The NFL Combine and Fantasy Football

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1 Data Gathering and Cleaning

1.1 Download the Data

```
qb_combine_1 <- read.csv("../data/2000QBcombine.csv", stringsAsFactors = FALSE)
qb_combine_2 <- read.csv("../data/2010QBcombine.csv", stringsAsFactors = FALSE)
qb_combine <- rbind(qb_combine_1, qb_combine_2)

rb_combine_1 <- read.csv("../data/2000RBcombine.csv", stringsAsFactors = FALSE)
rb_combine_2 <- read.csv("../data/2008RBcombine.csv", stringsAsFactors = FALSE)
rb_combine_3 <- read.csv("../data/2014RBcombine.csv", stringsAsFactors = FALSE)
rb_combine <- rbind(rb_combine_1, rb_combine_2, rb_combine_3)

wr_combine_1 <- read.csv("../data/2000WRcombine.csv", stringsAsFactors = FALSE)
wr_combine_2 <- read.csv("../data/2005WRCombine.csv", stringsAsFactors = FALSE)
wr_combine_3 <- read.csv("../data/2010WRCombine.csv", stringsAsFactors = FALSE)
wr_combine_4 <- read.csv("../data/2014WRcombine.csv", stringsAsFactors = FALSE)
wr_combine <- rbind(wr_combine_1, wr_combine_2, wr_combine_3, wr_combine_4)

te_combine_1 <- read.csv("../data/2000TEcombine.csv", stringsAsFactors = FALSE)
te_combine_2 <- read.csv("../data/2011TEcombine.csv", stringsAsFactors = FALSE)
te_combine <- rbind(te_combine_1, te_combine_2)
```

1.2 Write Helper Functions

```
clean_players <- function(fantasy) {
  players <- as.character(fantasy$Player)
  players <- strsplit(players, "[*+]")
  for (i in seq_along(players)) {
    fantasy$Player[i] <- players[[i]][1]
  }
  fantasy$Player
}

combine_and_football <- function(fantasy_year, position) {
  position <- casefold(position)
  if (position == "qb") {
    combine <- qb_combine
  } else if (position == "rb") {
    combine <- rb_combine
```

```
  } else if (position == "wr") {
    combine <- wr_combine
  } else if (position == "te") {
    combine <- te_combine
  } else {
    stop("Enter a valid position abbreviation!")
  }
  pos <- data.frame()
  for (i in fantasy_year) {
    fantasy <- read.csv(paste("../data/", i,"fantasy.csv", sep = ""),
                        stringsAsFactors = FALSE)
    combine_specific <- combine %>% filter(Year == i)
    fantasy$Player <- clean_players(fantasy)
    rookie <- fantasy[fantasy$Player %in% combine_specific$Player, ] %>%
      filter(FantPos == toupper(position))
    rookie <- rookie[order(rookie$Player), ]
    relevant <- combine_specific[as.character(combine_specific$Player) %in%
                                   rookie$Player, ]
    relevant <- relevant[order(relevant$Player), ]
    specific <- cbind(relevant, "Games" = rookie$G, "Points" = rookie$FantPt.)
    pos <- rbind(pos, specific)
  }
  pos
}
```

1.3 Create the Necesssary Data Frames

1.3.1 Years and Positions that Abide by the Function

```
qbs <- combine_and_football(2000:2019, "qb")

rbs_1 <- combine_and_football(2000:2001, "rb")
rbs_2 <- combine_and_football(2003:2006, "rb")
rbs_3 <- combine_and_football(2008:2019, "rb")

wrs_1 <- combine_and_football(2000:2006, "wr")
wrs_2 <- combine_and_football(2008:2009, "wr")
wrs_3 <- combine_and_football(2011:2019, "wr")

tes <- combine_and_football(2000:2019, "te")
```

1.3.2 Years and Positions that are Outliers

```
position <- "RB"
i <- 2002
combine <- rb_combine
fantasy <- read.csv(paste("../data/", i,"fantasy.csv", sep = ""), stringsAsFactors = FALSE)
combine_specific <- combine %>% filter(Year == i)
fantasy$Player <- clean_players(fantasy)
rookie <- fantasy[fantasy$Player %in% combine_specific$Player, ] %>%
  filter(FantPos == toupper(position))
rookie <- rookie[order(rookie$Player), ]
relevant <- combine_specific[as.character(combine_specific$Player) %in%
```

```
                                rookie$Player, ]
relevant <- relevant[order(relevant$Player), ]
rookie <- rookie[-11, ]
rbs_2002 <- cbind(relevant, "Games" = rookie$G, "Points" = rookie$FantPt.)
```

```
position <- "RB"
i <- 2007
combine <- rb_combine
fantasy <- read.csv(paste("../data/", i,"fantasy.csv", sep = ""), stringsAsFactors = FALSE)
combine_specific <- combine %>% filter(Year == i)
fantasy$Player <- clean_players(fantasy)
rookie <- fantasy[fantasy$Player %in% combine_specific$Player, ] %>%
  filter(FantPos == toupper(position))
rookie <- rookie[order(rookie$Player), ]
relevant <- combine_specific[as.character(combine_specific$Player) %in%
                                rookie$Player, ]
relevant <- relevant[order(relevant$Player), ]
rookie <- rookie[-2, ]
rbs_2007 <- cbind(relevant, "Games" = rookie$G, "Points" = rookie$FantPt.)
```

```
position <- "WR"
i <- 2007
combine <- wr_combine
fantasy <- read.csv(paste("../data/", i,"fantasy.csv", sep = ""), stringsAsFactors = FALSE)
combine_specific <- combine %>% filter(Year == i)
fantasy$Player <- clean_players(fantasy)
rookie <- fantasy[fantasy$Player %in% combine_specific$Player, ] %>%
  filter(FantPos == toupper(position))
rookie <- rookie[order(rookie$Player), ]
relevant <- combine_specific[as.character(combine_specific$Player) %in%
                                rookie$Player, ]
relevant <- relevant[order(relevant$Player), ]
rookie <- rookie[-c(5, 17), ]
wrs_2007 <- cbind(relevant, "Games" = rookie$G, "Points" = rookie$FantPt.)
```

```
position <- "WR"
i <- 2010
combine <- wr_combine
fantasy <- read.csv(paste("../data/", i,"fantasy.csv", sep = ""), stringsAsFactors = FALSE)
combine_specific <- combine %>% filter(Year == i)
fantasy$Player <- clean_players(fantasy)
rookie <- fantasy[fantasy$Player %in% combine_specific$Player, ] %>%
  filter(FantPos == toupper(position))
rookie <- rookie[order(rookie$Player), ]
relevant <- combine_specific[as.character(combine_specific$Player) %in% rookie$Player, ]
relevant <- relevant[order(relevant$Player), ]
rookie <- rookie[-25, ]
wrs_2010 <- cbind(relevant, "Games" = rookie$G, "Points" = rookie$FantPt.)
```

```
rbs <- rbind(rbs_1, rbs_2002, rbs_2, rbs_2007, rbs_3)
wrs <- rbind(wrs_1, wrs_2007, wrs_2, wrs_2010, wrs_3)
```

1.4 Subset the Proper Variables

```
qbs <- qbs %>% dplyr::select(Year:Pos, X40YD:Shuttle, Games:Points)
rbs <- rbs %>% dplyr::select(Year:Pos, X40YD:Shuttle, Games:Points)
wrs <- wrs %>% dplyr::select(Year:Pos, X40YD:Shuttle, Games:Points)
tes <- tes %>% dplyr::select(Year:Pos, X40YD:Shuttle, Games:Points)
```

1.5 Remove Combine Non-Participants

```
no_combine <- function(position) {
  combine_stats <- position %>% dplyr::select(X40YD:Shuttle)
  any_combine <- apply(combine_stats, 1, is.na)
  none <- apply(any_combine, 2, sum)
  events <- ncol(combine_stats)
  position$Player[none == events]
}
no_combine(qbs)
```

```
[1] "Zach Mettenberger" "Lamar Jackson"     "Kyler Murray"
```

```
qbs <- qbs[qbs$Player != no_combine(qbs)[1] &
             qbs$Player != no_combine(qbs)[2] &
             qbs$Player != no_combine(qbs)[3], ]
qbs <- qbs[!is.na(qbs$Points), ]
no_combine(rbs)
```

```
[1] "Josh Jacobs"
```

```
rbs <- rbs[rbs$Player != no_combine(rbs), ]
rbs <- rbs[!is.na(rbs$Points), ]
no_combine(wrs)
```

```
[1] "Corey Davis"     "Dede Westbrook"  "Dante Pettis"    "Deontay Burnett"
[5] "Marquise Brown"
```

```
wrs <- wrs[wrs$Player != no_combine(wrs)[1] &
             wrs$Player != no_combine(wrs)[2] &
             wrs$Player != no_combine(wrs)[3] &
             wrs$Player != no_combine(wrs)[4]&
             wrs$Player != no_combine(wrs)[5], ]
wrs <- wrs[!is.na(wrs$Points), ]
no_combine(tes)
```

```
[1] "Jordan Akins"
```

```
tes <- tes[tes$Player != no_combine(tes), ]
tes <- tes[!is.na(tes$Points), ]
```

1.6 Eight Game Minimum

```
qbs <- qbs %>% filter(Games >= 8) %>% filter(Points >= 10)
rbs <- rbs %>% filter(Games >= 8) %>% filter(Points >= 10)
wrs <- wrs %>% filter(Games >= 8) %>% filter(Points >= 10)
tes <- tes %>% filter(Games >= 8) %>% filter(Points >= 10)
```

2 Data Analysis

Note: When determining analysis on the combine events, before simply fitting a model to ***everything****, we first only consider the events in which* ***at least 60% of the participants at that position*** *partook in the event during the combine.*

2.1 Helper Function

```
total_nas <- function(position) {
  na_chart <- lapply(position, is.na)
  vapply(na_chart, sum, numeric(1))
}
```

2.2 The Quarterback

```
nrow(qbs)
```

```
[1] 54
```

```
total_nas(qbs)
```

```
      Year     Player        Pos      X40YD   Vertical  BenchReps Broad.Jump
         0          0          0          1         14         53         15
    X3Cone    Shuttle      Games     Points
        16         15          0          0
```

```
total_nas(qbs) / nrow(qbs)
```

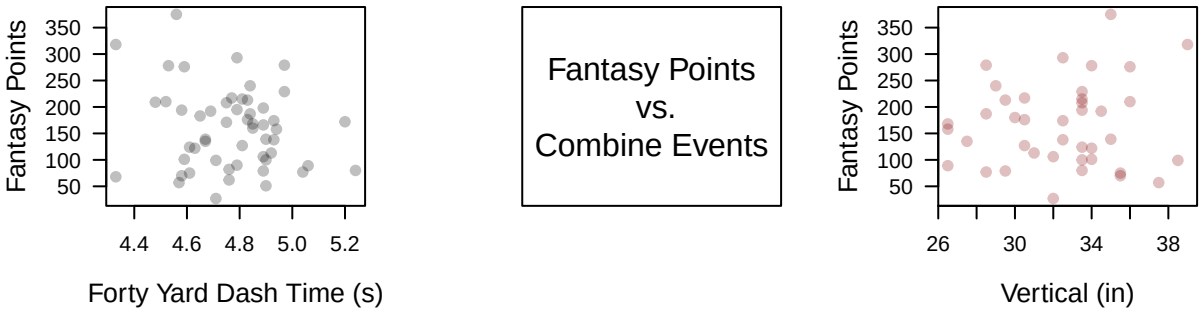
```
      Year     Player        Pos      X40YD   Vertical  BenchReps Broad.Jump
0.00000000 0.00000000 0.00000000 0.01851852 0.25925926 0.98148148 0.27777778
    X3Cone    Shuttle      Games     Points
0.29629630 0.27777778 0.00000000 0.00000000
```

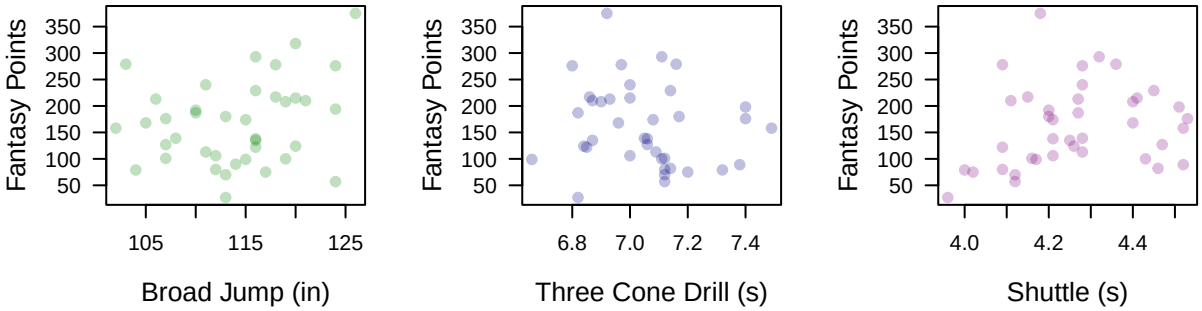
```
names(qbs)[total_nas(qbs) / nrow(qbs) >= 0.4]
```

```
[1] "BenchReps"
```

```
qb_rel_vars <- qbs %>% dplyr::select(Player,
                             X40YD:Vertical,
                             Broad.Jump:Shuttle,
                             Points)
par(mfrow = c(2, 3))
plot(Points ~ X40YD, data = qb_rel_vars,
     xlab = "Forty Yard Dash Time (s)",
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[1],
     cex.lab = 1.25,
     las = 1)
plot(0:10, 0:10, type = "n",
     xaxt = "n", yaxt = "n",
     xlab = "", ylab = "")
text(5, 5, "Fantasy Points\n vs.\nCombine Events",
     cex = 1.5)
plot(Points ~ Vertical, data = qb_rel_vars,
     xlab = "Vertical (in)",
     ylab = "Fantasy Points",
```

```
     pch = 19, col = color_scheme[2],
     cex.lab = 1.25,
     las = 1)
plot(Points ~ Broad.Jump, data = qb_rel_vars,
     xlab = "Broad Jump (in)",
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[3],
     cex.lab = 1.25,
     las = 1)
plot(Points ~ X3Cone, data = qb_rel_vars,
     xlab = "Three Cone Drill (s)",
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[4],
     cex.lab = 1.25,
     las = 1)
plot(Points ~ Shuttle, data = qb_rel_vars,
     xlab = "Shuttle (s)",
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[5],
     cex.lab = 1.25,
     las = 1)
```






```
with(qb_rel_vars, cor(X40YD, Points, use = "complete.obs"))
```

```
[1] -0.1893663
```

```
with(qb_rel_vars, cor(Vertical, Points, use = "complete.obs"))
```

```
[1] 0.09480982
```

```
with(qb_rel_vars, cor(Broad.Jump, Points, use = "complete.obs"))
```

```
[1] 0.2581988
```

```
with(qb_rel_vars, cor(X3Cone, Points, use = "complete.obs"))
```

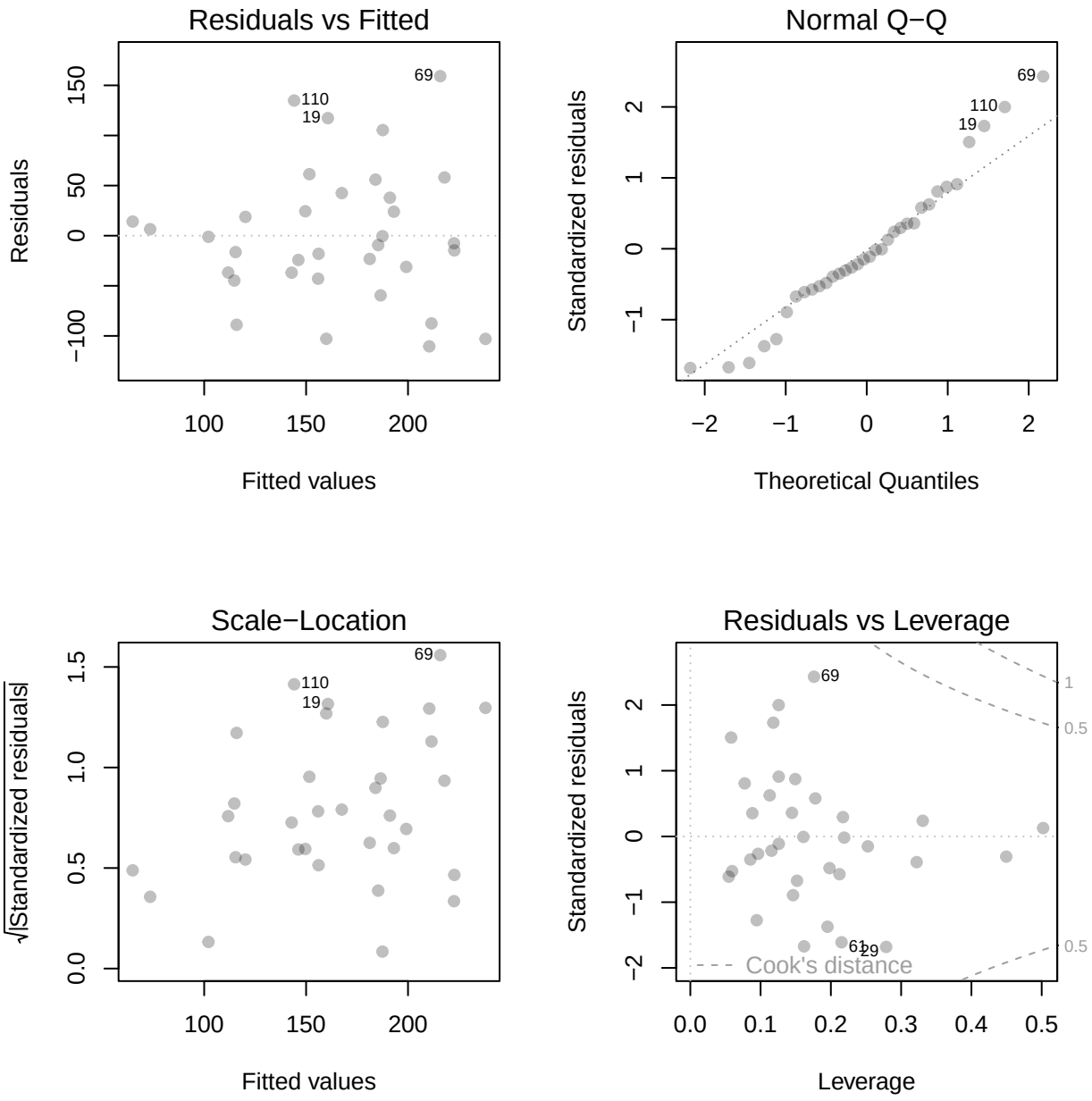
```
[1] -0.1544544
```

```
with(qb_rel_vars, cor(Shuttle, Points, use = "complete.obs"))
```

```
[1] 0.2290112
```

2.2.1 A Model

```
qb_model <- lm(Points ~ . - Player, data = qb_rel_vars)
par(mfrow = c(2, 2))
plot(qb_model,
     pch = 19,
     col = rgb(0, 0, 0, alpha = 0.25),
     add.smooth = FALSE)
```




```
summary(qb_model)
```

```
Call:
lm(formula = Points ~ . - Player, data = qb_rel_vars)

Residuals:
     Min       1Q   Median       3Q      Max
-110.440  -36.879   -8.477   34.496  159.175

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -470.438    871.893  -0.540   0.5938
X40YD        -73.101     95.488  -0.766   0.4504
Vertical      -9.522      6.113  -1.558   0.1306
```

```
Broad.Jump     5.768      2.999   1.923   0.0647 .
X3Cone       -36.248     85.826  -0.422   0.6760
Shuttle      209.796     96.383   2.177   0.0381 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 72.16 on 28 degrees of freedom
  (20 observations deleted due to missingness)
Multiple R-squared:  0.3024,    Adjusted R-squared:  0.1779
F-statistic: 2.428 on 5 and 28 DF,  p-value: 0.05997
```

2.2.2 A Transformation

```
summary(powerTransform(Points ~ . - Player, data = qb_rel_vars))
```

```
Warning in estimateTransform.default(X, Y, weights, family, ...): Convergence
failure: return code = 52
```

