Salary MLR 2nd Draft

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Contents


```
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --
```

```
## v ggplot2 3.3.5     v purrr   0.3.4
## v tibble  3.1.6     v dplyr   1.0.8
## v tidyr   1.2.0     v stringr 1.4.0
## v readr   2.1.2     v forcats 0.5.1
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(randomForest)
```

```
## randomForest 4.7-1
```

```
## Type rfNews() to see new features/changes/bug fixes.
```

```
##
## Attaching package: 'randomForest'

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

## The following object is masked from 'package:ggplot2':
##
##     margin
```

```
library(parallel)
library(rpart)
library(readr)
library(janitor)
```

```
##
## Attaching package: 'janitor'

## The following objects are masked from 'package:stats':
##
##     chisq.test, fisher.test
```

```
library(car)
```

```
## Loading required package: carData

##
## Attaching package: 'car'

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

## The following object is masked from 'package:purrr':
##
##     some
```

```
library(MASS)
```

```
##
## Attaching package: 'MASS'

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

```
library(Hmisc)
```

```
## Loading required package: lattice

## Loading required package: survival

## Loading required package: Formula

##
## Attaching package: 'Hmisc'

## The following objects are masked from 'package:dplyr':
##
##     src, summarize
```

```
## The following objects are masked from 'package:base':
##
##     format.pval, units
```

```
library(rstatix)
```

```
##
## Attaching package: 'rstatix'
```

```
## The following object is masked from 'package:MASS':
##
##     select
```

```
## The following object is masked from 'package:janitor':
##
##     make_clean_names
```

```
## The following object is masked from 'package:stats':
##
##     filter
```

```
library(forcats)
library(GGally)
```

```
## Registered S3 method overwritten by 'GGally':
##   method from
##   +.gg   ggplot2
```

```
library(performance)
library(caret)
```

```
##
## Attaching package: 'caret'
```

```
## The following object is masked from 'package:survival':
##
##     cluster
```

```
## The following object is masked from 'package:purrr':
##
##     lift
```

```
library(lmtest)
```

```
## Loading required package: zoo
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
library(corrplot)
```

```
## corrplot 0.92 loaded
```

```
library(PerformanceAnalytics)
```

```
## Loading required package: xts
```

```
##
```

```
## Attaching package: 'xts'

## The following objects are masked from 'package:dplyr':
##
##     first, last

##
## Attaching package: 'PerformanceAnalytics'

## The following object is masked from 'package:graphics':
##
##     legend
```

```
library(plotly)
```

```
##
## Attaching package: 'plotly'

## The following object is masked from 'package:Hmisc':
##
##     subplot

## The following object is masked from 'package:MASS':
##
##     select

## The following object is masked from 'package:ggplot2':
##
##     last_plot

## The following object is masked from 'package:stats':
##
##     filter

## The following object is masked from 'package:graphics':
##
##     layout
```

```
library(mlbench)
```

Intro

blahblahblah Hi

Question - How do the various stats from the ESPN website explain the salaries of NBA players?

Where data is from

Variables explained

Data Exploration

```
# Load dataset

players <- read_csv("players.csv")
```

```
## Rows: 558 Columns: 12
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (5): Name, Position, Team, Height, College
```

```
## dbl (7): Age, Height_i, Weight, Salary, Points, Rebounds, Assists
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
active_p <- read_csv("active_players_2.csv")
```

```
## Rows: 558 Columns: 9
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (5): Name, Team, Position, Height, College
## dbl (4): Age, Height_i, Weight, Salary
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
# Structure/Dimensions of the data.frame
str(active_p)
```

```
## spec_tbl_df [558 x 9] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ Name    : chr [1:558] "Juhann Begarin" "Jaylen Brown" "Kris Dunn" "Carsen Edwards" ...
##  $ Team    : chr [1:558] "Boston Celtics" "Boston Celtics" "Boston Celtics" "Boston Celtics" ...
##  $ Position: chr [1:558] "SG" "SG" "PG" "PG" ...
##  $ Age     : num [1:558] 19 24 27 23 25 23 35 29 26 21 ...
##  $ Height  : chr [1:558] "6' 5\"" "6' 6\"" "6' 3\"" "5' 11\"" ...
##  $ Height_i: num [1:558] 6.5 6.6 6.3 5.11 7.5 6.9 6.9 6.1 7.2 6.4 ...
##  $ Weight  : num [1:558] 185 223 205 200 311 240 240 250 250 216 ...
##  $ College : chr [1:558] "nan" "California" "Providence" "Purdue" ...
##  $ Salary  : num [1:558] NaN 26758928 5005350 1782621 NaN ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   Name = col_character(),
##   ..   Team = col_character(),
##   ..   Position = col_character(),
##   ..   Age = col_double(),
##   ..   Height = col_character(),
##   ..   Height_i = col_double(),
##   ..   Weight = col_double(),
##   ..   College = col_character(),
##   ..   Salary = col_double()
##   .. )
##  - attr(*, "problems")=<externalptr>
```

```
# Number of columns containing `NA` or `NaN`
colSums(is.na(active_p))
```

```
##     Name     Team Position      Age   Height Height_i   Weight  College
##        0        0        0        0        0        0        0        0
##   Salary
##      113
```

Data Cleaning

```
#identifying the rows with NAs
rownames(active_p)[apply(active_p, 2, anyNA)]
```

```
##  [1] "9"   "18"  "27"  "36"  "45"  "54"  "63"  "72"  "81"  "90"  "99"  "108"
## [13] "117" "126" "135" "144" "153" "162" "171" "180" "189" "198" "207" "216"
## [25] "225" "234" "243" "252" "261" "270" "279" "288" "297" "306" "315" "324"
## [37] "333" "342" "351" "360" "369" "378" "387" "396" "405" "414" "423" "432"
## [49] "441" "450" "459" "468" "477" "486" "495" "504" "513" "522" "531" "540"
## [61] "549" "558"
```

```
#removing all `Salary` observations with NAs
ap_cl <- active_p[!(is.na(active_p$Salary)), ]
```

```
# Checking for leftover `NA` after cleaning
rownames(active_p)[apply(ap_cl, 2, anyNA)]
```

```
## character(0)
```

```
# Transforming Team,Position,College into factors
ap_cl_f <- transform (
  ap_cl,
  fTeam = as.factor(Team),
  fPosition = as.factor(Position),
  fCollege = as.factor(College)
)
```

```
# Rename `fCollege` factor level "nan" as "None"
# levels(ap_cl_f$fCollege)[levels(ap_cl_f$fCollege)=="nan"] <- "None"
#levels(ap_cl_f$fCollege)
```

