FinalProject_analysis

2022-12-12

```r
if(!require(tidyverse)) install.packages("tidyverse")
```

```
## Loading required package: tidyverse

## -- Attaching packages --------------------------------------- tidyverse 1.3.2 --
## v ggplot2 3.3.6      v purrr   0.3.5
## v tibble  3.1.8      v dplyr   1.0.10
## v tidyr   1.2.1      v stringr 1.4.1
## v readr   2.1.3      v forcats 0.5.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```r
if(!require(sqldf)) install.packages("sqldf")
```

```
## Loading required package: sqldf
## Loading required package: gsubfn
## Loading required package: proto

## Warning in doTryCatch(return(expr), name, parentenv, handler): unable to load shared object '/Library
##   dlopen(/Library/Frameworks/R.framework/Resources/modules//R_X11.so, 0x0006): Library not loaded: /
##   Referenced from: <FF564E7B-F7DD-3BAE-972C-DE65F8735FC9> /Library/Frameworks/R.framework/Versions/4
##   Reason: tried: '/opt/X11/lib/libSM.6.dylib' (no such file), '/System/Volumes/Preboot/Cryptexes/OS/

## Warning in system2("/usr/bin/otool", c("-L", shQuote(DSO)), stdout = TRUE):
## running command ''/usr/bin/otool' -L '/Library/Frameworks/R.framework/Resources/
## library/tcltk/libs//tcltk.so'' had status 1

## Could not load tcltk.  Will use slower R code instead.
## Loading required package: RSQLite
```

```r
library(tidyverse)
library(sqldf)
```

Read the CSV files

```r
players <- read.csv("/Users/devyanimardia/Downloads/datadavis-nba-salaries/players.csv")
salaries <- read.csv("/Users/devyanimardia/Downloads/datadavis-nba-salaries/salaries_1985to2018.csv")
```

Joining both datasets with player_id into salaries dataset

```r
salaries <- salaries %>% inner_join(players, by = c("player_id" = "X_id"))
```

Age, Height and Weight changes to make it easily usable

```r
#Age at end of season

salaries$birthDate <- sub(",","", salaries$birthDate)

salaries$birthDate <- as.Date(salaries$birthDate,
```

```
  format = "%B %d %Y")

salaries$Current_age = as.numeric(difftime(Sys.Date(),salaries$birthDate, units = "weeks"))/52.25

salaries$AgeatSeasonEnd= as.integer(salaries$Current_age - (2022- salaries$season_end))
#Weight

salaries$weight <- as.numeric(sub("lb","", salaries$weight))

#Height
salaries$height = as.character(sub("-",".", salaries$height))

salaries <- salaries %>% separate(height, c('Feet', 'Inch'))

salaries$heightincm <- as.numeric(salaries$Feet)*30.48 + as.numeric(salaries$Inch)*2.54


head(salaries)
```

```
##   league player_id  salary  season season_end season_start
## 1    NBA abdelal01  395000 1990-91       1991         1990
## 2    NBA abdelal01  494000 1991-92       1992         1991
## 3    NBA abdelal01  500000 1992-93       1993         1992
## 4    NBA abdelal01  805000 1993-94       1994         1993
## 5    NBA abdelal01  650000 1994-95       1995         1994
## 6    NBA abdulka01 1530000 1984-85       1985         1984
##                    team  birthDate         birthPlace career_AST career_FG.
## 1 Portland Trail Blazers 1968-06-24       Cairo, Egypt        0.3       50.2
## 2 Portland Trail Blazers 1968-06-24       Cairo, Egypt        0.3       50.2
## 3         Boston Celtics 1968-06-24       Cairo, Egypt        0.3       50.2
## 4         Boston Celtics 1968-06-24       Cairo, Egypt        0.3       50.2
## 5      Sacramento Kings 1968-06-24       Cairo, Egypt        0.3       50.2
## 6     Los Angeles Lakers 1947-04-16 New York, New York        3.6       55.9
##   career_FG3. career_FT. career_G career_PER career_PTS career_TRB career_WS
## 1         0.0       70.1      256       13.0        5.7        3.3       4.8
## 2         0.0       70.1      256       13.0        5.7        3.3       4.8
## 3         0.0       70.1      256       13.0        5.7        3.3       4.8
## 4         0.0       70.1      256       13.0        5.7        3.3       4.8
## 5         0.0       70.1      256       13.0        5.7        3.3       4.8
## 6         5.6       72.1     1560       24.6       24.6       11.2     273.4
##   career_eFG.                               college   draft_pick draft_round
## 1        50.2                        Duke University 25th overall   1st round
## 2        50.2                        Duke University 25th overall   1st round
## 3        50.2                        Duke University 25th overall   1st round
## 4        50.2                        Duke University 25th overall   1st round
## 5        50.2                        Duke University 25th overall   1st round
## 6        55.9 University of California, Los Angeles  1st overall   1st round
##                draft_team draft_year Feet Inch
## 1 Portland Trail Blazers       1990    6   10
## 2 Portland Trail Blazers       1990    6   10
## 3 Portland Trail Blazers       1990    6   10
## 4 Portland Trail Blazers       1990    6   10
## 5 Portland Trail Blazers       1990    6   10
## 6         Milwaukee Bucks       1969    7    2
```

```
##                            highSchool                    name        position shoots
## 1 Bloomfield in Bloomfield, New Jersey      Alaa Abdelnaby Power Forward  Right
## 2 Bloomfield in Bloomfield, New Jersey      Alaa Abdelnaby Power Forward  Right
## 3 Bloomfield in Bloomfield, New Jersey      Alaa Abdelnaby Power Forward  Right
## 4 Bloomfield in Bloomfield, New Jersey      Alaa Abdelnaby Power Forward  Right
## 5 Bloomfield in Bloomfield, New Jersey      Alaa Abdelnaby Power Forward  Right
## 6 Power Memorial in New York, New York Kareem Abdul-Jabbar        Center  Right
##   weight Current_age AgeatSeasonEnd heightincm
## 1    240    54.39234             23     208.28
## 2    240    54.39234             24     208.28
## 3    240    54.39234             25     208.28
## 4    240    54.39234             26     208.28
## 5    240    54.39234             27     208.28
## 6    225    75.55434             38     218.44
```

Converting to numeric for better usage

```
salaries$career_FG3. <- as.numeric(salaries$career_FG3.)
```

```
## Warning: NAs introduced by coercion
```

```
salaries$career_FG. <- as.numeric(salaries$career_FG.)
```

```
## Warning: NAs introduced by coercion
```

```
salaries$career_FT. <- as.numeric(salaries$career_FT.)
```

```
## Warning: NAs introduced by coercion
```

```
salaries$career_PER <- as.numeric(salaries$career_PER)
```

```
## Warning: NAs introduced by coercion
```

```
salaries$career_TRB <- as.numeric(salaries$career_TRB)
salaries$career_WS <- as.numeric(salaries$career_WS)
salaries$career_eFG. <- as.numeric(salaries$career_eFG.)
```

```
## Warning: NAs introduced by coercion
```

```
salaries$heightincm <- as.numeric(salaries$heightincm)
```

Variable name changes and slicing the salaries csv to only get the variables important for us

```
experimentwithseason <- salaries[c("player_id","heightincm", "weight","season_end", "AgeatSeasonEnd","te
```

```
names(experimentwithseason) = c("id","height", "weight","season_end", "AgeatSeasonEnd","team","Assits",
```

Factorize categorical variables

```
experimentwithseason$team.f <- factor(experimentwithseason$team)
is.factor(experimentwithseason$team.f)
```

```
## [1] TRUE
```

```
experimentwithseason$shoots.f <- factor(experimentwithseason$shoots)
is.factor(experimentwithseason$shoots.f)
```

```
## [1] TRUE
```

```
experimentwithseason$position.f <- factor(experimentwithseason$position)
is.factor(experimentwithseason$position.f)
```

```
## [1] TRUE
```

Creating 2015 dataframe and removing unwanted columns

```r
df_2015 = subset(experimentwithseason, season_end == 2015)


df_2015 = subset(df_2015, season_end == 2015,select = -c(team,shoots,position))

names(df_2015) = c("id","height", "weight","season_end", "AgeatSeasonEnd","Assits","Points","FieldGoals"

df_2015 <- sqldf('select weight, height, AgeatSeasonEnd, team, Assits, FieldGoals, FieldGoals3, position
```

```r
str(df_2015)
```

```
## 'data.frame':    507 obs. of  17 variables:
##  $ weight               : num  240 209 265 245 210 248 240 250 260 260 ...
##  $ height               : num  201 196 213 201 196 ...
##  $ AgeatSeasonEnd       : int  25 21 22 29 30 27 24 27 30 26 ...
##  $ team                 : chr  "New York Knicks" "Memphis Grizzlies" "Oklahoma City Thunder" "Houst
##  $ Assits               : num  0.6 0.6 1 0.7 1.8 0.5 0.7 0.5 2 1 ...
##  $ FieldGoals           : num  44.4 40.2 58.8 47.4 45 50.3 51.3 52.7 49.1 47.1 ...
##  $ FieldGoals3          : num  35 38.5 0 0 38.6 28.6 0 NA 28.3 13.3 ...
##  $ position             : chr  "Power Forward and Small Forward" "Shooting Guard" "Center" "Power Fe
##  $ shoots               : chr  "Right" "Right" "Right" "Right" ...
##  $ FreeThrows           : num  75.9 60.7 55.3 62.8 82.5 79.7 48.1 73.8 81 68.2 ...
##  $ Games                : int  337 32 467 153 762 293 41 339 950 388 ...
##  $ PlayerEfficiencyRating: num  11.2 13.1 16.7 15 11.9 14.9 12 16.6 20.9 12.5 ...
##  $ TotalRebounds        : num  3.5 0.9 7.4 4.3 2.9 3.9 4.3 3.3 8.4 4.8 ...
##  $ WinShares            : num  8.7 0.4 38.7 4.4 33.5 7.5 1.4 9.6 107 13.8 ...
##  $ effectiveFieldGoal   : num  51.3 45.7 58.8 47.4 51.4 50.7 51.3 52.7 49.5 47.2 ...
##  $ Points               : num  4.9 3.2 9.7 4.6 10.8 5.3 2.3 3.1 19.6 4.8 ...
##  $ salary               : int  915243 1344120 2184960 981084 7750000 981084 3000000 981084 16006000
```

```r
head(df_2015)
```

```
##   weight height AgeatSeasonEnd                  team Assits FieldGoals
## 1    240 200.66             25       New York Knicks    0.6       44.4
## 2    209 195.58             21     Memphis Grizzlies    0.6       40.2
## 3    265 213.36             22 Oklahoma City Thunder    1.0       58.8
## 4    245 200.66             29       Houston Rockets    0.7       47.4
## 5    210 195.58             30 Portland Trail Blazers    1.8       45.0
## 6    248 218.44             27   New Orleans Pelicans    0.5       50.3
##   FieldGoals3                        position shoots FreeThrows Games
## 1        35.0  Power Forward and Small Forward  Right       75.9   337
## 2        38.5                   Shooting Guard  Right       60.7    32
## 3         0.0                           Center  Right       55.3   467
## 4         0.0                    Power Forward  Right       62.8   153
## 5        38.6 Shooting Guard and Small Forward  Right       82.5   762
```

```
## 6         28.6        Power Forward and Center  Right      79.7  293
##    PlayerEfficiencyRating TotalRebounds WinShares effectiveFieldGoal Points
## 1                   11.2           3.5       8.7               51.3    4.9
## 2                   13.1           0.9       0.4               45.7    3.2
## 3                   16.7           7.4      38.7               58.8    9.7
## 4                   15.0           4.3       4.4               47.4    4.6
## 5                   11.9           2.9      33.5               51.4   10.8
## 6                   14.9           3.9       7.5               50.7    5.3
##    salary
## 1  915243
## 2 1344120
## 3 2184960
## 4  981084
## 5 7750000
## 6  981084
```