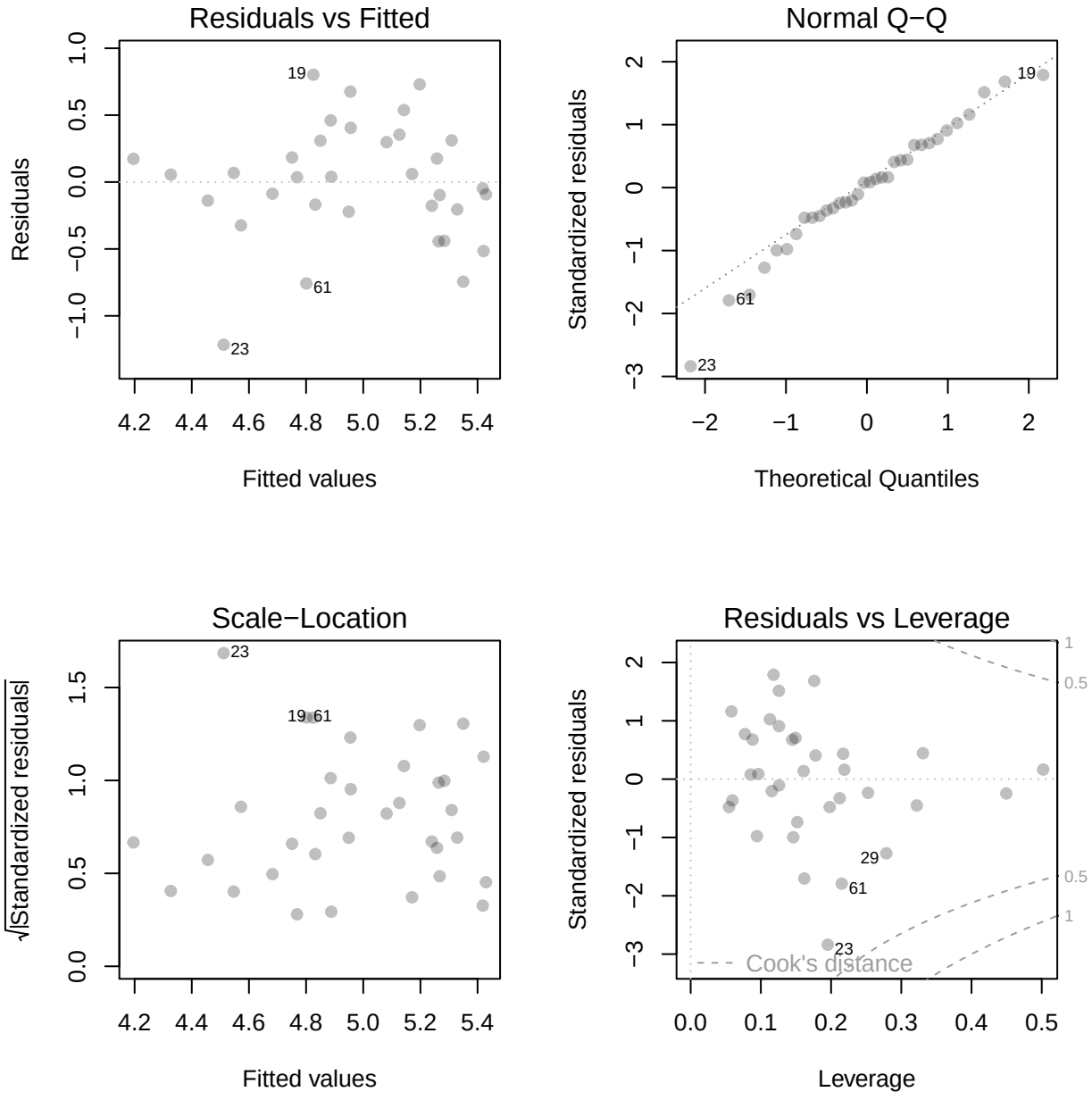
```
bcPower Transformation to Normality
   Est Power Rounded Pwr Wald Lwr Bnd Wald Upr Bnd
Y1    0.3553           0      -0.1459       0.8565

Likelihood ratio test that transformation parameter is equal to 0
 (log transformation)
                           LRT df   pval
LR test, lambda = (0) 2.138913  1 0.1436

Likelihood ratio test that no transformation is needed
                           LRT df     pval
LR test, lambda = (1) 5.305285  1 0.021261
```

```
summary(powerTransform(cbind(X40YD, Vertical, Broad.Jump,
                             X3Cone, Shuttle) ~ 1,
                       data = qb_rel_vars))
```

```
bcPower Transformations to Multinormality
           Est Power Rounded Pwr Wald Lwr Bnd Wald Upr Bnd
X40YD        -7.7176           1     -16.6223       1.1870
Vertical      1.4037           1      -1.5119       4.3192
Broad.Jump    0.4020           1      -5.4326       6.2367
X3Cone       -2.8106           1     -13.2733       7.6522
Shuttle       1.3605           1      -7.9540      10.6751

Likelihood ratio test that transformation parameters are equal to 0
 (all log transformations)
                                    LRT df    pval
LR test, lambda = (0 0 0 0 0) 4.365722  5 0.49805

Likelihood ratio test that no transformations are needed
                                    LRT df    pval
LR test, lambda = (1 1 1 1 1) 4.846294  5 0.43493
```

```
qb_relevant_transformed <- qb_rel_vars %>% mutate("New_Points" = log(Points))
qb_transformed_model <- lm(New_Points ~ . - Points - Player,
                           data = qb_relevant_transformed)
par(mfrow = c(2, 2))
```

```
plot(qb_transformed_model,
     pch = 19,
     col = rgb(0, 0, 0, alpha = 0.25),
     add.smooth = FALSE)
```




```
summary(qb_transformed_model)
```

```
Call:
lm(formula = New_Points ~ . - Points - Player, data = qb_relevant_transformed)

Residuals:
     Min       1Q   Median       3Q      Max
-1.21560 -0.19795  0.03742  0.30621  0.80218
```

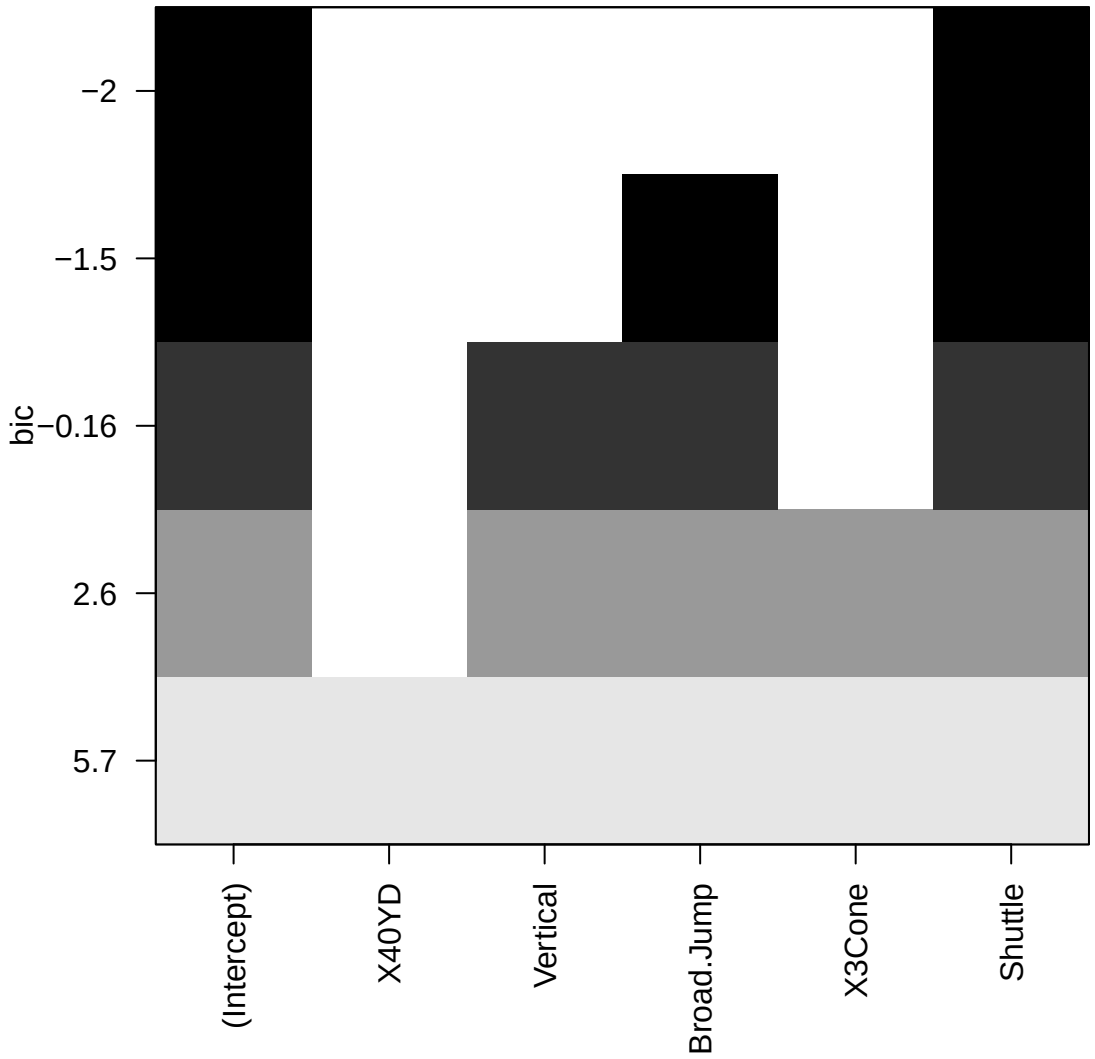
```
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.49999    5.76765  -0.087   0.9315
X40YD       -0.40512    0.63166  -0.641   0.5265
Vertical    -0.05570    0.04044  -1.377   0.1793
Broad.Jump   0.03056    0.01984   1.540   0.1347
X3Cone      -0.37061    0.56775  -0.653   0.5192
Shuttle      1.96380    0.63759   3.080   0.0046 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4773 on 28 degrees of freedom
  (20 observations deleted due to missingness)
Multiple R-squared:  0.3661,    Adjusted R-squared:  0.2529
F-statistic: 3.234 on 5 and 28 DF,  p-value: 0.01984
```

2.2.3 Model Selection

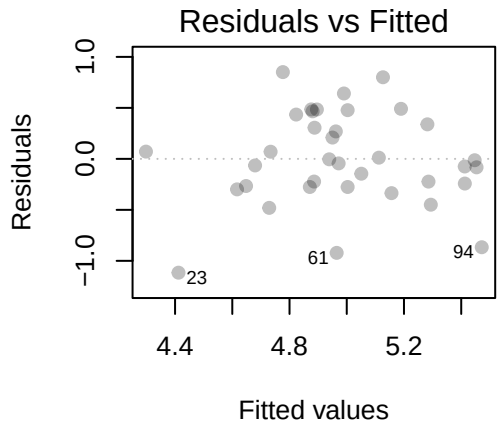
```
qb_best_subsets <- regsubsets(New_Points ~ . - Points - Player,
                              data = qb_relevant_transformed,
                              nvmax = 5)
summary(qb_best_subsets)
```

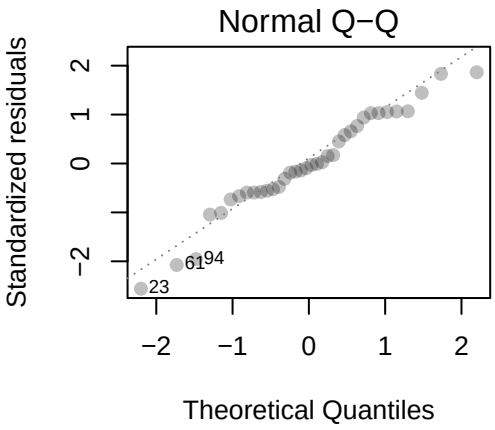
```
Subset selection object
Call: regsubsets.formula(New_Points ~ . - Points - Player, data = qb_relevant_transformed,
    nvmax = 5)
5 Variables  (and intercept)
           Forced in Forced out
X40YD          FALSE      FALSE
Vertical       FALSE      FALSE
Broad.Jump     FALSE      FALSE
X3Cone         FALSE      FALSE
Shuttle        FALSE      FALSE
1 subsets of each size up to 5
Selection Algorithm: exhaustive
         X40YD Vertical Broad.Jump X3Cone Shuttle
1  ( 1 ) " "   " "      " "        " "    "*"
2  ( 1 ) " "   " "      "*"        " "    "*"
3  ( 1 ) " "   "*"      "*"        " "    "*"
4  ( 1 ) " "   "*"      "*"        "*"    "*"
5  ( 1 ) "*"   "*"      "*"        "*"    "*"
```

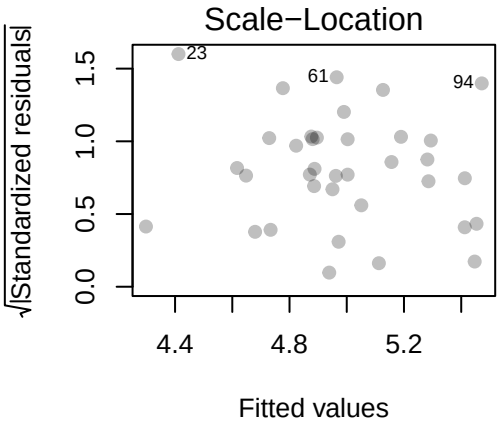
```
plot(qb_best_subsets)
```

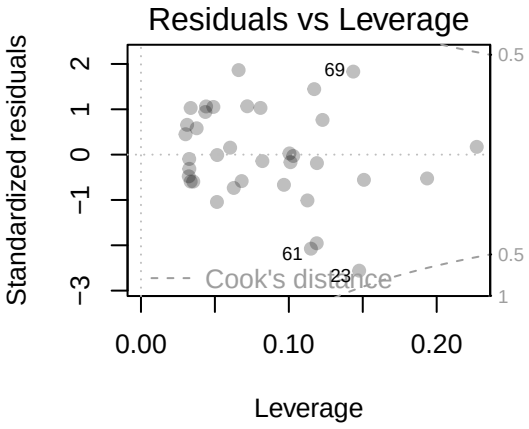



```
final_qb_model <- lm(New_Points ~ Broad.Jump + Shuttle,
                     data = qb_relevant_transformed)
par(mfrow = c(2, 2))
plot(final_qb_model,
     pch = 19,
     col = rgb(0, 0, 0, alpha = 0.25),
     add.smooth = FALSE)
```










```
summary(final_qb_model)
```

```
Call:
lm(formula = New_Points ~ Broad.Jump + Shuttle, data = qb_relevant_transformed)

Residuals:
     Min       1Q   Median       3Q      Max
-1.11619 -0.26852 -0.02889  0.36250  0.85084

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -5.85609    3.15626  -1.855  0.07249 .
Broad.Jump   0.02144    0.01337   1.603  0.11847
Shuttle      1.98119    0.56961   3.478  0.00144 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4722 on 33 degrees of freedom
```

```
  (18 observations deleted due to missingness)
Multiple R-squared:  0.2778,    Adjusted R-squared:  0.234
F-statistic: 6.346 on 2 and 33 DF,  p-value: 0.004655
```

2.3 The Running Back

```
nrow(rbs)
```

```
[1] 215
```

```
total_nas(rbs)
```

```
      Year     Player        Pos      X40YD   Vertical  BenchReps Broad.Jump
         0          0          0          4         39         52         42
    X3Cone    Shuttle      Games     Points
        98         93          0          0
```

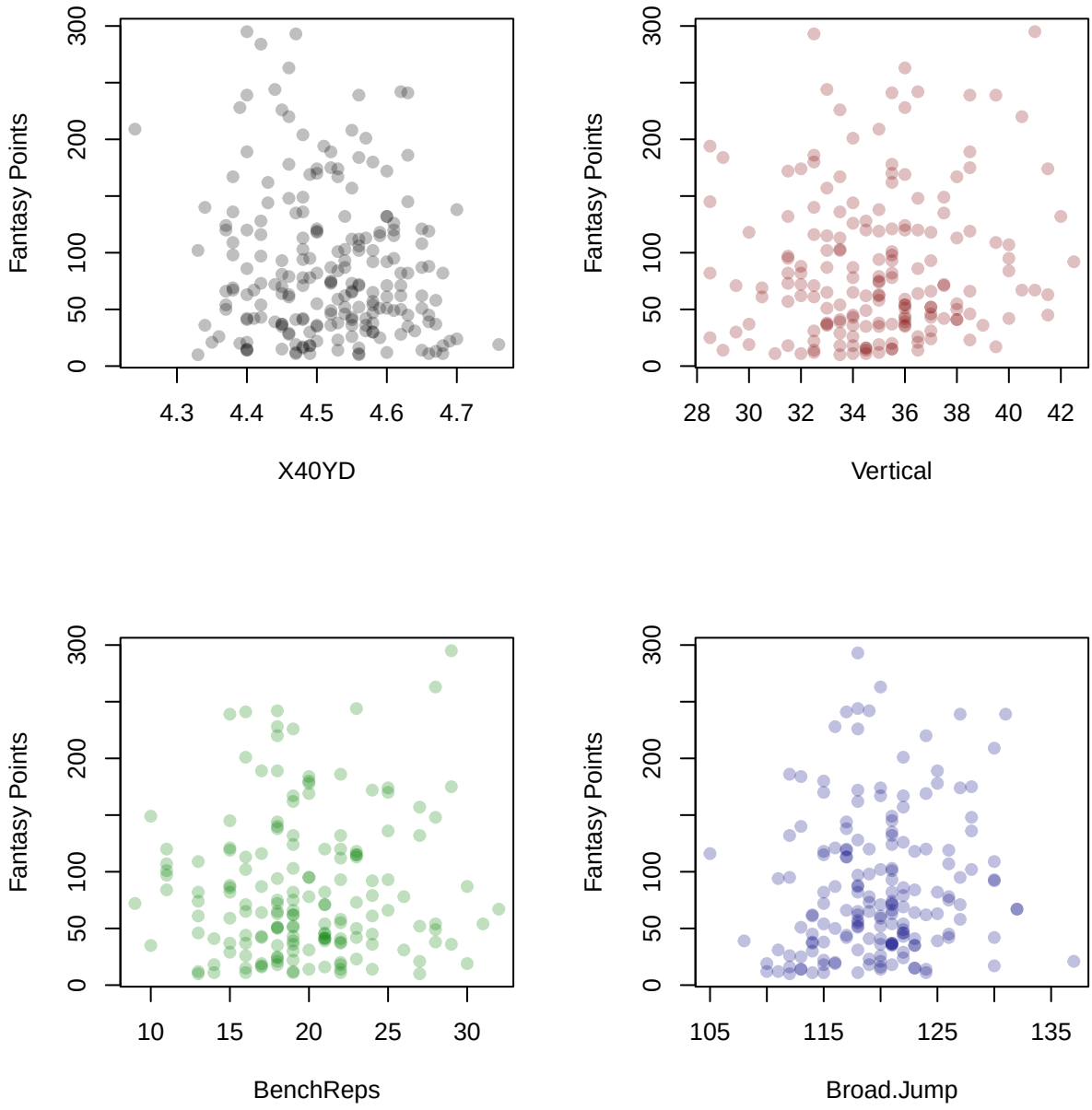
```
total_nas(rbs) / nrow(rbs)
```

```
      Year     Player        Pos      X40YD   Vertical  BenchReps Broad.Jump
0.00000000 0.00000000 0.00000000 0.01860465 0.18139535 0.24186047 0.19534884
    X3Cone    Shuttle      Games     Points
0.45581395 0.43255814 0.00000000 0.00000000
```

```
names(rbs)[total_nas(rbs) / nrow(rbs) >= 0.4]
```