```
str(ap_cl_f)
```

```
## 'data.frame':    445 obs. of  12 variables:
##  $ Name     : chr  "Jaylen Brown" "Kris Dunn" "Carsen Edwards" "Bruno Fernando" ...
##  $ Team     : chr  "Boston Celtics" "Boston Celtics" "Boston Celtics" "Boston Celtics" ...
##  $ Position : chr  "SG" "PG" "PG" "F" ...
##  $ Age      : num  24 27 23 23 35 29 21 21 26 23 ...
##  $ Height   : chr  "6' 6\"" "6' 3\"" "5' 11\"" "6' 9\"" ...
##  $ Height_i : num  6.6 6.3 5.11 6.9 6.9 6.1 6.4 6.5 6.8 6.1 ...
##  $ Weight   : num  223 205 200 240 240 250 216 215 245 195 ...
##  $ College  : chr  "California" "Providence" "Purdue" "Maryland" ...
##  $ Salary   : num  26758928 5005350 1782621 1782621 27000000 ...
##  $ fTeam    : Factor w/ 30 levels "Atlanta Hawks",..: 2 2 2 2 2 2 2 2 2 2 ...
##  $ fPosition: Factor w/ 7 levels "C","F","G","PF",..: 7 5 5 2 1 1 7 6 4 5 ...
##  $ fCollege : Factor w/ 119 levels "Alabama","Arizona",..: 15 79 80 50 26 41 36 104 25 75 ...
```

Recoding for Logistic Regression

```
# Start with `ap_cl_f` data.frame, reclassify as tibble

ap_tibble <- as_tibble(ap_cl_f)
class(ap_tibble)
```

```
## [1] "tbl_df"     "tbl"        "data.frame"
```

```
# Calculate quantiles of Salary for good cutoff point
quantile(ap_tibble$Salary, probs = seq(0,1,1/20))
```

```
##       0%       5%      10%      15%      20%      25%      30%      35%
##   925258  1517981  1669178  1669178  1778656  1802057  2103509  2573040
```

```
##      40%      45%      50%      55%      60%      65%      70%      75%
##  3242760  3900751  4447896  5027304  6412964  8222063  9697392 12000000
##      80%      85%      90%      95%     100%
## 14324647 17943158 23600000 31650600 45780966
```

```
ap_tibble <- ap_tibble %>% mutate(Salary.Dummy = if_else(Salary >= 8222063, 1, 0))
```

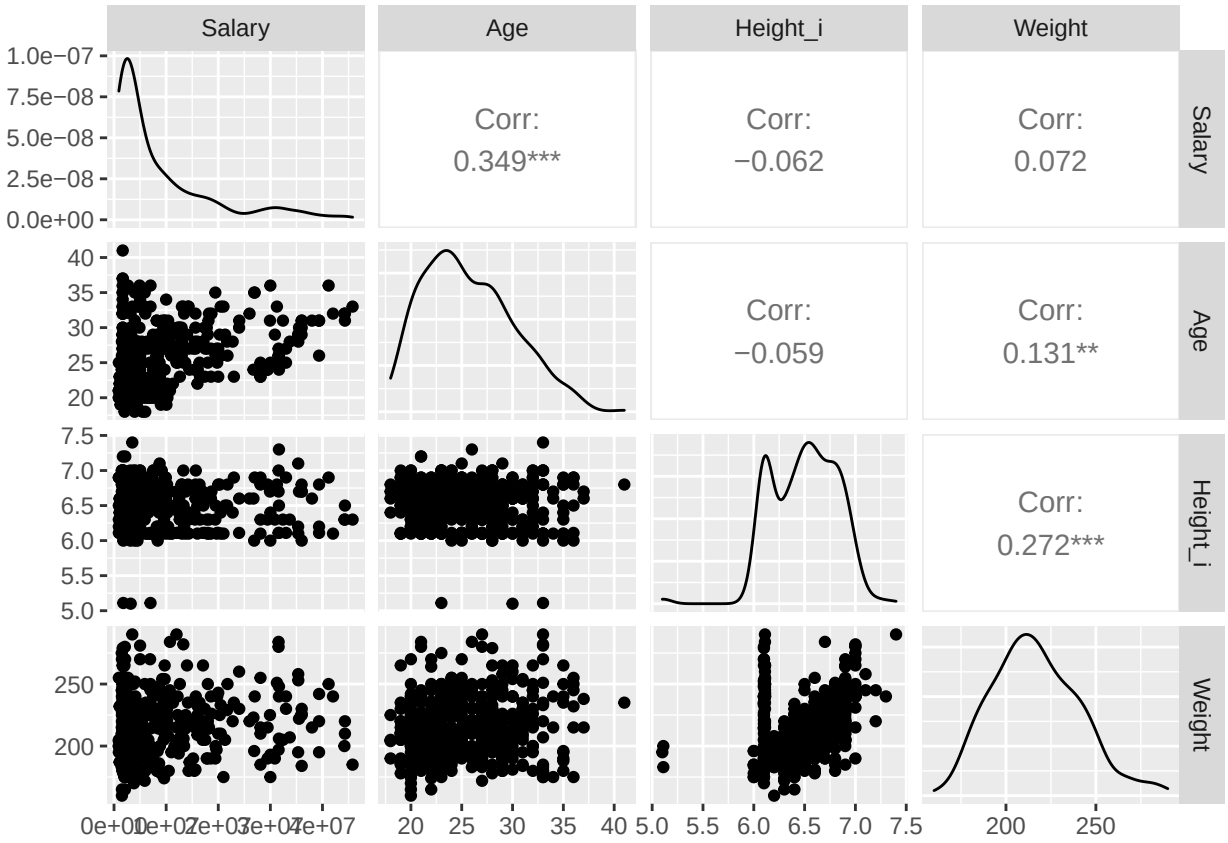
```
str(ap_tibble)
```

