <- sample(1:nrow(nfl_data),round(0.3*nrow(nfl_data)),replace=F)
select_rows
```

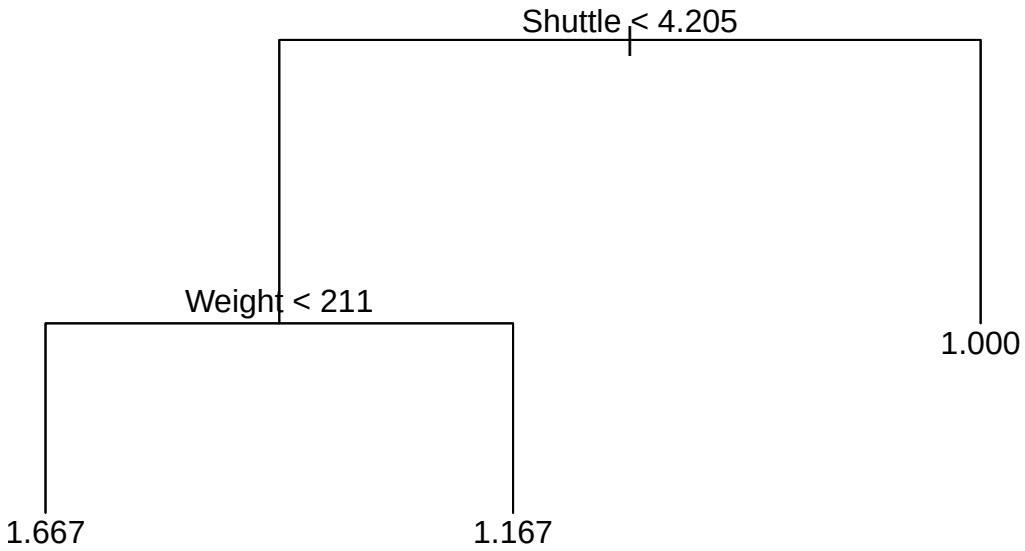
```
##  [1]  9 40 19 16 28 46  6 13 25 26 21 20 49 38 32
```

```
test <- nfl_data[select_rows,]
train <- nfl_data[-(select_rows),]
nfl_data$new_column <- nfl_data$TD / nfl_data$Gms
nfl_data$new_column4 <- (nfl_data$TD + nfl_data$Yds) /nfl_data$Gms #doesn't work
```

```
## Warning in Ops.factor(nfl_data$TD, nfl_data$Yds): '+' not meaningful for
```

```
## factors
```

```
nfl_data$Division <- c(1,1,1,NA,1,1,1,1,1,1,1,NA,1,1,1,1,1,1,1,NA,1,1,1,NA,1,1,1,1,1,1,1,1,1,3,NA,1,2
model_tree <-tree(nfl_data$Division~Weight+X40Yard+Shuttle+BenchPress, data = nfl_data)
plot(model_tree)
text(model_tree)
```




```
pred <- predict(model_tree,newdata = test)
pred
```

```
##        9       40       19       16       28       46        6       13
## 1.166667 1.000000 1.192308 1.192308 1.166667 1.666667 1.192308 1.192308
##       25       26       21       20       49       38       32
## 1.000000 1.000000 1.192308 1.192308 1.166667 1.166667 1.000000
```

For this decision tree the "X variables" that we used were the divisors from the first tree of scenario one; Weight, 40 Yard Dash and Shuttle. We also added a 4th variable of Bench Press because we determined that this variable correlated with the previous 3 in testing a players strength, since Bench Press usually relates to weight. The best scenario from this decision tree is that if a player runs the shuttle less than a 4.2 the player is more likely to be in devision one. This does show what you would expect since it is stating that a player who runs the shuttle at a faster speed is more likely to end up in the better devision.

```
installed.packages("tree")
```

```
##      Package LibPath Version Priority Depends Imports LinkingTo Suggests
##      Enhances License License_is_FOSS License_restricts_use OS_type Archs
##      MD5sum NeedsCompilation Built
```

```
library(tree)
nfl_data <-read.csv("/home/students/kadoshn/GitHub/Sports Analytics/CombineData.csv")
str(nfl_data)
```

```
## 'data.frame':    50 obs. of  18 variables:
##  $ X         : Factor w/ 50 levels "Aaron Jones",..: 29 48 34 37 38 28 41 36 8 18 ...
##  $ College   : Factor w/ 34 levels "","Alabama","Alabama State",..: 31 12 18 1 2 14 34 15 7 22 ...
##  $ POS       : Factor w/ 4 levels "","ILB","QB",..: 4 4 4 1 4 4 4 4 4 4 ...
##  $ Height    : num  70.5 72.6 73.4 NA 69.1 ...
##  $ Weight    : int  216 222 230 NA 215 230 215 240 224 225 ...
##  $ X40Yard   : num  4.62 4.52 4.6 NA 4.62 NA 4.52 4.51 4.6 4.47 ...
```

```
##  $ BenchPress: int  18 17 24 NA 21 16 19 NA 17 NA ...
##  $ VertLeap  : num  36.5 NA 31.5 NA 31.5 34 35 28.5 32 32.5 ...
##  $ BroadJump : int  119 NA 118 NA 113 122 126 NA 119 118 ...
##  $ Shuttle   : num  NA NA 4.24 NA 4.62 NA 4.07 NA 4.12 NA ...
##  $ X3Cone    : num  NA NA 6.75 NA 7.13 NA 7.04 NA 7.15 NA ...
##  $ Gms       : int  16 15 15 16 16 16 16 13 16 10 ...
##  $ Att       : int  272 279 321 287 230 276 284 268 245 242 ...
##  $ Yds       : Factor w/ 50 levels "1,007","1,040",..: 9 8 7 6 5 4 3 2 1 50 ...
##  $ Avg       : num  4.88 4.68 4.02 3.97 4.89 4.07 3.89 3.88 4.11 4.06 ...
##  $ YPG       : num  82.9 87 86.1 71.1 70.2 70.1 69.1 80 62.9 98.3 ...
##  $ Lg        : int  69 57 27 48 72 53 87 90 40 30 ...
##  $ TD        : int  8 13 9 6 12 9 8 9 3 7 ...
```