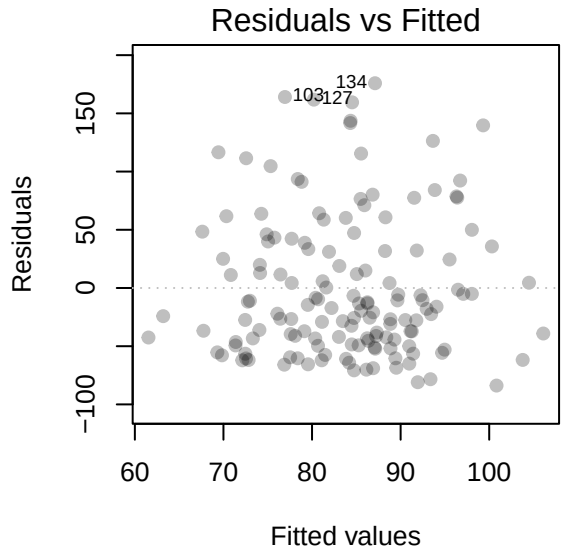
```
[1] "X3Cone"  "Shuttle"
```

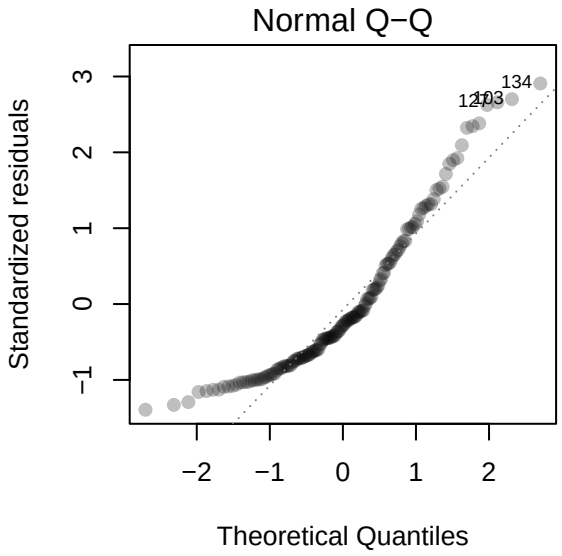
```
rb_rel_vars <- rbs %>% dplyr::select(Player,
                             X40YD:Broad.Jump,
                             Points)
par(mfrow = c(2, 2))
plot(Points ~ X40YD, data = rb_rel_vars,
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[1])
plot(Points ~ Vertical, data = rb_rel_vars,
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[2])
plot(Points ~ BenchReps, data = rb_rel_vars,
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[3])
plot(Points ~ Broad.Jump, data = rb_rel_vars,
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[4])
```

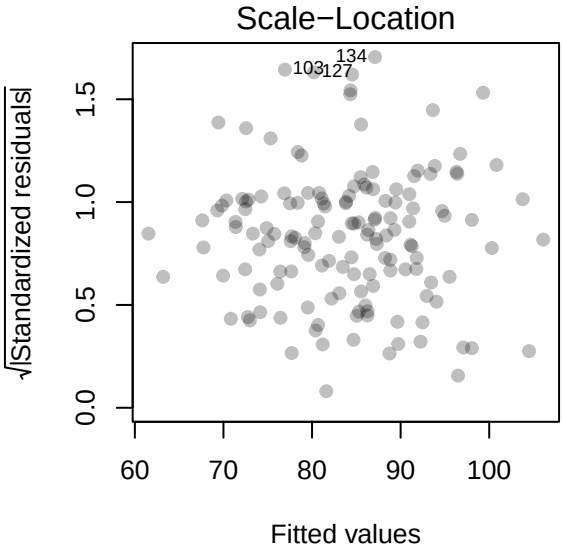


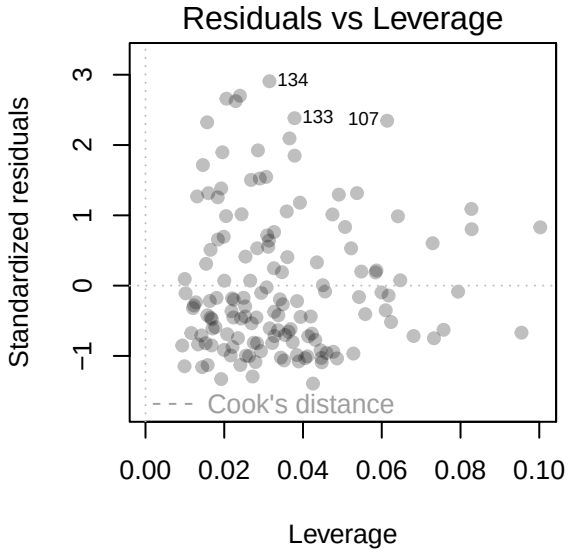
2.3.1 A Model

```
rb_model <- lm(Points ~ . - Player, data = rb_rel_vars)
par(mfrow = c(2, 2))
plot(rb_model,
     pch = 19,
     col = rgb(0, 0, 0, alpha = 0.25),
     add.smooth = FALSE)
```







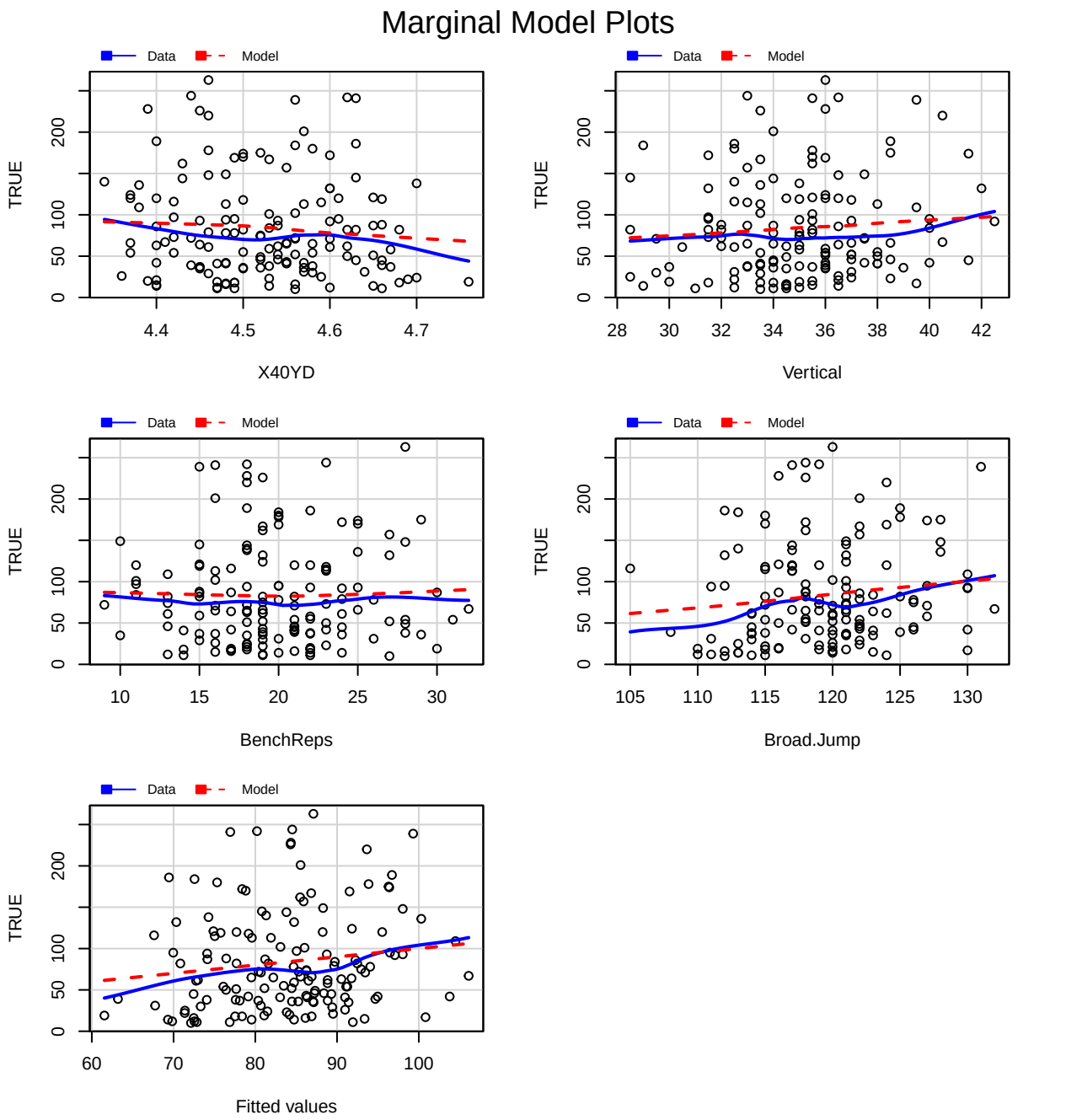



```
summary(rb_model)
```

```
Call:
lm(formula = Points ~ . - Player, data = rb_rel_vars)

Residuals:
   Min     1Q Median     3Q    Max
-83.83 -45.36 -17.20  35.70 175.89

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  78.29926  329.75352   0.237    0.813
X40YD       -36.14237   59.79563  -0.604    0.547
Vertical      0.22259    2.21984   0.100    0.920
```

```
BenchReps    -0.01209    1.10074  -0.011    0.991
Broad.Jump    1.35275    1.27340   1.062    0.290

Residual standard error: 61.47 on 140 degrees of freedom
  (70 observations deleted due to missingness)
Multiple R-squared:  0.02029,   Adjusted R-squared:  -0.007705
F-statistic: 0.7247 on 4 and 140 DF,  p-value: 0.5764
```

```
mmps(rb_model)
```



2.3.2 A Transformation

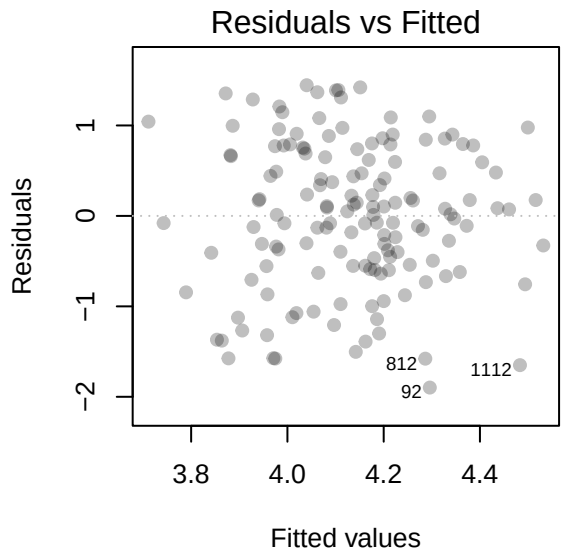
```
summary(powerTransform(Points ~ . - Player, data = rb_rel_vars))
```

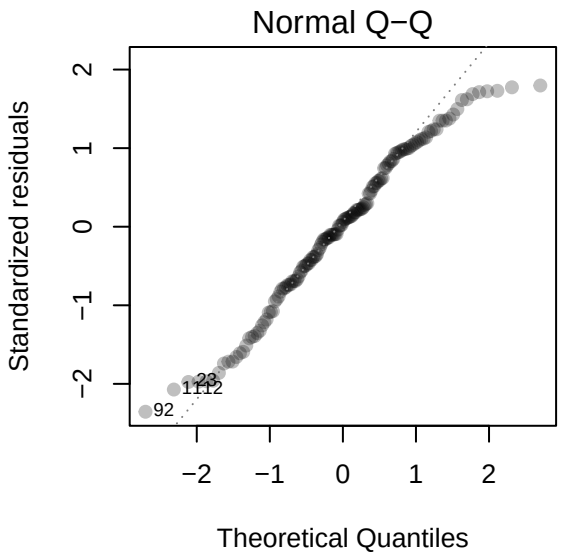
```
bcPower Transformation to Normality
   Est Power Rounded Pwr Wald Lwr Bnd Wald Upr Bnd
Y1    0.1878           0      -0.0096       0.3852

Likelihood ratio test that transformation parameter is equal to 0
 (log transformation)
                            LRT df    pval
LR test, lambda = (0) 3.528021  1 0.06034

Likelihood ratio test that no transformation is needed
                            LRT df       pval
LR test, lambda = (1) 58.55035  1 1.9762e-14
```

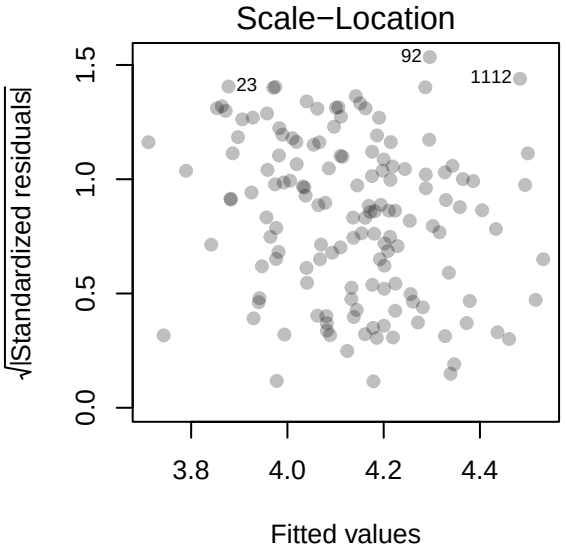
```
summary(powerTransform(cbind(X40YD, Vertical,
                             BenchReps, Broad.Jump) ~ 1,
                       data = rb_rel_vars))
```

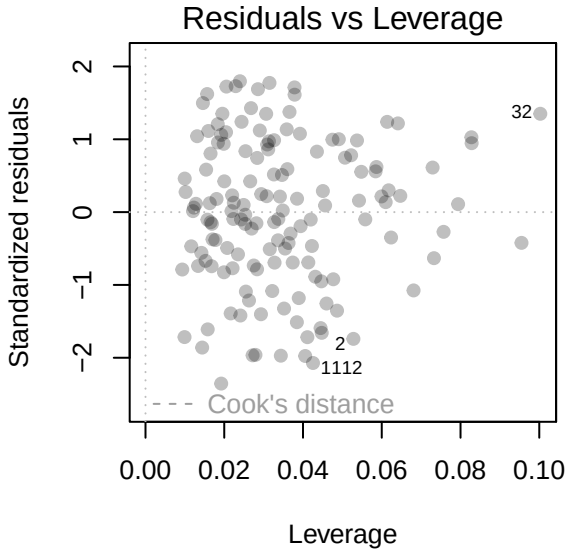
```
bcPower Transformations to Multinormality
           Est Power Rounded Pwr Wald Lwr Bnd Wald Upr Bnd
X40YD        -0.4595           1      -8.3813       7.4624
Vertical      1.0758           1      -0.4287       2.5803
BenchReps     0.6701           1       0.1152       1.2251
Broad.Jump    0.8828           1      -2.0134       3.7789

Likelihood ratio test that transformation parameters are equal to 0
 (all log transformations)
                                  LRT df     pval
LR test, lambda = (0 0 0 0) 8.007816  4 0.091292

Likelihood ratio test that no transformations are needed
                                  LRT df    pval
LR test, lambda = (1 1 1 1) 1.476565  4 0.83078
```

```
rb_relevant_transformed <- rb_rel_vars %>% mutate("New_Points" = log(Points))
rb_transformed_model <- lm(New_Points ~ . - Points - Player,
                           data = rb_relevant_transformed)
par(mfrow = c(2, 2))
plot(rb_transformed_model,
     pch = 19,
     col = rgb(0, 0, 0, alpha = 0.25),
     add.smooth = FALSE)
```










```
summary(rb_transformed_model)
```

```
Call:
lm(formula = New_Points ~ . - Points - Player, data = rb_relevant_transformed)

Residuals:
     Min       1Q   Median       3Q      Max
-1.89799 -0.55298  0.04995  0.67209  1.44476

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  1.5240649  4.3651628   0.349   0.7275
X40YD       -0.2438744  0.7915538  -0.308   0.7585
Vertical    -0.0009534  0.0293855  -0.032   0.9742
```

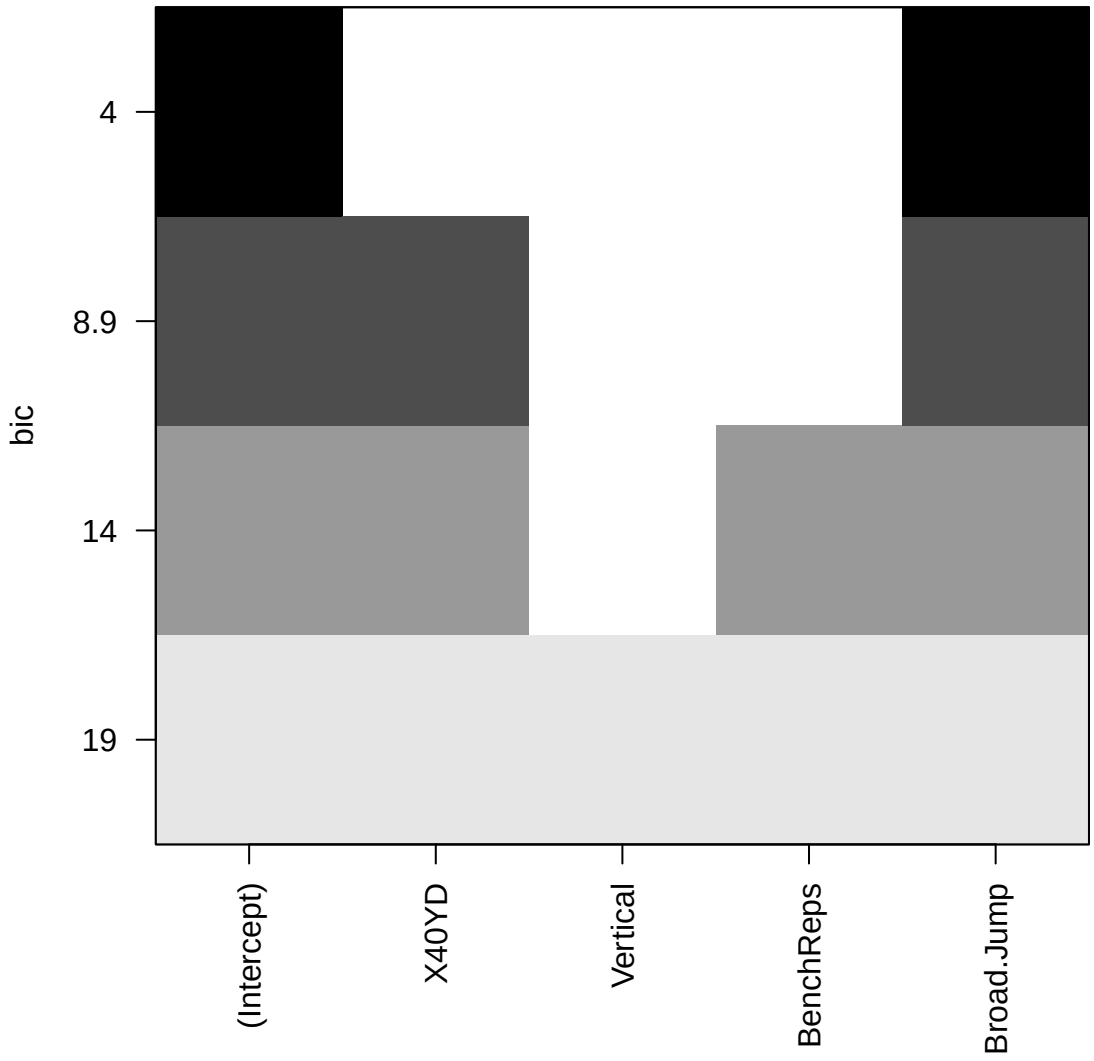
```
BenchReps   -0.0020753  0.0145712  -0.142   0.8869
Broad.Jump   0.0317279  0.0168568   1.882   0.0619 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.8138 on 140 degrees of freedom
  (70 observations deleted due to missingness)
Multiple R-squared:  0.04106,   Adjusted R-squared:  0.01366
F-statistic: 1.499 on 4 and 140 DF,  p-value: 0.2059
```