```
## tibble [445 x 13] (S3: tbl_df/tbl/data.frame)
##  $ Name        : chr [1:445] "Jaylen Brown" "Kris Dunn" "Carsen Edwards" "Bruno Fernando" ...
##  $ Team        : chr [1:445] "Boston Celtics" "Boston Celtics" "Boston Celtics" "Boston Celtics" ...
##  $ Position    : chr [1:445] "SG" "PG" "PG" "F" ...
##  $ Age         : num [1:445] 24 27 23 23 35 29 21 21 26 23 ...
##  $ Height      : chr [1:445] "6' 6\"" "6' 3\"" "5' 11\"" "6' 9\"" ...
##  $ Height_i    : num [1:445] 6.6 6.3 5.11 6.9 6.9 6.1 6.4 6.5 6.8 6.1 ...
##  $ Weight      : num [1:445] 223 205 200 240 240 250 216 215 245 195 ...
##  $ College     : chr [1:445] "California" "Providence" "Purdue" "Maryland" ...
##  $ Salary      : num [1:445] 26758928 5005350 1782621 1782621 27000000 ...
##  $ fTeam       : Factor w/ 30 levels "Atlanta Hawks",..: 2 2 2 2 2 2 2 2 2 2 ...
##  $ fPosition   : Factor w/ 7 levels "C","F","G","PF",..: 7 5 5 2 1 1 7 6 4 5 ...
##  $ fCollege    : Factor w/ 119 levels "Alabama","Arizona",..: 15 79 80 50 26 41 36 104 25 75 ...
##  $ Salary.Dummy: num [1:445] 1 0 0 0 1 0 0 0 0 0 ...
```

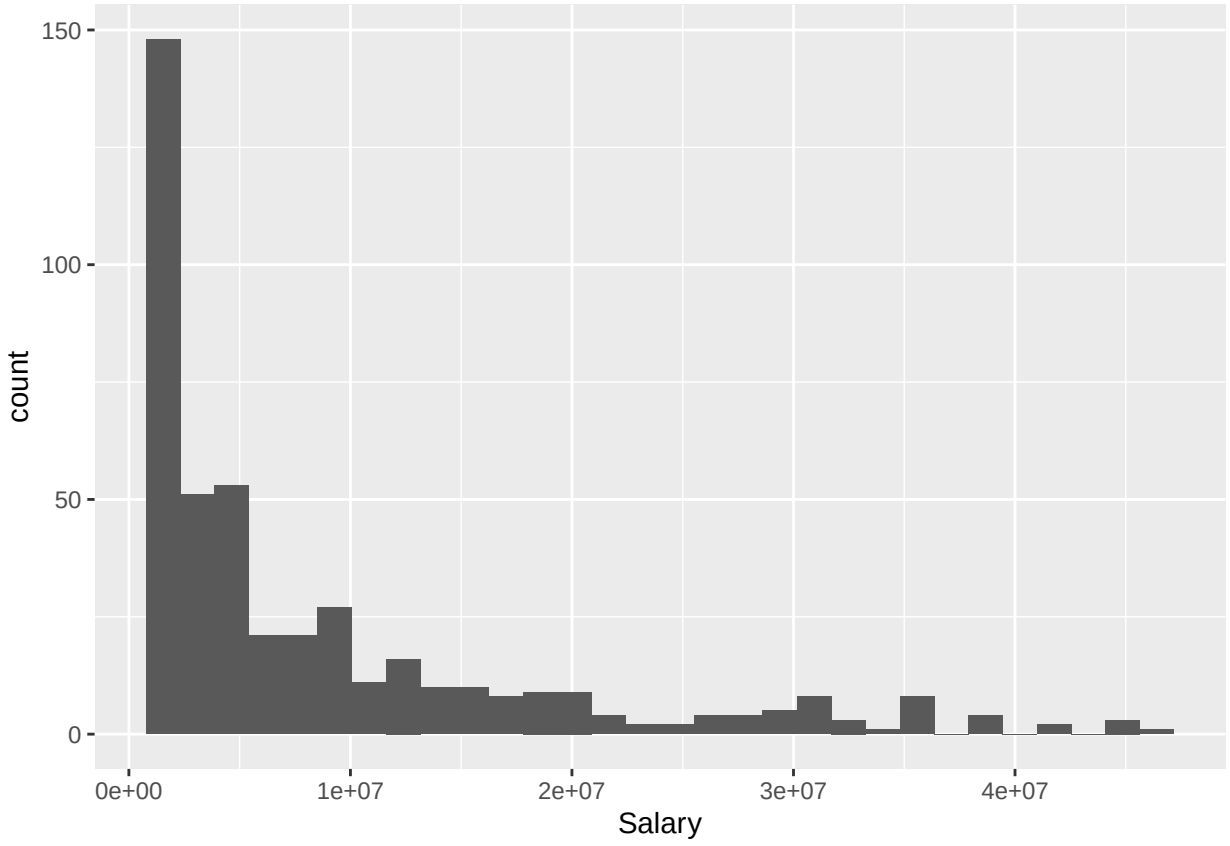
Model Building

Initial Graphs

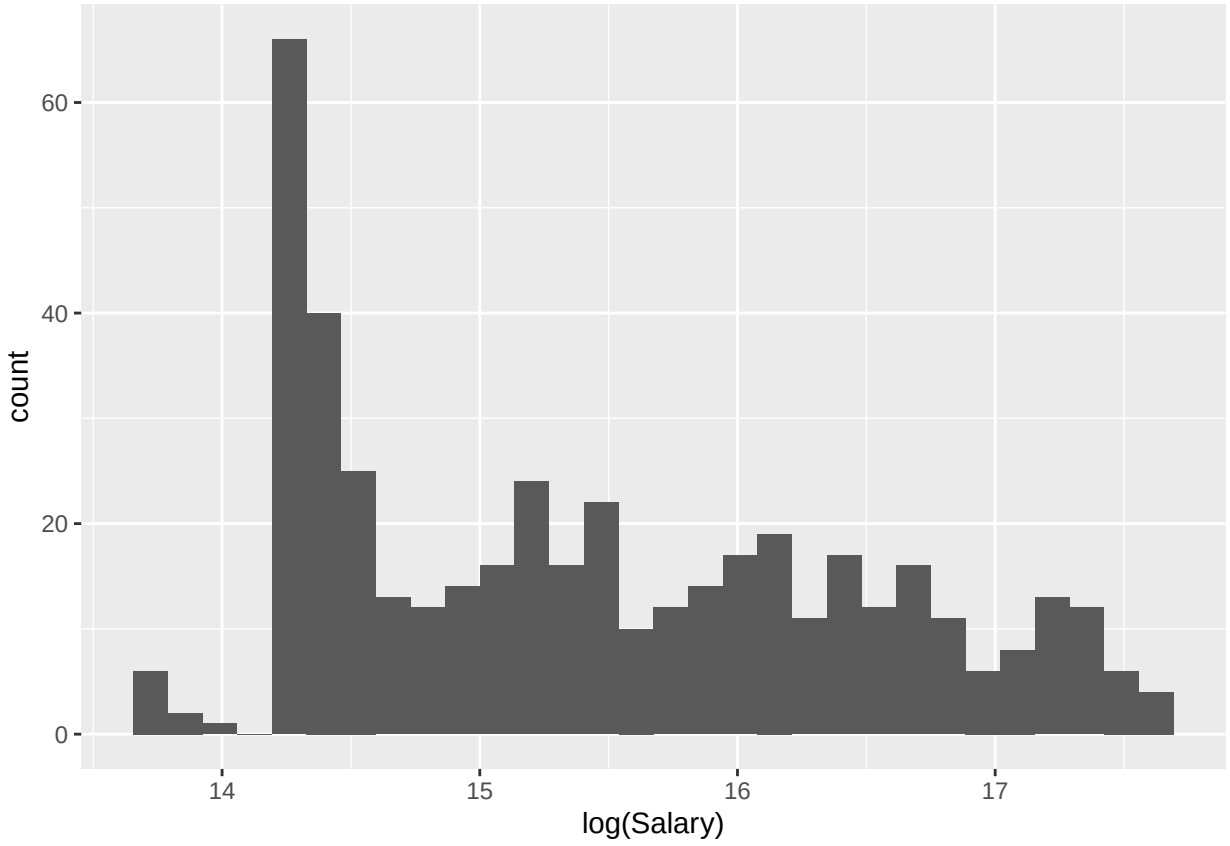
```
# The diagonal consists of the densities of the three variables and the upper panels consist of the cor

ggpairs(ap_tibble, columns = c(9,4,6,7), cardinality_threshold = NULL)
```




```
ggplot(ap_tibble, aes(Salary)) +
  geom_histogram(bins = 30)
```




```
ggplot(ap_tibble, aes(log(Salary))) +
  geom_histogram(bins = 30)
```



Full(Initial) Model