Fitting an initial model with no changes

```
str(df_2015)
```

```
## 'data.frame':    507 obs. of  17 variables:
##  $ weight              : num  240 209 265 245 210 248 240 250 260 260 ...
##  $ height              : num  201 196 213 201 196 ...
##  $ AgeatSeasonEnd      : int  25 21 22 29 30 27 24 27 30 26 ...
##  $ team                : chr  "New York Knicks" "Memphis Grizzlies" "Oklahoma City Thunder" "Houst
##  $ Assits              : num  0.6 0.6 1 0.7 1.8 0.5 0.7 0.5 2 1 ...
##  $ FieldGoals          : num  44.4 40.2 58.8 47.4 45 50.3 51.3 52.7 49.1 47.1 ...
##  $ FieldGoals3         : num  35 38.5 0 0 38.6 28.6 0 NA 28.3 13.3 ...
##  $ position            : chr  "Power Forward and Small Forward" "Shooting Guard" "Center" "Power F
##  $ shoots              : chr  "Right" "Right" "Right" "Right" ...
##  $ FreeThrows          : num  75.9 60.7 55.3 62.8 82.5 79.7 48.1 73.8 81 68.2 ...
##  $ Games               : int  337 32 467 153 762 293 41 339 950 388 ...
##  $ PlayerEfficiencyRating: num  11.2 13.1 16.7 15 11.9 14.9 12 16.6 20.9 12.5 ...
##  $ TotalRebounds       : num  3.5 0.9 7.4 4.3 2.9 3.9 4.3 3.3 8.4 4.8 ...
##  $ WinShares           : num  8.7 0.4 38.7 4.4 33.5 7.5 1.4 9.6 107 13.8 ...
##  $ effectiveFieldGoal  : num  51.3 45.7 58.8 47.4 51.4 50.7 51.3 52.7 49.5 47.2 ...
##  $ Points              : num  4.9 3.2 9.7 4.6 10.8 5.3 2.3 3.1 19.6 4.8 ...
##  $ salary              : int  915243 1344120 2184960 981084 7750000 981084 3000000 981084 16006000
```

```
model1 = lm(salary ~ ., data=df_2015)
summary(model1)
```

```
##
## Call:
## lm(formula = salary ~ ., data = df_2015)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -9754242 -1664716   -53253  1428116 10935067
##
## Coefficients:
##                                                          Estimate
## (Intercept)                                             -10830342
## weight                                                      30631
## height                                                      32628
## AgeatSeasonEnd                                              -27277
```

```
## teamBoston Celtics                                                      718377
## teamBrooklyn Nets                                                      2676090
## teamCharlotte Hornets                                                  1253437
## teamChicago Bulls                                                       -91382
## teamCleveland Cavaliers                                                 223369
## teamDallas Mavericks                                                    118450
## teamDenver Nuggets                                                      309600
## teamDetroit Pistons                                                     351786
## teamGolden State Warriors                                               229241
## teamHouston Rockets                                                     997487
## teamIndiana Pacers                                                     1953410
## teamLos Angeles Clippers                                                680731
## teamLos Angeles Lakers                                                  135424
## teamMemphis Grizzlies                                                  1051638
## teamMiami Heat                                                         1081685
## teamMilwaukee Bucks                                                    -188040
## teamMinnesota Timberwolves                                              342922
## teamNew Orleans Pelicans                                              1663026
## teamNew York Knicks                                                   1994866
## teamOklahoma City Thunder                                              517916
## teamOrlando Magic                                                     -894418
## teamPhiladelphia 76ers                                                  20937
## teamPhoenix Suns                                                        634842
## teamPortland Trail Blazers                                            1148067
## teamSacramento Kings                                                  1391533
## teamSan Antonio Spurs                                                 -177173
## teamToronto Raptors                                                    889479
## teamUtah Jazz                                                         1596222
## teamWashington Wizards                                                 420544
## Assits                                                                 582859
## FieldGoals                                                              94091
## FieldGoals3                                                             -6364
## positionCenter and Power Forward                                      1418080
## positionCenter and Small Forward and Power Forward                    2031790
## positionPoint Guard                                                   1080979
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard -6678158
## positionPoint Guard and Shooting Guard                                -573770
## positionPoint Guard and Small Forward and Shooting Guard               303341
## positionPower Forward                                                  539553
## positionPower Forward and Center                                      1292970
## positionPower Forward and Center and Small Forward                    3150355
## positionPower Forward and Shooting Guard                              1260173
## positionPower Forward and Small Forward                                -47854
## positionPower Forward and Small Forward and Shooting Guard            4084965
## positionShooting Guard                                                 851770
## positionShooting Guard and Point Guard                                 561041
## positionShooting Guard and Small Forward                               768890
## positionShooting Guard and Small Forward and Point Guard              -635183
## positionShooting Guard and Small Forward and Power Forward             982228
## positionSmall Forward                                                  330251
## positionSmall Forward and Center and Power Forward                     351999
## positionSmall Forward and Power Forward                                386204
## positionSmall Forward and Power Forward and Shooting Guard            1206722
## positionSmall Forward and Shooting Guard                               362192
```

```
## positionSmall Forward and Shooting Guard and Point Guard                      258056
## positionSmall Forward and Shooting Guard and Power Forward                   1889181
## shootsLeft Right                                                             -637516
## shootsRight                                                                  -191980
## FreeThrows                                                                    -22985
## Games                                                                           1537
## PlayerEfficiencyRating                                                         -97011
## TotalRebounds                                                                 -91044
## WinShares                                                                      39161
## effectiveFieldGoal                                                           -111157
## Points                                                                        355283
##                                                                           Std. Error
## (Intercept)                                                                 10385504
## weight                                                                         13470
## height                                                                         46206
## AgeatSeasonEnd                                                                 58105
## teamBoston Celtics                                                           1193700
## teamBrooklyn Nets                                                            1267677
## teamCharlotte Hornets                                                        1188526
## teamChicago Bulls                                                            1218267
## teamCleveland Cavaliers                                                      1355613
## teamDallas Mavericks                                                         1191447
## teamDenver Nuggets                                                           1210854
## teamDetroit Pistons                                                          1267356
## teamGolden State Warriors                                                    1266100
## teamHouston Rockets                                                          1210178
## teamIndiana Pacers                                                           1274219
## teamLos Angeles Clippers                                                     1228884
## teamLos Angeles Lakers                                                       1199502
## teamMemphis Grizzlies                                                        1239238
## teamMiami Heat                                                               1221208
## teamMilwaukee Bucks                                                          1255671
## teamMinnesota Timberwolves                                                   1327388
## teamNew Orleans Pelicans                                                     1223392
## teamNew York Knicks                                                          1236660
## teamOklahoma City Thunder                                                    1225535
## teamOrlando Magic                                                            1167056
## teamPhiladelphia 76ers                                                       1133765
## teamPhoenix Suns                                                             1162847
## teamPortland Trail Blazers                                                   1211746
## teamSacramento Kings                                                         1244486
## teamSan Antonio Spurs                                                        1246011
## teamToronto Raptors                                                          1208027
## teamUtah Jazz                                                                1222499
## teamWashington Wizards                                                       1271111
## Assits                                                                        189296
## FieldGoals                                                                     85435
## FieldGoals3                                                                    19018
## positionCenter and Power Forward                                              812484
## positionCenter and Small Forward and Power Forward                           3477851
## positionPoint Guard                                                          1767936
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard   3490224
## positionPoint Guard and Shooting Guard                                       1622737
## positionPoint Guard and Small Forward and Shooting Guard                     3678982
```

```
## positionPower Forward                                                842084
## positionPower Forward and Center                                     757874
## positionPower Forward and Center and Small Forward                   2517934
## positionPower Forward and Shooting Guard                             3541178
## positionPower Forward and Small Forward                              1119298
## positionPower Forward and Small Forward and Shooting Guard           3612412
## positionShooting Guard                                               1402515
## positionShooting Guard and Point Guard                               1591959
## positionShooting Guard and Small Forward                             1293231
## positionShooting Guard and Small Forward and Point Guard             2272982
## positionShooting Guard and Small Forward and Power Forward           2682194
## positionSmall Forward                                                1127588
## positionSmall Forward and Center and Power Forward                   2124351
## positionSmall Forward and Power Forward                              1114723
## positionSmall Forward and Power Forward and Shooting Guard           2681475
## positionSmall Forward and Shooting Guard                             1275096
## positionSmall Forward and Shooting Guard and Point Guard             2655385
## positionSmall Forward and Shooting Guard and Power Forward           1944729
## shootsLeft Right                                                     3567460
## shootsRight                                                          585832
## FreeThrows                                                           24110
## Games                                                                1199
## PlayerEfficiencyRating                                               106602
## TotalRebounds                                                        155375
## WinShares                                                            11147
## effectiveFieldGoal                                                   73823
## Points                                                               81432
##                                                                      t value
## (Intercept)                                                          -1.043
## weight                                                               2.274
## height                                                               0.706
## AgeatSeasonEnd                                                       -0.469
## teamBoston Celtics                                                   0.602
## teamBrooklyn Nets                                                    2.111
## teamCharlotte Hornets                                                1.055
## teamChicago Bulls                                                    -0.075
## teamCleveland Cavaliers                                              0.165
## teamDallas Mavericks                                                 0.099
## teamDenver Nuggets                                                   0.256
## teamDetroit Pistons                                                  0.278
## teamGolden State Warriors                                            0.181
## teamHouston Rockets                                                  0.824
## teamIndiana Pacers                                                   1.533
## teamLos Angeles Clippers                                             0.554
## teamLos Angeles Lakers                                               0.113
## teamMemphis Grizzlies                                                0.849
## teamMiami Heat                                                       0.886
## teamMilwaukee Bucks                                                  -0.150
## teamMinnesota Timberwolves                                           0.258
## teamNew Orleans Pelicans                                             1.359
## teamNew York Knicks                                                  1.613
## teamOklahoma City Thunder                                            0.423
## teamOrlando Magic                                                    -0.766
## teamPhiladelphia 76ers                                               0.018
```

```
## teamPhoenix Suns                                                              0.546
## teamPortland Trail Blazers                                                     0.947
## teamSacramento Kings                                                           1.118
## teamSan Antonio Spurs                                                         -0.142
## teamToronto Raptors                                                            0.736
## teamUtah Jazz                                                                  1.306
## teamWashington Wizards                                                         0.331
## Assits                                                                         3.079
## FieldGoals                                                                     1.101
## FieldGoals3                                                                   -0.335
## positionCenter and Power Forward                                              1.745
## positionCenter and Small Forward and Power Forward                            0.584
## positionPoint Guard                                                           0.611
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard   -1.913
## positionPoint Guard and Shooting Guard                                       -0.354
## positionPoint Guard and Small Forward and Shooting Guard                      0.082
## positionPower Forward                                                         0.641
## positionPower Forward and Center                                              1.706
## positionPower Forward and Center and Small Forward                            1.251
## positionPower Forward and Shooting Guard                                      0.356
## positionPower Forward and Small Forward                                      -0.043
## positionPower Forward and Small Forward and Shooting Guard                    1.131
## positionShooting Guard                                                        0.607
## positionShooting Guard and Point Guard                                        0.352
## positionShooting Guard and Small Forward                                      0.595
## positionShooting Guard and Small Forward and Point Guard                     -0.279
## positionShooting Guard and Small Forward and Power Forward                    0.366
## positionSmall Forward                                                         0.293
## positionSmall Forward and Center and Power Forward                            0.166
## positionSmall Forward and Power Forward                                       0.346
## positionSmall Forward and Power Forward and Shooting Guard                    0.450
## positionSmall Forward and Shooting Guard                                      0.284
## positionSmall Forward and Shooting Guard and Point Guard                      0.097
## positionSmall Forward and Shooting Guard and Power Forward                    0.971
## shootsLeft Right                                                             -0.179
## shootsRight                                                                  -0.328
## FreeThrows                                                                   -0.953
## Games                                                                         1.282
## PlayerEfficiencyRating                                                       -0.910
## TotalRebounds                                                                -0.586
## WinShares                                                                     3.513
## effectiveFieldGoal                                                           -1.506
## Points                                                                        4.363
##                                                                           Pr(>|t|)
## (Intercept)                                                               0.297630
## weight                                                                    0.023473
## height                                                                    0.480493
## AgeatSeasonEnd                                                            0.638993
## teamBoston Celtics                                                        0.547630
## teamBrooklyn Nets                                                         0.035365
## teamCharlotte Hornets                                                     0.292212
## teamChicago Bulls                                                         0.940243
## teamCleveland Cavaliers                                                   0.869202
## teamDallas Mavericks                                                      0.920855
```

```
## teamDenver Nuggets                                                             0.798318
## teamDetroit Pistons                                                            0.781476
## teamGolden State Warriors                                                      0.856408
## teamHouston Rockets                                                            0.410270
## teamIndiana Pacers                                                             0.126028
## teamLos Angeles Clippers                                                       0.579915
## teamLos Angeles Lakers                                                         0.910164
## teamMemphis Grizzlies                                                          0.396582
## teamMiami Heat                                                                 0.376263
## teamMilwaukee Bucks                                                            0.881032
## teamMinnesota Timberwolves                                                     0.796270
## teamNew Orleans Pelicans                                                       0.174768
## teamNew York Knicks                                                            0.107477
## teamOklahoma City Thunder                                                      0.672802
## teamOrlando Magic                                                             0.443879
## teamPhiladelphia 76ers                                                         0.985276
## teamPhoenix Suns                                                               0.585400
## teamPortland Trail Blazers                                                     0.343959
## teamSacramento Kings                                                           0.264143
## teamSan Antonio Spurs                                                          0.886997
## teamToronto Raptors                                                            0.461958
## teamUtah Jazz                                                                  0.192373
## teamWashington Wizards                                                         0.740926
## Assits                                                                         0.002214
## FieldGoals                                                                     0.271393
## FieldGoals3                                                                    0.738091
## positionCenter and Power Forward                                               0.081658
## positionCenter and Small Forward and Power Forward                             0.559396
## positionPoint Guard                                                            0.541245
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard     0.056383
## positionPoint Guard and Shooting Guard                                         0.723831
## positionPoint Guard and Small Forward and Shooting Guard                       0.934326
## positionPower Forward                                                          0.522047
## positionPower Forward and Center                                               0.088744
## positionPower Forward and Center and Small Forward                             0.211575
## positionPower Forward and Shooting Guard                                       0.722123
## positionPower Forward and Small Forward                                        0.965918
## positionPower Forward and Small Forward and Shooting Guard                     0.258783
## positionShooting Guard                                                         0.543972
## positionShooting Guard and Point Guard                                         0.724700
## positionShooting Guard and Small Forward                                       0.552467
## positionShooting Guard and Small Forward and Point Guard                       0.780039
## positionShooting Guard and Small Forward and Power Forward                     0.714399
## positionSmall Forward                                                          0.769757
## positionSmall Forward and Center and Power Forward                             0.868476
## positionSmall Forward and Power Forward                                        0.729173
## positionSmall Forward and Power Forward and Shooting Guard                     0.652929
## positionSmall Forward and Shooting Guard                                       0.776513
## positionSmall Forward and Shooting Guard and Point Guard                       0.922629
## positionSmall Forward and Shooting Guard and Power Forward                     0.331894
## shootsLeft Right                                                               0.858258
## shootsRight                                                                    0.743299
## FreeThrows                                                                     0.340972
## Games                                                                          0.200443
```

```
## PlayerEfficiencyRating                                                0.363333
## TotalRebounds                                                         0.558219
## WinShares                                                             0.000491
## effectiveFieldGoal                                                    0.132897
## Points                                                                1.62e-05
##
## (Intercept)
## weight                                                                       *
## height
## AgeatSeasonEnd
## teamBoston Celtics
## teamBrooklyn Nets                                                            *
## teamCharlotte Hornets
## teamChicago Bulls
## teamCleveland Cavaliers
## teamDallas Mavericks
## teamDenver Nuggets
## teamDetroit Pistons
## teamGolden State Warriors
## teamHouston Rockets
## teamIndiana Pacers
## teamLos Angeles Clippers
## teamLos Angeles Lakers
## teamMemphis Grizzlies
## teamMiami Heat
## teamMilwaukee Bucks
## teamMinnesota Timberwolves
## teamNew Orleans Pelicans
## teamNew York Knicks
## teamOklahoma City Thunder
## teamOrlando Magic
## teamPhiladelphia 76ers
## teamPhoenix Suns
## teamPortland Trail Blazers
## teamSacramento Kings
## teamSan Antonio Spurs
## teamToronto Raptors
## teamUtah Jazz
## teamWashington Wizards
## Assits                                                                      **
## FieldGoals
## FieldGoals3
## positionCenter and Power Forward                                             .
## positionCenter and Small Forward and Power Forward
## positionPoint Guard
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard .
## positionPoint Guard and Shooting Guard
## positionPoint Guard and Small Forward and Shooting Guard
## positionPower Forward
## positionPower Forward and Center                                             .
## positionPower Forward and Center and Small Forward
## positionPower Forward and Shooting Guard
## positionPower Forward and Small Forward
## positionPower Forward and Small Forward and Shooting Guard
```
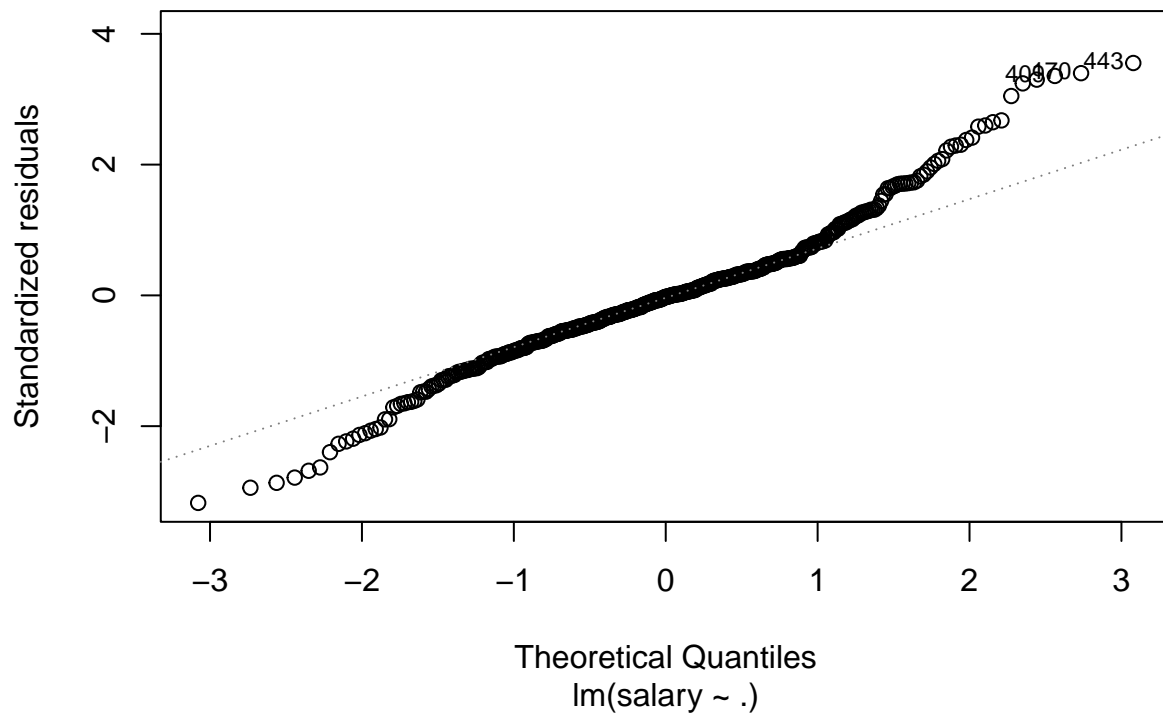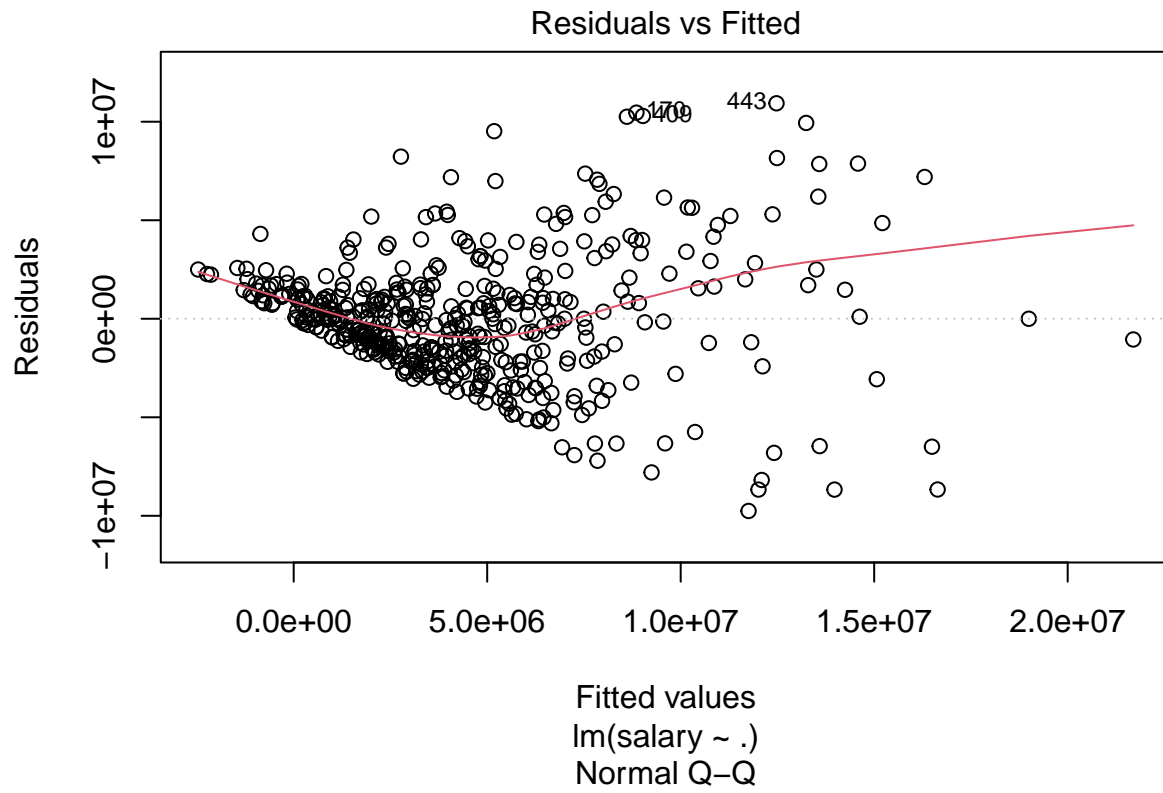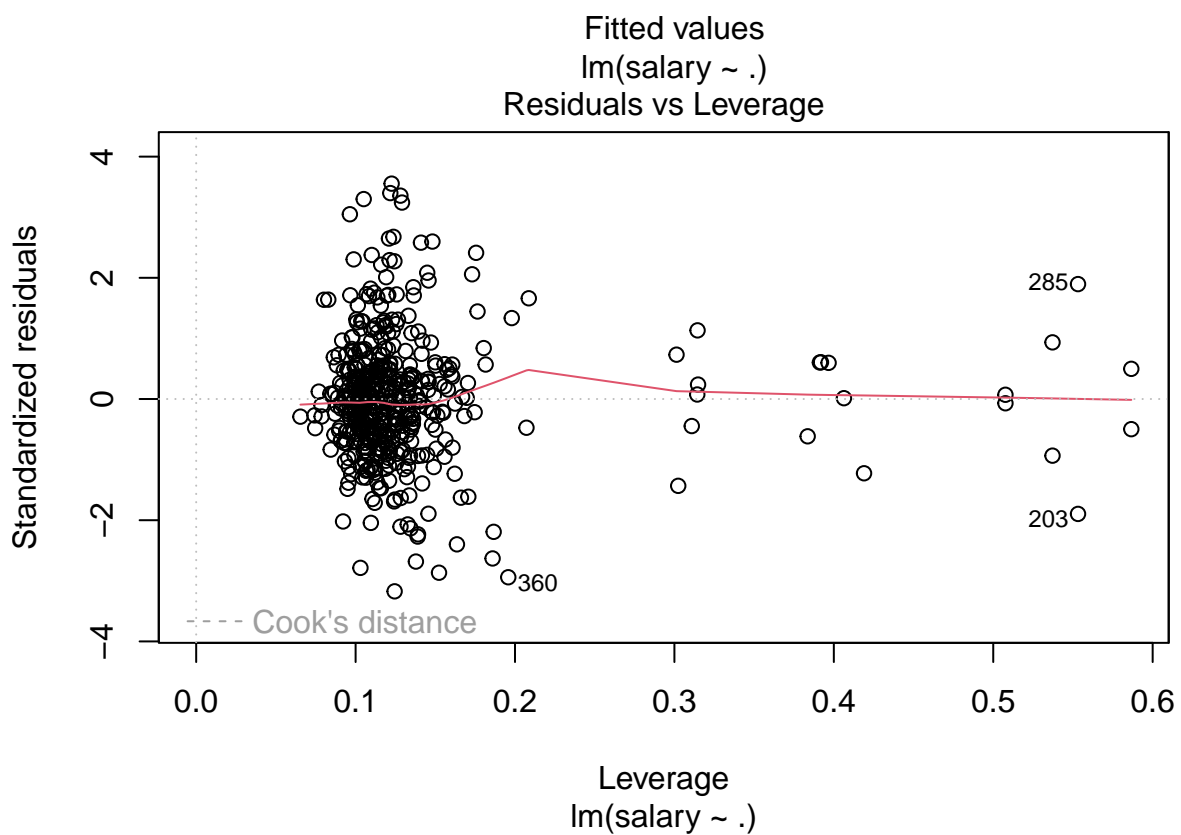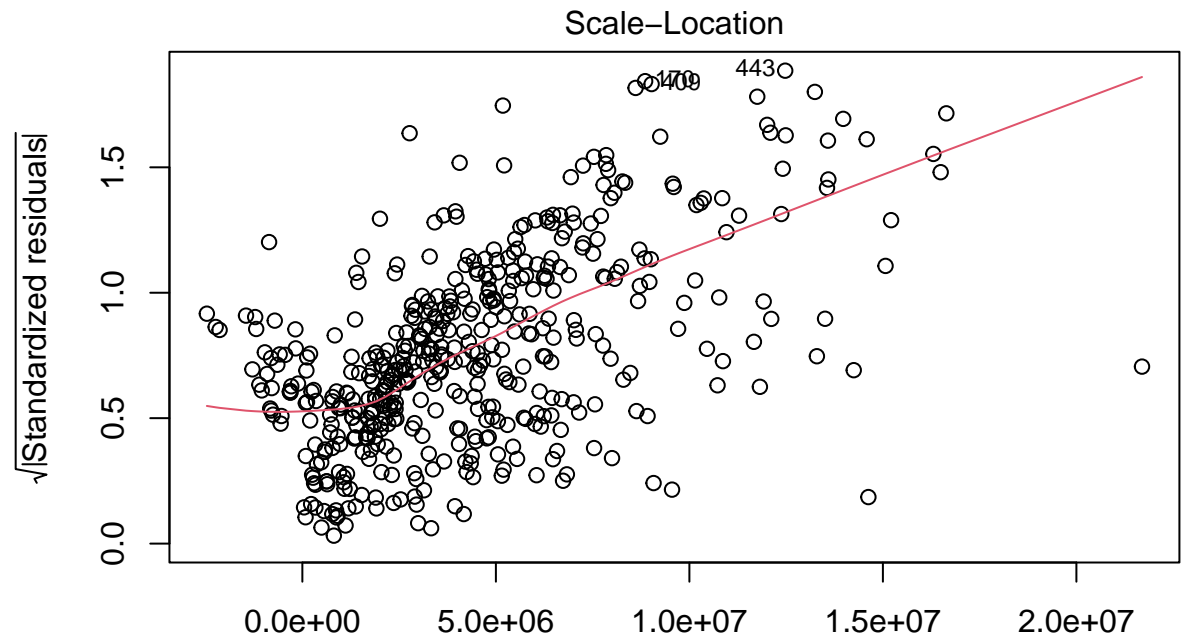
```
## positionShooting Guard
## positionShooting Guard and Point Guard
## positionShooting Guard and Small Forward
## positionShooting Guard and Small Forward and Point Guard
## positionShooting Guard and Small Forward and Power Forward
## positionSmall Forward
## positionSmall Forward and Center and Power Forward
## positionSmall Forward and Power Forward
## positionSmall Forward and Power Forward and Shooting Guard
## positionSmall Forward and Shooting Guard
## positionSmall Forward and Shooting Guard and Point Guard
## positionSmall Forward and Shooting Guard and Power Forward
## shootsLeft Right
## shootsRight
## FreeThrows
## Games
## PlayerEfficiencyRating
## TotalRebounds
## WinShares                                                      ***
## effectiveFieldGoal
## Points                                                         ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3285000 on 417 degrees of freedom
##   (21 observations deleted due to missingness)
## Multiple R-squared:  0.5912, Adjusted R-squared:  0.5246
## F-statistic: 8.869 on 68 and 417 DF,  p-value: < 2.2e-16
```

```
plot(model1)
```

```
## Warning: not plotting observations with leverage one:
##   17, 117, 130, 243, 432, 441
```

Residuals vs Fitted

lm(salary ~ .)

Normal Q−Q

lm(salary ~ .)

Scale–Location

√|Standardized residuals|

443

170 471

Fitted values
lm(salary ~ .)