2.3.3 Model Selection

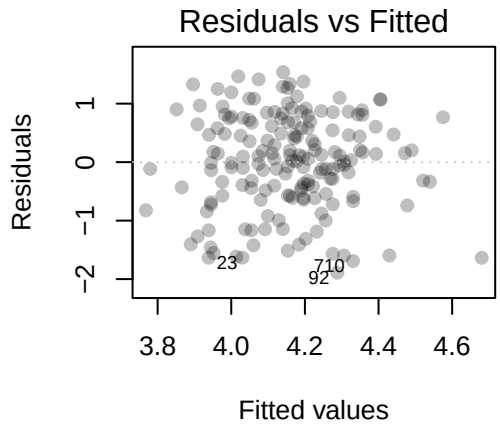
```
rb_best_subsets <- regsubsets(New_Points ~ . - Points - Player,
                              data = rb_relevant_transformed,
                              nvmax = 4)
summary(rb_best_subsets)
```

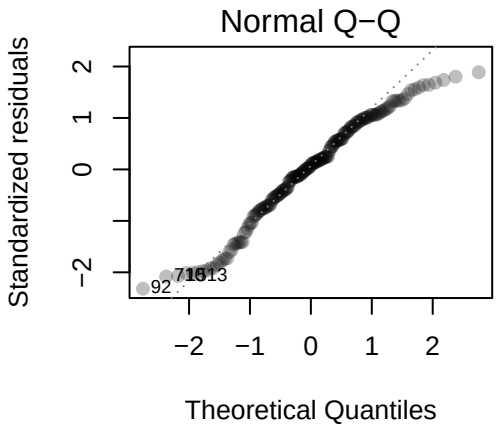
```
Subset selection object
Call: regsubsets.formula(New_Points ~ . - Points - Player, data = rb_relevant_transformed,
    nvmax = 4)
4 Variables  (and intercept)
           Forced in Forced out
X40YD          FALSE      FALSE
Vertical       FALSE      FALSE
BenchReps      FALSE      FALSE
Broad.Jump     FALSE      FALSE
1 subsets of each size up to 4
Selection Algorithm: exhaustive
         X40YD Vertical BenchReps Broad.Jump
1  ( 1 ) " "   " "      " "       "*"
2  ( 1 ) "*"   " "      " "       "*"
3  ( 1 ) "*"   " "      "*"       "*"
4  ( 1 ) "*"   "*"      "*"       "*"
```

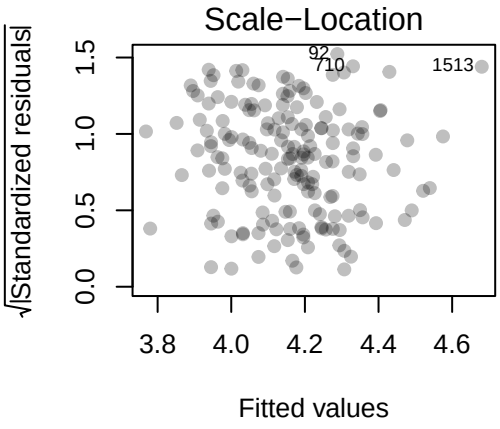
```
plot(rb_best_subsets)
```

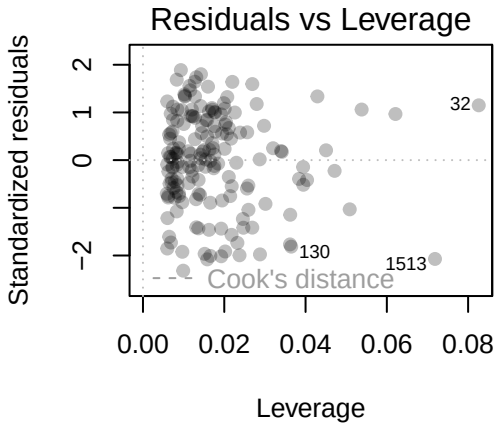



```
final_rb_model <- lm(New_Points ~ Broad.Jump + X40YD, data = rb_relevant_transformed)
par(mfrow = c(2, 2))
plot(final_rb_model,
     pch = 19,
     col = rgb(0, 0, 0, alpha = 0.25),
     add.smooth = FALSE)
```










```
summary(final_rb_model)
```

```
Call:
lm(formula = New_Points ~ Broad.Jump + X40YD, data = rb_relevant_transformed)

Residuals:
     Min       1Q   Median       3Q      Max
-1.89030 -0.55716  0.05755  0.67639  1.53941

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  3.95120    4.06020   0.973   0.3319
Broad.Jump   0.02457    0.01294   1.899   0.0592 .
X40YD       -0.60625    0.71524  -0.848   0.3979
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.8193 on 168 degrees of freedom
```

```
  (44 observations deleted due to missingness)
Multiple R-squared:  0.0363,    Adjusted R-squared:  0.02483
F-statistic: 3.164 on 2 and 168 DF,  p-value: 0.04477
```

2.4 The Wide Receiver

```
nrow(wrs)
```

```
[1] 274
```

```
total_nas(wrs)
```

```
      Year     Player        Pos      X40YD   Vertical  BenchReps Broad.Jump
         0          0          0          2         60        144         64
    X3Cone    Shuttle      Games     Points
       108        100          0          0
```

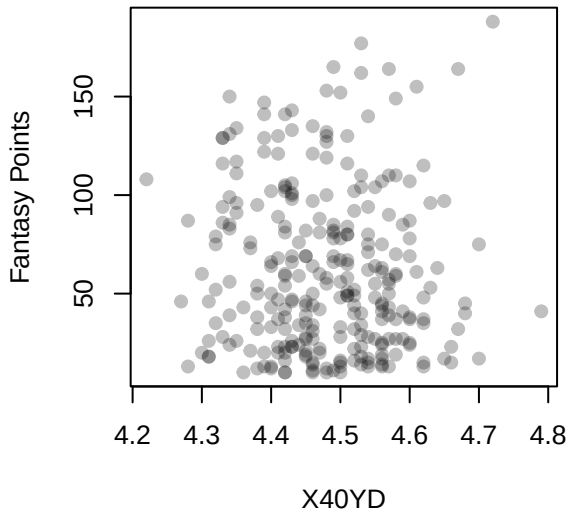
```
total_nas(wrs) / nrow(wrs)
```

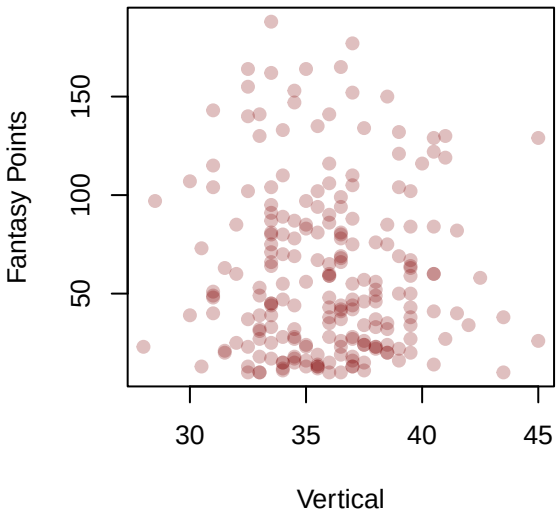
```
      Year     Player        Pos      X40YD   Vertical  BenchReps Broad.Jump
0.00000000 0.00000000 0.00000000 0.00729927 0.21897810 0.52554745 0.23357664
    X3Cone    Shuttle      Games     Points
0.39416058 0.36496350 0.00000000 0.00000000
```

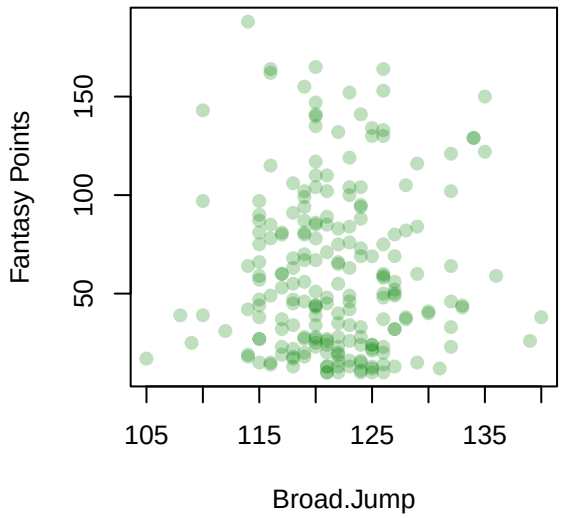
```
names(wrs)[total_nas(wrs) / nrow(wrs) >= 0.4]
```

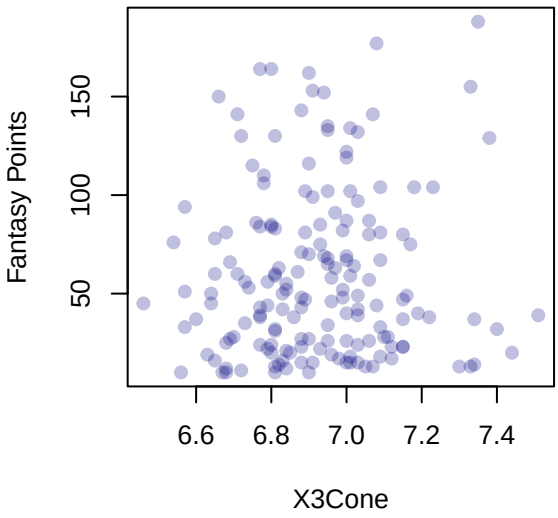
```
[1] "BenchReps"
```

```
wr_rel_vars <- wrs %>% dplyr::select(Player,
                             X40YD:Vertical,
                             Broad.Jump:Shuttle,
                             Points)
par(mfrow = c(2, 2))
plot(Points ~ X40YD, data = wr_rel_vars,
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[1])
plot(Points ~ Vertical, data = wr_rel_vars,
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[2])
plot(Points ~ Broad.Jump, data = wr_rel_vars,
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[3])
plot(Points ~ X3Cone, data = wr_rel_vars,
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[4])
```

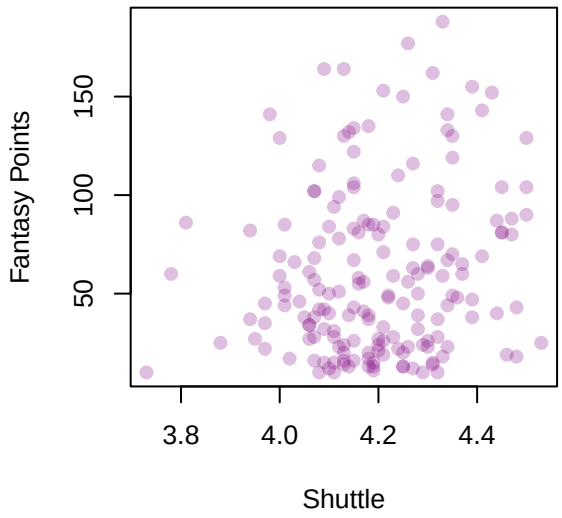






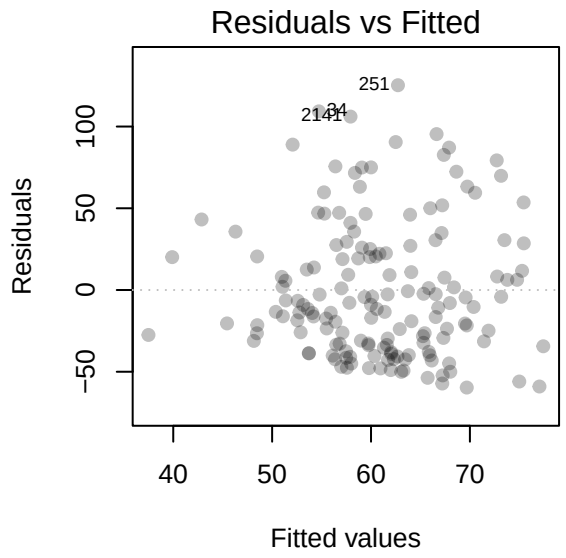


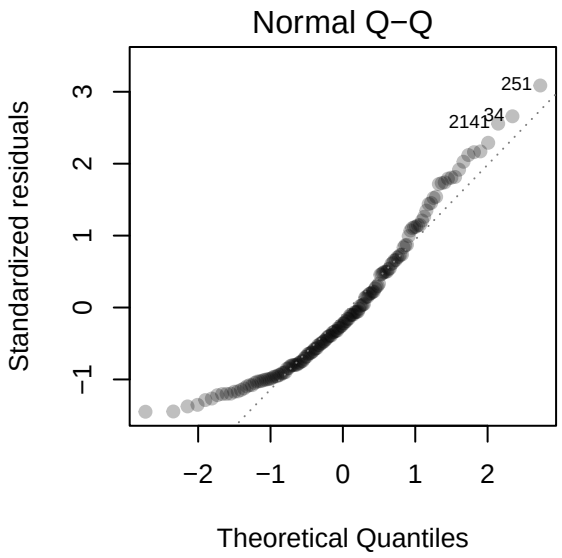

```
plot(Points ~ Shuttle, data = wr_rel_vars,
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[5])
```

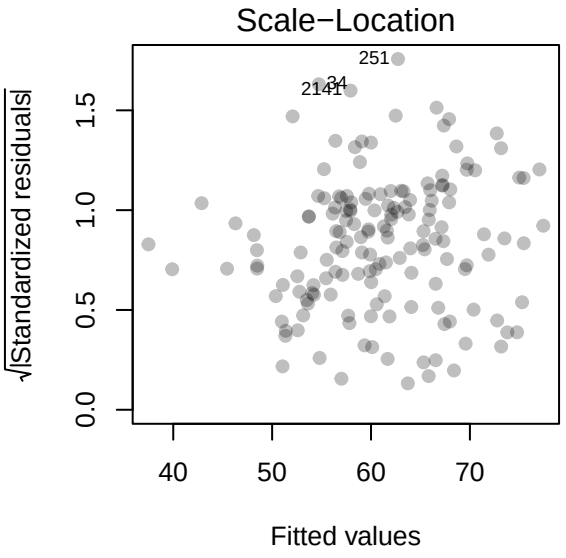


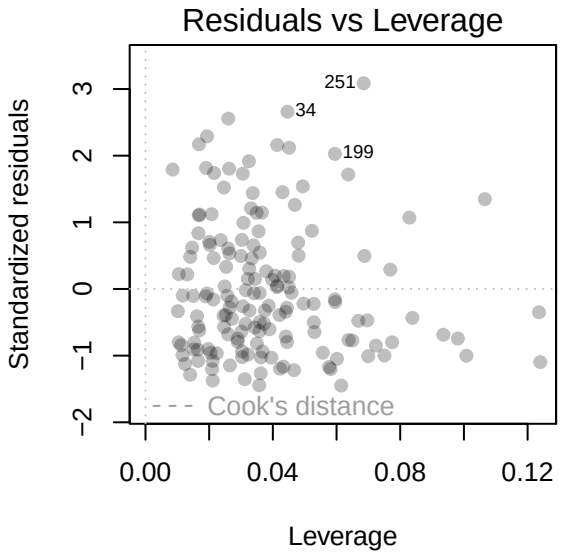
2.4.1 A Model

```
wr_model <- lm(Points ~ . - Player, data = wr_rel_vars)
par(mfrow = c(2, 2))
plot(wr_model,
     pch = 19,
     col = rgb(0, 0, 0, alpha = 0.25),
     add.smooth = FALSE)
```







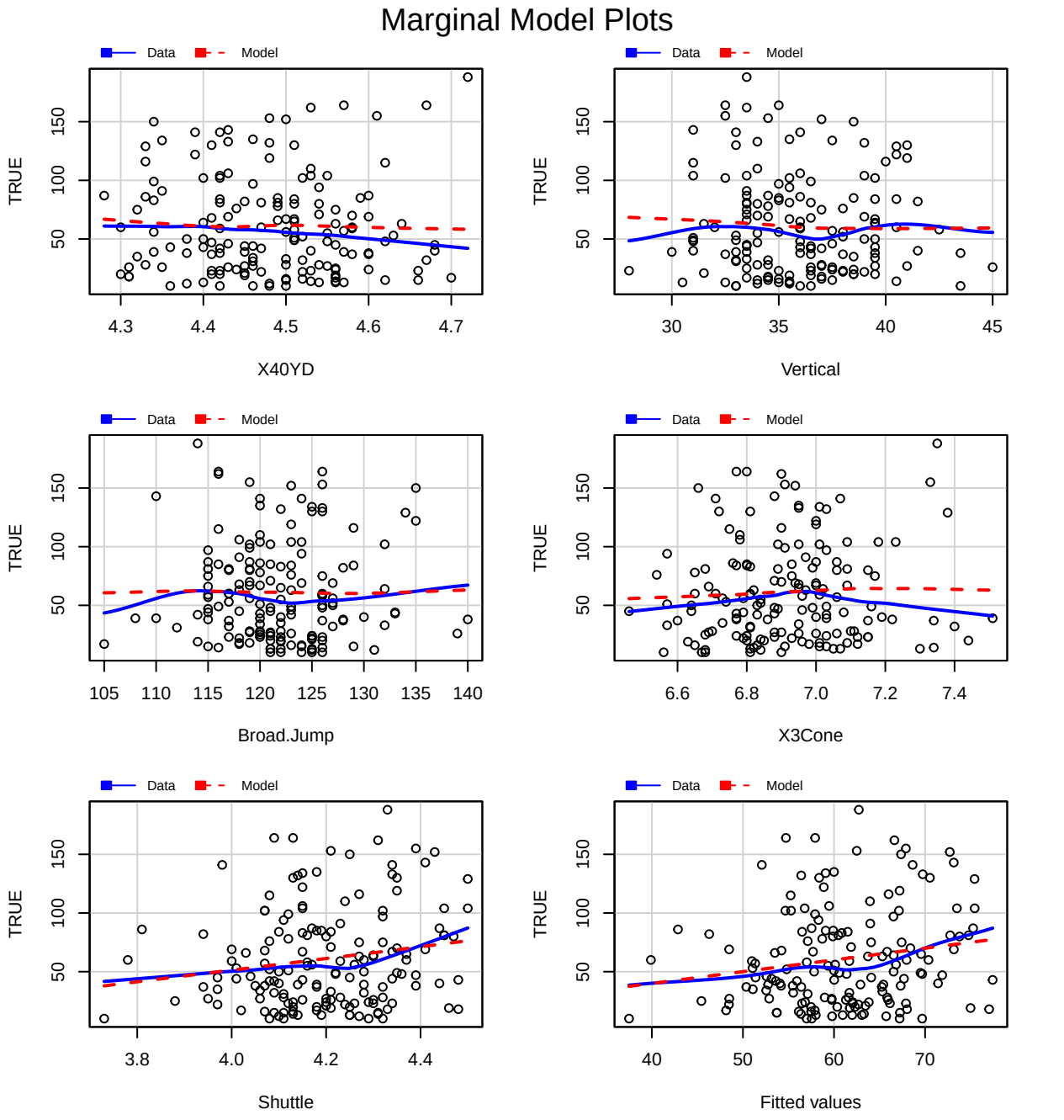



```
summary(wr_model)
```

```
Call:
lm(formula = Points ~ . - Player, data = wr_rel_vars)

Residuals:
   Min     1Q Median     3Q    Max
-59.68 -32.83  -9.14  25.09 125.27

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -73.25331  243.72721  -0.301   0.7642
X40YD       -10.08902   38.76219  -0.260   0.7950
Vertical     -0.27956    1.39016  -0.201   0.8409
```

```
Broad.Jump    0.09779    0.72757   0.134   0.8933
X3Cone       -6.32532   20.30223  -0.312   0.7558
Shuttle      52.72718   27.44265   1.921   0.0566 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 42.05 on 151 degrees of freedom
  (117 observations deleted due to missingness)
Multiple R-squared:  0.0317,    Adjusted R-squared:  -0.0003603
F-statistic: 0.9888 on 5 and 151 DF,  p-value: 0.4266
```

```
mmps(wr_model)
```