```
summary(lm1 <- lm(Salary ~ fTeam+fPosition+fCollege+Age+Height_i+Weight, data=ap_tibble))
```

```
##
## Call:
## lm(formula = Salary ~ fTeam + fPosition + fCollege + Age + Height_i +
##     Weight, data = ap_tibble)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -18232129  -4355864         0   2782057  27394419
##
## Coefficients:
##                                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   -43409716   16626942  -2.611 0.009506 **
## fTeamBoston Celtics            -2139600    3999655  -0.535 0.593100
## fTeamBrooklyn Nets              1376171    3812791   0.361 0.718412
## fTeamCharlotte Hornets         -2482487    3742196  -0.663 0.507620
## fTeamChicago Bulls              1451456    4130193   0.351 0.725526
## fTeamCleveland Cavaliers        2396367    4078738   0.588 0.557310
## fTeamDallas Mavericks          -2179304    3816160  -0.571 0.568396
## fTeamDenver Nuggets              618798    3904190   0.158 0.874177
## fTeamDetroit Pistons           -3902716    3911500  -0.998 0.319236
## fTeamGolden State Warriors     -1024287    3989880  -0.257 0.797577
## fTeamHouston Rockets           -2388664    3848381  -0.621 0.535292
```

```
## fTeamIndiana Pacers                -391881    3957015  -0.099 0.921180
## fTeamLos Angeles Clippers         -1764702    4039118  -0.437 0.662509
## fTeamLos Angeles Lakers           -3269636    4131496  -0.791 0.429366
## fTeamMemphis Grizzlies            -2112003    3994901  -0.529 0.597438
## fTeamMiami Heat                   -3585954    4065171  -0.882 0.378449
## fTeamMilwaukee Bucks                965708    4021669   0.240 0.810403
## fTeamMinnesota Timberwolves        4551282    4220656   1.078 0.281786
## fTeamNew Orleans Pelicans          -647960    3745909  -0.173 0.862790
## fTeamNew York Knicks              -1878918    3824003  -0.491 0.623554
## fTeamOklahoma City Thunder        -2754850    3934686  -0.700 0.484402
## fTeamOrlando Magic                -1166824    3960187  -0.295 0.768482
## fTeamPhiladelphia Sixers            605822    3977677   0.152 0.879053
## fTeamPhoenix Suns                   917437    4004371   0.229 0.818947
## fTeamPortland Trail Blazers       -5390573    4402004  -1.225 0.221737
## fTeamSacremento Kings              1570102    4017930   0.391 0.696253
## fTeamSan Antonio Spurs             -473258    3895515  -0.121 0.903389
## fTeamToronto Raptors              -1433236    4269557  -0.336 0.737351
## fTeamUtah Jazz                     1116045    4098972   0.272 0.785606
## fTeamWashington Wizards           -1153886    3721264  -0.310 0.756725
## fPositionF                         1204828    4375387   0.275 0.783233
## fPositionG                        10656218    5190359   2.053 0.040968 *
## fPositionPF                        2889966    1929730   1.498 0.135332
## fPositionPG                       11138355    2996036   3.718 0.000242 ***
## fPositionSF                        6497102    2150070   3.022 0.002738 **
## fPositionSG                        7196111    2549099   2.823 0.005089 **
## fCollegeArizona                     660692    5617835   0.118 0.906462
## fCollegeArizona State              9982902    7299120   1.368 0.172477
## fCollegeArkansas                    469247    6682154   0.070 0.944064
## fCollegeAuburn                     1571889    7223599   0.218 0.827891
## fCollegeBaylor                    -2481774    6392019  -0.388 0.698109
## fCollegeBelmont                   -4855131   10707722  -0.453 0.650585
## fCollegeBoise State               -3368144   10882863  -0.309 0.757172
## fCollegeBoston College            -2494383   10912629  -0.229 0.819359
## fCollegeBowling Green              4292252   10993543   0.390 0.696504
## fCollegeBucknell                   -955784   11010106  -0.087 0.930883
## fCollegeButler                     5918936    8385665   0.706 0.480858
## fCollegeBYU                       -7249423   10885559  -0.666 0.505965
## fCollegeCal Poly                  -2510893   10854196  -0.231 0.817223
## fCollegeCalifornia                20654255   10910430   1.893 0.059350 .
## fCollegeCharleston                -7563826   10944739  -0.691 0.490064
## fCollegeCleveland State           -3436899   10754028  -0.320 0.749509
## fCollegeColorado                   3697341    7210164   0.513 0.608487
## fCollegeConnecticut                2729879    6316981   0.432 0.665956
## fCollegeCreighton                   117698    8236695   0.014 0.988609
## fCollegeDavidson                  33917971   10894796   3.113 0.002037 **
## fCollegeDayton                     4072786   10799793   0.377 0.706364
## fCollegeDePaul                    -3115672    8308080  -0.375 0.707924
## fCollegeDrexel                    -6131316   10875214  -0.564 0.573337
## fCollegeDuke                       3327920    4889327   0.681 0.496640
## fCollegeFlorida                    7222763    6360647   1.136 0.257094
## fCollegeFlorida State              2056866    5638667   0.365 0.715544
## fCollegeFresno State              28832960   10936707   2.636 0.008835 **
## fCollegeGeorge Washington         -4562823   10945256  -0.417 0.677079
## fCollegeGeorgetown                -4952188    7222440  -0.686 0.493475
```