Residuals vs Leverage

Standardized residuals
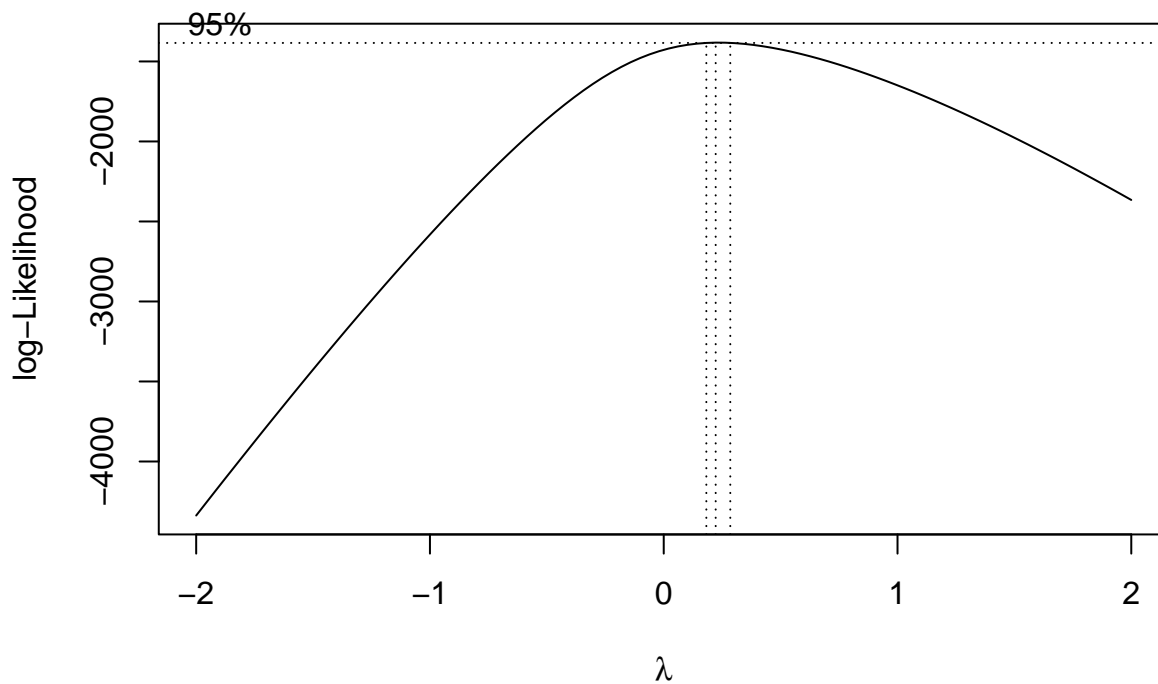
285

203

360

Cook's distance

Leverage
lm(salary ~ .)

```
library(MASS)

##
## Attaching package: 'MASS'

## The following object is masked from 'package:dplyr':
##
```

```
##      select
lambda = 0.303
box_cox = boxcox(model1)
```



```
#lambda= box_cox$x[which.max(box_cox$y)]
#lambda
modeltest1 = lm(((salary^lambda-1)/lambda)~., df_2015)
summary(modeltest1)
```

```
##
## Call:
## lm(formula = ((salary^lambda - 1)/lambda) ~ ., data = df_2015)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -195.38  -43.97    0.00   47.21  194.08
##
## Coefficients:
##                                                     Estimate
## (Intercept)                                       -343.10478
## weight                                               0.75354
## height                                               1.96225
## AgeatSeasonEnd                                      -2.94189
## teamBoston Celtics                                  33.08661
## teamBrooklyn Nets                                   31.96190
## teamCharlotte Hornets                               37.52617
## teamChicago Bulls                                   -9.67672
## teamCleveland Cavaliers                              3.57356
## teamDallas Mavericks                               -15.59396
## teamDenver Nuggets                                   7.47447
## teamDetroit Pistons                                  4.65728
## teamGolden State Warriors                           -8.60263
```

```
## teamHouston Rockets                                                              22.04927
## teamIndiana Pacers                                                               33.79727
## teamLos Angeles Clippers                                                          -9.89140
## teamLos Angeles Lakers                                                           -21.80277
## teamMemphis Grizzlies                                                             3.70717
## teamMiami Heat                                                                    10.77648
## teamMilwaukee Bucks                                                               -8.27445
## teamMinnesota Timberwolves                                                        26.71739
## teamNew Orleans Pelicans                                                          20.70421
## teamNew York Knicks                                                               14.29822
## teamOklahoma City Thunder                                                         12.14732
## teamOrlando Magic                                                                -21.51674
## teamPhiladelphia 76ers                                                            -3.99459
## teamPhoenix Suns                                                                  8.55366
## teamPortland Trail Blazers                                                        26.03141
## teamSacramento Kings                                                              17.98058
## teamSan Antonio Spurs                                                             1.76058
## teamToronto Raptors                                                               27.54287
## teamUtah Jazz                                                                     21.02947
## teamWashington Wizards                                                            10.39797
## Assits                                                                            15.40716
## FieldGoals                                                                        1.74644
## FieldGoals3                                                                       -0.31013
## positionCenter and Power Forward                                                  34.92351
## positionCenter and Small Forward and Power Forward                                40.88037
## positionPoint Guard                                                               45.46488
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard      -126.77509
## positionPoint Guard and Shooting Guard                                            12.34283
## positionPoint Guard and Small Forward and Shooting Guard                          -0.90409
## positionPower Forward                                                             24.20103
## positionPower Forward and Center                                                  31.57875
## positionPower Forward and Center and Small Forward                                61.36509
## positionPower Forward and Shooting Guard                                          10.31007
## positionPower Forward and Small Forward                                           1.15122
## positionPower Forward and Small Forward and Shooting Guard                        58.32417
## positionShooting Guard                                                            48.49940
## positionShooting Guard and Point Guard                                            32.52221
## positionShooting Guard and Small Forward                                          29.30226
## positionShooting Guard and Small Forward and Point Guard                          10.84653
## positionShooting Guard and Small Forward and Power Forward                        26.75062
## positionSmall Forward                                                             21.04719
## positionSmall Forward and Center and Power Forward                                20.73883
## positionSmall Forward and Power Forward                                           23.14421
## positionSmall Forward and Power Forward and Shooting Guard                        45.66800
## positionSmall Forward and Shooting Guard                                          19.40305
## positionSmall Forward and Shooting Guard and Point Guard                          9.42591
## positionSmall Forward and Shooting Guard and Power Forward                        67.16814
## shootsLeft Right                                                                  9.74921
## shootsRight                                                                       -8.59162
## FreeThrows                                                                        -0.23119
## Games                                                                             0.17547
## PlayerEfficiencyRating                                                            0.11776
## TotalRebounds                                                                     -1.91175
## WinShares                                                                         -0.15975
```

```
## effectiveFieldGoal                                                          -1.73107
## Points                                                                        6.05532
##                                                                            Std. Error
## (Intercept)                                                                 225.33386
## weight                                                                        0.29226
## height                                                                        1.00252
## AgeatSeasonEnd                                                                1.26070
## teamBoston Celtics                                                           25.89966
## teamBrooklyn Nets                                                            27.50473
## teamCharlotte Hornets                                                        25.78739
## teamChicago Bulls                                                            26.43269
## teamCleveland Cavaliers                                                      29.41268
## teamDallas Mavericks                                                         25.85077
## teamDenver Nuggets                                                           26.27184
## teamDetroit Pistons                                                          27.49778
## teamGolden State Warriors                                                    27.47051
## teamHouston Rockets                                                          26.25718
## teamIndiana Pacers                                                           27.64669
## teamLos Angeles Clippers                                                     26.66305
## teamLos Angeles Lakers                                                       26.02555
## teamMemphis Grizzlies                                                        26.88770
## teamMiami Heat                                                               26.49650
## teamMilwaukee Bucks                                                          27.24423
## teamMinnesota Timberwolves                                                   28.80029
## teamNew Orleans Pelicans                                                     26.54390
## teamNew York Knicks                                                          26.83176
## teamOklahoma City Thunder                                                    26.59038
## teamOrlando Magic                                                            25.32157
## teamPhiladelphia 76ers                                                       24.59925
## teamPhoenix Suns                                                             25.23024
## teamPortland Trail Blazers                                                   26.29120
## teamSacramento Kings                                                         27.00156
## teamSan Antonio Spurs                                                        27.03466
## teamToronto Raptors                                                          26.21052
## teamUtah Jazz                                                                26.52451
## teamWashington Wizards                                                       27.57925
## Assits                                                                        4.10714
## FieldGoals                                                                    1.85368
## FieldGoals3                                                                   0.41264
## positionCenter and Power Forward                                             17.62844
## positionCenter and Small Forward and Power Forward                           75.45879
## positionPoint Guard                                                          38.35884
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard   75.72725
## positionPoint Guard and Shooting Guard                                       35.20846
## positionPoint Guard and Small Forward and Shooting Guard                     79.82273
## positionPower Forward                                                        18.27065
## positionPower Forward and Center                                             16.44357
## positionPower Forward and Center and Small Forward                           54.63152
## positionPower Forward and Shooting Guard                                     76.83279
## positionPower Forward and Small Forward                                      24.28537
## positionPower Forward and Small Forward and Shooting Guard                   78.37835
## positionShooting Guard                                                       30.43032
## positionShooting Guard and Point Guard                                       34.54066
## positionShooting Guard and Small Forward                                     28.05918
```

```
## positionShooting Guard and Small Forward and Point Guard        49.31679
## positionShooting Guard and Small Forward and Power Forward       58.19544
## positionSmall Forward                                            24.46523
## positionSmall Forward and Center and Power Forward               46.09196
## positionSmall Forward and Power Forward                          24.18610
## positionSmall Forward and Power Forward and Shooting Guard       58.17986
## positionSmall Forward and Shooting Guard                         27.66571
## positionSmall Forward and Shooting Guard and Point Guard         57.61378
## positionSmall Forward and Shooting Guard and Power Forward       42.19470
## shootsLeft Right                                                 77.40304
## shootsRight                                                      12.71076
## FreeThrows                                                        0.52312
## Games                                                             0.02601
## PlayerEfficiencyRating                                            2.31295
## TotalRebounds                                                     3.37116
## WinShares                                                         0.24186
## effectiveFieldGoal                                                1.60174
## Points                                                            1.76682
##                                                                  t value
## (Intercept)                                                       -1.523
## weight                                                             2.578
## height                                                             1.957
## AgeatSeasonEnd                                                    -2.334
## teamBoston Celtics                                                 1.277
## teamBrooklyn Nets                                                  1.162
## teamCharlotte Hornets                                              1.455
## teamChicago Bulls                                                 -0.366
## teamCleveland Cavaliers                                            0.121
## teamDallas Mavericks                                              -0.603
## teamDenver Nuggets                                                 0.285
## teamDetroit Pistons                                                0.169
## teamGolden State Warriors                                         -0.313
## teamHouston Rockets                                                0.840
## teamIndiana Pacers                                                 1.222
## teamLos Angeles Clippers                                          -0.371
## teamLos Angeles Lakers                                            -0.838
## teamMemphis Grizzlies                                              0.138
## teamMiami Heat                                                     0.407
## teamMilwaukee Bucks                                               -0.304
## teamMinnesota Timberwolves                                         0.928
## teamNew Orleans Pelicans                                           0.780
## teamNew York Knicks                                                0.533
## teamOklahoma City Thunder                                          0.457
## teamOrlando Magic                                                 -0.850
## teamPhiladelphia 76ers                                            -0.162
## teamPhoenix Suns                                                   0.339
## teamPortland Trail Blazers                                         0.990
## teamSacramento Kings                                               0.666
## teamSan Antonio Spurs                                              0.065
## teamToronto Raptors                                                1.051
## teamUtah Jazz                                                      0.793
## teamWashington Wizards                                             0.377
## Assits                                                             3.751
## FieldGoals                                                         0.942
```

```
## FieldGoals3                                                                     -0.752
## positionCenter and Power Forward                                                 1.981
## positionCenter and Small Forward and Power Forward                               0.542
## positionPoint Guard                                                              1.185
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard       -1.674
## positionPoint Guard and Shooting Guard                                           0.351
## positionPoint Guard and Small Forward and Shooting Guard                         -0.011
## positionPower Forward                                                            1.325
## positionPower Forward and Center                                                 1.920
## positionPower Forward and Center and Small Forward                               1.123
## positionPower Forward and Shooting Guard                                         0.134
## positionPower Forward and Small Forward                                          0.047
## positionPower Forward and Small Forward and Shooting Guard                       0.744
## positionShooting Guard                                                           1.594
## positionShooting Guard and Point Guard                                           0.942
## positionShooting Guard and Small Forward                                         1.044
## positionShooting Guard and Small Forward and Point Guard                         0.220
## positionShooting Guard and Small Forward and Power Forward                       0.460
## positionSmall Forward                                                            0.860
## positionSmall Forward and Center and Power Forward                               0.450
## positionSmall Forward and Power Forward                                          0.957
## positionSmall Forward and Power Forward and Shooting Guard                       0.785
## positionSmall Forward and Shooting Guard                                         0.701
## positionSmall Forward and Shooting Guard and Point Guard                         0.164
## positionSmall Forward and Shooting Guard and Power Forward                       1.592
## shootsLeft Right                                                                 0.126
## shootsRight                                                                     -0.676
## FreeThrows                                                                      -0.442
## Games                                                                            6.747
## PlayerEfficiencyRating                                                           0.051
## TotalRebounds                                                                   -0.567
## WinShares                                                                       -0.661
## effectiveFieldGoal                                                              -1.081
## Points                                                                           3.427
##                                                                                 Pr(>|t|)
## (Intercept)                                                                      0.128604
## weight                                                                           0.010271
## height                                                                           0.050976
## AgeatSeasonEnd                                                                   0.020094
## teamBoston Celtics                                                               0.202139
## teamBrooklyn Nets                                                                0.245880
## teamCharlotte Hornets                                                            0.146362
## teamChicago Bulls                                                                0.714484
## teamCleveland Cavaliers                                                          0.903356
## teamDallas Mavericks                                                             0.546684
## teamDenver Nuggets                                                               0.776165
## teamDetroit Pistons                                                              0.865588
## teamGolden State Warriors                                                        0.754317
## teamHouston Rockets                                                              0.401534
## teamIndiana Pacers                                                               0.222220
## teamLos Angeles Clippers                                                         0.710842
## teamLos Angeles Lakers                                                           0.402654
## teamMemphis Grizzlies                                                            0.890405
## teamMiami Heat                                                                   0.684427
```
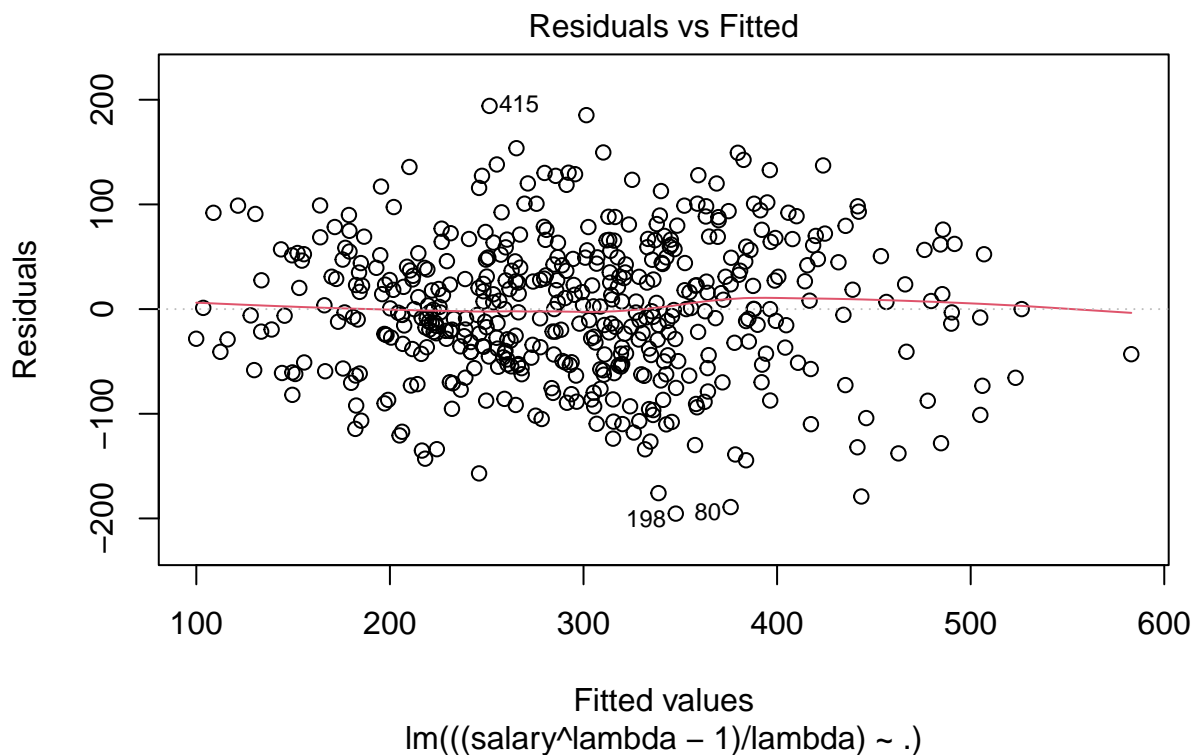
```
## teamMilwaukee Bucks                                                         0.761497
## teamMinnesota Timberwolves                                                  0.354111
## teamNew Orleans Pelicans                                                    0.435834
## teamNew York Knicks                                                         0.594398
## teamOklahoma City Thunder                                                   0.648030
## teamOrlando Magic                                                           0.395957
## teamPhiladelphia 76ers                                                      0.871080
## teamPhoenix Suns                                                            0.734762
## teamPortland Trail Blazers                                                  0.322690
## teamSacramento Kings                                                        0.505837
## teamSan Antonio Spurs                                                       0.948107
## teamToronto Raptors                                                         0.293944
## teamUtah Jazz                                                               0.428327
## teamWashington Wizards                                                      0.706349
## Assits                                                                      0.000201
## FieldGoals                                                                  0.346662
## FieldGoals3                                                                 0.452741
## positionCenter and Power Forward                                            0.048238
## positionCenter and Small Forward and Power Forward                          0.588275
## positionPoint Guard                                                         0.236593
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard  0.094861
## positionPoint Guard and Shooting Guard                                      0.726092
## positionPoint Guard and Small Forward and Shooting Guard                    0.990969
## positionPower Forward                                                       0.186034
## positionPower Forward and Center                                            0.055485
## positionPower Forward and Center and Small Forward                          0.261976
## positionPower Forward and Shooting Guard                                    0.893318
## positionPower Forward and Small Forward                                     0.962214
## positionPower Forward and Small Forward and Shooting Guard                  0.457213
## positionShooting Guard                                                      0.111742
## positionShooting Guard and Point Guard                                      0.346962
## positionShooting Guard and Small Forward                                    0.296951
## positionShooting Guard and Small Forward and Point Guard                    0.826029
## positionShooting Guard and Small Forward and Power Forward                  0.645994
## positionSmall Forward                                                       0.390124
## positionSmall Forward and Center and Power Forward                          0.652984
## positionSmall Forward and Power Forward                                     0.339161
## positionSmall Forward and Power Forward and Shooting Guard                  0.432931
## positionSmall Forward and Shooting Guard                                    0.483483
## positionSmall Forward and Shooting Guard and Point Guard                    0.870121
## positionSmall Forward and Shooting Guard and Power Forward                  0.112173
## shootsLeft Right                                                            0.899829
## shootsRight                                                                 0.499458
## FreeThrows                                                                  0.658755
## Games                                                                       5.06e-11
## PlayerEfficiencyRating                                                      0.959418
## TotalRebounds                                                               0.570958
## WinShares                                                                   0.509296
## effectiveFieldGoal                                                          0.280435
## Points                                                                      0.000670
##
## (Intercept)
## weight                                                                         *
## height                                                                         .
```
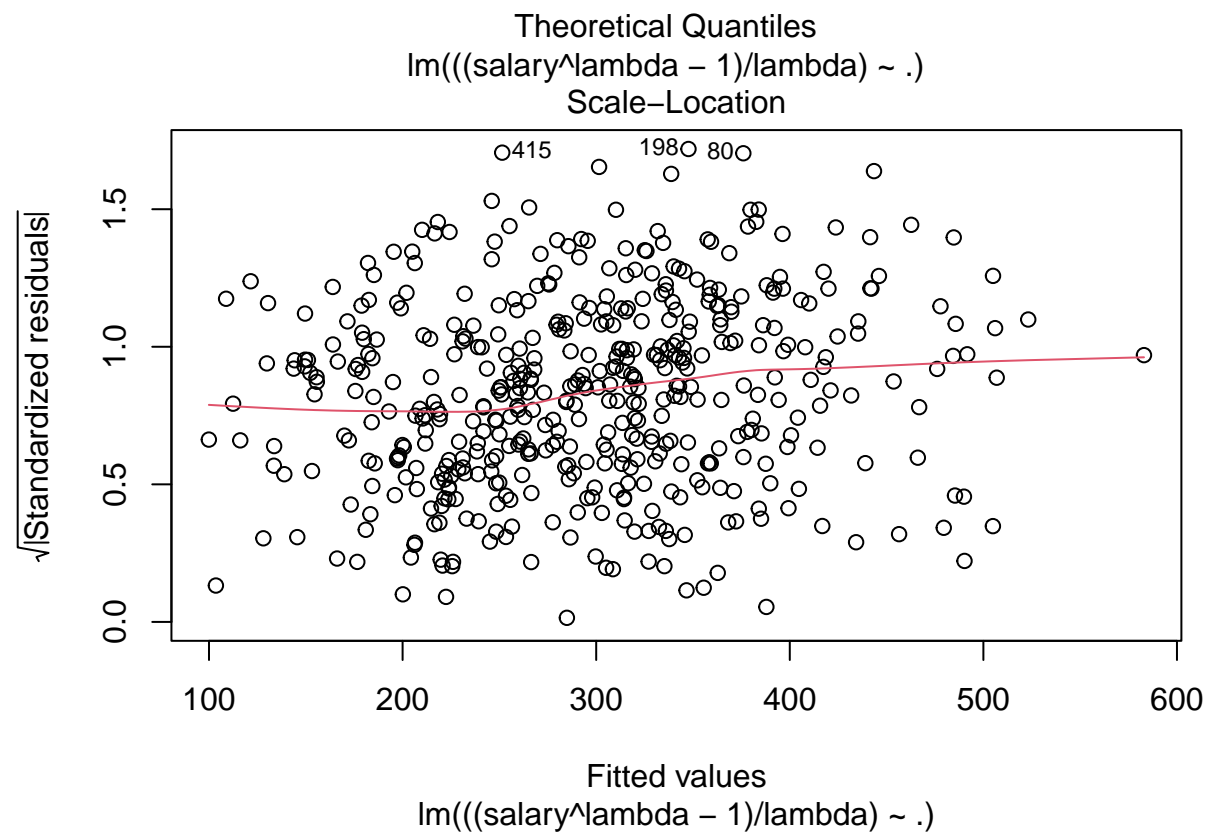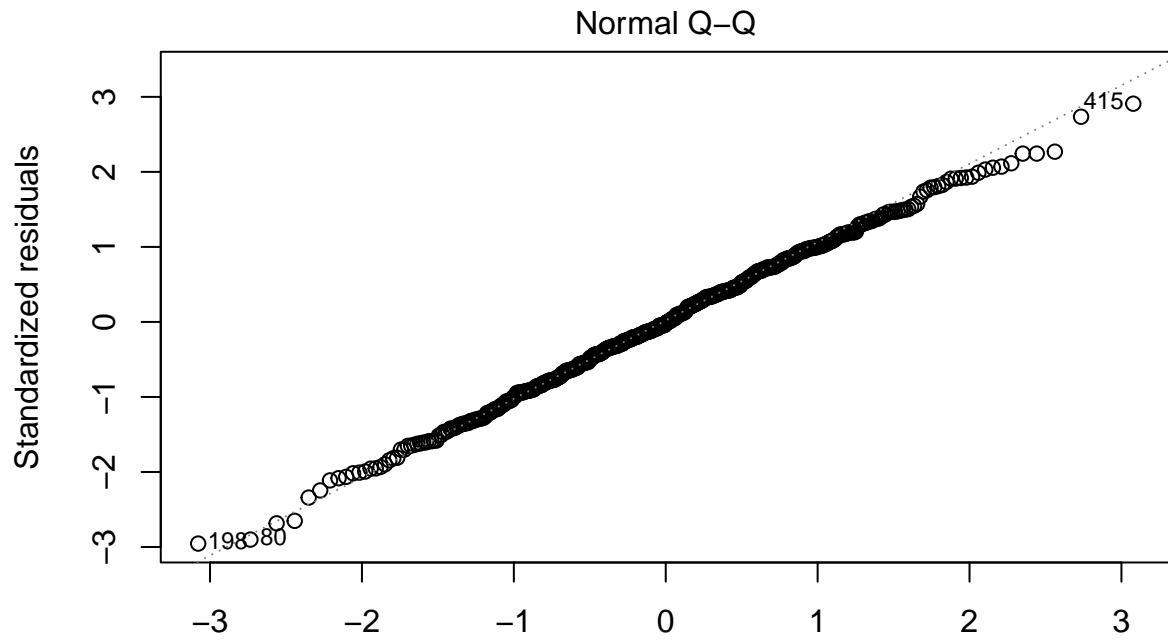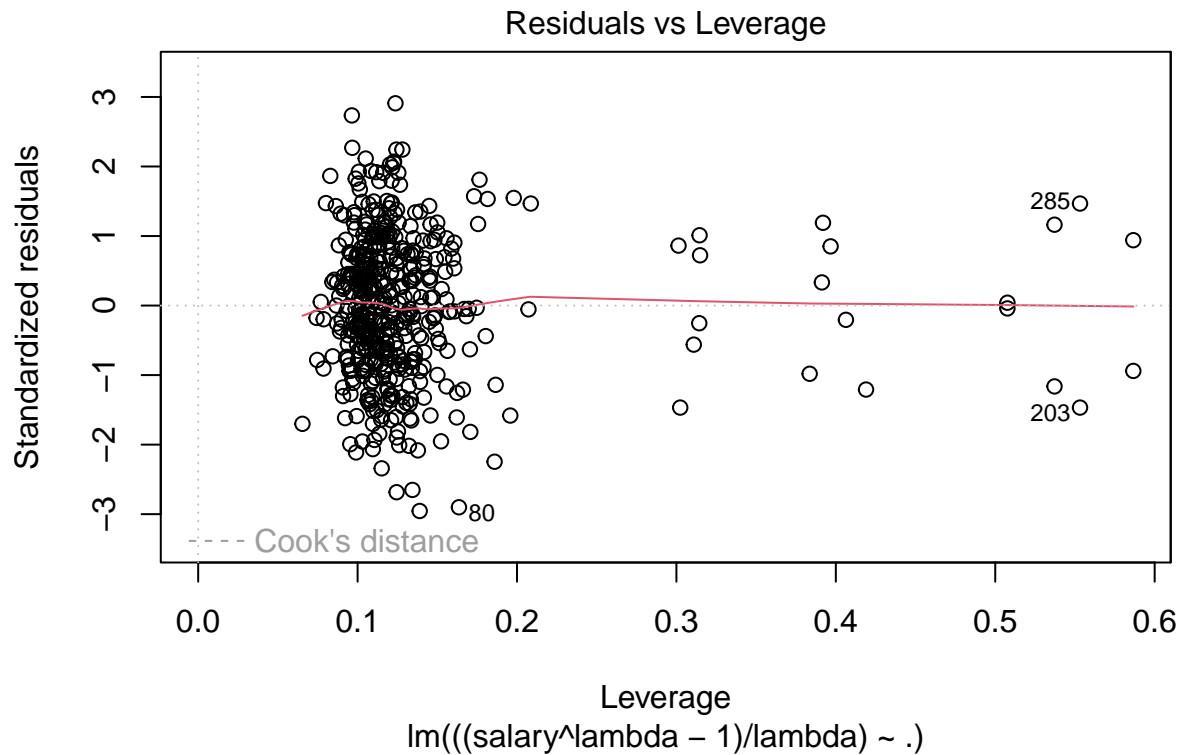
```
## AgeatSeasonEnd                                                              *
## teamBoston Celtics
## teamBrooklyn Nets
## teamCharlotte Hornets
## teamChicago Bulls
## teamCleveland Cavaliers
## teamDallas Mavericks
## teamDenver Nuggets
## teamDetroit Pistons
## teamGolden State Warriors
## teamHouston Rockets
## teamIndiana Pacers
## teamLos Angeles Clippers
## teamLos Angeles Lakers
## teamMemphis Grizzlies
## teamMiami Heat
## teamMilwaukee Bucks
## teamMinnesota Timberwolves
## teamNew Orleans Pelicans
## teamNew York Knicks
## teamOklahoma City Thunder
## teamOrlando Magic
## teamPhiladelphia 76ers
## teamPhoenix Suns
## teamPortland Trail Blazers
## teamSacramento Kings
## teamSan Antonio Spurs
## teamToronto Raptors
## teamUtah Jazz
## teamWashington Wizards
## Assits                                                                    ***
## FieldGoals
## FieldGoals3
## positionCenter and Power Forward                                            *
## positionCenter and Small Forward and Power Forward
## positionPoint Guard
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard .
## positionPoint Guard and Shooting Guard
## positionPoint Guard and Small Forward and Shooting Guard
## positionPower Forward
## positionPower Forward and Center                                            .
## positionPower Forward and Center and Small Forward
## positionPower Forward and Shooting Guard
## positionPower Forward and Small Forward
## positionPower Forward and Small Forward and Shooting Guard
## positionShooting Guard
## positionShooting Guard and Point Guard
## positionShooting Guard and Small Forward
## positionShooting Guard and Small Forward and Point Guard
## positionShooting Guard and Small Forward and Power Forward
## positionSmall Forward
## positionSmall Forward and Center and Power Forward
## positionSmall Forward and Power Forward
## positionSmall Forward and Power Forward and Shooting Guard
```

```
## positionSmall Forward and Shooting Guard
## positionSmall Forward and Shooting Guard and Point Guard
## positionSmall Forward and Shooting Guard and Power Forward
## shootsLeft Right
## shootsRight
## FreeThrows
## Games                                                        ***
## PlayerEfficiencyRating
## TotalRebounds
## WinShares
## effectiveFieldGoal
## Points                                                       ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 71.27 on 417 degrees of freedom
##   (21 observations deleted due to missingness)
## Multiple R-squared:  0.6246, Adjusted R-squared:  0.5634
## F-statistic:  10.2 on 68 and 417 DF,  p-value: < 2.2e-16
```

```
plot(modeltest1)
```

```
## Warning: not plotting observations with leverage one:
##   17, 117, 130, 243, 432, 441
```


Residuals vs Fitted

Normal Q-Q

lm(((salary^lambda − 1)/lambda) ~ .)

Scale−Location

Fitted values
lm(((salary^lambda − 1)/lambda) ~ .)

Residuals vs Leverage

Leverage
lm((((salary^lambda − 1)/lambda) ~ .)