2.4.2 A Transformation

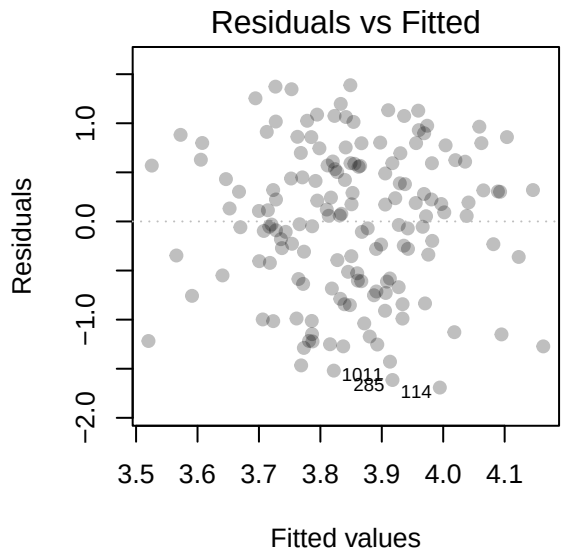
```
summary(powerTransform(Points ~ . - Player, data = wr_rel_vars))
```

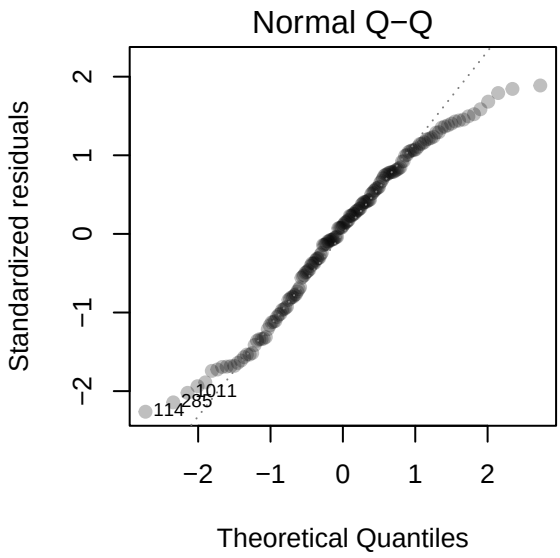
```
bcPower Transformation to Normality
   Est Power Rounded Pwr Wald Lwr Bnd Wald Upr Bnd
Y1    0.1811           0      -0.0321       0.3943

Likelihood ratio test that transformation parameter is equal to 0
 (log transformation)
                            LRT df     pval
LR test, lambda = (0) 2.793331  1 0.094657

Likelihood ratio test that no transformation is needed
                            LRT df       pval
LR test, lambda = (1) 52.88876  1 3.5294e-13
```

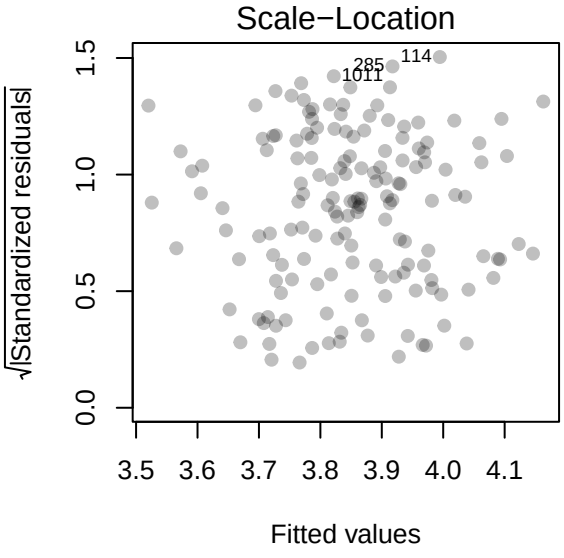
```
summary(powerTransform(cbind(X40YD, Vertical, Broad.Jump,
                             X3Cone, Shuttle) ~ 1,
                       data = wr_rel_vars))
```

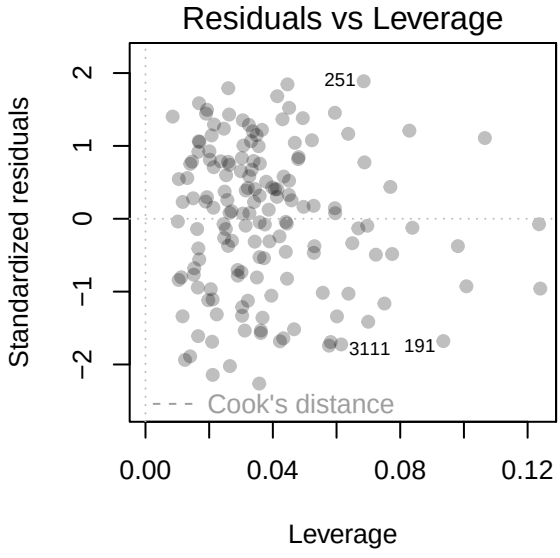
```
bcPower Transformations to Multinormality
           Est Power Rounded Pwr Wald Lwr Bnd Wald Upr Bnd
X40YD         0.0036           1      -6.5455       6.5528
Vertical      0.5047           1      -0.9666       1.9761
Broad.Jump   -0.2165           1      -2.5288       2.0958
X3Cone       -4.4547          -1      -8.7949      -0.1145
Shuttle       3.0331           1      -0.4006       6.4668

Likelihood ratio test that transformation parameters are equal to 0
 (all log transformations)
                                    LRT df    pval
LR test, lambda = (0 0 0 0 0) 8.009242  5 0.15573

Likelihood ratio test that no transformations are needed
                                    LRT df    pval
LR test, lambda = (1 1 1 1 1) 9.218736  5 0.10065
```

```
wr_relevant_transformed <- wr_rel_vars %>% mutate("New_Points" = log(Points))
wr_transformed_model <- lm(New_Points ~ . - Points - Player,
                           data = wr_relevant_transformed)
par(mfrow = c(2, 2))
plot(wr_transformed_model,
     pch = 19,
     col = rgb(0, 0, 0, alpha = 0.25),
     add.smooth = FALSE)
```










```
summary(wr_transformed_model)
```

```
Call:
lm(formula = New_Points ~ . - Points - Player, data = wr_relevant_transformed)

Residuals:
     Min       1Q   Median       3Q      Max
-1.69191 -0.58633  0.07789  0.59310  1.38758

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.966194   4.414616   0.672   0.5027
X40YD       -0.310414   0.702097  -0.442   0.6590
Vertical     0.006149   0.025180   0.244   0.8074
```

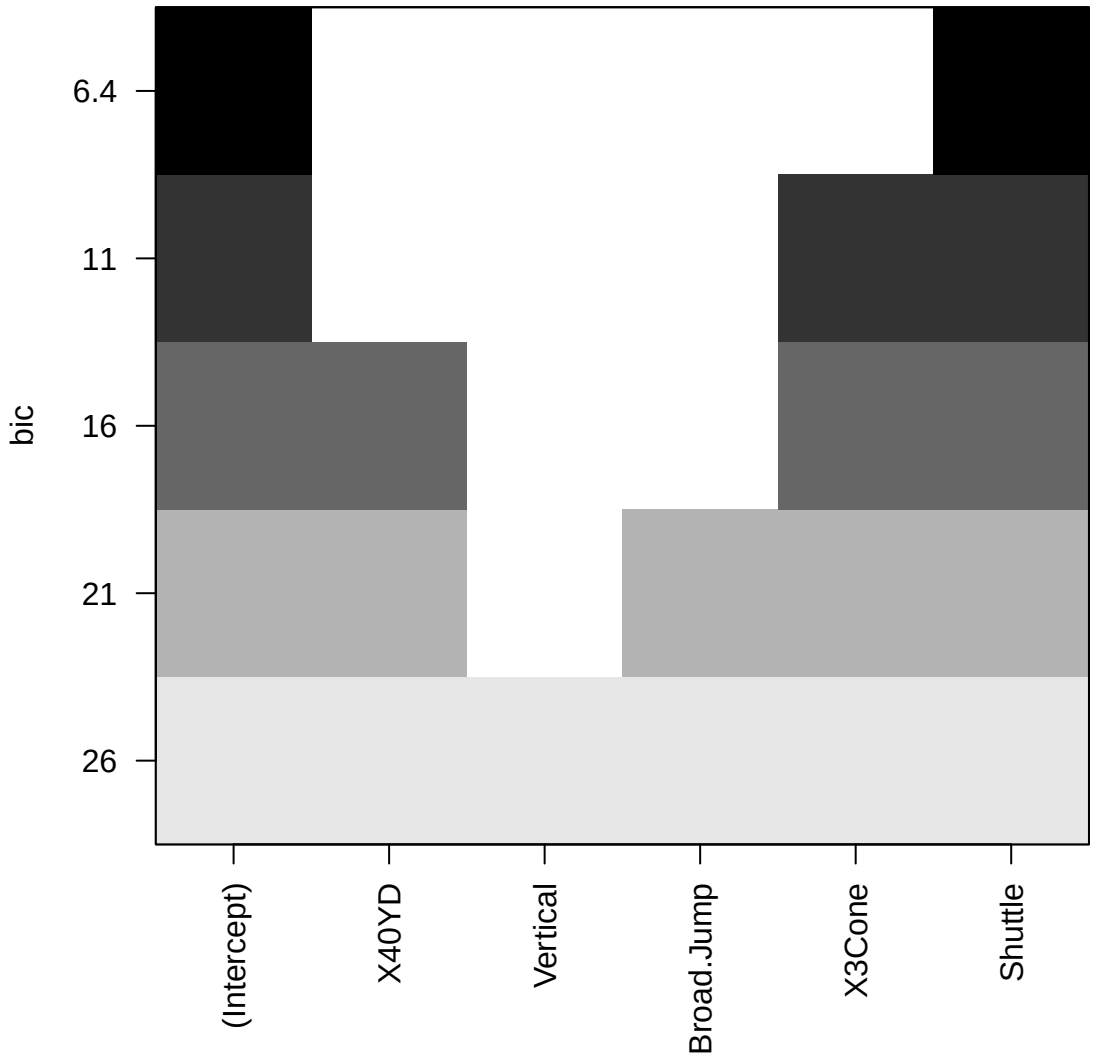
```
Broad.Jump  -0.005236   0.013178  -0.397   0.6917
X3Cone      -0.179449   0.367733  -0.488   0.6263
Shuttle      0.937100   0.497067   1.885   0.0613 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.7616 on 151 degrees of freedom
  (117 observations deleted due to missingness)
Multiple R-squared:  0.0278,    Adjusted R-squared:  -0.004393
F-statistic: 0.8635 on 5 and 151 DF,  p-value: 0.5072
```

2.4.3 Model Selection

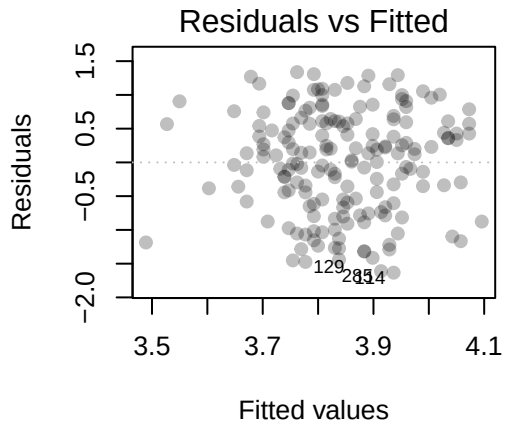
```
wr_best_subsets <- regsubsets(New_Points ~ . - Points - Player,
                              data = wr_relevant_transformed,
                              nvmax = 5)
summary(wr_best_subsets)
```

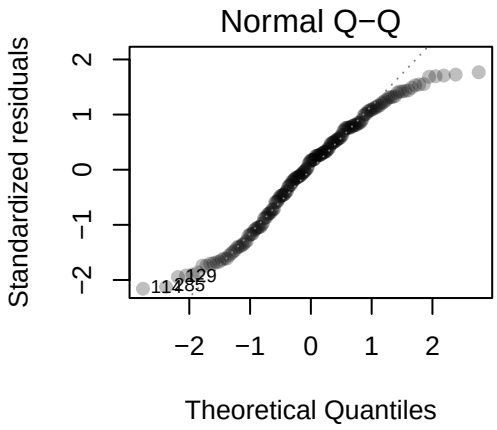
```
Subset selection object
Call: regsubsets.formula(New_Points ~ . - Points - Player, data = wr_relevant_transformed,
    nvmax = 5)
5 Variables  (and intercept)
           Forced in Forced out
X40YD          FALSE      FALSE
Vertical       FALSE      FALSE
Broad.Jump     FALSE      FALSE
X3Cone         FALSE      FALSE
Shuttle        FALSE      FALSE
1 subsets of each size up to 5
Selection Algorithm: exhaustive
         X40YD Vertical Broad.Jump X3Cone Shuttle
1  ( 1 ) " "   " "      " "        " "    "*"
2  ( 1 ) " "   " "      " "        "*"    "*"
3  ( 1 ) "*"   " "      " "        "*"    "*"
4  ( 1 ) "*"   " "      "*"        "*"    "*"
5  ( 1 ) "*"   "*"      "*"        "*"    "*"
```

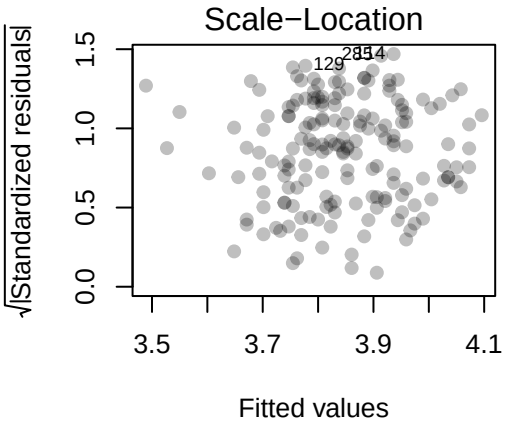
```
plot(wr_best_subsets)
```

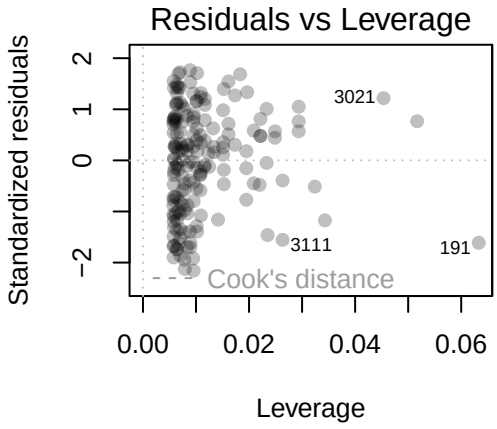



```
final_wr_model <- lm(New_Points ~ Shuttle, data = wr_relevant_transformed)
par(mfrow = c(2, 2))
plot(final_wr_model,
     pch = 19,
     col = rgb(0, 0, 0, alpha = 0.25),
     add.smooth = FALSE)
```







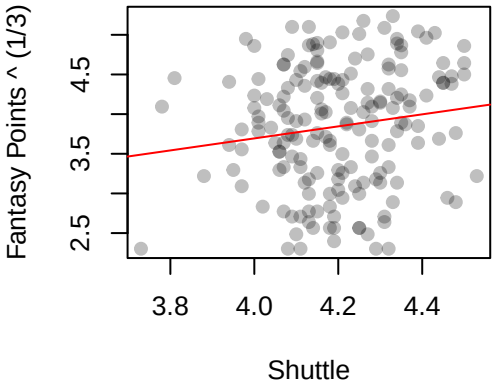



```
summary(final_wr_model)
```

```
Call:
lm(formula = New_Points ~ Shuttle, data = wr_relevant_transformed)

Residuals:
    Min      1Q  Median      3Q     Max
-1.6338 -0.5912  0.1268  0.5909  1.3378

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   0.6612     1.6333   0.405   0.6861
Shuttle       0.7581     0.3887   1.950   0.0527 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.7604 on 172 degrees of freedom
  (100 observations deleted due to missingness)
```

```
Multiple R-squared:  0.02164,   Adjusted R-squared:  0.01595
F-statistic: 3.804 on 1 and 172 DF,  p-value: 0.05274
```

```
plot(New_Points ~ Shuttle, data = wr_relevant_transformed,
     ylab = "Fantasy Points ^ (1/3)",
     pch = 19,
     col = rgb(0, 0, 0, alpha = 0.25))
abline(final_wr_model, col = "red")
```



2.5 The Tight End

```
nrow(tes)
```

```
[1] 102
```

```
total_nas(tes)
```

```
      Year     Player        Pos      X40YD   Vertical  BenchReps Broad.Jump
         0          0          0          3         22         23         25
    X3Cone    Shuttle      Games     Points
        30         30          0          0
```

```
total_nas(tes) / nrow(tes)
```

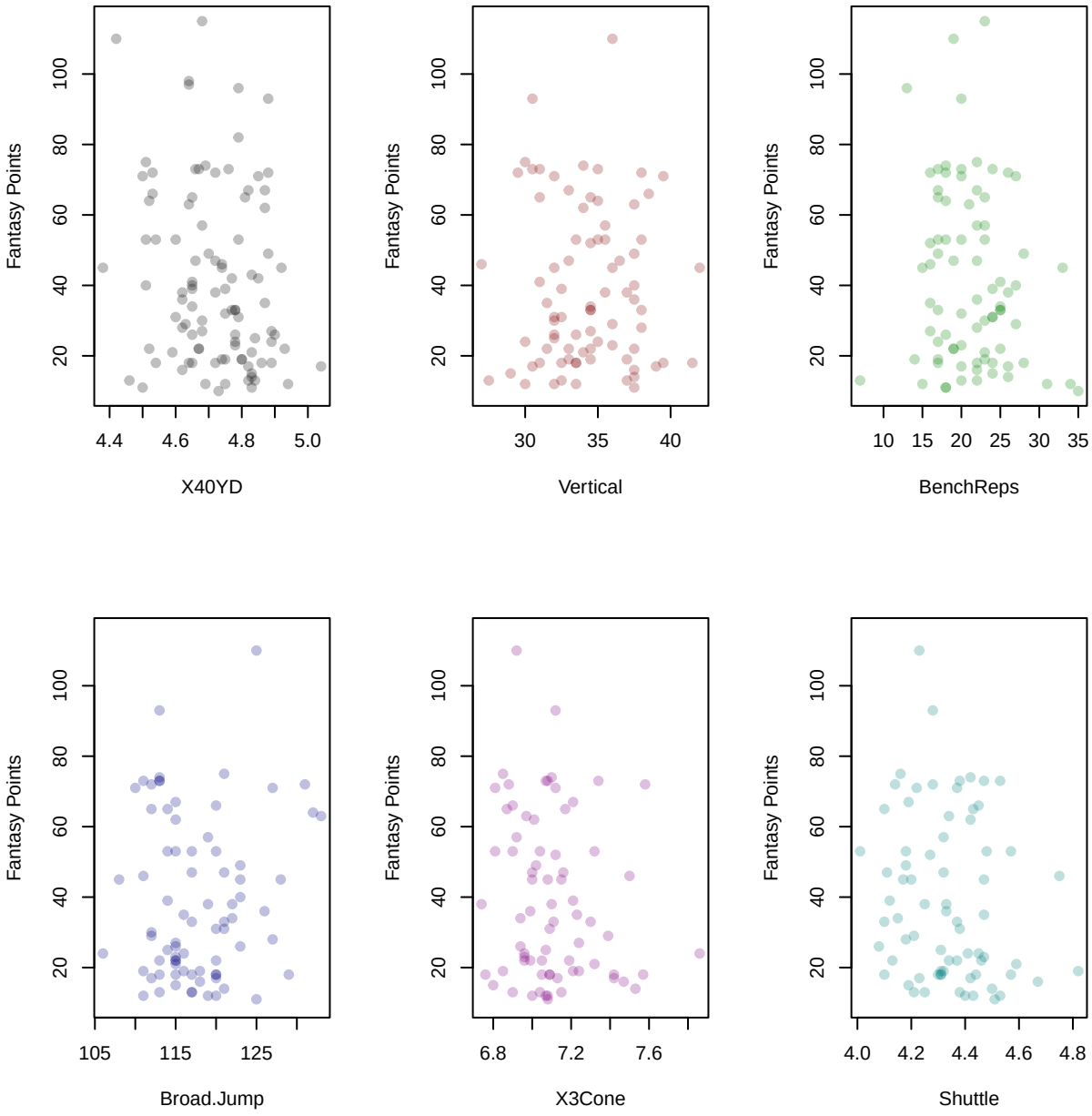
```
      Year     Player        Pos      X40YD   Vertical  BenchReps Broad.Jump
0.00000000 0.00000000 0.00000000 0.02941176 0.21568627 0.22549020 0.24509804
    X3Cone    Shuttle      Games     Points
0.29411765 0.29411765 0.00000000 0.00000000
```

```
names(tes)[total_nas(tes) / nrow(tes) >= 0.4]
```

```
character(0)
```