```
## fCollegeGeorgia                    1704338    7265198   0.235 0.814694
## fCollegeGeorgia Tech               -162680    7296193  -0.022 0.982227
## fCollegeGonzaga                    3856775    5893987   0.654 0.513404
## fCollegeHouston                   -4382913    8216914  -0.533 0.594167
## fCollegeIllinois                  -2109111    8695076  -0.243 0.808516
## fCollegeIndiana                    2041078    5902780   0.346 0.729759
## fCollegeIowa State                -1846631    6292715  -0.293 0.769385
## fCollegeIUPUI                    -11029514   11901368  -0.927 0.354836
## fCollegeKansas                     6022649    5599807   1.076 0.283047
## fCollegeKansas State              -3378939    7184555  -0.470 0.638492
## fCollegeKentucky                   7582646    4841408   1.566 0.118398
## fCollegeLehigh                    29182543   11042973   2.643 0.008676 **
## fCollegeLiberty                   -3208200   10817453  -0.297 0.767004
## fCollegeLouisiana-Lafayette       -9654690   10882355  -0.887 0.375718
## fCollegeLouisville                 5632489    6343176   0.888 0.375303
## fCollegeLoyola (MD)                3748003   10921836   0.343 0.731724
## fCollegeLSU                         356961    6584833   0.054 0.956806
## fCollegeMarquette                  6687787    7321909   0.913 0.361799
## fCollegeMarshall                 -11070017   10986738  -1.008 0.314502
## fCollegeMaryland                  -1916231    6356430  -0.301 0.763279
## fCollegeMemphis                    5812091    6643567   0.875 0.382387
## fCollegeMiami (FL)                 -811418    8207611  -0.099 0.921317
## fCollegeMichigan                   3993331    5748518   0.695 0.487821
## fCollegeMichigan State             7610990    6394741   1.190 0.234950
## fCollegeMinnesota                  2246389   10908141   0.206 0.836986
## fCollegeMississippi State         -7276374   10965548  -0.664 0.507498
## fCollegeMissouri                   -688399    7200677  -0.096 0.923903
## fCollegeMissouri State            -2738954   10820839  -0.253 0.800357
## fCollegeMurray State               1990539    8321722   0.239 0.811122
## fCollegenan                        3285715    4643254   0.708 0.479746
## fCollegeNebraska                  -1116174    8350171  -0.134 0.893756
## fCollegeNevada                    -5189084    8364267  -0.620 0.535494
## fCollegeNew Mexico                -2333981   11045614  -0.211 0.832800
## fCollegeNew Mexico JC              5006924   11080370   0.452 0.651700
## fCollegeNew Mexico State          19434510   11053679   1.758 0.079777 .
## fCollegeNorth Carolina             -949428    5521054  -0.172 0.863586
## fCollegeNorth Carolina State       3651398   10887643   0.335 0.737590
## fCollegeNotre Dame                -4567492   10892999  -0.419 0.675306
## fCollegeOhio                      -3366614   10864360  -0.310 0.756879
## fCollegeOhio State                 6567510    7284072   0.902 0.368009
## fCollegeOklahoma                    540170    7256431   0.074 0.940712
## fCollegeOklahoma State             4055621    8379129   0.484 0.628743
## fCollegeOld Dominion              -3988140   10922934  -0.365 0.715293
## fCollegeOle Miss                  -2925069   10901041  -0.268 0.788638
## fCollegeOregon                     755727    6247375   0.121 0.903801
## fCollegeOregon State              -4591241   10728739  -0.428 0.669016
## fCollegePenn State                -4050789   11386818  -0.356 0.722293
## fCollegePittsburgh                10090316   11007453   0.917 0.360077
## fCollegeProvidence                -4574929   10858708  -0.421 0.673840
## fCollegePurdue                    -4613061   11090707  -0.416 0.677764
## fCollegeRadford                  -12134400   10912877  -1.112 0.267094
## fCollegeSaint Joseph's            -1392672    8514159  -0.164 0.870183
## fCollegeSaint Mary's              -6101377    8244976  -0.740 0.459896
## fCollegeSalt Lake CC UT           -8037516   10865039  -0.740 0.460048
```

```
## fCollegeSan Diego State              9244590    7253561   1.274 0.203517
## fCollegeSMU                         -4825688    7272754  -0.664 0.507522
## fCollegeSouth Carolina              -4588005   10681331  -0.430 0.667855
## fCollegeSt. John's                  -6903125   10934001  -0.631 0.528316
## fCollegeStanford                      781509    6103557   0.128 0.898206
## fCollegeSyracuse                    -1627849    6331447  -0.257 0.797281
## fCollegeTCU                         -2381903    8336740  -0.286 0.775304
## fCollegeTennessee                    6904659    6421508   1.075 0.283167
## fCollegeTennessee State             12472584   11084456   1.125 0.261428
## fCollegeTexas                       7193501    5372870   1.339 0.181673
## fCollegeTexas A&M                   6348154    6736758   0.942 0.346821
## fCollegeTexas Tech                   156150    8670496   0.018 0.985644
## fCollegeUC Santa Barbara            -4543256   10815854  -0.420 0.674758
## fCollegeUCLA                         8760281    5414101   1.618 0.106747
## fCollegeUNLV                         6960075    7410230   0.939 0.348388
## fCollegeUSC                          3612676    5610377   0.644 0.520135
## fCollegeUSC Upstate                 -5806804   10900473  -0.533 0.594644
## fCollegeUtah                         4123587    7198620   0.573 0.567207
## fCollegeUtah State                  -2882745   10855217  -0.266 0.790766
## fCollegeVanderbilt                  -1368396    6621199  -0.207 0.836414
## fCollegeVillanova                    -148498    5520203  -0.027 0.978558
## fCollegeVirginia                      522108    5781111   0.090 0.928102
## fCollegeVirginia Commonwealth        -561324   10687760  -0.053 0.958151
## fCollegeVirginia Tech               -1338244   10510698  -0.127 0.898774
## fCollegeWake Forest                  4051041    6318899   0.641 0.521968
## fCollegeWashington                   2105986    5699779   0.369 0.712037
## fCollegeWashington State            15483585    8425597   1.838 0.067139 .
## fCollegeWeber State                31799371   11072060   2.872 0.004381 **
## fCollegeWest Virginia              -5678638    8274292  -0.686 0.493077
## fCollegeWestern Texas Coll. (J.C.) -6332252   10759470  -0.589 0.556639
## fCollegeWichita State                6661369    8415955   0.792 0.429294
## fCollegeWisconsin                   -4235075    8582977  -0.493 0.622087
## fCollegeWyoming                      1513570    8402762   0.180 0.857179
## fCollegeXavier                      -5456878    8094128  -0.674 0.500739
## fCollegeYale                        -5344975   10870850  -0.492 0.623320
## Age                                   632383     129540   4.882 1.74e-06 ***
## Height_i                               -1394    1908175  -0.001 0.999418
## Weight                                131345      38186   3.440 0.000669 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 9385000 on 288 degrees of freedom
## Multiple R-squared:  0.4155, Adjusted R-squared:  0.09891
## F-statistic: 1.312 on 156 and 288 DF,  p-value: 0.02448
```