For-

ward Selection

```
n = nrow(df_2015)
out.null=lm(salary ~1, df_2015)
out.full=lm(salary~.,df_2015)
full=formula(lm( salary~., df_2015))
#out.forward= step(out.null,scope=list(lower=~1,upper=full), k= 2,direction="forward",trace= TRUE)

#out.forward= step(out.null,scope=list(lower=~1,upper=full), k= log(n),direction="forward",trace= TRUE)
```

Backward Elimination

```
#out.backward=step(out.full ,scope=list(lower=~1,upper=full),direction="backward",trace=TRUE ,k=log(n))

#out.backward=step(out.full ,scope=list(lower=~1,upper=full),direction="backward",trace=TRUE ,k= 2)

model_3_forwardsel_param = lm(salary ~ WinShares + Points + weight + Assits, data=df_2015)
summary(model_3_forwardsel_param)
```

```
##
## Call:
## lm(formula = salary ~ WinShares + Points + weight + Assits, data = df_2015)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -10114789  -1678362   -235095   1260728  12872070
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -8660051    1506080  -5.750 1.55e-08 ***
## WinShares      50316       6441   7.812 3.32e-14 ***
## Points        269064      45412   5.925 5.81e-09 ***
```

```
## weight              36240         6458    5.612 3.32e-08 ***
## Assits             483838       136538    3.544 0.000432 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3198000 on 502 degrees of freedom
## Multiple R-squared:  0.5481, Adjusted R-squared:  0.5445
## F-statistic: 152.2 on 4 and 502 DF,  p-value: < 2.2e-16
```
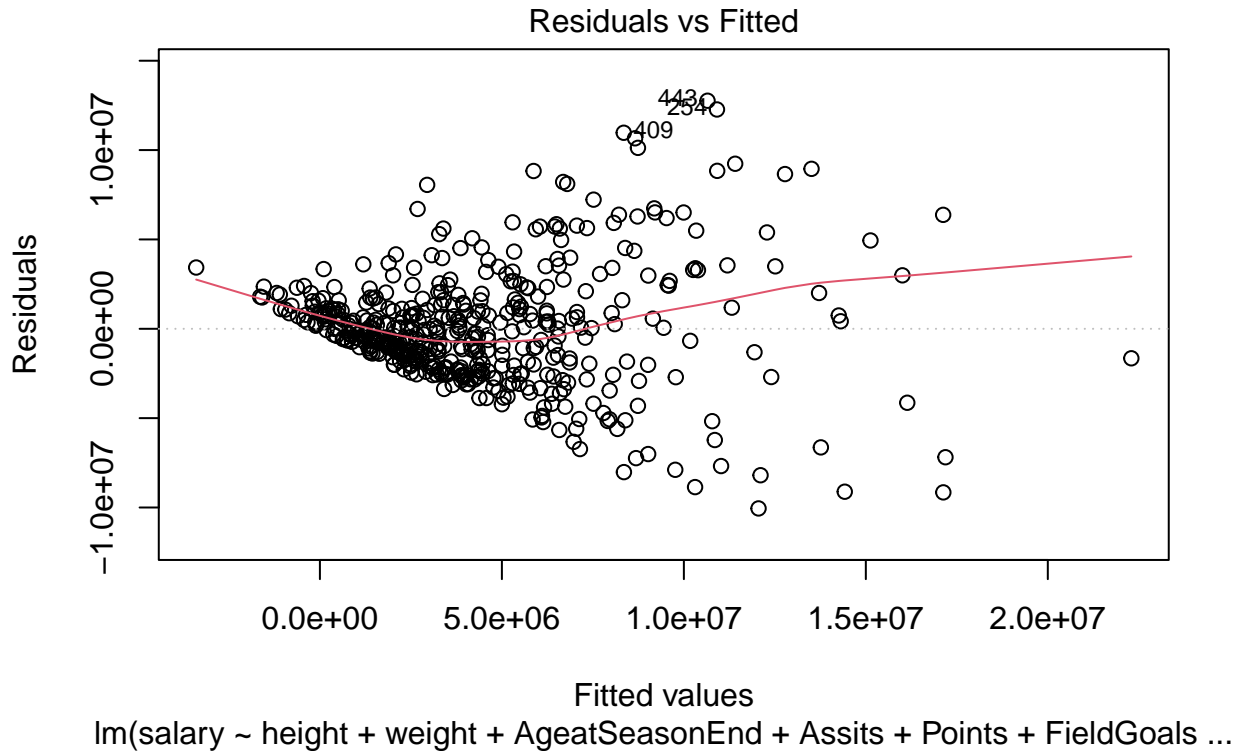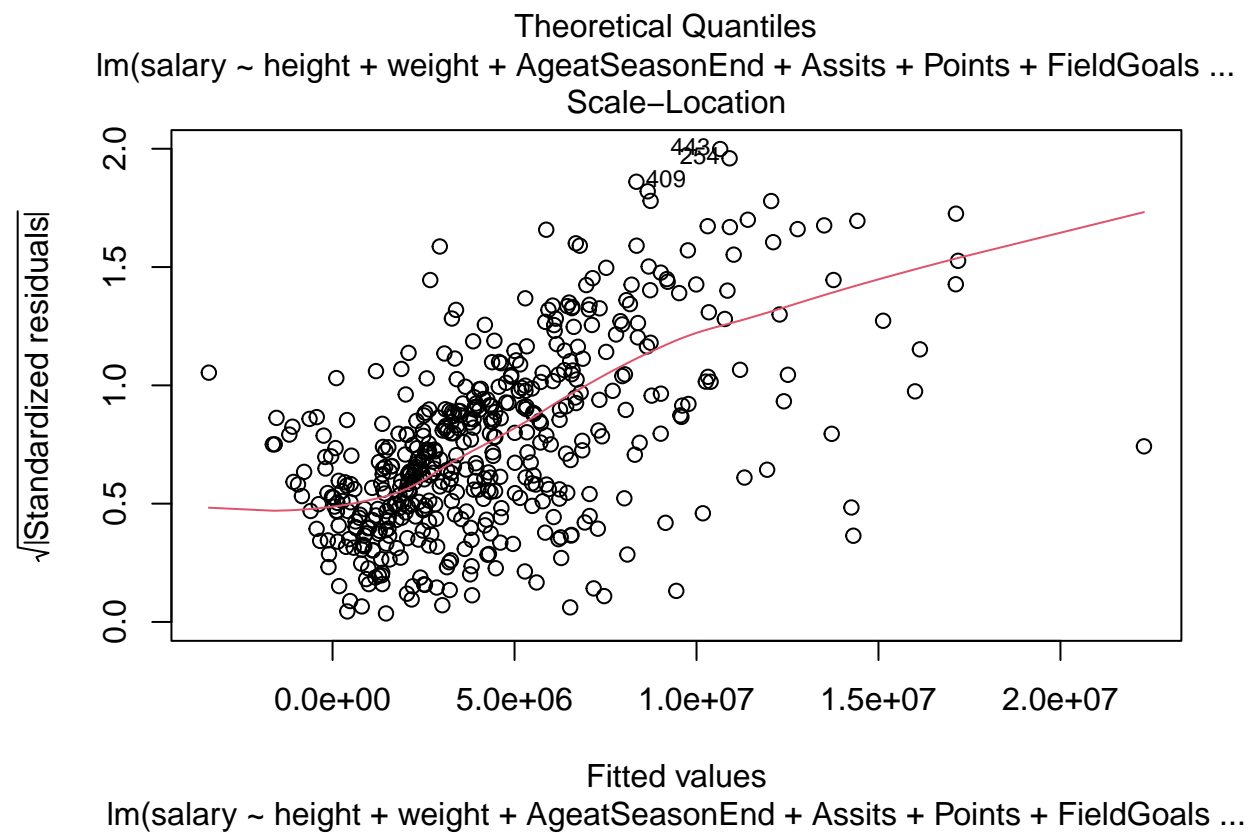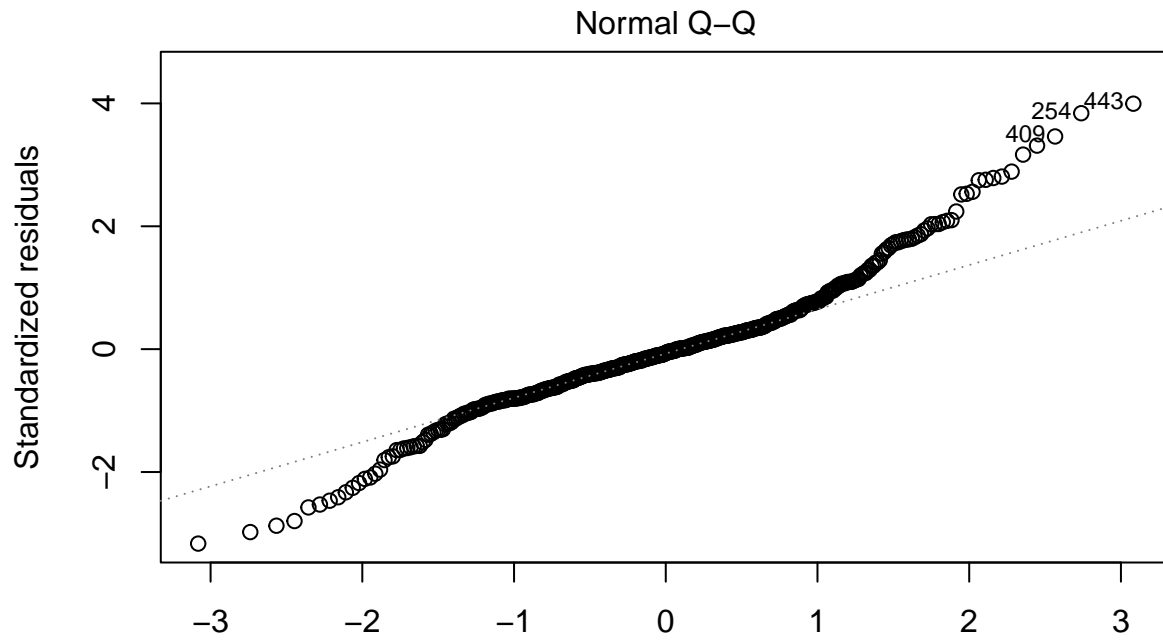
```
plot(model_3_forwardsel_param)
```


Residuals vs Fitted

lm(salary ~ WinShares + Points + weight + Assits)

Normal Q–Q

254 443
170

Standardized residuals

Theoretical Quantiles
lm(salary ~ WinShares + Points + weight + Assits)

Scale–Location

254 443
170

√|Standardized residuals|

Fitted values
lm(salary ~ WinShares + Points + weight + Assits)

Residuals vs Leverage

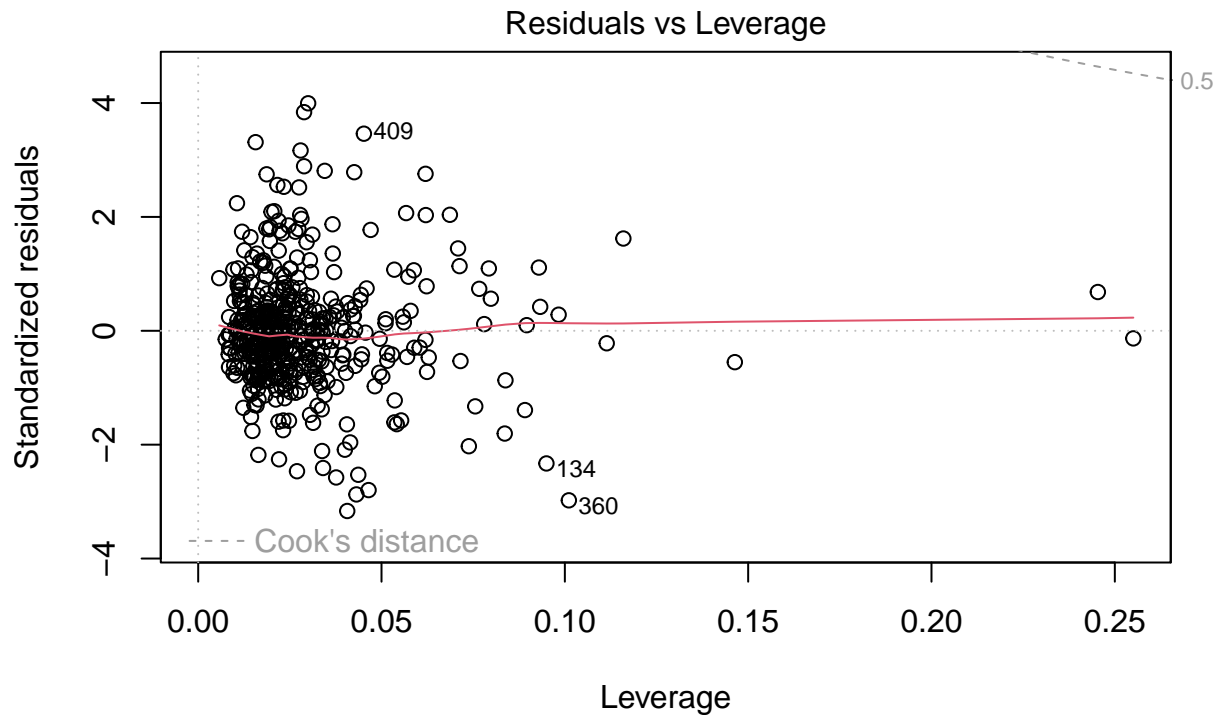lm(salary ~ WinShares + Points + weight + Assits)
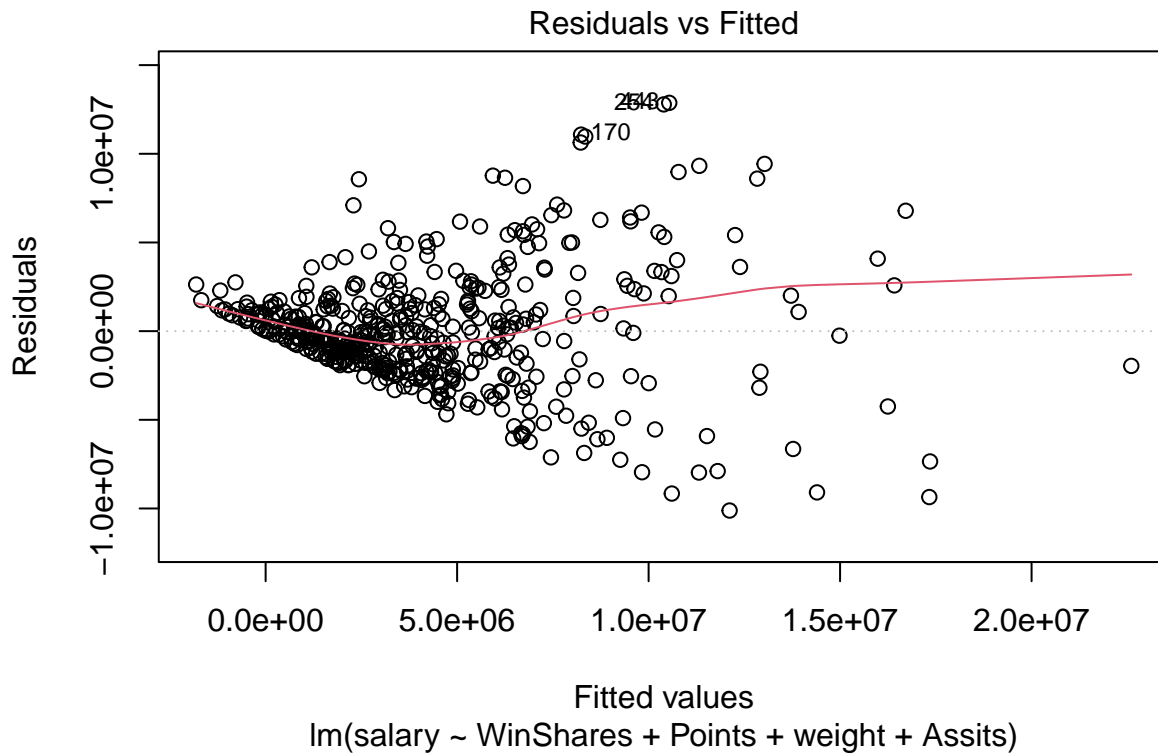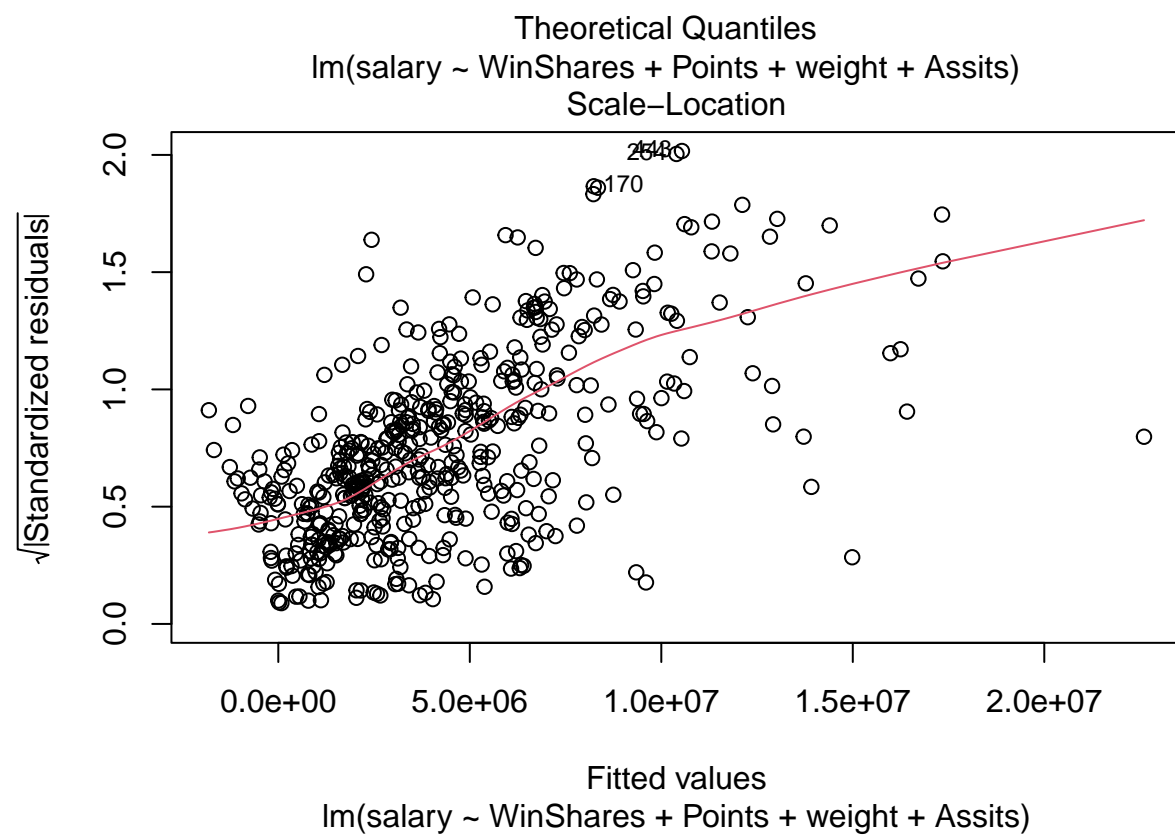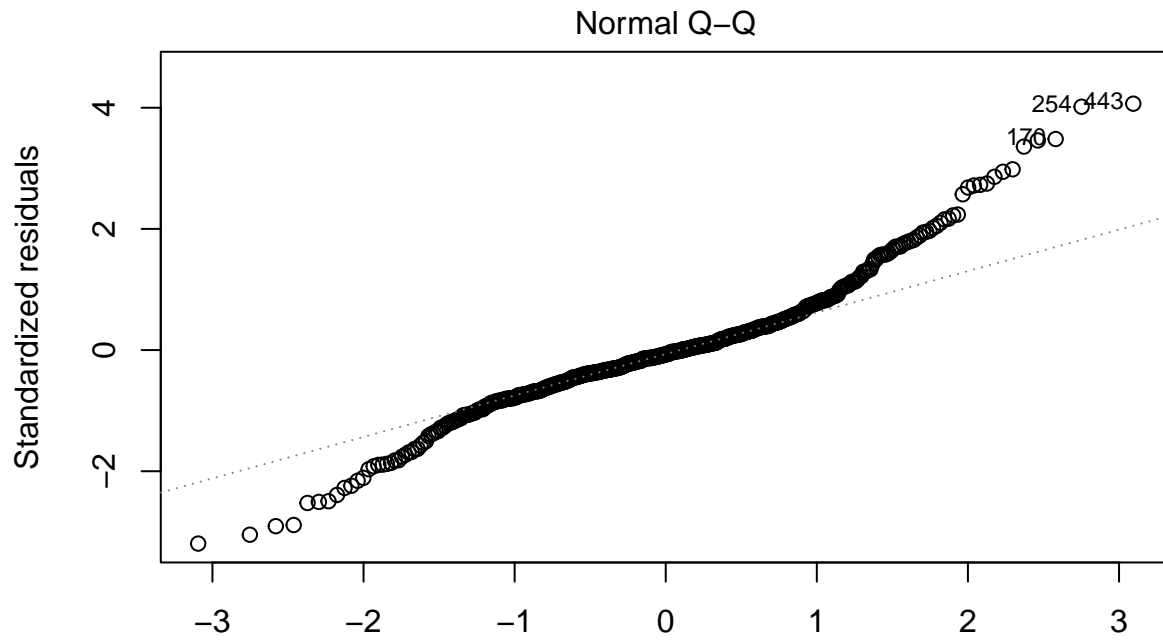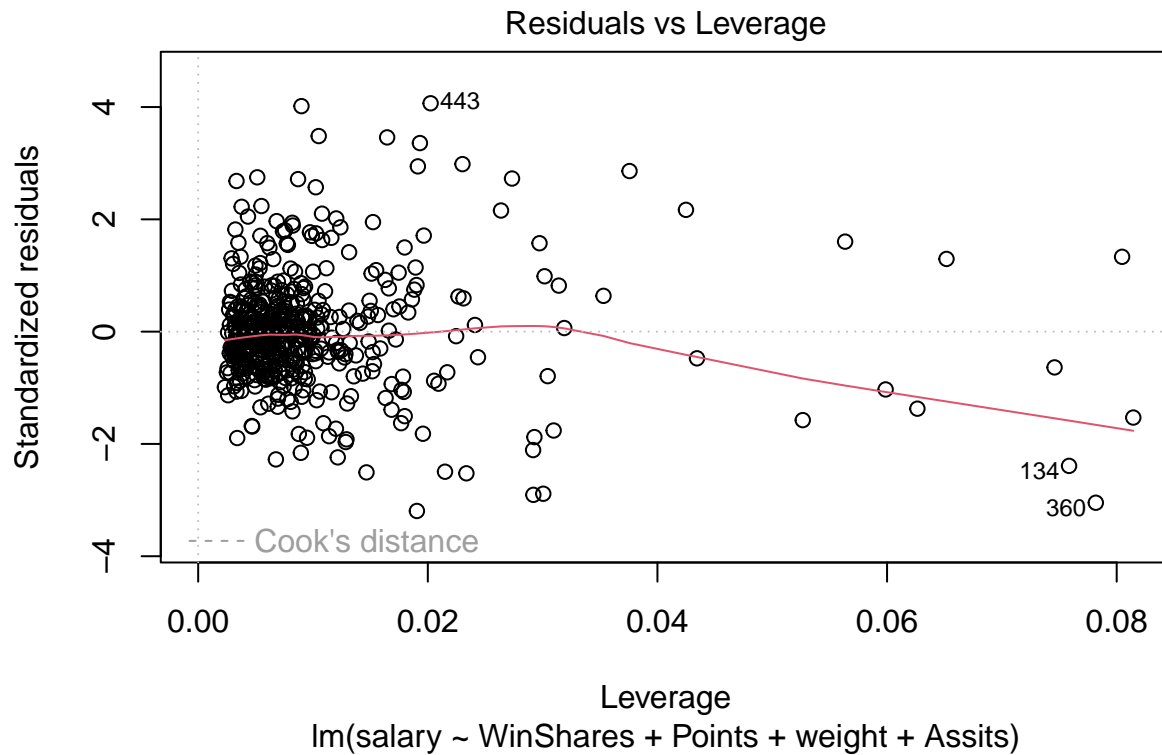
```
model_6_back_param = lm(salary ~ height + weight + AgeatSeasonEnd + Assits + Points +
    FieldGoals + FieldGoals3 + FreeThrows + Games + PlayerEfficiencyRating +
    TotalRebounds + WinShares + effectiveFieldGoal, data=df_2015)
summary(model_6_back_param)
```

```
##
## Call:
## lm(formula = salary ~ height + weight + AgeatSeasonEnd + Assits +
##     Points + FieldGoals + FieldGoals3 + FreeThrows + Games +
##     PlayerEfficiencyRating + TotalRebounds + WinShares + effectiveFieldGoal,
##     data = df_2015)
##
## Residuals:
##       Min       1Q    Median       3Q       Max
## -10051962  -1778744   -212429   1316751  12760448
##
## Coefficients:
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)            -8952758.2  6123288.4  -1.462  0.14438
## height                    24622.7    34565.5   0.712  0.47660
## weight                    30529.8    11134.3   2.742  0.00634 **
## AgeatSeasonEnd            -6916.7    54981.0  -0.126  0.89994
## Assits                   511111.8   156310.3   3.270  0.00115 **
## Points                   350515.0    70028.5   5.005 7.89e-07 ***
## FieldGoals               101794.7    77245.3   1.318  0.18821
## FieldGoals3               -8190.7    17173.4  -0.477  0.63362
## FreeThrows               -18393.6    21860.3  -0.841  0.40054
## Games                       862.9     1079.1   0.800  0.42429
## PlayerEfficiencyRating   -96131.5    97351.1  -0.987  0.32392
## TotalRebounds           -109376.4   139816.9  -0.782  0.43444
```

```
## WinShares                    46540.8     9878.5   4.711 3.24e-06 ***
## effectiveFieldGoal        -111047.0    64595.8  -1.719  0.08625 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3243000 on 472 degrees of freedom
##   (21 observations deleted due to missingness)
## Multiple R-squared:  0.5491, Adjusted R-squared:  0.5367
## F-statistic: 44.21 on 13 and 472 DF,  p-value: < 2.2e-16
```

```
plot(model_6_back_param)
```


Residuals vs Fitted

Fitted values
lm(salary ~ height + weight + AgeatSeasonEnd + Assits + Points + FieldGoals ...