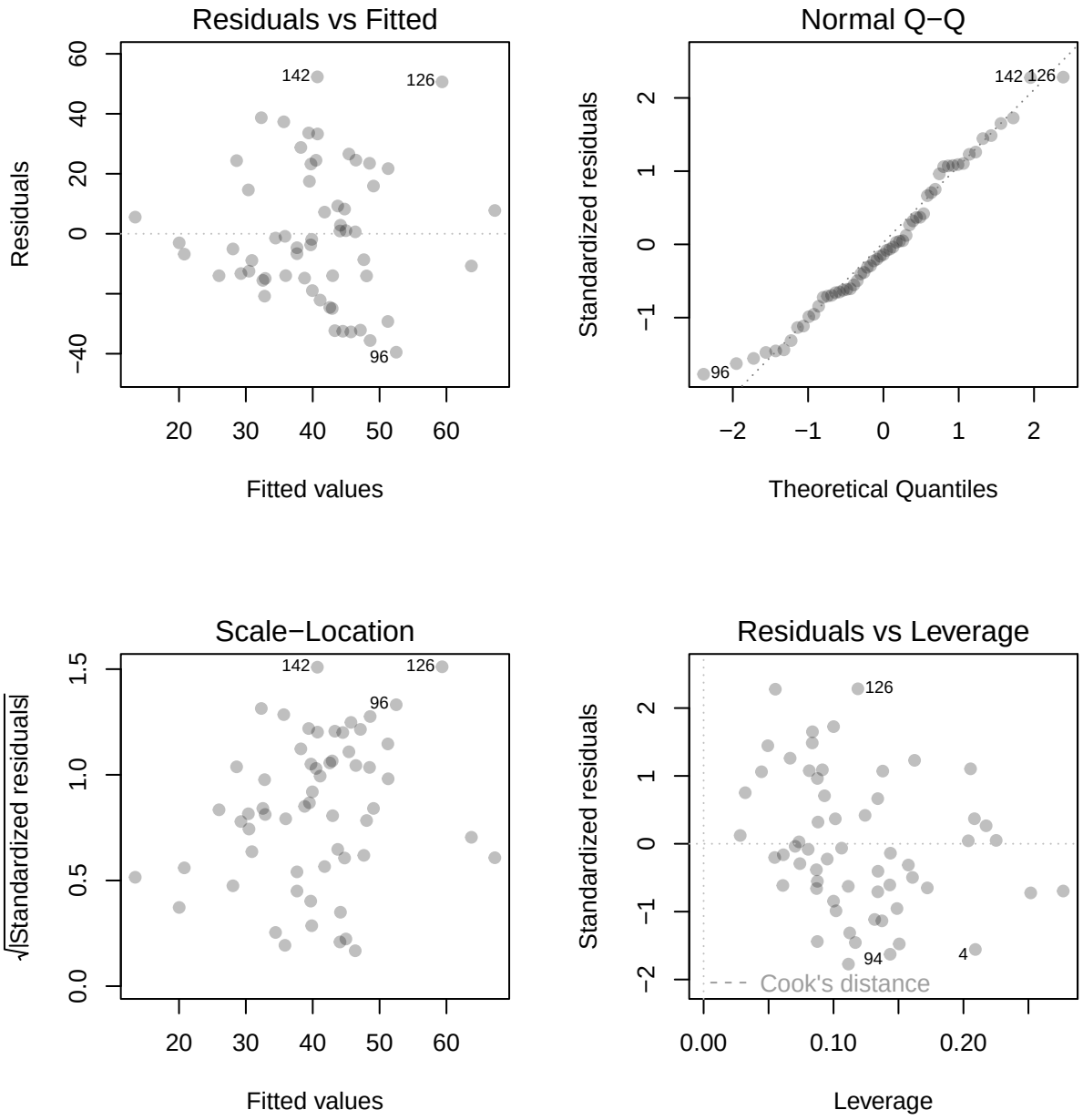
```
te_rel_vars <- tes %>% dplyr::select(Player,
                                     X40YD:Shuttle,
                                     Points)
par(mfrow = c(2, 3))
plot(Points ~ X40YD, data = te_rel_vars,
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[1])
plot(Points ~ Vertical, data = te_rel_vars,
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[2])
plot(Points ~ BenchReps, data = te_rel_vars,
     ylab = "Fantasy Points",
```

```
     pch = 19, col = color_scheme[3])
plot(Points ~ Broad.Jump, data = te_rel_vars,
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[4])
plot(Points ~ X3Cone, data = te_rel_vars,
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[5])
plot(Points ~ Shuttle, data = te_rel_vars,
     ylab = "Fantasy Points",
     pch = 19, col = color_scheme[6])
```



2.5.1 A Model

```r
te_model <- lm(Points ~ . - Player, data = te_rel_vars)
par(mfrow = c(2, 2))
plot(te_model,
     pch = 19,
     col = rgb(0, 0, 0, alpha = 0.25),
     add.smooth = FALSE)
```

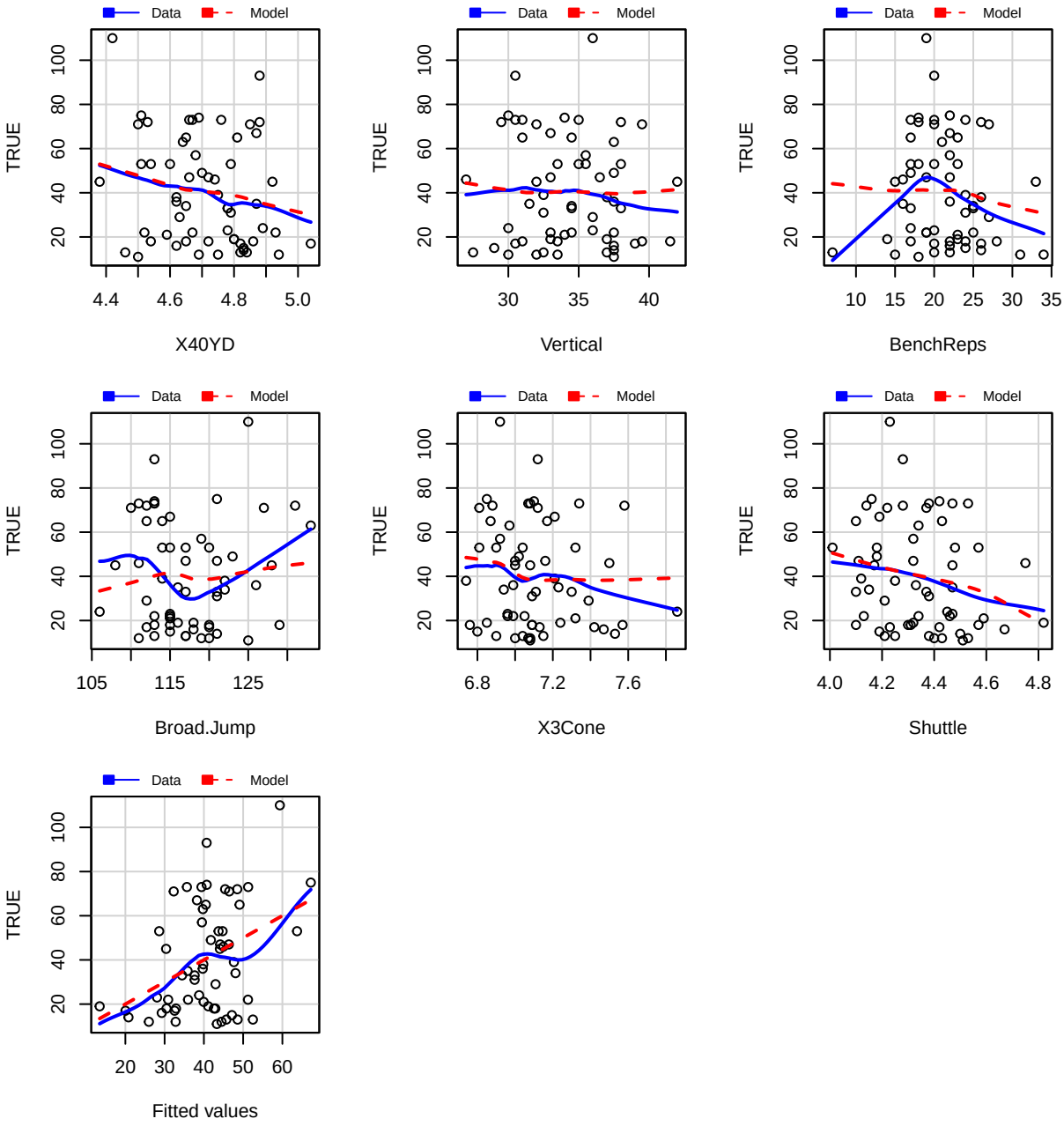



```r
summary(te_model)
```

```
Call:
lm(formula = Points ~ . - Player, data = te_rel_vars)

Residuals:
   Min     1Q Median     3Q    Max
```

```
-39.49 -14.42  -3.03  16.70  52.30

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 505.1175   214.3477   2.357   0.0222 *
X40YD       -60.1252    28.3699  -2.119   0.0389 *
Vertical     -2.2412     1.3437  -1.668   0.1014
BenchReps    -0.4947     0.6984  -0.708   0.4819
Broad.Jump    0.1628     0.8120   0.200   0.8419
X3Cone        3.5874    17.0011   0.211   0.8337
Shuttle     -31.9374    20.6852  -1.544   0.1287
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 23.63 on 52 degrees of freedom
  (43 observations deleted due to missingness)
Multiple R-squared:  0.1574,    Adjusted R-squared:  0.06021
F-statistic: 1.619 on 6 and 52 DF,  p-value: 0.1605
```

```
mmps(te_model)
```



2.5.2 A Transformation

```
summary(powerTransform(Points ~ . - Player, data = te_rel_vars))
```

```
bcPower Transformation to Normality
   Est Power Rounded Pwr Wald Lwr Bnd Wald Upr Bnd
Y1    0.1494           0      -0.3088       0.6077

Likelihood ratio test that transformation parameter is equal to 0
 (log transformation)
                            LRT df    pval
LR test, lambda = (0) 0.4073206  1 0.52333
```

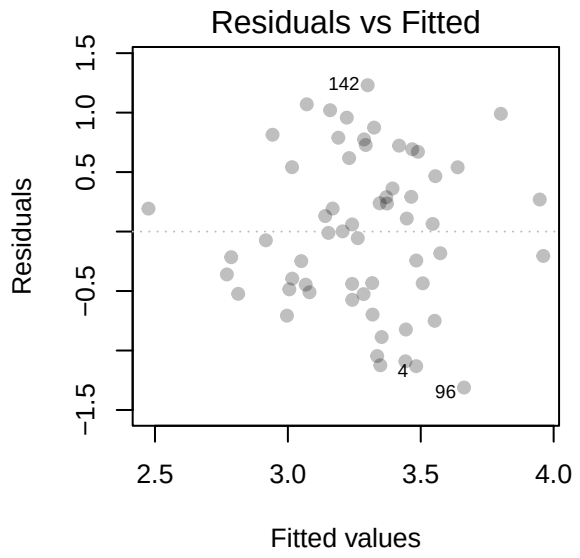
```
Likelihood ratio test that no transformation is needed
                            LRT df       pval
LR test, lambda = (1) 13.24616  1 0.00027314
```

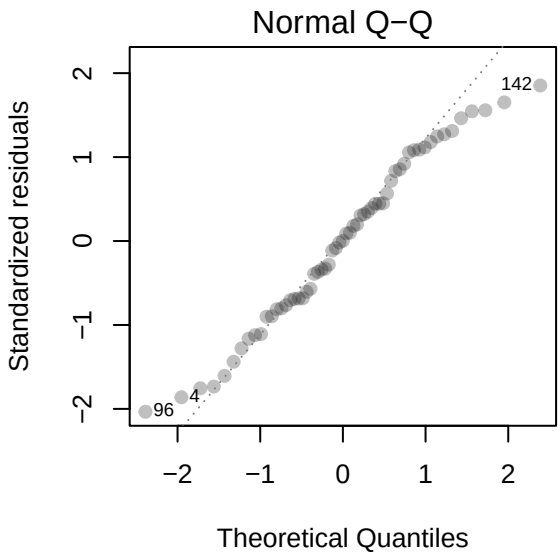
```
summary(powerTransform(cbind(X40YD, Vertical, BenchReps,
                             Broad.Jump, X3Cone, Shuttle) ~ 1,
                       data = te_rel_vars))
```

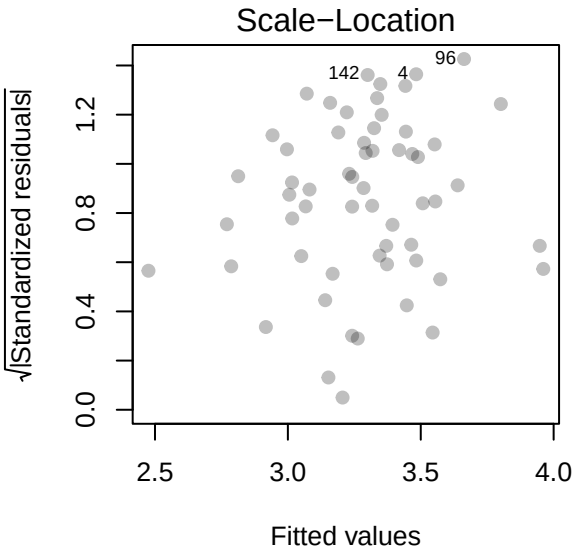
```
Warning in estimateTransform.default(X, Y, weights, family, ...): Convergence
failure: return code = 52
```

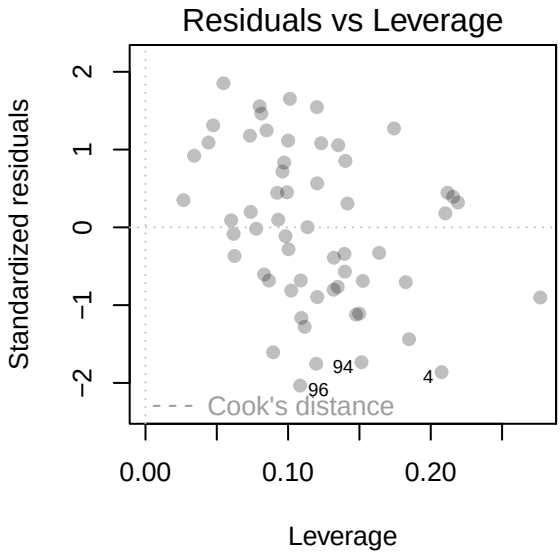
```
bcPower Transformations to Multinormality
           Est Power Rounded Pwr Wald Lwr Bnd Wald Upr Bnd
X40YD         2.8043        1.00      -4.2388       9.8474
Vertical      1.8463        1.00      -0.2157       3.9083
BenchReps     0.9178        1.00       0.2382       1.5974
Broad.Jump   -3.6491       -1.00      -6.6295      -0.6686
X3Cone      -11.7318      -11.73     -12.1793     -11.2842
Shuttle      -3.8940        1.00      -9.5811       1.7932

Likelihood ratio test that transformation parameters are equal to 0
 (all log transformations)
                                     LRT df       pval
LR test, lambda = (0 0 0 0 0 0) 29.99437  6 3.9406e-05

Likelihood ratio test that no transformations are needed
                                     LRT df       pval
LR test, lambda = (1 1 1 1 1 1) 24.35547  6 0.00044918
```

```
te_relevant_transformed <- te_rel_vars %>% mutate("New_Points" = Points^(1/3),
                                                  "New_3_Cone" = X3Cone^(-11.81),
                                                  "New_Broad" = Broad.Jump^(-1))
te_transformed_model <- lm(New_Points ~ . - Points - X3Cone - Broad.Jump - Player,
                           data = te_relevant_transformed)
par(mfrow = c(2, 2))
plot(te_transformed_model,
     pch = 19,
     col = rgb(0, 0, 0, alpha = 0.25),
     add.smooth = FALSE)
```










```
summary(te_transformed_model)
```

```
Call:
lm(formula = New_Points ~ . - Points - X3Cone - Broad.Jump -
    Player, data = te_relevant_transformed)

Residuals:
     Min       1Q   Median       3Q      Max
-1.31160 -0.46603  0.00159  0.54078  1.23036

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  1.856e+01  6.279e+00   2.955  0.00469 **
X40YD       -1.760e+00  8.324e-01  -2.114  0.03931 *
```

```
Vertical    -5.006e-02  3.898e-02  -1.284  0.20470
BenchReps   -1.590e-02  2.024e-02  -0.786  0.43571
Shuttle     -1.143e+00  6.169e-01  -1.853  0.06962 .
New_3_Cone  -2.349e+09  3.810e+09  -0.617  0.54021
New_Broad    3.032e+01  3.329e+02   0.091  0.92779
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6829 on 52 degrees of freedom
  (43 observations deleted due to missingness)
Multiple R-squared:  0.1517,    Adjusted R-squared:  0.05379
F-statistic:  1.55 on 6 and 52 DF,  p-value: 0.1808
```

2.5.3 Model Selection

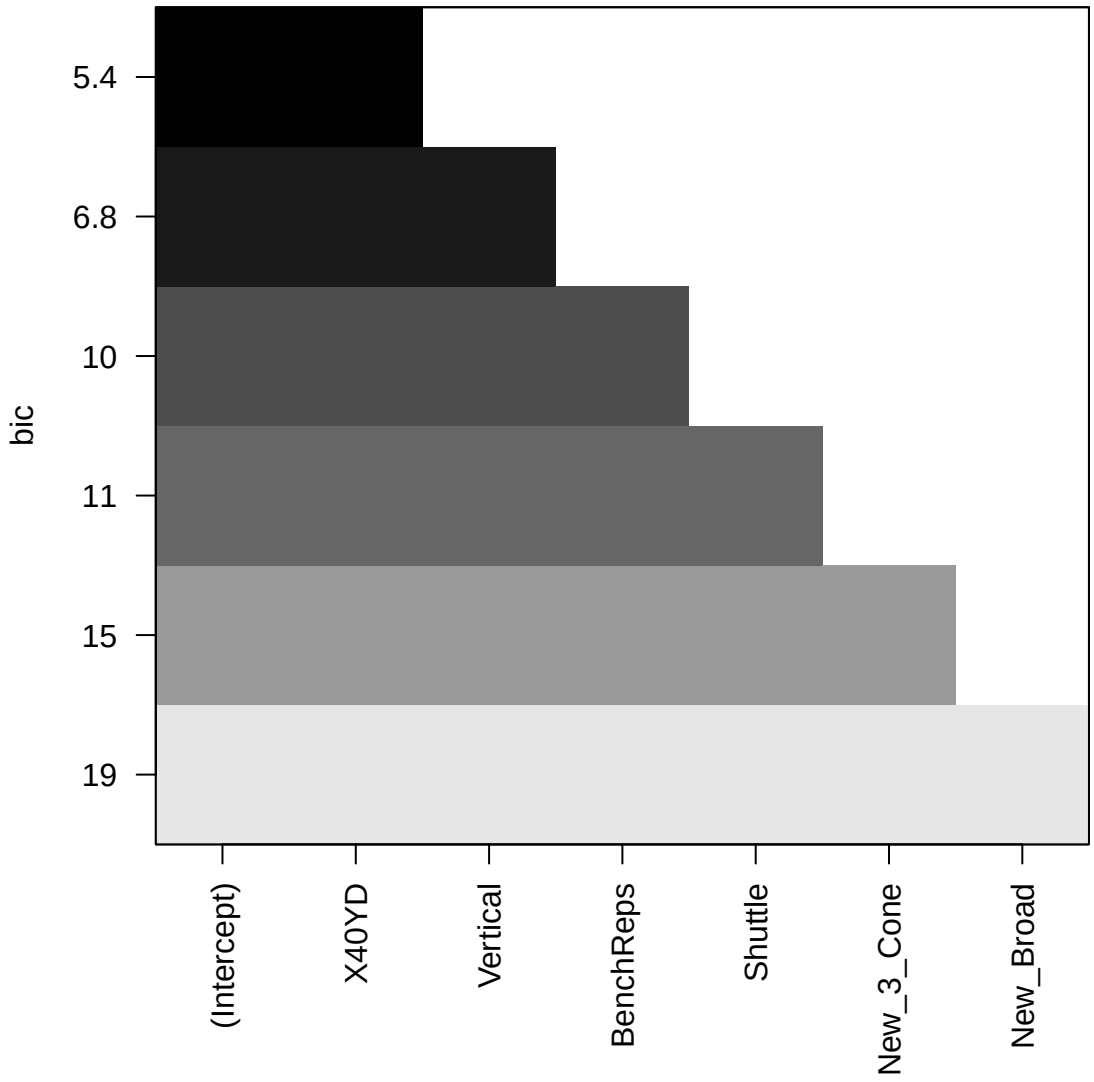
```
te_best_subsets <- regsubsets(New_Points ~ . - Points - X3Cone - Broad.Jump - Player,
                              data = te_relevant_transformed,
                              nvmax = 6)
```

```
Warning in leaps.exhaustive(a, really.big): XHAUST returned error code -999
```