```
shapiro.test(resid(lm1))
```

```
##
##  Shapiro-Wilk normality test
##
## data:  resid(lm1)
## W = 0.9352, p-value = 5.455e-13
```

```
bptest(lm1)
```

```
##
##  studentized Breusch-Pagan test
##
## data:  lm1
## BP = 181.76, df = 156, p-value = 0.07744
```

log(Full Model)

```
summary(lm_l1 <- lm(log(Salary) ~ fTeam+fPosition+fCollege+Age+Height_i+Weight, data=ap_tibble))
```

```
##
## Call:
## lm(formula = log(Salary) ~ fTeam + fPosition + fCollege + Age +
##     Height_i + Weight, data = ap_tibble)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -1.9390 -0.5096  0.0000  0.5006  2.0837
##
## Coefficients:
##                                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)                     1.019e+01  1.704e+00   5.981 6.57e-09 ***
## fTeamBoston Celtics            -3.519e-01  4.098e-01  -0.859 0.391211
## fTeamBrooklyn Nets             -3.157e-01  3.907e-01  -0.808 0.419695
## fTeamCharlotte Hornets         -2.616e-01  3.834e-01  -0.682 0.495661
## fTeamChicago Bulls              5.956e-02  4.232e-01   0.141 0.888167
## fTeamCleveland Cavaliers        3.029e-01  4.179e-01   0.725 0.469158
## fTeamDallas Mavericks          -2.849e-01  3.910e-01  -0.729 0.466886
## fTeamDenver Nuggets            -1.534e-01  4.000e-01  -0.384 0.701595
## fTeamDetroit Pistons           -4.307e-01  4.008e-01  -1.075 0.283378
## fTeamGolden State Warriors     -3.802e-01  4.088e-01  -0.930 0.353184
## fTeamHouston Rockets           -4.673e-01  3.943e-01  -1.185 0.236914
## fTeamIndiana Pacers             2.479e-05  4.054e-01   0.000 0.999951
## fTeamLos Angeles Clippers      -2.494e-01  4.138e-01  -0.603 0.547291
## fTeamLos Angeles Lakers        -9.898e-01  4.233e-01  -2.338 0.020058 *
## fTeamMemphis Grizzlies         -1.615e-01  4.093e-01  -0.395 0.693389
## fTeamMiami Heat                -7.197e-01  4.165e-01  -1.728 0.085068 .
## fTeamMilwaukee Bucks           -4.504e-01  4.121e-01  -1.093 0.275300
## fTeamMinnesota Timberwolves     3.236e-01  4.325e-01   0.748 0.454928
## fTeamNew Orleans Pelicans      -1.511e-01  3.838e-01  -0.394 0.694192
## fTeamNew York Knicks           -3.476e-01  3.918e-01  -0.887 0.375776
## fTeamOklahoma City Thunder     -3.002e-01  4.031e-01  -0.745 0.457064
## fTeamOrlando Magic             -3.362e-02  4.058e-01  -0.083 0.934023
## fTeamPhiladelphia Sixers       -2.516e-01  4.076e-01  -0.617 0.537461
## fTeamPhoenix Suns               4.483e-02  4.103e-01   0.109 0.913068
## fTeamPortland Trail Blazers    -7.391e-01  4.510e-01  -1.639 0.102380
## fTeamSacremento Kings          -1.278e-02  4.117e-01  -0.031 0.975255
## fTeamSan Antonio Spurs         -1.354e-01  3.991e-01  -0.339 0.734708
## fTeamToronto Raptors           -2.856e-01  4.375e-01  -0.653 0.514437
## fTeamUtah Jazz                 -1.014e-01  4.200e-01  -0.241 0.809467
## fTeamWashington Wizards        -2.724e-01  3.813e-01  -0.714 0.475550
## fPositionF                     -1.160e-01  4.483e-01  -0.259 0.796030
```

```
## fPositionG                          1.439e+00  5.318e-01   2.705 0.007235 **
## fPositionPF                         2.784e-01  1.977e-01   1.408 0.160200
## fPositionPG                         1.122e+00  3.070e-01   3.655 0.000306 ***
## fPositionSF                         6.935e-01  2.203e-01   3.148 0.001816 **
## fPositionSG                         8.278e-01  2.612e-01   3.169 0.001692 **
## fCollegeArizona                    -5.687e-03  5.756e-01  -0.010 0.992124
## fCollegeArizona State               2.313e-01  7.479e-01   0.309 0.757384
## fCollegeArkansas                   -1.152e-01  6.847e-01  -0.168 0.866477
## fCollegeAuburn                     -1.507e-01  7.401e-01  -0.204 0.838788
## fCollegeBaylor                     -3.934e-01  6.549e-01  -0.601 0.548492
## fCollegeBelmont                    -1.104e+00  1.097e+00  -1.006 0.315289
## fCollegeBoise State                -3.856e-01  1.115e+00  -0.346 0.729723
## fCollegeBoston College              2.154e-03  1.118e+00   0.002 0.998464
## fCollegeBowling Green               8.366e-01  1.126e+00   0.743 0.458233
## fCollegeBucknell                   -2.955e-01  1.128e+00  -0.262 0.793568
## fCollegeButler                     -1.978e-01  8.592e-01  -0.230 0.818121
## fCollegeBYU                        -1.074e+00  1.115e+00  -0.963 0.336431
## fCollegeCal Poly                   -7.272e-02  1.112e+00  -0.065 0.947907
## fCollegeCalifornia                  1.678e+00  1.118e+00   1.501 0.134481
## fCollegeCharleston                 -1.227e+00  1.121e+00  -1.095 0.274615
## fCollegeCleveland State            -3.873e-01  1.102e+00  -0.352 0.725461
## fCollegeColorado                    5.909e-01  7.388e-01   0.800 0.424476
## fCollegeConnecticut                 3.018e-02  6.472e-01   0.047 0.962846
## fCollegeCreighton                  -1.533e-01  8.439e-01  -0.182 0.855972
## fCollegeDavidson                    1.766e+00  1.116e+00   1.582 0.114654
## fCollegeDayton                      6.805e-01  1.107e+00   0.615 0.539034
## fCollegeDePaul                     -7.680e-01  8.512e-01  -0.902 0.367714
## fCollegeDrexel                     -1.065e+00  1.114e+00  -0.956 0.339791
## fCollegeDuke                        2.588e-01  5.010e-01   0.517 0.605780
## fCollegeFlorida                     3.140e-01  6.517e-01   0.482 0.630327
## fCollegeFlorida State               8.523e-02  5.777e-01   0.148 0.882829
## fCollegeFresno State                1.469e+00  1.121e+00   1.311 0.190801
## fCollegeGeorge Washington          -1.022e+00  1.121e+00  -0.911 0.363084
## fCollegeGeorgetown                 -7.592e-01  7.400e-01  -1.026 0.305807
## fCollegeGeorgia                     3.399e-01  7.444e-01   0.457 0.648330
## fCollegeGeorgia Tech                1.457e-01  7.476e-01   0.195 0.845559
## fCollegeGonzaga                     4.516e-01  6.039e-01   0.748 0.455193
## fCollegeHouston                    -1.001e+00  8.419e-01  -1.189 0.235234
## fCollegeIllinois                   -6.296e-01  8.909e-01  -0.707 0.480322
## fCollegeIndiana                     7.484e-02  6.048e-01   0.124 0.901609
## fCollegeIowa State                  6.467e-02  6.448e-01   0.100 0.920171
## fCollegeIUPUI                      -1.109e+00  1.219e+00  -0.909 0.364023
## fCollegeKansas                      3.708e-01  5.738e-01   0.646 0.518624
## fCollegeKansas State               -1.062e+00  7.361e-01  -1.443 0.150095
## fCollegeKentucky                    4.924e-01  4.961e-01   0.993 0.321723
## fCollegeLehigh                      2.263e+00  1.131e+00   2.000 0.046470 *
## fCollegeLiberty                    -1.035e+00  1.108e+00  -0.934 0.351132
## fCollegeLouisiana-Lafayette        -1.647e+00  1.115e+00  -1.477 0.140777
## fCollegeLouisville                  4.744e-01  6.499e-01   0.730 0.465988
## fCollegeLoyola (MD)                -1.505e-01  1.119e+00  -0.134 0.893140
## fCollegeLSU                        -2.511e-01  6.747e-01  -0.372 0.710035
## fCollegeMarquette                   3.169e-01  7.502e-01   0.422 0.673011
## fCollegeMarshall                   -1.677e+00  1.126e+00  -1.490 0.137322
## fCollegeMaryland                   -2.306e-01  6.513e-01  -0.354 0.723507
```