Normal Q-Q

Standardized residuals

Theoretical Quantiles

lm(salary ~ height + weight + AgeatSeasonEnd + Assits + Points + FieldGoals ...

Scale-Location

√|Standardized residuals|

Fitted values

lm(salary ~ height + weight + AgeatSeasonEnd + Assits + Points + FieldGoals ...

Residuals vs Leverage

lm(salary ~ height + weight + AgeatSeasonEnd + Assits + Points + FieldGoals ...

```
#The frequent positions with the positions which are used in categorical variables
df_2015_frequentpos <- df_2015 %>% filter(position %in% c('Point Guard','Center','Shooting Guard','Powe

#Best model

lambda=0.222
model_9 = lm(((salary^lambda-1)/lambda)~ ., data = df_2015_frequentpos)
plot(model_9)
```

Residuals vs Fitted

Residuals

191 211

115

Fitted values
lm((((salary^lambda − 1)/lambda) ~ .)

Normal Q−Q

Standardized residuals

211 191

115

Theoretical Quantiles
lm((((salary^lambda − 1)/lambda) ~ .)

Scale−Location

Fitted values
lm(((salary^lambda − 1)/lambda) ~ .)

Residuals vs Leverage

Leverage
lm(((salary^lambda − 1)/lambda) ~ .)
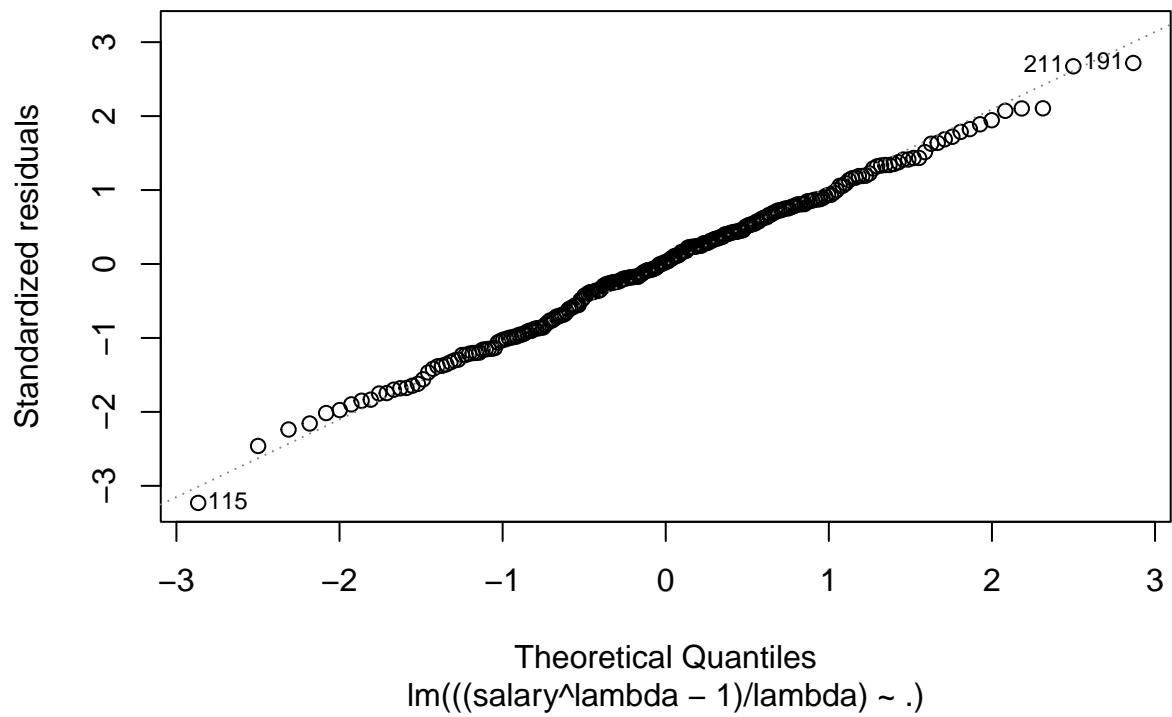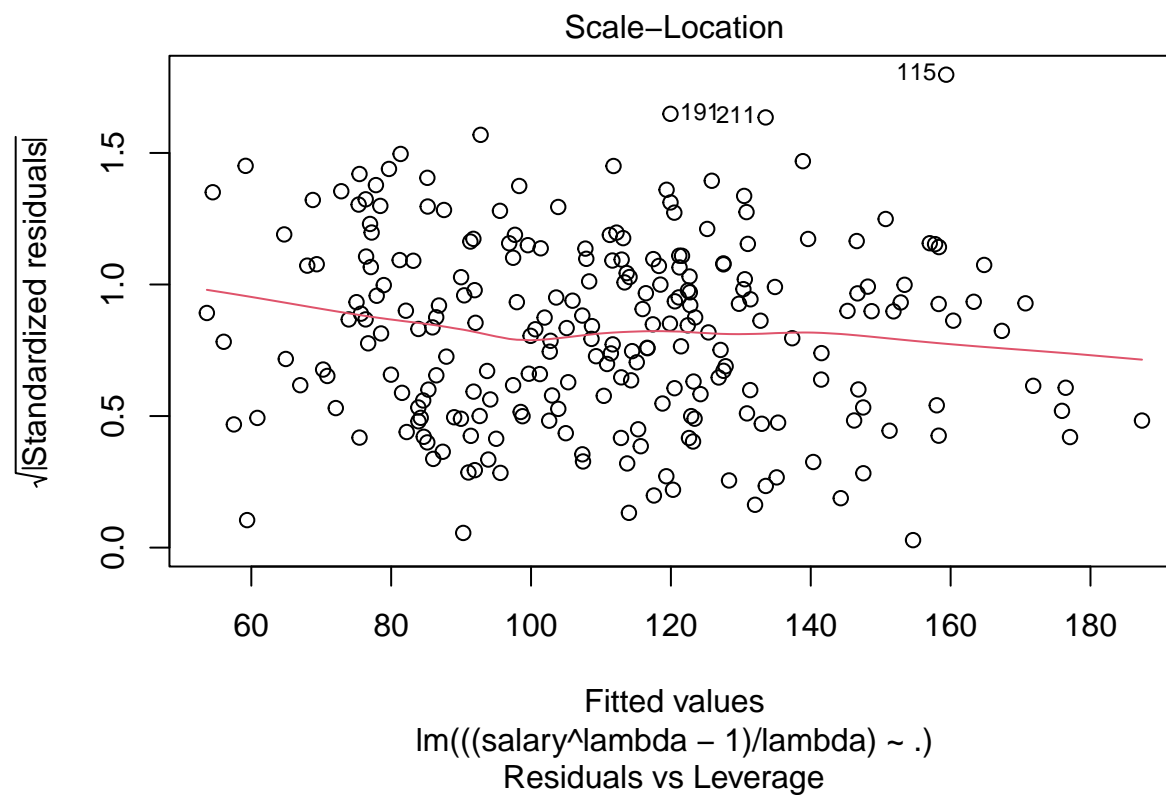
```
summary(model_9)
```

```
##
## Call:
## lm(formula = ((salary^lambda - 1)/lambda) ~ ., data = df_2015_frequentpos)
##
## Residuals:
```

```
##      Min     1Q  Median     3Q     Max
## -58.829 -13.122   0.498  12.693  51.265
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)               -132.83004   89.27780  -1.488  0.13843
## weight                       0.35466    0.13455   2.636  0.00908 **
## height                       0.82186    0.42770   1.922  0.05613 .
## AgeatSeasonEnd              -0.92634    0.52238  -1.773  0.07775 .
## teamBoston Celtics           3.07897   10.34517   0.298  0.76631
## teamBrooklyn Nets            4.45225   10.95970   0.406  0.68502
## teamCharlotte Hornets        6.71211   10.41012   0.645  0.51984
## teamChicago Bulls           13.23323   10.91515   1.212  0.22685
## teamCleveland Cavaliers     -2.96653   14.30500  -0.207  0.83593
## teamDallas Mavericks        -4.48047   10.17583  -0.440  0.66021
## teamDenver Nuggets          -3.98848    9.94476  -0.401  0.68882
## teamDetroit Pistons         -4.04575    9.84494  -0.411  0.68157
## teamGolden State Warriors  -14.74037   12.20719  -1.208  0.22871
## teamHouston Rockets          8.27029   10.89706   0.759  0.44881
## teamIndiana Pacers           7.02731   10.92677   0.643  0.52090
## teamLos Angeles Clippers     3.13382   12.30074   0.255  0.79917
## teamLos Angeles Lakers     -21.43954   10.44050  -2.053  0.04137 *
## teamMemphis Grizzlies       -3.63207   10.30776  -0.352  0.72495
## teamMiami Heat              -4.77460   11.46655  -0.416  0.67758
## teamMilwaukee Bucks         -4.19549   10.77426  -0.389  0.69741
## teamMinnesota Timberwolves  15.87846   10.84469   1.464  0.14477
## teamNew Orleans Pelicans    10.80935   11.91700   0.907  0.36551
## teamNew York Knicks         -2.59524   11.01223  -0.236  0.81394
## teamOklahoma City Thunder   -3.85270   10.21057  -0.377  0.70635
## teamOrlando Magic          -10.61259   10.36050  -1.024  0.30696
## teamPhiladelphia 76ers      -3.48873    9.69157  -0.360  0.71926
## teamPhoenix Suns            -4.03589   10.14812  -0.398  0.69129
## teamPortland Trail Blazers  -1.65642   10.30483  -0.161  0.87246
## teamSacramento Kings         2.32699   10.35375   0.225  0.82241
## teamSan Antonio Spurs      -10.27857   10.42513  -0.986  0.32540
## teamToronto Raptors          2.16126   10.12165   0.214  0.83114
## teamUtah Jazz               -0.74961    9.91638  -0.076  0.93982
## teamWashington Wizards       5.63435   12.03312   0.468  0.64014
## Assits                       4.58091    1.70859   2.681  0.00797 **
## FieldGoals                   0.37093    0.73859   0.502  0.61609
## FieldGoals3                  0.07032    0.14866   0.473  0.63675
## positionPoint Guard         18.77619   14.69415   1.278  0.20285
## positionPower Forward        5.06605    5.89606   0.859  0.39128
## positionShooting Guard      21.46642   11.35113   1.891  0.06011 .
## positionSmall Forward        6.87123    8.80708   0.780  0.43623
## shootsRight                 -5.97081    5.78591  -1.032  0.30338
## FreeThrows                  -0.04965    0.18908  -0.263  0.79316
## Games                        0.06312    0.01092   5.780 2.96e-08 ***
## PlayerEfficiencyRating       0.42135    0.84236   0.500  0.61750
## TotalRebounds               -1.84161    1.41659  -1.300  0.19514
## WinShares                    0.11491    0.12672   0.907  0.36565
## effectiveFieldGoal          -0.75999    0.66432  -1.144  0.25404
## Points                       0.91238    0.70671   1.291  0.19824
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 20.41 on 193 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.6946, Adjusted R-squared:  0.6202
## F-statistic: 9.339 on 47 and 193 DF,  p-value: < 2.2e-16
```
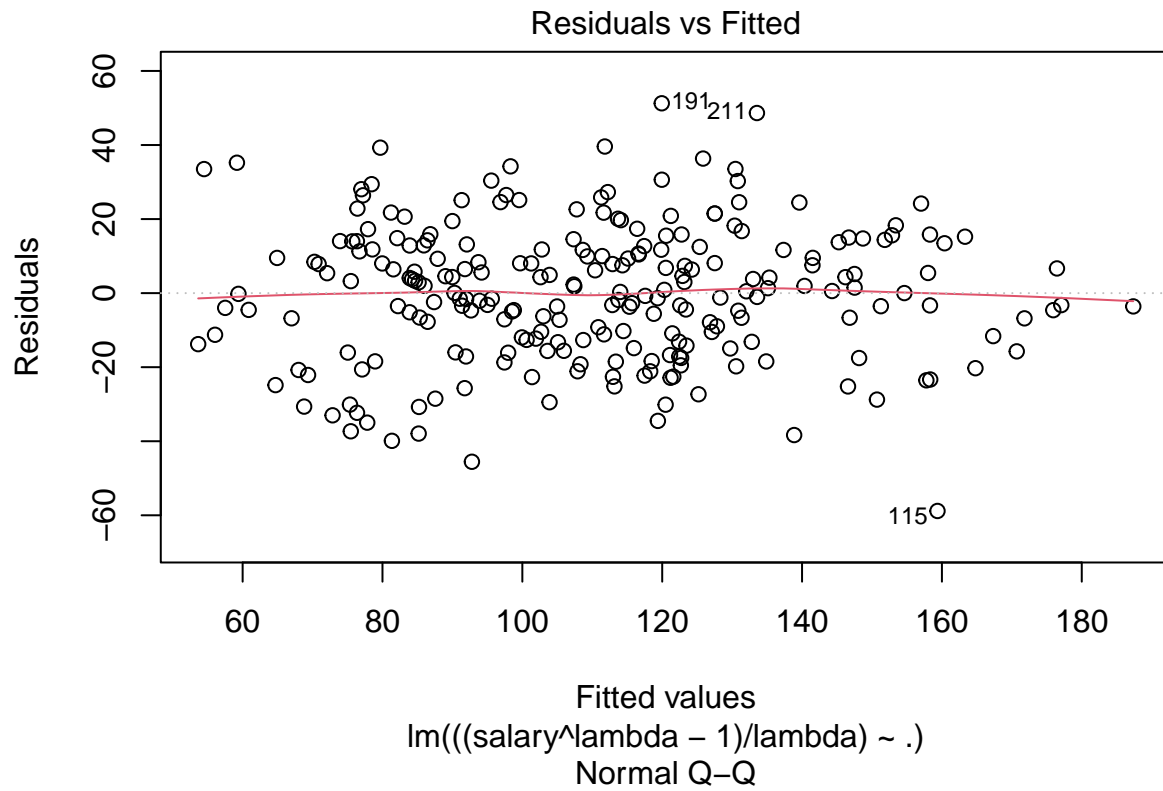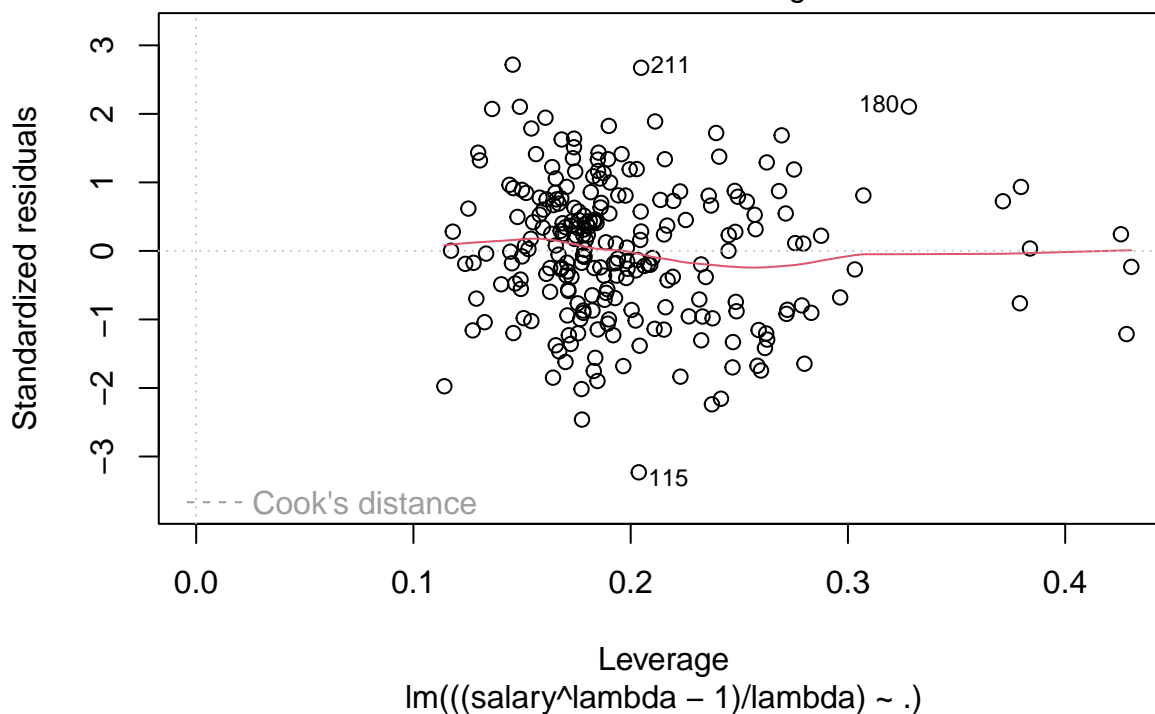
```
z = experimentwithseason %>% separate_rows(position, sep = " and ") %>% filter(season_end == 2015)


df_2015_2 = subset(z, season_end == 2015,select = -c(id,team,shoots,position))


names(df_2015_2) = c("height", "weight","season_end", "age_atendofseason","Assits","Points","FieldGoals
```

```
model12 = lm(salary ~ .,df_2015_2)
summary(model12)
```

```
##
## Call:
## lm(formula = salary ~ ., data = df_2015_2)
##
## Residuals:
##      Min      1Q  Median      3Q     Max
## -9119694 -1718428  -100266  1513945 11222725
##
## Coefficients: (1 not defined because of singularities)
##                                                           Estimate
## (Intercept)                                              -14584369
## height                                                       57645
## weight                                                       22710
## season_end                                                      NA
## age_atendofseason                                           -77456
## Assits                                                      483187
## Points                                                      369430
## FieldGoals                                                   70654
## FieldGoals3                                                 -22206
## FreeThrows                                                  -24833
## Games                                                         1670
## PlayerEfficiencyRating                                      -84910
## TotalRebounds                                              -101392
## WinShares                                                    40487
## effectiveFieldGoal                                          -64282
## teamBoston Celtics                                         1357526
## teamBrooklyn Nets                                          3357102
## teamCharlotte Hornets                                      2062915
## teamChicago Bulls                                          -516108
## teamCleveland Cavaliers                                     274527
## teamDallas Mavericks                                       -381299
## teamDenver Nuggets                                         1080495
## teamDetroit Pistons                                        1141751
## teamGolden State Warriors                                  1136146
## teamHouston Rockets                                         887435
## teamIndiana Pacers                                         2400370
## teamLos Angeles Clippers                                    300378
## teamLos Angeles Lakers                                      432601
## teamMemphis Grizzlies                                      1360780
```

```
## teamMiami Heat                                                                 1522489
## teamMilwaukee Bucks                                                             385799
## teamMinnesota Timberwolves                                                      219696
## teamNew Orleans Pelicans                                                       1939358
## teamNew York Knicks                                                            3172179
## teamOklahoma City Thunder                                                      1167715
## teamOrlando Magic                                                              -461167
## teamPhiladelphia 76ers                                                          447138
## teamPhoenix Suns                                                               1057925
## teamPortland Trail Blazers                                                     1844400
## teamSacramento Kings                                                           1873972
## teamSan Antonio Spurs                                                           519918
## teamToronto Raptors                                                            1349727
## teamUtah Jazz                                                                  2427333
## teamWashington Wizards                                                          549716
## shootsLeft Right                                                               -560171
## shootsRight                                                                     54803
## positionCenter and Power Forward                                              1131409
## positionCenter and Small Forward and Power Forward                            2191904
## positionPoint Guard                                                           1663144
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard    -6996961
## positionPoint Guard and Shooting Guard                                         308486
## positionPoint Guard and Small Forward and Shooting Guard                       972526
## positionPower Forward                                                          848334
## positionPower Forward and Center                                              1427917
## positionPower Forward and Center and Small Forward                            3396577
## positionPower Forward and Shooting Guard                                      1893405
## positionPower Forward and Small Forward                                          -1224
## positionPower Forward and Small Forward and Shooting Guard                    3926981
## positionShooting Guard                                                        1069874
## positionShooting Guard and Point Guard                                        1135866
## positionShooting Guard and Small Forward                                      1146510
## positionShooting Guard and Small Forward and Point Guard                      -285032
## positionShooting Guard and Small Forward and Power Forward                    1341743
## positionSmall Forward                                                          558433
## positionSmall Forward and Center and Power Forward                              83013
## positionSmall Forward and Power Forward                                         458591
## positionSmall Forward and Power Forward and Shooting Guard                    1470466
## positionSmall Forward and Shooting Guard                                       874792
## positionSmall Forward and Shooting Guard and Point Guard                       863749
## positionSmall Forward and Shooting Guard and Power Forward                    2553368
##                                                                             Std. Error
## (Intercept)                                                                   8248654
## height                                                                          35457
## weight                                                                          10242
## season_end                                                                         NA
## age_atendofseason                                                               45842
## Assits                                                                         152037
## Points                                                                          66006
## FieldGoals                                                                      68558
## FieldGoals3                                                                     16203
## FreeThrows                                                                      20204
## Games                                                                             930
## PlayerEfficiencyRating                                                          88607
```

```
## TotalRebounds                                                          122545
## WinShares                                                                 8297
## effectiveFieldGoal                                                       57994
## teamBoston Celtics                                                       929827
## teamBrooklyn Nets                                                        993404
## teamCharlotte Hornets                                                    910563
## teamChicago Bulls                                                        931488
## teamCleveland Cavaliers                                                  968088
## teamDallas Mavericks                                                     911543
## teamDenver Nuggets                                                       940630
## teamDetroit Pistons                                                     1033072
## teamGolden State Warriors                                                963813
## teamHouston Rockets                                                      898581
## teamIndiana Pacers                                                       948872
## teamLos Angeles Clippers                                                 909151
## teamLos Angeles Lakers                                                   921648
## teamMemphis Grizzlies                                                    939363
## teamMiami Heat                                                           923852
## teamMilwaukee Bucks                                                      962505
## teamMinnesota Timberwolves                                              1030929
## teamNew Orleans Pelicans                                                 918188
## teamNew York Knicks                                                      951683
## teamOklahoma City Thunder                                                975496
## teamOrlando Magic                                                        899843
## teamPhiladelphia 76ers                                                   874396
## teamPhoenix Suns                                                         860598
## teamPortland Trail Blazers                                               943542
## teamSacramento Kings                                                     963877
## teamSan Antonio Spurs                                                    977253
## teamToronto Raptors                                                      955243
## teamUtah Jazz                                                            972653
## teamWashington Wizards                                                   918054
## shootsLeft Right                                                        2509294
## shootsRight                                                              431447
## positionCenter and Power Forward                                         646971
## positionCenter and Small Forward and Power Forward                      2121012
## positionPoint Guard                                                     1433728
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard 1894643
## positionPoint Guard and Shooting Guard                                  1272423
## positionPoint Guard and Small Forward and Shooting Guard                2283923
## positionPower Forward                                                    773648
## positionPower Forward and Center                                         617361
## positionPower Forward and Center and Small Forward                      1558115
## positionPower Forward and Shooting Guard                                2548195
## positionPower Forward and Small Forward                                  870762
## positionPower Forward and Small Forward and Shooting Guard              2242901
## positionShooting Guard                                                  1164823
## positionShooting Guard and Point Guard                                  1262714
## positionShooting Guard and Small Forward                                1019533
## positionShooting Guard and Small Forward and Point Guard                1358436
## positionShooting Guard and Small Forward and Power Forward              1705424
## positionSmall Forward                                                    969850
## positionSmall Forward and Center and Power Forward                      1191309
## positionSmall Forward and Power Forward                                  874016
```