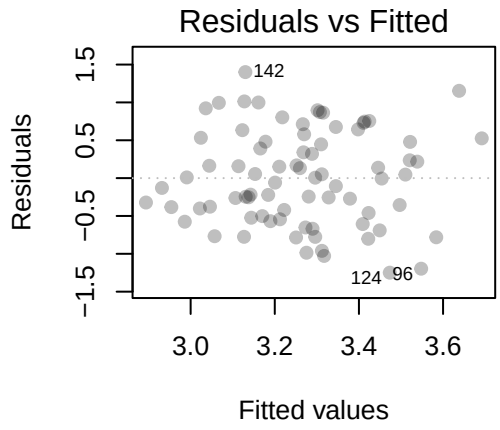
```
summary(te_best_subsets)
```

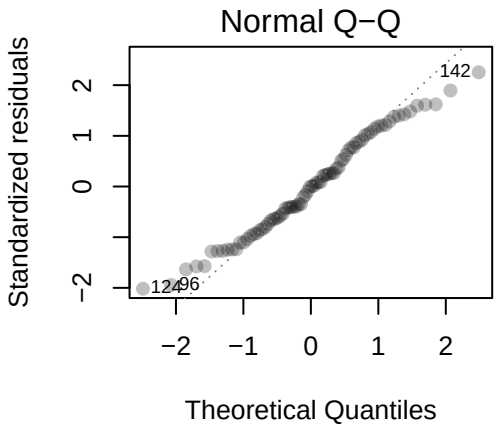
```
Subset selection object
Call: regsubsets.formula(New_Points ~ . - Points - X3Cone - Broad.Jump -
    Player, data = te_relevant_transformed, nvmax = 6)
6 Variables  (and intercept)
           Forced in Forced out
X40YD          FALSE      FALSE
Vertical       FALSE      FALSE
BenchReps      FALSE      FALSE
Shuttle        FALSE      FALSE
New_3_Cone     FALSE      FALSE
New_Broad      FALSE      FALSE
1 subsets of each size up to 6
Selection Algorithm: exhaustive
         X40YD Vertical BenchReps Shuttle New_3_Cone New_Broad
1  ( 1 ) "*"   " "      " "       " "     " "         " "
2  ( 1 ) "*"   "*"      " "       " "     " "         " "
3  ( 1 ) "*"   "*"      "*"       " "     " "         " "
4  ( 1 ) "*"   "*"      "*"       "*"     " "         " "
5  ( 1 ) "*"   "*"      "*"       "*"     "*"         " "
6  ( 1 ) "*"   "*"      "*"       "*"     "*"         "*"
```

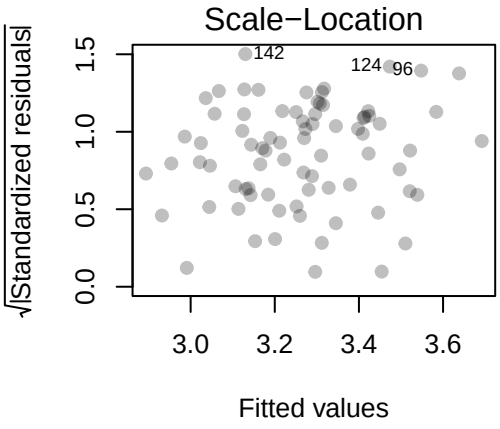
```
plot(te_best_subsets)
```

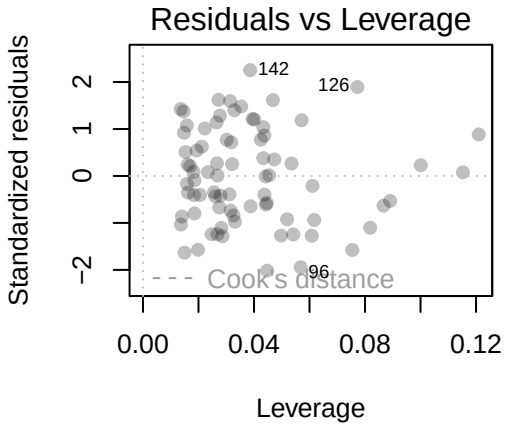



```
final_te_model <- lm(New_Points ~ X40YD + Vertical,
                     data = te_relevant_transformed)
par(mfrow = c(2, 2))
plot(final_te_model,
     pch = 19,
     col = rgb(0, 0, 0, alpha = 0.25),
     add.smooth = FALSE)
```










```
summary(final_te_model)
```

```
Call:
lm(formula = New_Points ~ X40YD + Vertical, data = te_relevant_transformed)

Residuals:
     Min       1Q   Median       3Q      Max
-1.24937 -0.49164 -0.00008  0.51420  1.40056

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 11.28489    3.48527   3.238  0.00179 **
X40YD       -1.47657    0.61935  -2.384  0.01965 *
Vertical    -0.03112    0.02692  -1.156  0.25136
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6337 on 75 degrees of freedom
```

```
  (24 observations deleted due to missingness)
Multiple R-squared:  0.07053,   Adjusted R-squared:  0.04575
F-statistic: 2.846 on 2 and 75 DF,  p-value: 0.06439
```

3 Final Models

3.1 Quarterback

```
summary(final_qb_model)
```

```

Call:
lm(formula = New_Points ~ Broad.Jump + Shuttle, data = qb_relevant_transformed)

Residuals:
     Min       1Q   Median       3Q      Max
-1.11619 -0.26852 -0.02889  0.36250  0.85084

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -5.85609    3.15626  -1.855  0.07249 .
Broad.Jump   0.02144    0.01337   1.603  0.11847
Shuttle      1.98119    0.56961   3.478  0.00144 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4722 on 33 degrees of freedom
  (18 observations deleted due to missingness)
Multiple R-squared:  0.2778,    Adjusted R-squared:  0.234
F-statistic: 6.346 on 2 and 33 DF,  p-value: 0.004655
```

$$\hat{log(FantasyPoints)} = -5.856 + 0.02(BroadJump) + 1.98(Shuttle)$$

3.2 Running Back

```
summary(final_rb_model)
```

```

Call:
lm(formula = New_Points ~ Broad.Jump + X40YD, data = rb_relevant_transformed)

Residuals:
     Min       1Q   Median       3Q      Max
-1.89030 -0.55716  0.05755  0.67639  1.53941

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  3.95120    4.06020   0.973   0.3319
Broad.Jump   0.02457    0.01294   1.899   0.0592 .
X40YD       -0.60625    0.71524  -0.848   0.3979
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
Residual standard error: 0.8193 on 168 degrees of freedom
  (44 observations deleted due to missingness)
Multiple R-squared:  0.0363,    Adjusted R-squared:  0.02483
F-statistic: 3.164 on 2 and 168 DF,  p-value: 0.04477
```

$$\hat{log(FantasyPoints)} = 3.95 + 0.0246(BroadJump) - 0.606(FortyYardTime)$$

3.3 Wide Receiver

```
summary(final_wr_model)
```

```

Call:
lm(formula = New_Points ~ Shuttle, data = wr_relevant_transformed)

Residuals:
    Min      1Q  Median      3Q     Max
-1.6338 -0.5912  0.1268  0.5909  1.3378

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   0.6612     1.6333   0.405   0.6861
Shuttle       0.7581     0.3887   1.950   0.0527 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.7604 on 172 degrees of freedom
  (100 observations deleted due to missingness)
Multiple R-squared:  0.02164,   Adjusted R-squared:  0.01595
F-statistic: 3.804 on 1 and 172 DF,  p-value: 0.05274
```

$$\hat{log(FantasyPoints)} = 0.66 + 0.76(ShuttleTime)$$

3.4 Tight End

```
summary(final_te_model)
```

```

Call:
lm(formula = New_Points ~ X40YD + Vertical, data = te_relevant_transformed)

Residuals:
     Min       1Q   Median       3Q      Max
-1.24937 -0.49164 -0.00008  0.51420  1.40056

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 11.28489    3.48527   3.238  0.00179 **
X40YD       -1.47657    0.61935  -2.384  0.01965 *
Vertical    -0.03112    0.02692  -1.156  0.25136
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
Residual standard error: 0.6337 on 75 degrees of freedom
  (24 observations deleted due to missingness)
Multiple R-squared:  0.07053,   Adjusted R-squared:  0.04575
F-statistic: 2.846 on 2 and 75 DF,  p-value: 0.06439
```

$$\hat{(FantasyPoints)^{\frac{1}{3}}} = 11.28 - 1.48(FortyYardTime) - 0.03(Vertical)$$

4 How Good Are These Rookies?

4.1 Quarterbacks

```
rookie_qb <- qbs %>% summarise(meanFPts = mean(Points)) %>% as.numeric
rookie_qb
```

```
[1] 158.963
```

```
rookie_qb / 16
```

```
[1] 9.935185
```

```
with(qbs, tapply(Points, Year, mean))
```

```
    2001     2002     2003     2004     2005     2006     2007     2008
 91.7500 108.3333 117.5000 111.0000  58.0000 149.6667  82.0000 192.5000
    2009     2010     2011     2012     2013     2014     2015     2016
121.6667 111.5000 208.5000 244.2000 176.0000 182.0000 244.5000 196.3333
    2017     2018     2019
155.5000 182.2500 173.6667
```

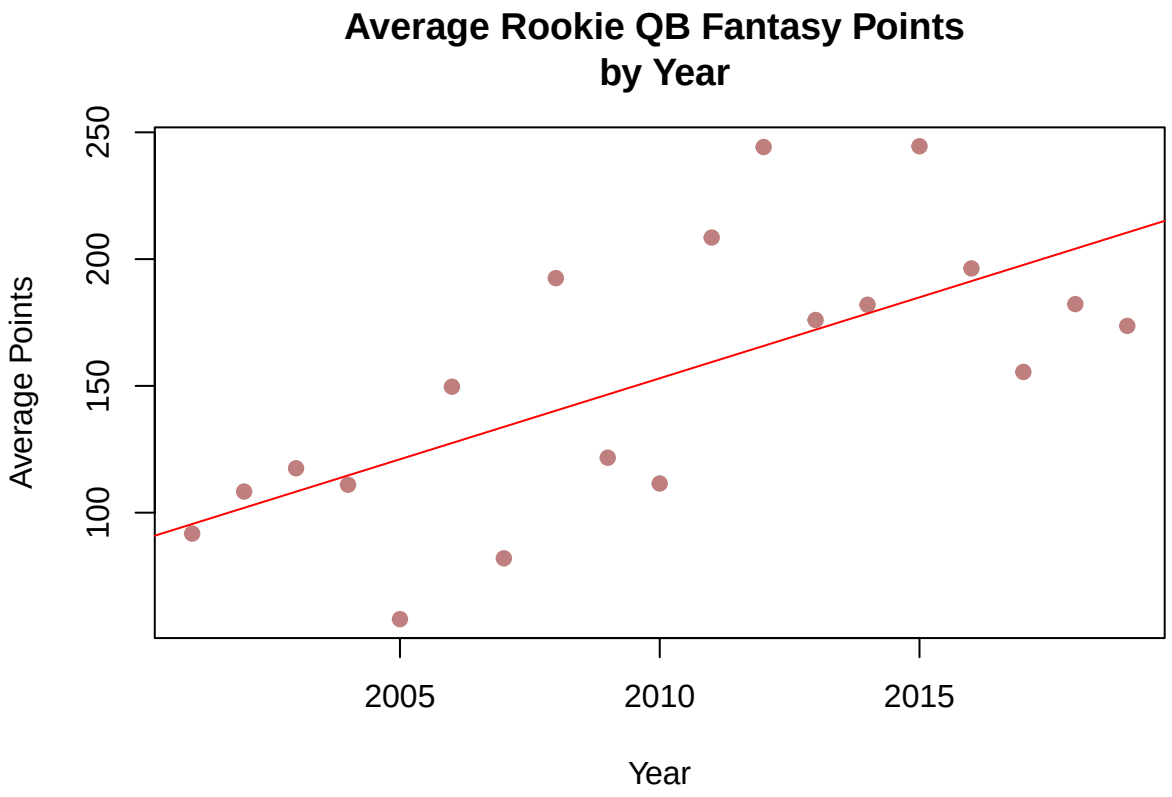
4.1.1 Change Over Time

```
ppy <- with(qbs, tapply(Points, Year, mean))
year <- 2001:2019
plot(ppy ~ year,
     xlab = "Year",
     ylab = "Average Points",
     main = "Average Rookie QB Fantasy Points \n by Year",
     pch = 19, col = rgb(0.5, 0, 0, alpha = 0.5))
qb_yr_lm <- lm(ppy ~ year)
summary(qb_yr_lm)
```

```
Call:
lm(formula = ppy ~ year)

Residuals:
    Min      1Q  Median      3Q     Max
-63.057 -30.875   3.459  15.719  78.433

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -12685.089   3426.860  -3.702  0.00177 **
year             6.387      1.705   3.746  0.00161 **
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 40.7 on 17 degrees of freedom
Multiple R-squared:  0.4522,    Adjusted R-squared:  0.42
F-statistic: 14.03 on 1 and 17 DF,  p-value: 0.001608
```

```
abline(qb_yr_lm, col = "red")
```



4.2 Running Backs

```
rookie_rb <- rbs %>% summarise(meanFPts = mean(Points)) %>% as.numeric
rookie_rb
```

```
[1] 86.71163
```

```
rookie_rb / 16
```

```
[1] 5.419477
```

```
with(rbs, tapply(Points, Year, mean))
```

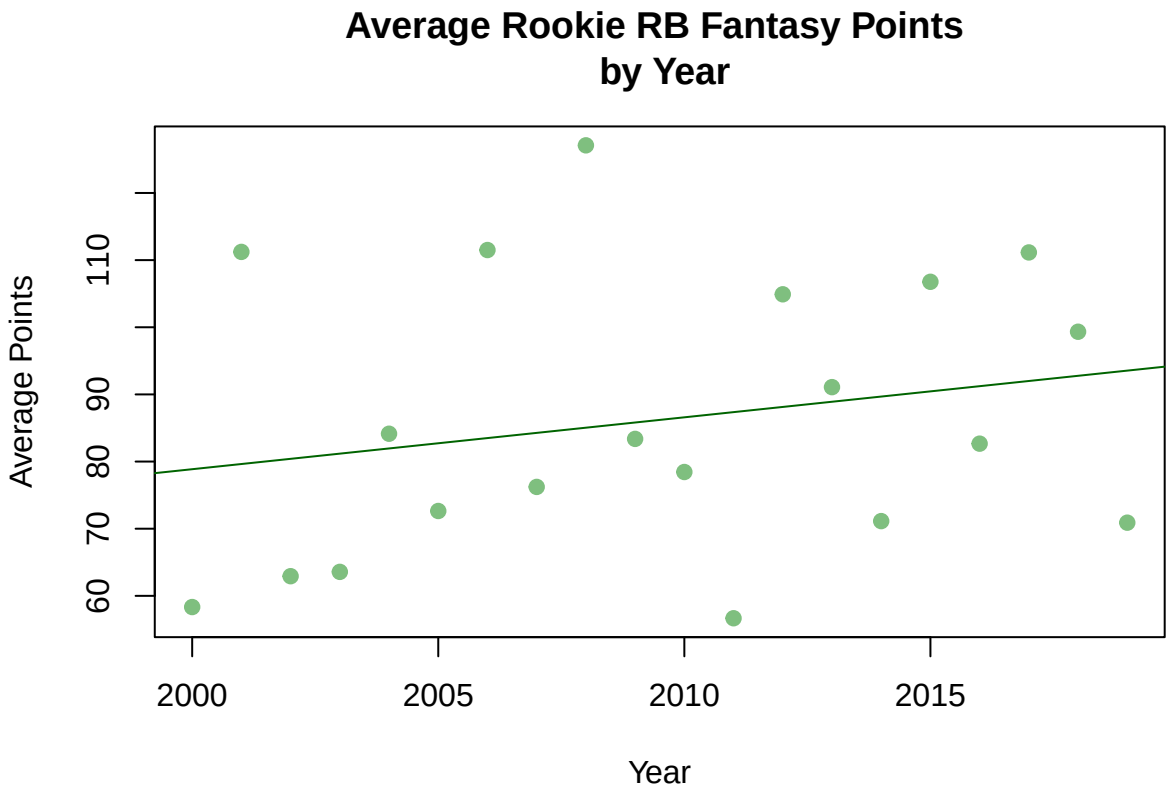
```
     2000      2001      2002      2003      2004      2005      2006      2007
 58.33333 111.22222  62.92857  63.57143  84.14286  72.63636 111.50000  76.22222
     2008      2009      2010      2011      2012      2013      2014      2015
127.09091  83.37500  78.44444  56.66667 104.90909  91.08333  71.13333 106.76923
     2016      2017      2018      2019
 82.66667 111.14286  99.33333  70.90000
```

4.2.1 Change Over Time

```
ppy <- with(rbs, tapply(Points, Year, mean))
year <- 2000:2019
plot(ppy ~ year,
     xlab = "Year",
     ylab = "Average Points",
     main = "Average Rookie RB Fantasy Points \n by Year",
     pch = 19, col = rgb(0, 0.5, 0, alpha = 0.5))
rb_yr_lm <- lm(ppy ~ year)
summary(rb_yr_lm)
```

```
Call:
lm(formula = ppy ~ year)

Residuals:
    Min      1Q  Median      3Q     Max
-30.696 -17.512  -5.246  16.430  42.046

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -1466.6793  1608.0049  -0.912    0.374
year            0.7728     0.8002   0.966    0.347

Residual standard error: 20.64 on 18 degrees of freedom
Multiple R-squared:  0.04926,   Adjusted R-squared:  -0.003559
F-statistic: 0.9326 on 1 and 18 DF,  p-value: 0.347
```

```
abline(rb_yr_lm, col = "dark green")
```



4.3 Wide Receivers

```
rookie_wr <- wrs %>% summarise(meanFPts = mean(Points)) %>% as.numeric
rookie_wr
```

```
[1] 61.94891
```

```
rookie_wr / 16
```

```
[1] 3.871807
```

```
with(wrs, tapply(Points, Year, mean))
```

```
    2000     2001     2002     2003     2004     2005     2006     2007
40.68750 50.46154 60.53846 58.75000 68.21429 48.50000 57.00000 60.60000
    2008     2009     2010     2011     2012     2013     2014     2015
63.70000 69.66667 48.22727 84.18182 53.11111 73.93750 78.52632 55.40000
    2016     2017     2018     2019
57.16667 46.76923 84.66667 96.90909
```