```
## fCollegeMemphis                   8.919e-01  6.807e-01   1.310 0.191148
## fCollegeMiami (FL)                1.562e-01  8.410e-01   0.186 0.852744
## fCollegeMichigan                  1.357e-01  5.890e-01   0.230 0.817940
## fCollegeMichigan State            6.134e-01  6.552e-01   0.936 0.349983
## fCollegeMinnesota                -5.505e-01  1.118e+00  -0.493 0.622692
## fCollegeMississippi State        -1.327e+00  1.124e+00  -1.181 0.238645
## fCollegeMissouri                 -2.656e-02  7.378e-01  -0.036 0.971306
## fCollegeMissouri State           -4.607e-01  1.109e+00  -0.416 0.678059
## fCollegeMurray State              4.170e-01  8.526e-01   0.489 0.625176
## fCollegenan                       2.281e-01  4.757e-01   0.479 0.631961
## fCollegeNebraska                 -9.216e-01  8.556e-01  -1.077 0.282321
## fCollegeNevada                   -8.471e-01  8.570e-01  -0.988 0.323790
## fCollegeNew Mexico               -8.228e-01  1.132e+00  -0.727 0.467787
## fCollegeNew Mexico JC             8.206e-01  1.135e+00   0.723 0.470359
## fCollegeNew Mexico State          1.207e+00  1.133e+00   1.066 0.287349
## fCollegeNorth Carolina           -1.272e-01  5.657e-01  -0.225 0.822241
## fCollegeNorth Carolina State      4.695e-01  1.116e+00   0.421 0.674188
## fCollegeNotre Dame                4.433e-02  1.116e+00   0.040 0.968344
## fCollegeOhio                     -1.321e+00  1.113e+00  -1.187 0.236257
## fCollegeOhio State                2.907e-01  7.463e-01   0.390 0.697179
## fCollegeOklahoma                 -1.639e-02  7.435e-01  -0.022 0.982432
## fCollegeOklahoma State            7.368e-01  8.585e-01   0.858 0.391469
## fCollegeOld Dominion             -5.627e-01  1.119e+00  -0.503 0.615503
## fCollegeOle Miss                 -2.728e-01  1.117e+00  -0.244 0.807203
## fCollegeOregon                   -2.058e-02  6.401e-01  -0.032 0.974379
## fCollegeOregon State             -9.986e-01  1.099e+00  -0.908 0.364412
## fCollegePenn State               -9.945e-01  1.167e+00  -0.852 0.394691
## fCollegePittsburgh                1.013e+00  1.128e+00   0.899 0.369657
## fCollegeProvidence               -2.831e-01  1.113e+00  -0.254 0.799349
## fCollegePurdue                   -9.438e-01  1.136e+00  -0.831 0.406907
## fCollegeRadford                  -1.869e+00  1.118e+00  -1.671 0.095753 .
## fCollegeSaint Joseph's           -5.300e-01  8.724e-01  -0.608 0.543962
## fCollegeSaint Mary's             -9.261e-01  8.448e-01  -1.096 0.273894
## fCollegeSalt Lake CC UT          -1.128e+00  1.113e+00  -1.014 0.311647
## fCollegeSan Diego State           2.396e-01  7.432e-01   0.322 0.747425
## fCollegeSMU                      -7.416e-01  7.452e-01  -0.995 0.320461
## fCollegeSouth Carolina           -9.239e-01  1.094e+00  -0.844 0.399259
## fCollegeSt. John's               -6.082e-01  1.120e+00  -0.543 0.587648
## fCollegeStanford                  4.214e-02  6.254e-01   0.067 0.946317
## fCollegeSyracuse                 -5.396e-01  6.487e-01  -0.832 0.406254
## fCollegeTCU                      -8.616e-01  8.542e-01  -1.009 0.313972
## fCollegeTennessee                 4.604e-01  6.580e-01   0.700 0.484637
## fCollegeTennessee State           1.619e+00  1.136e+00   1.426 0.154963
## fCollegeTexas                     6.648e-01  5.505e-01   1.208 0.228190
## fCollegeTexas A&M                 5.730e-01  6.903e-01   0.830 0.407123
## fCollegeTexas Tech               -4.151e-01  8.884e-01  -0.467 0.640655
## fCollegeUC Santa Barbara         -7.964e-01  1.108e+00  -0.719 0.472957
## fCollegeUCLA                      6.803e-01  5.547e-01   1.226 0.221071
## fCollegeUNLV                      1.039e+00  7.593e-01   1.369 0.172176
## fCollegeUSC                       2.117e-01  5.748e-01   0.368 0.712893
## fCollegeUSC Upstate              -6.704e-01  1.117e+00  -0.600 0.548787
## fCollegeUtah                      6.648e-01  7.376e-01   0.901 0.368130
## fCollegeUtah State               -1.221e+00  1.112e+00  -1.098 0.273143
## fCollegeVanderbilt               -3.627e-01  6.784e-01  -0.535 0.593354
```