```
## positionSmall Forward and Power Forward and Shooting Guard            1710136
## positionSmall Forward and Shooting Guard                              1016294
## positionSmall Forward and Shooting Guard and Point Guard              1693112
## positionSmall Forward and Shooting Guard and Power Forward            1279504
##                                                                       t value
## (Intercept)                                                            -1.768
## height                                                                  1.626
## weight                                                                  2.217
## season_end                                                                 NA
## age_atendofseason                                                      -1.690
## Assits                                                                  3.178
## Points                                                                  5.597
## FieldGoals                                                              1.031
## FieldGoals3                                                            -1.371
## FreeThrows                                                             -1.229
## Games                                                                   1.796
## PlayerEfficiencyRating                                                 -0.958
## TotalRebounds                                                          -0.827
## WinShares                                                               4.880
## effectiveFieldGoal                                                     -1.108
## teamBoston Celtics                                                      1.460
## teamBrooklyn Nets                                                       3.379
## teamCharlotte Hornets                                                   2.266
## teamChicago Bulls                                                      -0.554
## teamCleveland Cavaliers                                                 0.284
## teamDallas Mavericks                                                   -0.418
## teamDenver Nuggets                                                      1.149
## teamDetroit Pistons                                                     1.105
## teamGolden State Warriors                                               1.179
## teamHouston Rockets                                                     0.988
## teamIndiana Pacers                                                      2.530
## teamLos Angeles Clippers                                                0.330
## teamLos Angeles Lakers                                                  0.469
## teamMemphis Grizzlies                                                   1.449
## teamMiami Heat                                                          1.648
## teamMilwaukee Bucks                                                     0.401
## teamMinnesota Timberwolves                                              0.213
## teamNew Orleans Pelicans                                                2.112
## teamNew York Knicks                                                     3.333
## teamOklahoma City Thunder                                               1.197
## teamOrlando Magic                                                      -0.512
## teamPhiladelphia 76ers                                                  0.511
## teamPhoenix Suns                                                        1.229
## teamPortland Trail Blazers                                              1.955
## teamSacramento Kings                                                    1.944
## teamSan Antonio Spurs                                                   0.532
## teamToronto Raptors                                                     1.413
## teamUtah Jazz                                                           2.496
## teamWashington Wizards                                                  0.599
## shootsLeft Right                                                       -0.223
## shootsRight                                                             0.127
## positionCenter and Power Forward                                        1.749
## positionCenter and Small Forward and Power Forward                      1.033
## positionPoint Guard                                                     1.160
```

```
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard  -3.693
## positionPoint Guard and Shooting Guard                                        0.242
## positionPoint Guard and Small Forward and Shooting Guard                       0.426
## positionPower Forward                                                          1.097
## positionPower Forward and Center                                               2.313
## positionPower Forward and Center and Small Forward                             2.180
## positionPower Forward and Shooting Guard                                       0.743
## positionPower Forward and Small Forward                                       -0.001
## positionPower Forward and Small Forward and Shooting Guard                     1.751
## positionShooting Guard                                                         0.918
## positionShooting Guard and Point Guard                                         0.900
## positionShooting Guard and Small Forward                                       1.125
## positionShooting Guard and Small Forward and Point Guard                      -0.210
## positionShooting Guard and Small Forward and Power Forward                     0.787
## positionSmall Forward                                                          0.576
## positionSmall Forward and Center and Power Forward                             0.070
## positionSmall Forward and Power Forward                                        0.525
## positionSmall Forward and Power Forward and Shooting Guard                     0.860
## positionSmall Forward and Shooting Guard                                       0.861
## positionSmall Forward and Shooting Guard and Point Guard                       0.510
## positionSmall Forward and Shooting Guard and Power Forward                     1.996
##                                                                             Pr(>|t|)
## (Intercept)                                                                 0.077460
## height                                                                      0.104423
## weight                                                                      0.026906
## season_end                                                                        NA
## age_atendofseason                                                           0.091520
## Assits                                                                      0.001544
## Points                                                                      3.08e-08
## FieldGoals                                                                  0.303078
## FieldGoals3                                                                 0.170944
## FreeThrows                                                                  0.219425
## Games                                                                       0.072918
## PlayerEfficiencyRating                                                      0.338239
## TotalRebounds                                                               0.408285
## WinShares                                                                   1.30e-06
## effectiveFieldGoal                                                          0.268039
## teamBoston Celtics                                                          0.144723
## teamBrooklyn Nets                                                           0.000765
## teamCharlotte Hornets                                                       0.023769
## teamChicago Bulls                                                           0.579700
## teamCleveland Cavaliers                                                     0.776815
## teamDallas Mavericks                                                        0.675850
## teamDenver Nuggets                                                          0.251056
## teamDetroit Pistons                                                         0.269434
## teamGolden State Warriors                                                   0.238857
## teamHouston Rockets                                                         0.323675
## teamIndiana Pacers                                                          0.011623
## teamLos Angeles Clippers                                                    0.741196
## teamLos Angeles Lakers                                                      0.638939
## teamMemphis Grizzlies                                                       0.147870
## teamMiami Heat                                                              0.099784
## teamMilwaukee Bucks                                                         0.688663
## teamMinnesota Timberwolves                                                  0.831304
```

```
## teamNew Orleans Pelicans                                                  0.035009
## teamNew York Knicks                                                       0.000901
## teamOklahoma City Thunder                                                 0.231673
## teamOrlando Magic                                                         0.608457
## teamPhiladelphia 76ers                                                    0.609247
## teamPhoenix Suns                                                          0.219356
## teamPortland Trail Blazers                                                0.050989
## teamSacramento Kings                                                      0.052252
## teamSan Antonio Spurs                                                     0.594873
## teamToronto Raptors                                                       0.158088
## teamUtah Jazz                                                             0.012793
## teamWashington Wizards                                                    0.549501
## shootsLeft Right                                                          0.823412
## shootsRight                                                               0.898959
## positionCenter and Power Forward                                          0.080746
## positionCenter and Small Forward and Power Forward                        0.301745
## positionPoint Guard                                                       0.246419
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard 0.000238
## positionPoint Guard and Shooting Guard                                    0.808507
## positionPoint Guard and Small Forward and Shooting Guard                  0.670368
## positionPower Forward                                                     0.273202
## positionPower Forward and Center                                          0.021001
## positionPower Forward and Center and Small Forward                        0.029579
## positionPower Forward and Shooting Guard                                  0.457696
## positionPower Forward and Small Forward                                   0.998879
## positionPower Forward and Small Forward and Shooting Guard                0.080388
## positionShooting Guard                                                    0.358665
## positionShooting Guard and Point Guard                                    0.368657
## positionShooting Guard and Small Forward                                  0.261149
## positionShooting Guard and Small Forward and Point Guard                  0.833863
## positionShooting Guard and Small Forward and Power Forward                0.431681
## positionSmall Forward                                                     0.564931
## positionSmall Forward and Center and Power Forward                        0.944466
## positionSmall Forward and Power Forward                                   0.599954
## positionSmall Forward and Power Forward and Shooting Guard                0.390150
## positionSmall Forward and Shooting Guard                                  0.389647
## positionSmall Forward and Shooting Guard and Point Guard                  0.610096
## positionSmall Forward and Shooting Guard and Power Forward                0.046346
##
## (Intercept)                                                              .
## height
## weight                                                                   *
## season_end
## age_atendofseason                                                        .
## Assits                                                                   **
## Points                                                                   ***
## FieldGoals
## FieldGoals3
## FreeThrows
## Games                                                                    .
## PlayerEfficiencyRating
## TotalRebounds
## WinShares                                                                ***
## effectiveFieldGoal
```

```
## teamBoston Celtics
## teamBrooklyn Nets                                                    ***
## teamCharlotte Hornets                                                *
## teamChicago Bulls
## teamCleveland Cavaliers
## teamDallas Mavericks
## teamDenver Nuggets
## teamDetroit Pistons
## teamGolden State Warriors
## teamHouston Rockets
## teamIndiana Pacers                                                   *
## teamLos Angeles Clippers
## teamLos Angeles Lakers
## teamMemphis Grizzlies
## teamMiami Heat                                                       .
## teamMilwaukee Bucks
## teamMinnesota Timberwolves
## teamNew Orleans Pelicans                                             *
## teamNew York Knicks                                                  ***
## teamOklahoma City Thunder
## teamOrlando Magic
## teamPhiladelphia 76ers
## teamPhoenix Suns
## teamPortland Trail Blazers                                           .
## teamSacramento Kings                                                 .
## teamSan Antonio Spurs
## teamToronto Raptors
## teamUtah Jazz                                                        *
## teamWashington Wizards
## shootsLeft Right
## shootsRight
## positionCenter and Power Forward                                     .
## positionCenter and Small Forward and Power Forward
## positionPoint Guard
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard ***
## positionPoint Guard and Shooting Guard
## positionPoint Guard and Small Forward and Shooting Guard
## positionPower Forward
## positionPower Forward and Center                                     *
## positionPower Forward and Center and Small Forward                   *
## positionPower Forward and Shooting Guard
## positionPower Forward and Small Forward
## positionPower Forward and Small Forward and Shooting Guard           .
## positionShooting Guard
## positionShooting Guard and Point Guard
## positionShooting Guard and Small Forward
## positionShooting Guard and Small Forward and Point Guard
## positionShooting Guard and Small Forward and Power Forward
## positionSmall Forward
## positionSmall Forward and Center and Power Forward
## positionSmall Forward and Power Forward
## positionSmall Forward and Power Forward and Shooting Guard
## positionSmall Forward and Shooting Guard
## positionSmall Forward and Shooting Guard and Point Guard
```
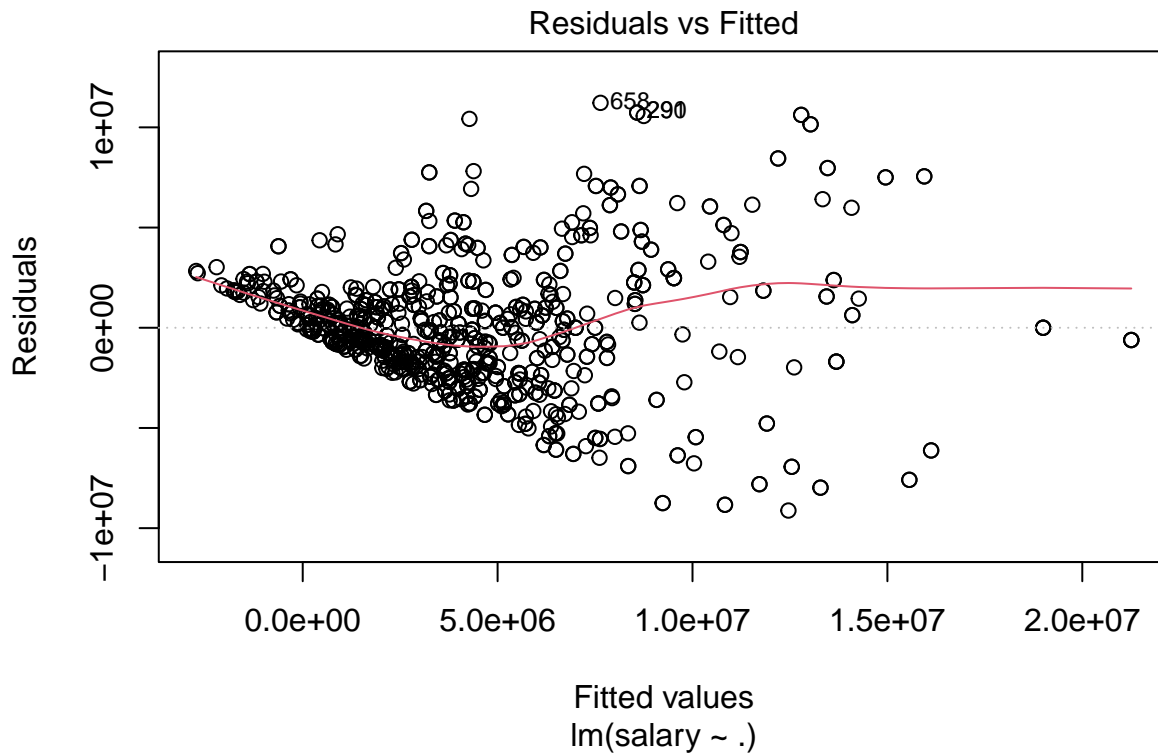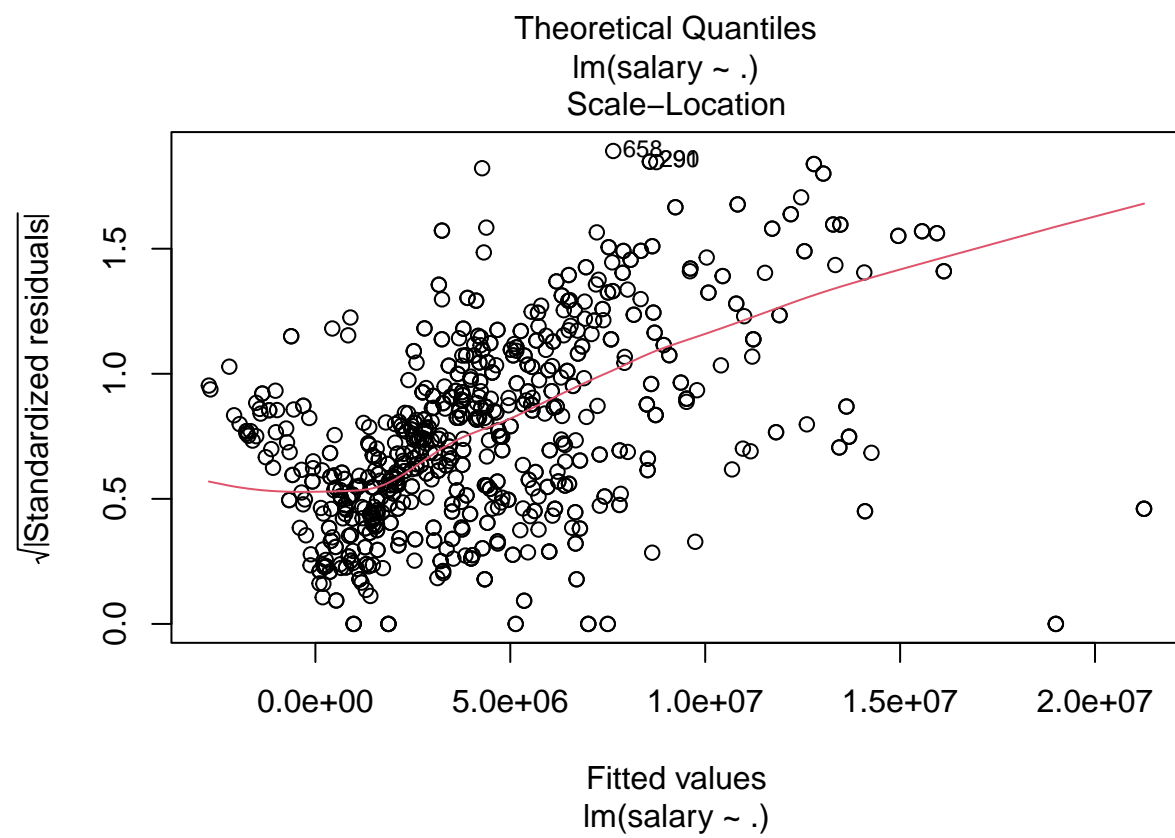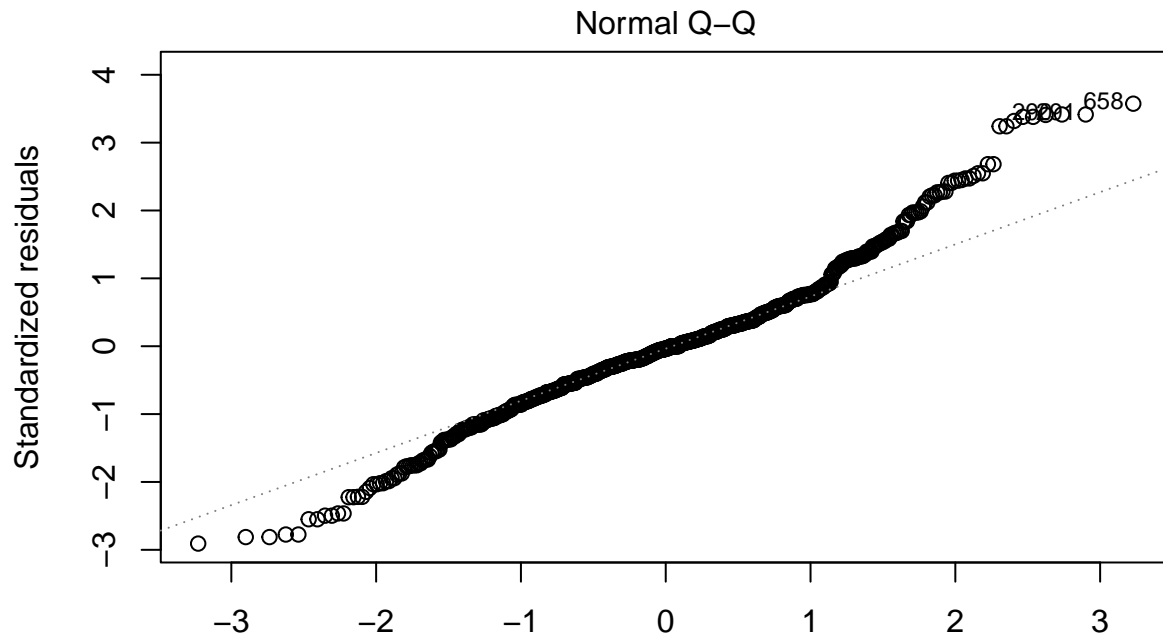
```
## positionSmall Forward and Shooting Guard and Power Forward                          *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3258000 on 736 degrees of freedom
##   (26 observations deleted due to missingness)
## Multiple R-squared:  0.5902, Adjusted R-squared:  0.5524
## F-statistic: 15.59 on 68 and 736 DF,  p-value: < 2.2e-16
```

```
plot(model12)
```