```
names(nfl_data)
```

```
##  [1] "X"          "College"    "POS"        "Height"     "Weight"
##  [6] "X40Yard"    "BenchPress" "VertLeap"   "BroadJump"  "Shuttle"
## [11] "X3Cone"     "Gms"        "Att"        "Yds"        "Avg"
## [16] "YPG"        "Lg"         "TD"
```

```
nrow(nfl_data)
```

```
## [1] 50
```

```
ncol(nfl_data)
```

```
## [1] 18
```

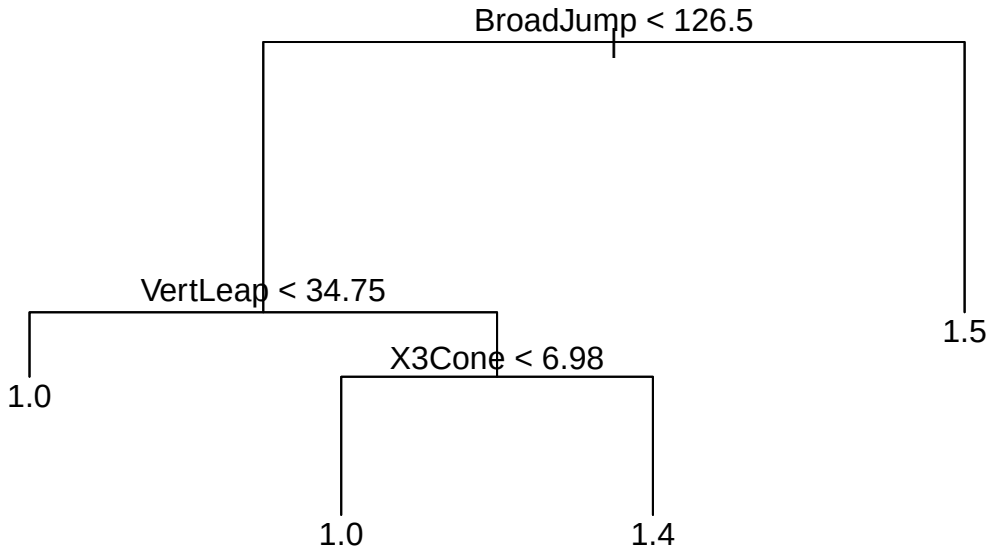
```
set.seed(3)
select_rows <- sample(1:nrow(nfl_data),round(0.3*nrow(nfl_data)),replace=F)
select_rows
```

```
##  [1]  9 40 19 16 28 46  6 13 25 26 21 20 49 38 32
```

```
test <- nfl_data[select_rows,]
train <- nfl_data[-(select_rows),]
nfl_data$new_column <- nfl_data$TD / nfl_data$Gms
nfl_data$new_column4 <- (nfl_data$TD + nfl_data$Yds) /nfl_data$Gms #doesn't work
```

```
## Warning in Ops.factor(nfl_data$TD, nfl_data$Yds): '+' not meaningful for
## factors
```

```
nfl_data$Division <- c(1,1,1,NA,1,1,1,1,1,1,1,NA,1,1,1,1,1,1,1,NA,1,1,1,NA,1,1,1,1,1,1,1,1,1,3,NA,1,2
model_tree <-tree(nfl_data$Division~VertLeap+BroadJump+X3Cone+X40Yard, data = nfl_data)
plot(model_tree)
text(model_tree)
```




```
pred <- predict(model_tree,newdata = test)
pred
```

```
##        9       40       19       16       28       46        6       13
## 1.000000 1.000000 1.181818 1.161290 1.500000 1.400000 1.000000 1.161290
##       25       26       21       20       49       38       32
## 1.500000 1.500000 1.161290 1.161290 1.000000 1.400000 1.000000
```

For this decision tree the "X variables" that we used were the divisors from the second tree of scenario one; Broad Jump, Veritical Leap and 3 Cone. We also added a 4th variable of 40 Yard Dash because we determined that this variable correlated with the previous 3 in testing a players speed and agility, since the skill of the 3 Cone relates to the 40 Yard Dash as they both test similar objectives. For this decision tree there are two scenarios where the outcome is optimal. For the first scenario, if the player's Broad Jump is greater than 126.5 and their Veritical Leap is greater than 34.8 inches, then the player is more likely to be in devision one. The second scenario is if the player's Broad Jump i greater than 126.5, Veritical Leap is greater than 34.8 inches, and 3 Cone Drill is greater than 6.98, then the player is more likely to be in division one. This also is what you would expect as it is stated the more skilled, faster and agile player will be more likely to be in division one.

The trees from scenario one and scenario two correlate to show that higher divisions usually have the better players in the league and the better players are usually in better divisions (division 1). This project is also showing that the nfl combine is not as good of an indicator of how a player will perform in regards to rushing yards within his NFL career. However, this could be because we are only using 50 players making for a small data set. It does show that certain aspects of the combine data are significant in predicting the players performance more than others.