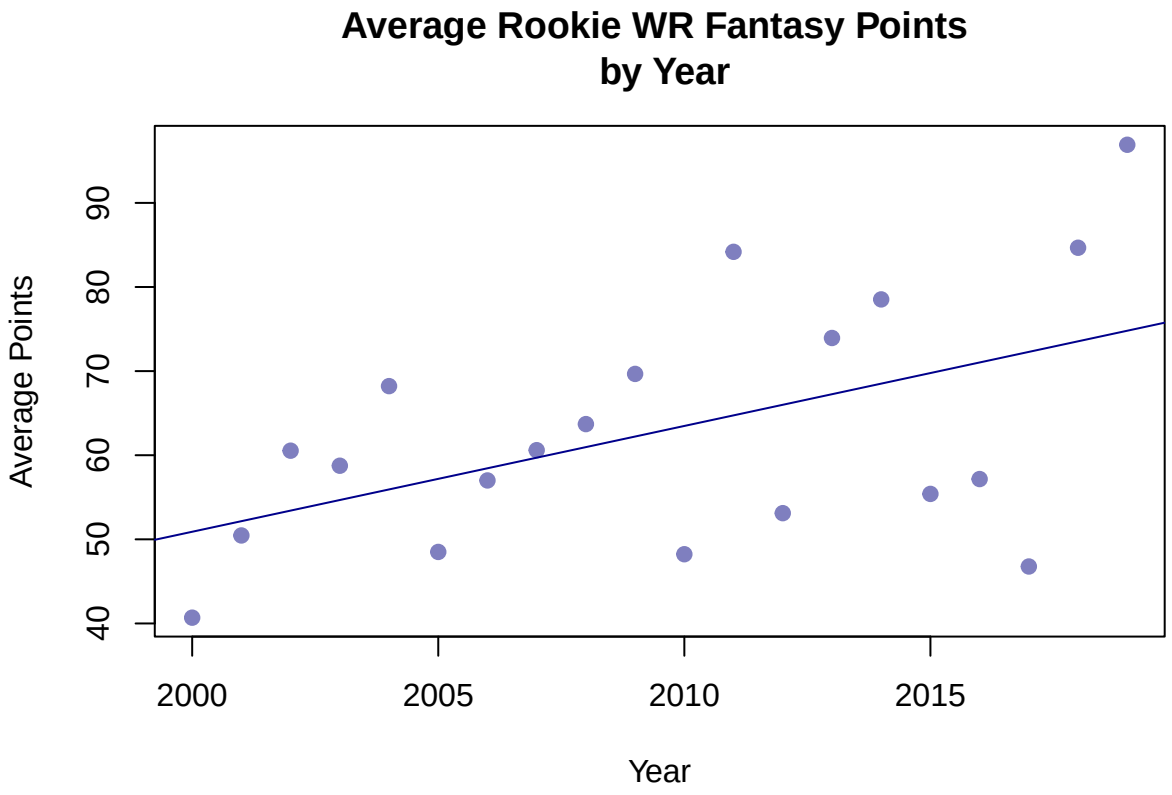
4.3.1 Change Over Time

```
ppy <- with(wrs, tapply(Points, Year, mean))
year <- 2000:2019
plot(ppy ~ year,
     xlab = "Year",
     ylab = "Average Points",
     main = "Average Rookie WR Fantasy Points \n by Year",
     pch = 19, col = rgb(0, 0, 0.5, alpha = 0.5))
```

```
wr_yr_lm <- lm(ppy ~ year)
summary(wr_yr_lm)
```

```
Call:
lm(formula = ppy ~ year)

Residuals:
    Min      1Q  Median      3Q     Max
-25.516 -10.881   1.815   8.088  22.108

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -2464.8577  1014.4530  -2.430   0.0258 *
year            1.2579     0.5048   2.492   0.0227 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 13.02 on 18 degrees of freedom
Multiple R-squared:  0.2565,    Adjusted R-squared:  0.2152
F-statistic: 6.209 on 1 and 18 DF,  p-value: 0.0227
```

```
abline(wr_yr_lm, col = "dark blue")
```



4.4 Tight Ends

```
rookie_te <- tes %>% summarise(meanFPts = mean(Points)) %>% as.numeric
rookie_te
```

```
[1] 41.51961
```

```
rookie_te / 16
```

```
[1] 2.594975
```

```
with(tes, tapply(Points, Year, mean))
```

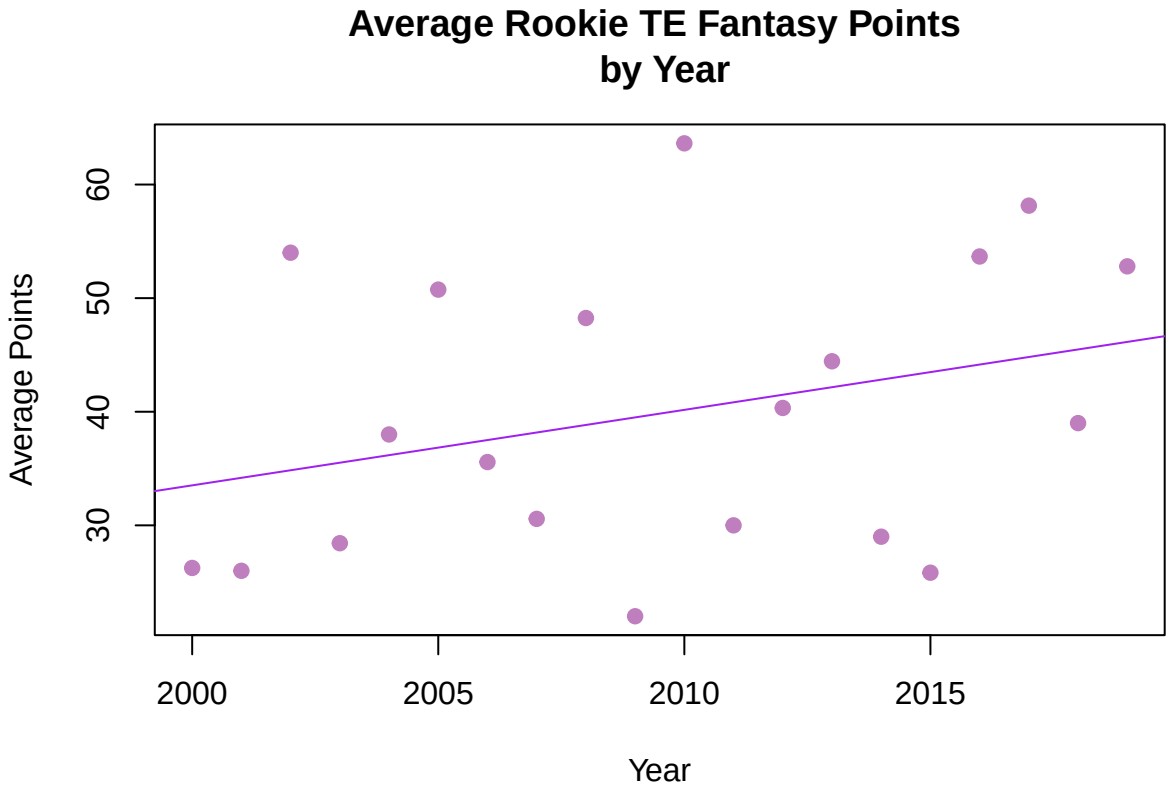
```
    2000     2001     2002     2003     2004     2005     2006     2007
26.25000 26.00000 54.00000 28.42857 38.00000 50.75000 35.57143 30.57143
    2008     2009     2010     2011     2012     2013     2014     2015
48.25000 22.00000 63.62500 30.00000 40.33333 44.44444 29.00000 25.83333
    2016     2017     2018     2019
53.66667 58.14286 39.00000 52.80000
```

4.4.1 Change Over Time

```
ppy <- with(tes, tapply(Points, Year, mean))
year <- 2000:2019
plot(ppy ~ year,
     xlab = "Year",
     ylab = "Average Points",
     main = "Average Rookie TE Fantasy Points \n by Year",
     pch = 19, col = rgb(0.5, 0, 0.5, alpha = 0.5))
te_yr_lm <- lm(ppy ~ year)
summary(te_yr_lm)
```

```

Call:
lm(formula = ppy ~ year)

Residuals:
    Min      1Q  Median      3Q     Max
-17.655  -7.746  -1.549   9.438  23.459

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -1295.6538   958.1454  -1.352    0.193
year            0.6646     0.4768   1.394    0.180

Residual standard error: 12.3 on 18 degrees of freedom
Multiple R-squared:  0.09742,   Adjusted R-squared:  0.04727
F-statistic: 1.943 on 1 and 18 DF,  p-value: 0.1803
```

```
abline(te_yr_lm, col = "purple")
```



5 Predictions

```
combine2020 <- read.csv("../data/2020combine.csv")
```

5.1 Quarterbacks

```
qbs_2020 <- filter(combine2020, Pos == "QB")
final_qb_model
```

```

Call:
lm(formula = New_Points ~ Broad.Jump + Shuttle, data = qb_relevant_transformed)

Coefficients:
(Intercept)   Broad.Jump      Shuttle
   -5.85609      0.02144      1.98119
```

```
qb_predictions <- predict(final_qb_model,
                          newdata = data.frame(Broad.Jump = qbs_2020$Broad.Jump,
                                               Shuttle = qbs_2020$Shuttle))
qb_predictions <- exp(qb_predictions)
names(qb_predictions) <- qbs_2020$Player
sort(qb_predictions, decreasing = TRUE, na.last = TRUE)
```

```
   Jacob Eason   Kelly Bryant   James Morgan  Cole McDonald    Jordan Love
      369.7571       317.0147       310.3789       296.7837       278.2963
Justin Herbert Shea Patterson     Jake Fromm  Steven Montez   Nate Stanley
      275.0659       256.2579       234.8156       227.9076       207.4827
```

```
 Brian Lewerke Kevin Davidson Tua Tagovailoa     Jake Luton    Jalen Hurts
      197.1073       170.4695             NA             NA             NA
Anthony Gordon     Joe Burrow
            NA             NA
```

5.2 Running Backs

```
rbs_2020 <- filter(combine2020, Pos == "RB")
final_rb_model
```

```

Call:
lm(formula = New_Points ~ Broad.Jump + X40YD, data = rb_relevant_transformed)

Coefficients:
(Intercept)   Broad.Jump        X40YD
    3.95120      0.02457     -0.60625
```

```
rb_predictions <- predict(final_rb_model,
                          newdata = data.frame(Broad.Jump = rbs_2020$Broad.Jump,
                                               X40YD = rbs_2020$X40YD))
rb_predictions <- exp(rb_predictions)
names(rb_predictions) <- rbs_2020$Player
sort(rb_predictions, decreasing = TRUE, na.last = TRUE)
```

```
           AJ Dillon       Darrynton Evans           Rico Dowdle
            83.41506              77.41232              75.14935
      Jonathan Taylor          Jet Anderson       LeVante Bellamy
            74.59896              73.81868              73.30165
        Brian Herrien             Cam Akers        Raymond Calais
            69.85382              69.34223              68.04861
        JaMycal Hasty        James Robinson         D'Andre Swift
            67.70269              67.33684              67.25015
          Javon Leake        Patrick Taylor         Joshua Kelley
            66.92984              66.88675              66.84368
Clyde Edwards-Helaire          Eno Benjamin         Sewo Olonilua
            65.68123              65.26322              63.33499
    Anthony McFarland          Salvon Ahmed         DeeJay Dallas
            60.93503              60.27826              60.25885
      Ke'Shawn Vaughn           J.J. Taylor       La'Mical Perine
            59.85606              57.73650              57.38753
           Tony Jones      Scottie Phillips           Benny LeMay
            56.71416              53.94221              45.76779
           Zack Moss          J.K. Dobbins          Mike Warren
                  NA                    NA                    NA
```

5.3 Wide Receivers

```
wrs_2020 <- filter(combine2020, Pos == "WR")
final_wr_model
```

```

Call:
lm(formula = New_Points ~ Shuttle, data = wr_relevant_transformed)
```

```
Coefficients:
(Intercept)      Shuttle
     0.6612       0.7581
```

```
wr_predictions <- predict(final_wr_model,
                          newdata = data.frame(Shuttle = wrs_2020$Shuttle))
wr_predictions <- exp(wr_predictions)
names(wr_predictions) <- wrs_2020$Player
sort(wr_predictions, decreasing = TRUE, na.last = TRUE)
```

```
       Isaiah Coulter         Gabriel Davis  Antonio Gandy-Golden
             64.31954              62.87315              60.99510
         Jerry Jeudy            Cody White          Omar Bayless
             60.07722              59.62347              58.72623
      Kendrick Rogers          Jalen Reagor        Stephen Guidry
             57.84249              56.97205              56.97205
         Denzel Mims           Austin Mack          James Proche
             55.69089              55.27027              54.43854
       Dezmon Patmon         Juwan Johnson          Quez Watkins
             53.61932              53.21435              52.81243
         K.J. Osborn        Quintez Cephus         Malcolm Perry
             52.41355              51.62481              50.84794
          Tony Brown         Freddie Swain          Aaron Parker
             49.32909              48.95652              47.85560
       John Hightower        Devin Duvernay       Michael Pittman
             47.13545              46.77945              44.69919
       Isaiah Hodgins           Jeff Thomas       Darrell Stewart
             44.02654                    NA                    NA
 Laviska Shenault Jr.       Henry Ruggs III             Joe Reed
                   NA                    NA                    NA
Donovan Peoples-Jones        Darnell Mooney       Kalija Lipscomb
                   NA                    NA                    NA
          CeeDee Lamb         Tyler Johnson        Collin Johnson
                   NA                    NA                    NA
       Jauan Jennings         Van Jefferson      Justin Jefferson
                   NA                    NA                    NA
     Trishton Jackson             K.J. Hill           Tee Higgins
                   NA                    NA                    NA
            KJ Hamler        Antonio Gibson          Aaron Fuller
                   NA                    NA                    NA
         Chris Finke          Bryan Edwards        Quartney Davis
                   NA                    NA                    NA
      Tyrie Cleveland        Chase Claypool      Marquez Callaway
                   NA                    NA                    NA
       Lawrence Cager           Lynn Bowden         Brandon Aiyuk
                   NA                    NA                    NA
           Ben Victor
                   NA
```

5.4 Tight Ends

```
tes_2020 <- filter(combine2020, Pos == "TE")
final_te_model
```

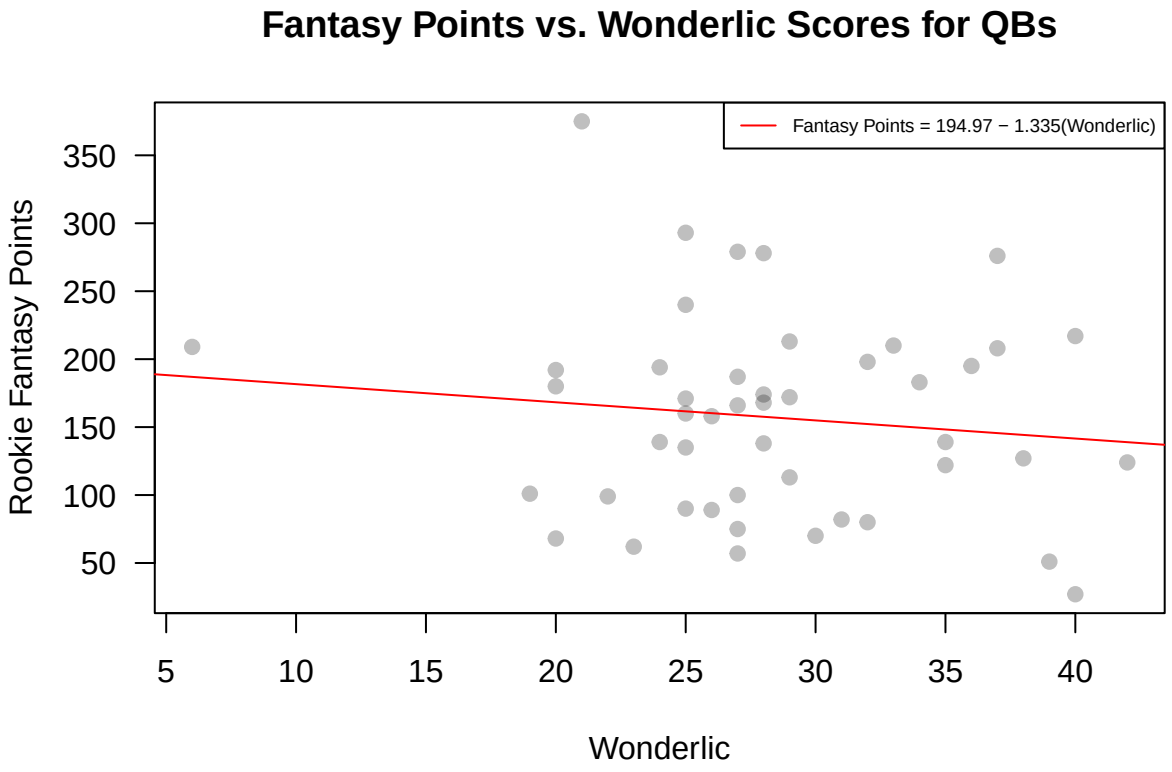
```
Call:
lm(formula = New_Points ~ X40YD + Vertical, data = te_relevant_transformed)

Coefficients:
(Intercept)        X40YD     Vertical
   11.28489     -1.47657     -0.03112
```

```
te_predictions <- predict(final_te_model,
                          newdata = data.frame(Vertical = tes_2020$Vertical,
                                               X40YD = tes_2020$X40YD))
te_predictions <- (te_predictions)^3
names(te_predictions) <- tes_2020$Player
sort(te_predictions, decreasing = TRUE, na.last = TRUE)
```

```
    Brycen Hopkins       Devin Asiasi    Harrison Bryant      Hunter Bryant
          37.98652           37.64853           35.58980           35.11267
      Dalton Keene   Stephen Sullivan    Colby Parkinson     Josiah Deguara
          35.03607           34.90865           33.70690           33.09917
         Cole Kmet    Charlie Woerner Charlie Taumoepeau       C.J. O'Grady
          32.57165           31.35332           30.82114           30.50390
     Adam Trautman    Mitchell Wilcox  Dom Wood-Anderson      Jared Pinkney
          30.48065           30.21196           25.17929                 NA
Albert Okwuegbunam      Thaddeus Moss        Sean McKeon     Jacob Breeland
                NA                 NA                 NA                 NA
```

6 Wonderlic Scores

```
wonderlic <- read.csv("../data/Wonderlic Scores - Sheet1.csv", stringsAsFactors = FALSE)
qb_wonder <- wonderlic %>% filter(Position == "QB")
qbs <- qbs[qbs$Player %in% qb_wonder$Player, ]
qb_wonder <- qb_wonder[qb_wonder$Player %in% qbs$Player, ]
qb_wonder <- qb_wonder[-47, ]
qb_wonder_score <- qb_wonder[[2]]
names(qb_wonder_score) <- qb_wonder[[1]]
qb_wonder_score <- qb_wonder_score[order(names(qb_wonder_score))]
qbs <- qbs[order(qbs$Player), ]
qb_and_wonder_score <- qbs %>% mutate(Wonderlic = qb_wonder_score)
fantasy_wonderlic <- lm(Points ~ Wonderlic, data = qb_and_wonder_score)
plot(Points ~ Wonderlic, data = qb_and_wonder_score,
     col = rgb(0, 0, 0, alpha = 0.25),
     pch = 19,
     las = 1,
     main = "Fantasy Points vs. Wonderlic Scores for QBs",
     ylab = "Rookie Fantasy Points")
abline(fantasy_wonderlic, col = "red")
legend("topright",
       legend = paste("Fantasy Points = ",
                      round(fantasy_wonderlic$coefficients[1], 2),
                      " - ",
                      round(abs(fantasy_wonderlic$coefficients[2]), 3),
                      "(Wonderlic)", sep = ""),
       col = "red", lty = 1,
       cex = 0.6)
```




```
summary(fantasy_wonderlic)
```

```
Call:
lm(formula = Points ~ Wonderlic, data = qb_and_wonder_score)

Residuals:
     Min       1Q   Median       3Q      Max
-114.570  -67.601   -1.594   39.585  208.066

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  194.967     46.727   4.172 0.000136 ***
Wonderlic     -1.335      1.604  -0.832 0.409555
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 73.47 on 45 degrees of freedom
Multiple R-squared:  0.01517,   Adjusted R-squared:  -0.00672
F-statistic: 0.693 on 1 and 45 DF,  p-value: 0.4096
```