Residuals vs Fitted

Fitted values
lm(salary ~ .)

Normal Q–Q

Standardized residuals

Theoretical Quantiles
lm(salary ~ .)

Scale–Location

√|Standardized residuals|

Fitted values
lm(salary ~ .)

Residuals vs Leverage

lm(salary ~ .)

```
box_cox = boxcox(model1)
```
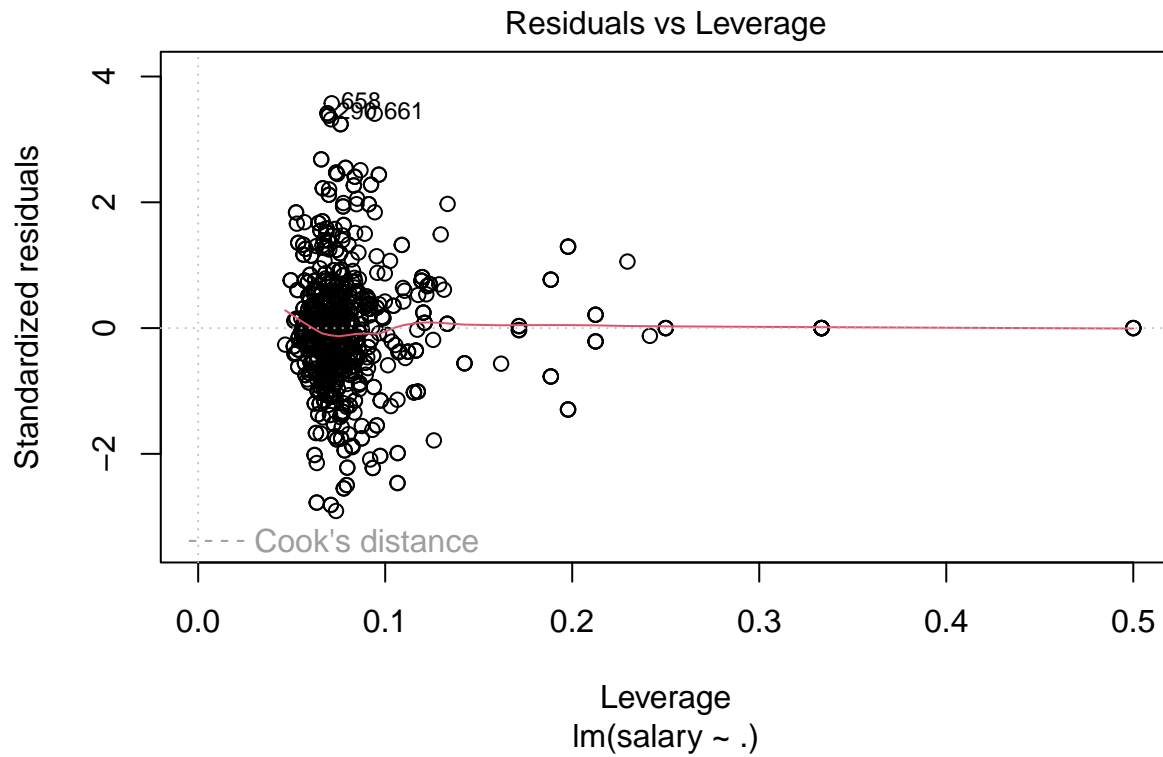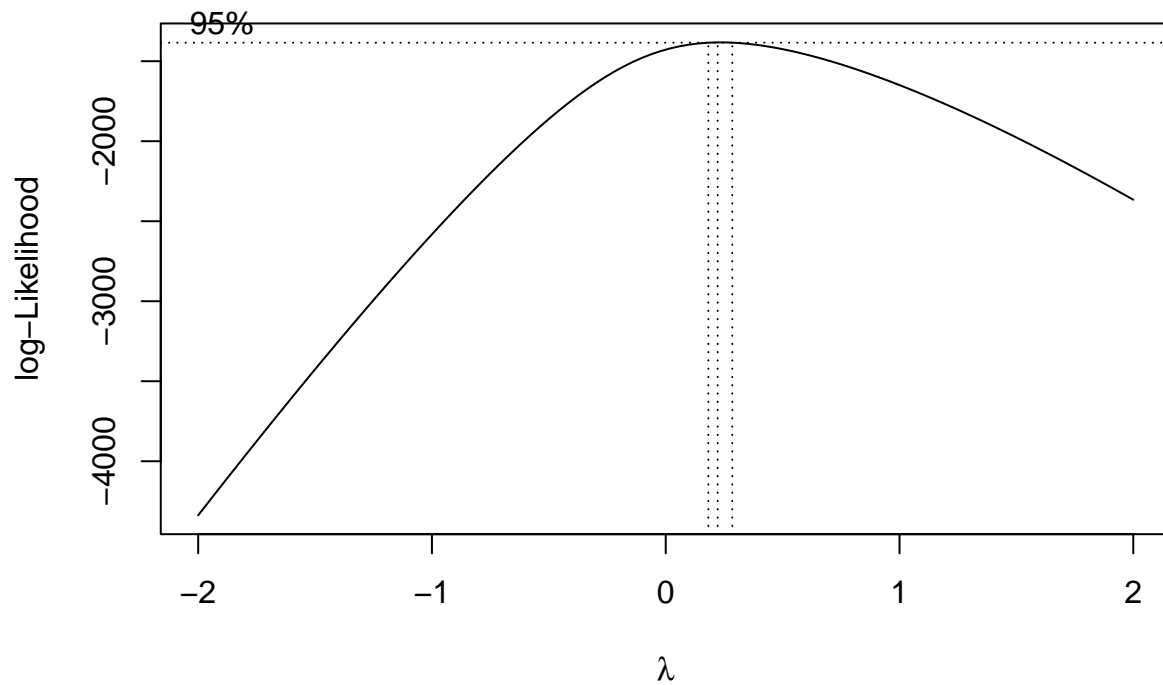


```
lambda= box_cox$x[which.max(box_cox$y)]
lambda
```

```
## [1] 0.2222222
```

```
modeltest2 = lm(((salary^lambda-1)/lambda)~., df_2015_2)
summary(modeltest2)
```

```
## 
## Call:
## lm(formula = ((salary^lambda - 1)/lambda) ~ ., data = df_2015_2)
## 
## Residuals:
##     Min     1Q Median     3Q    Max
## -56.96 -13.61   0.00  15.70  60.23
## 
## Coefficients: (1 not defined because of singularities)
##                                                            Estimate
## (Intercept)                                               -1.180e+02
## height                                                     7.173e-01
## weight                                                     2.518e-01
## season_end                                                        NA
## age_atendofseason                                         -1.326e+00
## Assits                                                     4.924e+00
## Points                                                     1.540e+00
## FieldGoals                                                 2.308e-01
## FieldGoals3                                               -2.335e-01
## FreeThrows                                                -6.684e-02
## Games                                                      6.221e-02
## PlayerEfficiencyRating                                     5.596e-01
## TotalRebounds                                             -7.540e-01
## WinShares                                                 -1.034e-01
## effectiveFieldGoal                                        -1.488e-01
## teamBoston Celtics                                         1.898e+01
## teamBrooklyn Nets                                          1.622e+01
## teamCharlotte Hornets                                      1.675e+01
## teamChicago Bulls                                         -2.274e+00
## teamCleveland Cavaliers                                    1.499e+00
## teamDallas Mavericks                                      -5.661e+00
## teamDenver Nuggets                                         1.046e+01
## teamDetroit Pistons                                        7.959e+00
## teamGolden State Warriors                                  5.213e+00
## teamHouston Rockets                                        7.172e+00
## teamIndiana Pacers                                         1.617e+01
## teamLos Angeles Clippers                                  -3.165e+00
## teamLos Angeles Lakers                                     4.558e-01
## teamMemphis Grizzlies                                      4.243e+00
## teamMiami Heat                                             8.075e+00
## teamMilwaukee Bucks                                        3.849e+00
## teamMinnesota Timberwolves                                 9.027e+00
## teamNew Orleans Pelicans                                   1.178e+01
## teamNew York Knicks                                        1.136e+01
## teamOklahoma City Thunder                                  1.187e+01
## teamOrlando Magic                                          4.537e-01
## teamPhiladelphia 76ers                                     7.483e+00
## teamPhoenix Suns                                           7.768e+00
## teamPortland Trail Blazers                                 1.385e+01
## teamSacramento Kings                                       9.051e+00
## teamSan Antonio Spurs                                      8.141e+00
## teamToronto Raptors                                        1.497e+01
## teamUtah Jazz                                              1.281e+01
## teamWashington Wizards                                     2.168e+00
```

```
## shootsLeft Right                                                                1.058e+01
## shootsRight                                                                      1.919e+00
## positionCenter and Power Forward                                                 1.123e+01
## positionCenter and Small Forward and Power Forward                               1.300e+01
## positionPoint Guard                                                              1.859e+01
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard      -3.761e+01
## positionPoint Guard and Shooting Guard                                           1.034e+01
## positionPoint Guard and Small Forward and Shooting Guard                         1.269e+01
## positionPower Forward                                                            1.124e+01
## positionPower Forward and Center                                                 1.163e+01
## positionPower Forward and Center and Small Forward                               2.181e+01
## positionPower Forward and Shooting Guard                                         4.000e+00
## positionPower Forward and Small Forward                                          2.712e+00
## positionPower Forward and Small Forward and Shooting Guard                       1.678e+01
## positionShooting Guard                                                           1.884e+01
## positionShooting Guard and Point Guard                                           1.387e+01
## positionShooting Guard and Small Forward                                         1.481e+01
## positionShooting Guard and Small Forward and Point Guard                         5.339e+00
## positionShooting Guard and Small Forward and Power Forward                       1.290e+01
## positionSmall Forward                                                            1.006e+01
## positionSmall Forward and Center and Power Forward                               5.057e+00
## positionSmall Forward and Power Forward                                          1.039e+01
## positionSmall Forward and Power Forward and Shooting Guard                       1.811e+01
## positionSmall Forward and Shooting Guard                                         1.287e+01
## positionSmall Forward and Shooting Guard and Point Guard                         5.300e+00
## positionSmall Forward and Shooting Guard and Power Forward                       2.736e+01
##                                                                                 Std. Error
## (Intercept)                                                                      5.582e+01
## height                                                                           2.400e-01
## weight                                                                           6.931e-02
## season_end                                                                              NA
## age_atendofseason                                                                3.102e-01
## Assits                                                                           1.029e+00
## Points                                                                           4.467e-01
## FieldGoals                                                                       4.640e-01
## FieldGoals3                                                                      1.097e-01
## FreeThrows                                                                       1.367e-01
## Games                                                                            6.294e-03
## PlayerEfficiencyRating                                                           5.996e-01
## TotalRebounds                                                                    8.293e-01
## WinShares                                                                        5.615e-02
## effectiveFieldGoal                                                               3.925e-01
## teamBoston Celtics                                                               6.293e+00
## teamBrooklyn Nets                                                                6.723e+00
## teamCharlotte Hornets                                                            6.162e+00
## teamChicago Bulls                                                                6.304e+00
## teamCleveland Cavaliers                                                          6.552e+00
## teamDallas Mavericks                                                             6.169e+00
## teamDenver Nuggets                                                               6.366e+00
## teamDetroit Pistons                                                              6.991e+00
## teamGolden State Warriors                                                        6.523e+00
## teamHouston Rockets                                                              6.081e+00
## teamIndiana Pacers                                                               6.421e+00
## teamLos Angeles Clippers                                                         6.153e+00
```

```
## teamLos Angeles Lakers                                                      6.237e+00
## teamMemphis Grizzlies                                                        6.357e+00
## teamMiami Heat                                                               6.252e+00
## teamMilwaukee Bucks                                                          6.514e+00
## teamMinnesota Timberwolves                                                   6.977e+00
## teamNew Orleans Pelicans                                                     6.214e+00
## teamNew York Knicks                                                          6.440e+00
## teamOklahoma City Thunder                                                    6.602e+00
## teamOrlando Magic                                                            6.090e+00
## teamPhiladelphia 76ers                                                       5.917e+00
## teamPhoenix Suns                                                             5.824e+00
## teamPortland Trail Blazers                                                   6.385e+00
## teamSacramento Kings                                                         6.523e+00
## teamSan Antonio Spurs                                                        6.614e+00
## teamToronto Raptors                                                          6.465e+00
## teamUtah Jazz                                                                6.582e+00
## teamWashington Wizards                                                       6.213e+00
## shootsLeft Right                                                             1.698e+01
## shootsRight                                                                  2.920e+00
## positionCenter and Power Forward                                            4.378e+00
## positionCenter and Small Forward and Power Forward                          1.435e+01
## positionPoint Guard                                                          9.703e+00
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard  1.282e+01
## positionPoint Guard and Shooting Guard                                       8.611e+00
## positionPoint Guard and Small Forward and Shooting Guard                     1.546e+01
## positionPower Forward                                                        5.236e+00
## positionPower Forward and Center                                             4.178e+00
## positionPower Forward and Center and Small Forward                           1.054e+01
## positionPower Forward and Shooting Guard                                     1.724e+01
## positionPower Forward and Small Forward                                      5.893e+00
## positionPower Forward and Small Forward and Shooting Guard                   1.518e+01
## positionShooting Guard                                                       7.883e+00
## positionShooting Guard and Point Guard                                       8.545e+00
## positionShooting Guard and Small Forward                                     6.900e+00
## positionShooting Guard and Small Forward and Point Guard                     9.193e+00
## positionShooting Guard and Small Forward and Power Forward                   1.154e+01
## positionSmall Forward                                                        6.563e+00
## positionSmall Forward and Center and Power Forward                           8.062e+00
## positionSmall Forward and Power Forward                                      5.915e+00
## positionSmall Forward and Power Forward and Shooting Guard                   1.157e+01
## positionSmall Forward and Shooting Guard                                     6.878e+00
## positionSmall Forward and Shooting Guard and Point Guard                     1.146e+01
## positionSmall Forward and Shooting Guard and Power Forward                   8.659e+00
##                                                                             t value
## (Intercept)                                                                  -2.114
## height                                                                        2.989
## weight                                                                        3.633
## season_end                                                                       NA
## age_atendofseason                                                            -4.275
## Assits                                                                        4.786
## Points                                                                        3.448
## FieldGoals                                                                    0.497
## FieldGoals3                                                                  -2.130
## FreeThrows                                                                   -0.489
```

```
## Games                                                                    9.884
## PlayerEfficiencyRating                                                    0.933
## TotalRebounds                                                            -0.909
## WinShares                                                                -1.841
## effectiveFieldGoal                                                       -0.379
## teamBoston Celtics                                                        3.016
## teamBrooklyn Nets                                                         2.412
## teamCharlotte Hornets                                                     2.718
## teamChicago Bulls                                                        -0.361
## teamCleveland Cavaliers                                                   0.229
## teamDallas Mavericks                                                     -0.918
## teamDenver Nuggets                                                        1.643
## teamDetroit Pistons                                                       1.138
## teamGolden State Warriors                                                 0.799
## teamHouston Rockets                                                       1.179
## teamIndiana Pacers                                                        2.518
## teamLos Angeles Clippers                                                 -0.514
## teamLos Angeles Lakers                                                    0.073
## teamMemphis Grizzlies                                                     0.667
## teamMiami Heat                                                            1.291
## teamMilwaukee Bucks                                                       0.591
## teamMinnesota Timberwolves                                               1.294
## teamNew Orleans Pelicans                                                  1.896
## teamNew York Knicks                                                       1.764
## teamOklahoma City Thunder                                                 1.798
## teamOrlando Magic                                                         0.075
## teamPhiladelphia 76ers                                                    1.265
## teamPhoenix Suns                                                          1.334
## teamPortland Trail Blazers                                               2.169
## teamSacramento Kings                                                      1.388
## teamSan Antonio Spurs                                                     1.231
## teamToronto Raptors                                                       2.316
## teamUtah Jazz                                                             1.946
## teamWashington Wizards                                                    0.349
## shootsLeft Right                                                          0.623
## shootsRight                                                               0.657
## positionCenter and Power Forward                                          2.565
## positionCenter and Small Forward and Power Forward                        0.905
## positionPoint Guard                                                       1.916
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard -2.933
## positionPoint Guard and Shooting Guard                                    1.201
## positionPoint Guard and Small Forward and Shooting Guard                  0.821
## positionPower Forward                                                     2.147
## positionPower Forward and Center                                          2.784
## positionPower Forward and Center and Small Forward                        2.068
## positionPower Forward and Shooting Guard                                  0.232
## positionPower Forward and Small Forward                                   0.460
## positionPower Forward and Small Forward and Shooting Guard                1.106
## positionShooting Guard                                                    2.390
## positionShooting Guard and Point Guard                                    1.623
## positionShooting Guard and Small Forward                                  2.147
## positionShooting Guard and Small Forward and Point Guard                  0.581
## positionShooting Guard and Small Forward and Power Forward                1.117
## positionSmall Forward                                                     1.533
```

```
## positionSmall Forward and Center and Power Forward            0.627
## positionSmall Forward and Power Forward                       1.757
## positionSmall Forward and Power Forward and Shooting Guard     1.564
## positionSmall Forward and Shooting Guard                       1.871
## positionSmall Forward and Shooting Guard and Point Guard       0.463
## positionSmall Forward and Shooting Guard and Power Forward     3.159
##                                                                Pr(>|t|)
## (Intercept)                                                    0.034886
## height                                                         0.002888
## weight                                                         0.000299
## season_end                                                           NA
## age_atendofseason                                              2.17e-05
## Assits                                                         2.06e-06
## Points                                                         0.000597
## FieldGoals                                                     0.619024
## FieldGoals3                                                    0.033510
## FreeThrows                                                     0.625100
## Games                                                          < 2e-16
## PlayerEfficiencyRating                                         0.351054
## TotalRebounds                                                  0.363543
## WinShares                                                      0.066003
## effectiveFieldGoal                                             0.704628
## teamBoston Celtics                                             0.002651
## teamBrooklyn Nets                                              0.016089
## teamCharlotte Hornets                                          0.006732
## teamChicago Bulls                                              0.718395
## teamCleveland Cavaliers                                        0.819130
## teamDallas Mavericks                                           0.359122
## teamDenver Nuggets                                             0.100725
## teamDetroit Pistons                                            0.255312
## teamGolden State Warriors                                      0.424387
## teamHouston Rockets                                            0.238649
## teamIndiana Pacers                                             0.012024
## teamLos Angeles Clippers                                       0.607142
## teamLos Angeles Lakers                                         0.941763
## teamMemphis Grizzlies                                          0.504666
## teamMiami Heat                                                 0.196936
## teamMilwaukee Bucks                                            0.554736
## teamMinnesota Timberwolves                                     0.196116
## teamNew Orleans Pelicans                                       0.058309
## teamNew York Knicks                                            0.078209
## teamOklahoma City Thunder                                      0.072538
## teamOrlando Magic                                              0.940632
## teamPhiladelphia 76ers                                         0.206401
## teamPhoenix Suns                                               0.182687
## teamPortland Trail Blazers                                     0.030370
## teamSacramento Kings                                           0.165697
## teamSan Antonio Spurs                                          0.218741
## teamToronto Raptors                                            0.020817
## teamUtah Jazz                                                  0.051987
## teamWashington Wizards                                         0.727274
## shootsLeft Right                                               0.533269
## shootsRight                                                    0.511313
## positionCenter and Power Forward                               0.010503
```
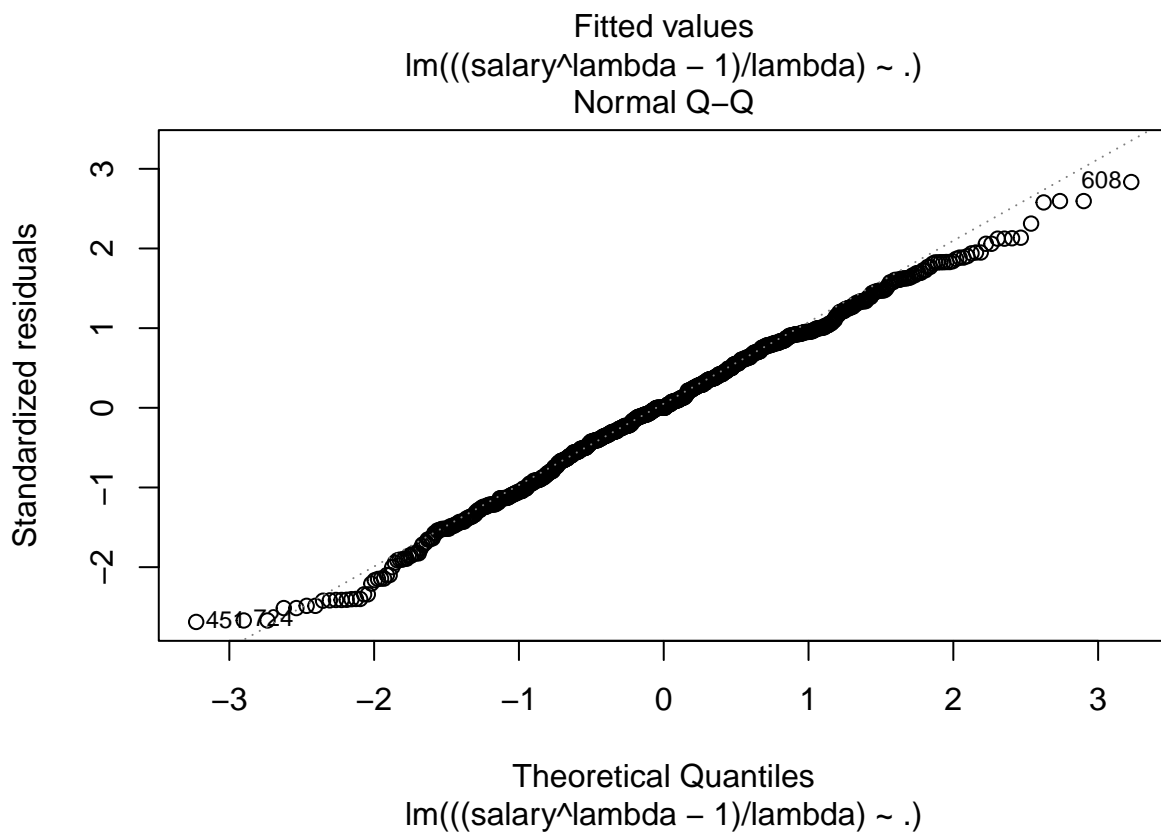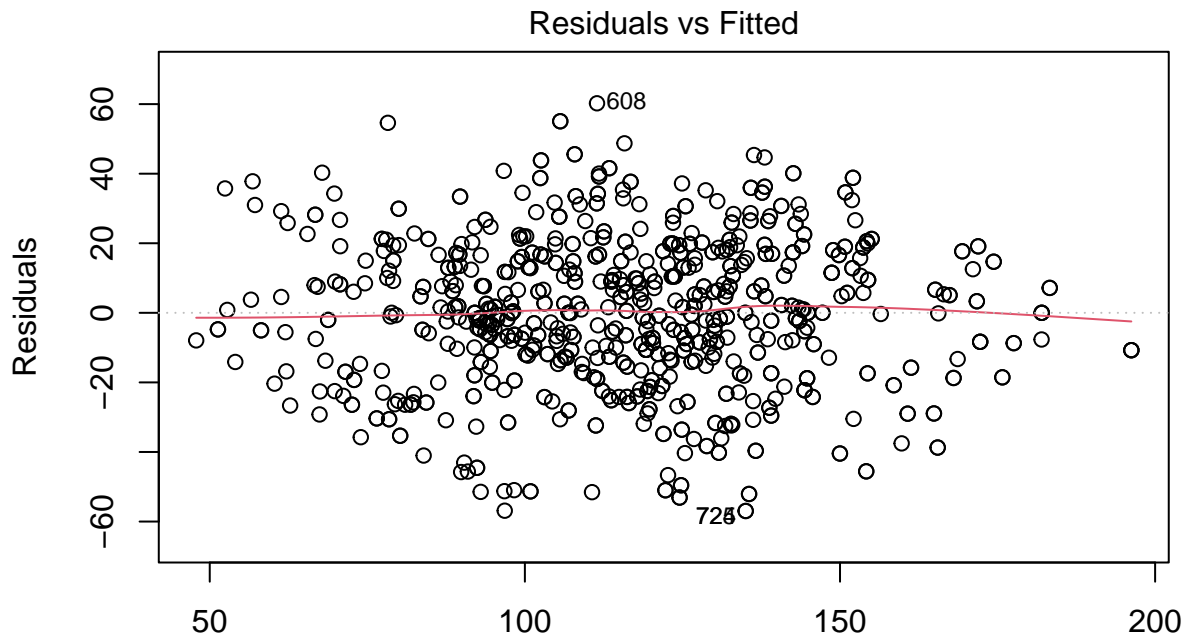
```
## positionCenter and Small Forward and Power Forward              0.365547
## positionPoint Guard                                             0.055758
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard 0.003457
## positionPoint Guard and Shooting Guard                          0.230306
## positionPoint Guard and Small Forward and Shooting Guard        0.412037
## positionPower Forward                                           0.032105
## positionPower Forward and Center                                0.005509
## positionPower Forward and Center and Small Forward              0.038950
## positionPower Forward and Shooting Guard                        0.816626
## positionPower Forward and Small Forward                         0.645503
## positionPower Forward and Small Forward and Shooting Guard      0.269215
## positionShooting Guard                                          0.017079
## positionShooting Guard and Point Guard                          0.104953
## positionShooting Guard and Small Forward                        0.032128
## positionShooting Guard and Small Forward and Point Guard        0.561575
## positionShooting Guard and Small Forward and Power Forward      0.264195
## positionSmall Forward                                           0.125747
## positionSmall Forward and Center and Power Forward              0.530684
## positionSmall Forward and Power Forward                         0.079291
## positionSmall Forward and Power Forward and Shooting Guard      0.118146
## positionSmall Forward and Shooting Guard                        0.061786
## positionSmall Forward and Shooting Guard and Point Guard        0.643834
## positionSmall Forward and Shooting Guard and Power Forward      0.001647
##
## (Intercept)                                                     *
## height                                                          **
## weight                                                          ***
## season_end
## age_atendofseason                                               ***
## Assits                                                          ***
## Points                                                          ***
## FieldGoals
## FieldGoals3                                                     *
## FreeThrows
## Games                                                           ***
## PlayerEfficiencyRating
## TotalRebounds
## WinShares                                                       .
## effectiveFieldGoal
## teamBoston Celtics                                              **
## teamBrooklyn Nets                                               *
## teamCharlotte Hornets                                           **
## teamChicago Bulls
## teamCleveland Cavaliers
## teamDallas Mavericks
## teamDenver Nuggets
## teamDetroit Pistons
## teamGolden State Warriors
## teamHouston Rockets
## teamIndiana Pacers                                              *
## teamLos Angeles Clippers
## teamLos Angeles Lakers
## teamMemphis Grizzlies
## teamMiami Heat
```
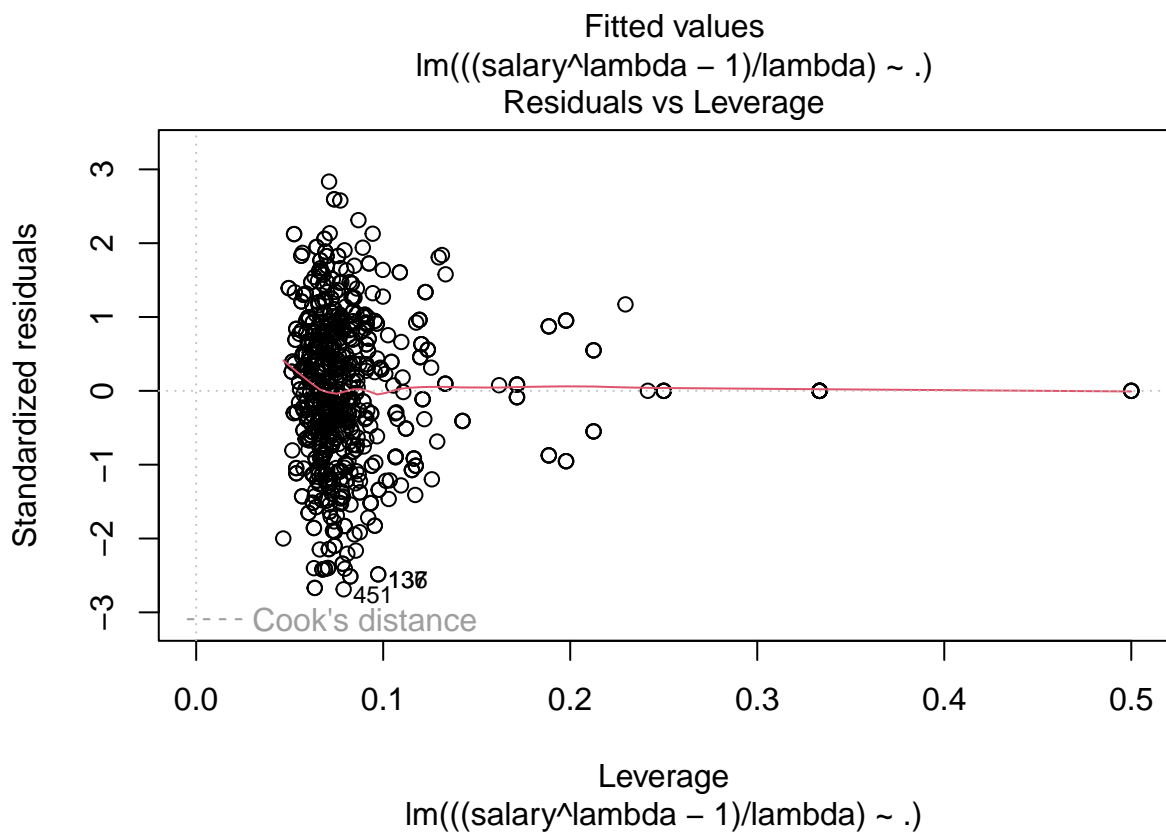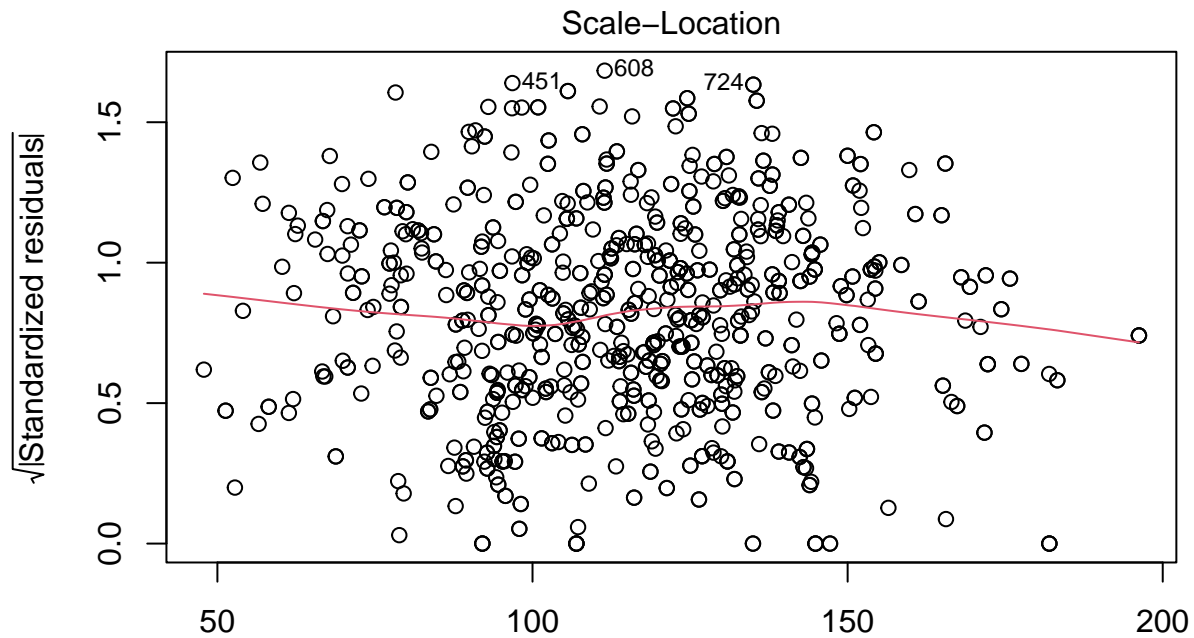
```
## teamMilwaukee Bucks
## teamMinnesota Timberwolves
## teamNew Orleans Pelicans                                                       .
## teamNew York Knicks                                                            .
## teamOklahoma City Thunder                                                      .
## teamOrlando Magic
## teamPhiladelphia 76ers
## teamPhoenix Suns
## teamPortland Trail Blazers                                                     *
## teamSacramento Kings
## teamSan Antonio Spurs
## teamToronto Raptors                                                            *
## teamUtah Jazz                                                                  .
## teamWashington Wizards
## shootsLeft Right
## shootsRight
## positionCenter and Power Forward                                              *
## positionCenter and Small Forward and Power Forward
## positionPoint Guard                                                            .
## positionPoint Guard and Power Forward and Small Forward and Shooting Guard **
## positionPoint Guard and Shooting Guard
## positionPoint Guard and Small Forward and Shooting Guard
## positionPower Forward                                                          *
## positionPower Forward and Center                                              **
## positionPower Forward and Center and Small Forward                            *
## positionPower Forward and Shooting Guard
## positionPower Forward and Small Forward
## positionPower Forward and Small Forward and Shooting Guard
## positionShooting Guard                                                         *
## positionShooting Guard and Point Guard
## positionShooting Guard and Small Forward                                       *
## positionShooting Guard and Small Forward and Point Guard
## positionShooting Guard and Small Forward and Power Forward
## positionSmall Forward
## positionSmall Forward and Center and Power Forward
## positionSmall Forward and Power Forward                                        .
## positionSmall Forward and Power Forward and Shooting Guard
## positionSmall Forward and Shooting Guard                                       .
## positionSmall Forward and Shooting Guard and Point Guard
## positionSmall Forward and Shooting Guard and Power Forward                    **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 22.05 on 736 degrees of freedom
##   (26 observations deleted due to missingness)
## Multiple R-squared:  0.6085, Adjusted R-squared:  0.5723
## F-statistic: 16.82 on 68 and 736 DF,  p-value: < 2.2e-16
```

```
plot(modeltest2)
```

Residuals vs Fitted

lm(((salary^lambda − 1)/lambda) ~ .)

Normal Q−Q

lm(((salary^lambda − 1)/lambda) ~ .)

Scale–Location

$\sqrt{|\text{Standardized residuals}|}$

Fitted values
lm((((salary^lambda – 1)/lambda) ~ .)

Residuals vs Leverage

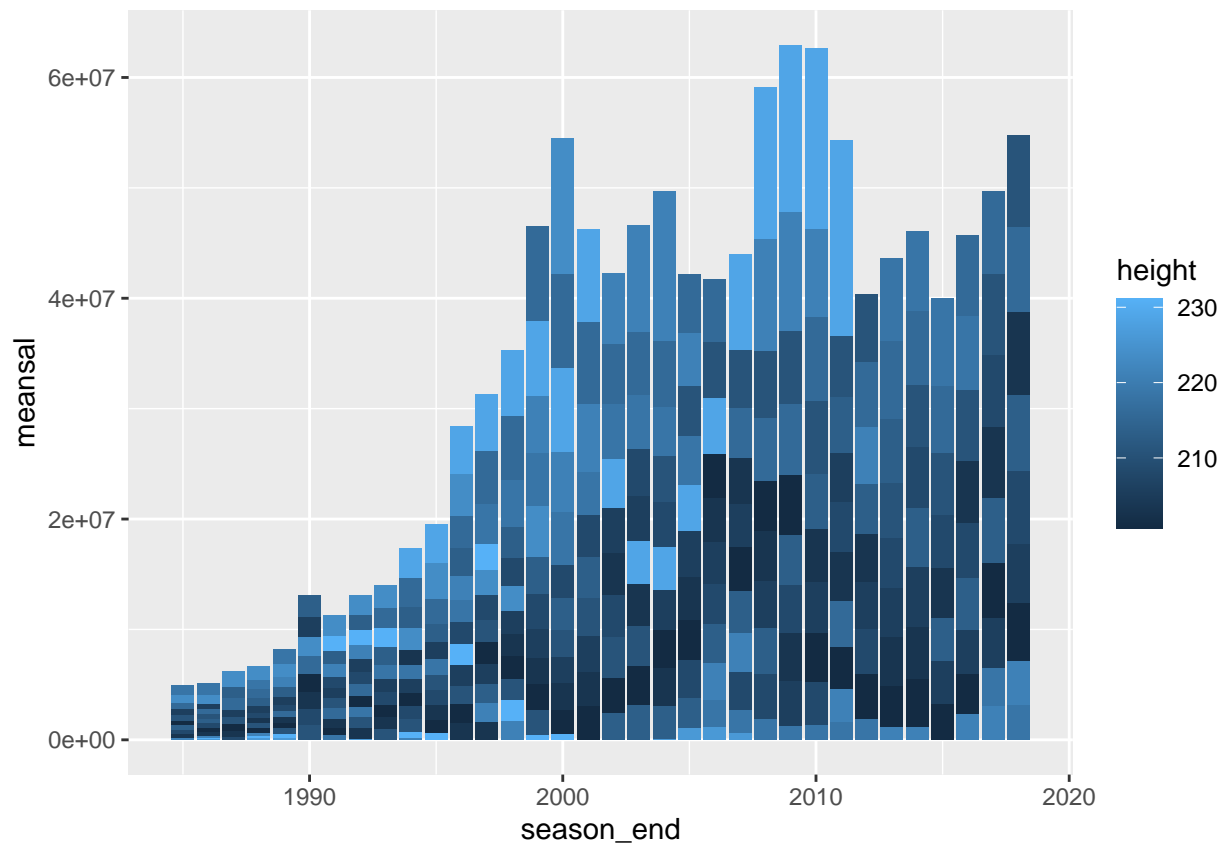Standardized residuals

Leverage
lm((((salary^lambda – 1)/lambda) ~ .)

```
m = sqldf('select height, avg(salary) as meansal, season_end from experimentwithseason group by height,

m = sqldf('select height, avg(salary) as meansal, season_end from experimentwithseason where height> 200

ggplot(m, aes(height, meansal)) + geom_col()
```
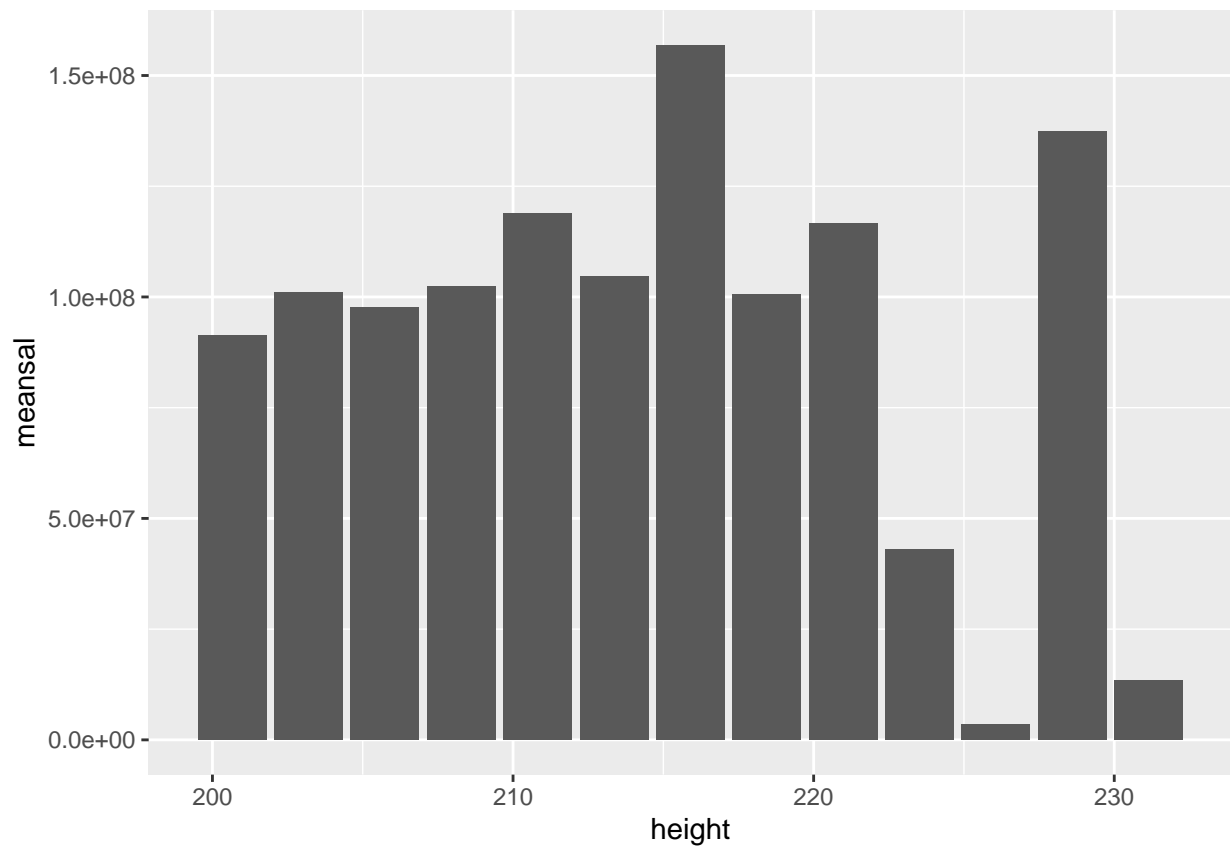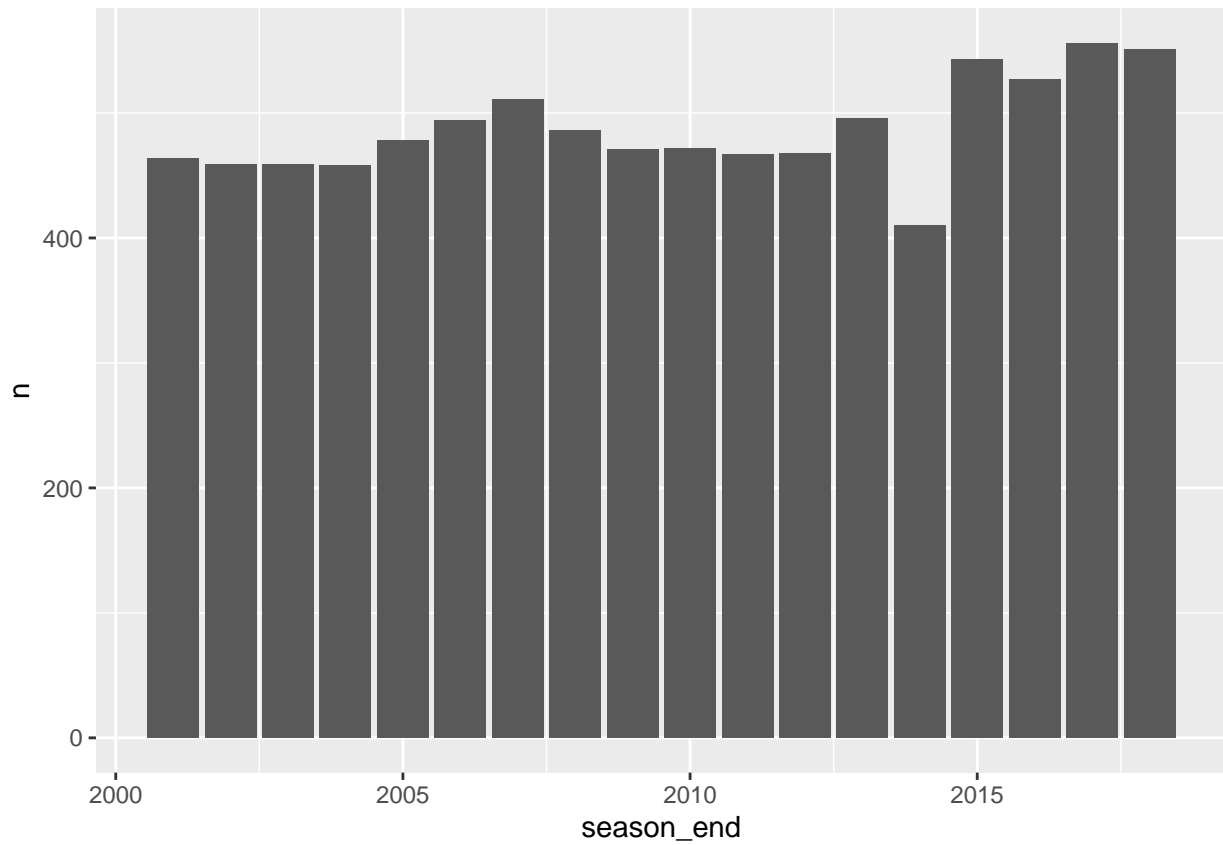
```
ggplot(m, aes(season_end, meansal, fill = height)) + geom_col()
```
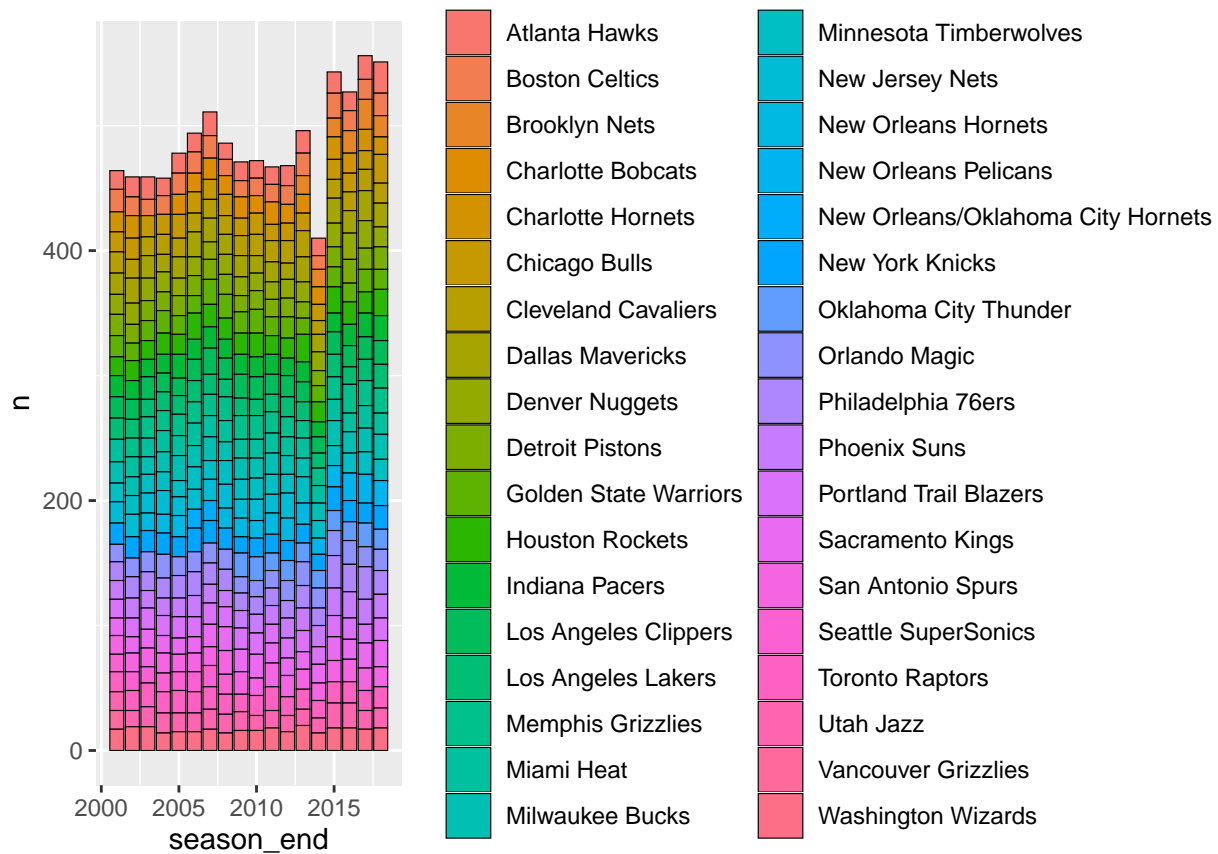
```
expafter006 = subset(experimentwithseason, season_end > 2000,select = -c(id))

expafter006 %>% group_by(team) %>% count() %>% arrange(desc(n)) %>% ggplot(aes(n, team)) + geom_col()
```
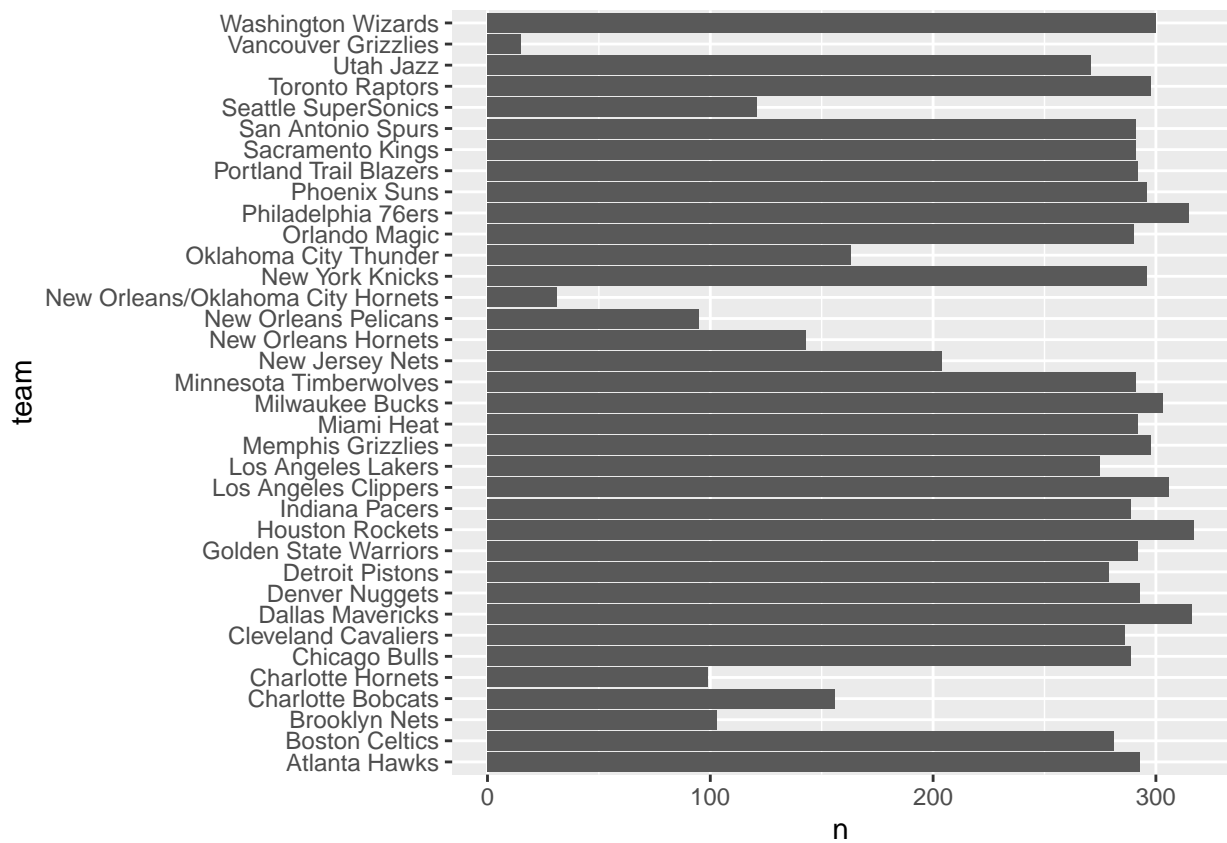
```
expafter006 %>% group_by(season_end) %>% count() %>% ggplot(aes(season_end, n)) + geom_col()
```

```
expafter006 %>% group_by(season_end, team) %>% count() %>% ggplot(aes(season_end, n, fill = team))+ geo
```

Legend:
- Atlanta Hawks
- Boston Celtics
- Brooklyn Nets
- Charlotte Bobcats
- Charlotte Hornets
- Chicago Bulls
- Cleveland Cavaliers
- Dallas Mavericks
- Denver Nuggets
- Detroit Pistons
- Golden State Warriors
- Houston Rockets
- Indiana Pacers
- Los Angeles Clippers
- Los Angeles Lakers
- Memphis Grizzlies
- Miami Heat
- Milwaukee Bucks
- Minnesota Timberwolves
- New Jersey Nets
- New Orleans Hornets
- New Orleans Pelicans
- New Orleans/Oklahoma City Hornets
- New York Knicks
- Oklahoma City Thunder
- Orlando Magic
- Philadelphia 76ers
- Phoenix Suns
- Portland Trail Blazers
- Sacramento Kings
- San Antonio Spurs
- Seattle SuperSonics
- Toronto Raptors
- Utah Jazz
- Vancouver Grizzlies
- Washington Wizards

```
shapiro.test(residuals(model_9))
```

```
##
##  Shapiro-Wilk normality test
##
## data:  residuals(model_9)
## W = 0.99761, p-value = 0.9779
```

```
shapiro.test(residuals(model1))
```

```
##
##  Shapiro-Wilk normality test
##
## data:  residuals(model1)
## W = 0.96902, p-value = 1.303e-08
```