```
## fCollegeVillanova                  -1.298e-01  5.656e-01  -0.229 0.818650
## fCollegeVirginia                   -1.059e-01  5.923e-01  -0.179 0.858169
## fCollegeVirginia Commonwealth      -2.968e-01  1.095e+00  -0.271 0.786539
## fCollegeVirginia Tech              -3.159e-01  1.077e+00  -0.293 0.769470
## fCollegeWake Forest                 1.980e-01  6.474e-01   0.306 0.760007
## fCollegeWashington                  1.117e-01  5.840e-01   0.191 0.848389
## fCollegeWashington State            6.777e-01  8.633e-01   0.785 0.433087
## fCollegeWeber State                 1.994e+00  1.134e+00   1.758 0.079800 .
## fCollegeWest Virginia              -8.985e-01  8.478e-01  -1.060 0.290096
## fCollegeWestern Texas Coll. (J.C.) -1.320e+00  1.102e+00  -1.197 0.232158
## fCollegeWichita State               5.866e-01  8.623e-01   0.680 0.496855
## fCollegeWisconsin                  -9.329e-01  8.794e-01  -1.061 0.289640
## fCollegeWyoming                     8.380e-02  8.610e-01   0.097 0.922531
## fCollegeXavier                     -1.139e+00  8.293e-01  -1.373 0.170670
## fCollegeYale                       -1.058e+00  1.114e+00  -0.950 0.342838
## Age                                 7.574e-02  1.327e-02   5.706 2.87e-08 ***
## Height_i                            2.641e-03  1.955e-01   0.014 0.989234
## Weight                              1.312e-02  3.913e-03   3.352 0.000909 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9616 on 288 degrees of freedom
## Multiple R-squared:  0.4318, Adjusted R-squared:  0.1241
## F-statistic: 1.403 on 156 and 288 DF,  p-value: 0.007015
```

```
shapiro.test(resid(lm_l1))
```

```
##
##  Shapiro-Wilk normality test
##
## data:  resid(lm_l1)
## W = 0.99129, p-value = 0.01014
```

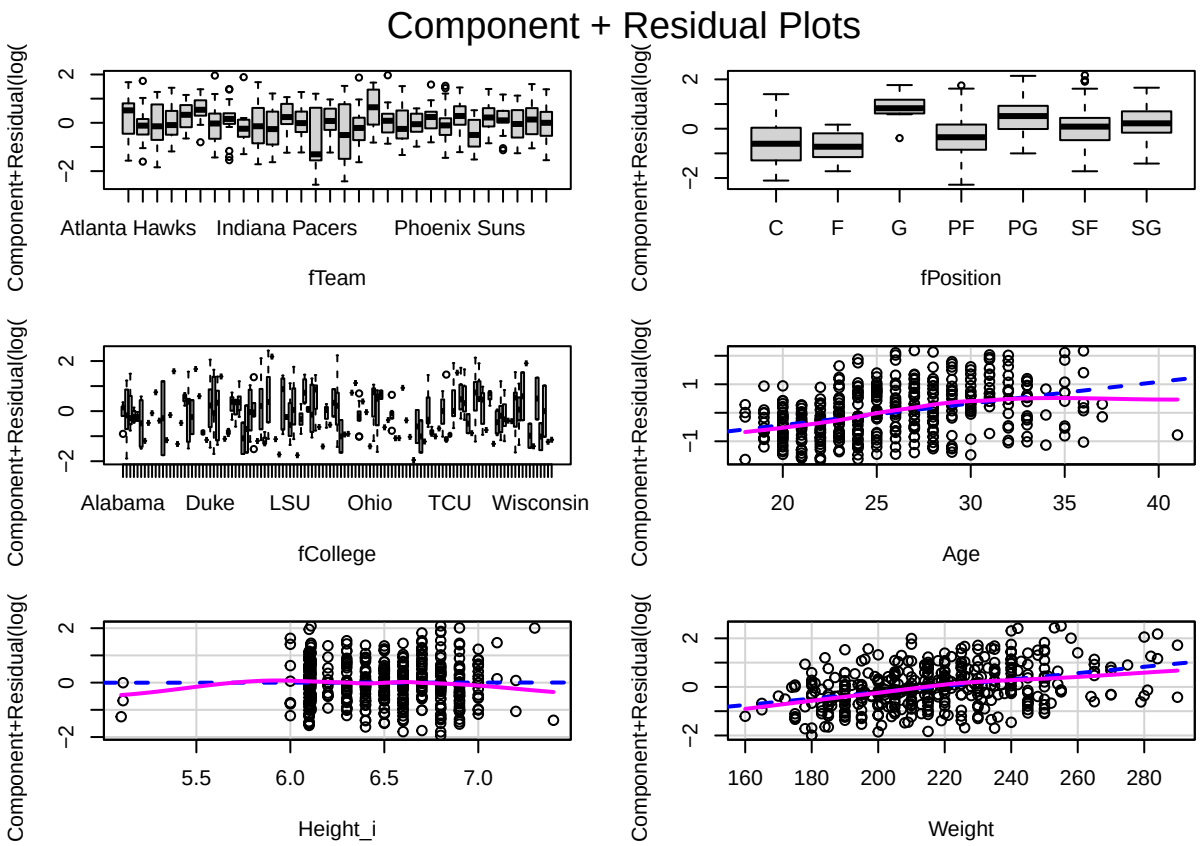
```
bptest(lm_l1)
```

```
##
##  studentized Breusch-Pagan test
##
## data:  lm_l1
## BP = 183.73, df = 156, p-value = 0.06393
```

Check for Polynomial Terms

`Age`, `Height_i`, and `Weight` appear to be misspecified.

```
crPlots(lm_l1)
```




```
#summary(lm(Salary ~ fTeam+fPosition+fCollege+poly(Age,2)+poly(Height_i,2)+poly(Weight,2),data=ap_tibbl
#summary(lm(Salary ~ fTeam+fPosition+fCollege+poly(Age,3)+poly(Height_i,3)+poly(Weight,3),data=ap_tibbl
#summary(lm(Salary ~ fTeam+fPosition+fCollege+poly(Age,4)+poly(Height_i,4)+poly(Weight,4),data=ap_tibbl
#summary(lm(Salary ~ fTeam+fPosition+fCollege+poly(Age,3)+Height_i+poly(Weight,2),data=ap_tibble))
#summary(lm(Salary ~ fTeam+fPosition+fCollege+poly(Age,3)+Height_i+poly(Weight,3),data=ap_tibble))
#summary(lm(Salary ~ fTeam+fPosition+fCollege+poly(Age,3)+Height_i+poly(Weight,4),data=ap_tibble))
summary(lm(Salary ~ fTeam+fPosition+fCollege+poly(Age,3)+Height_i+Weight,data=ap_tibble))
```

```
##
## Call:
## lm(formula = Salary ~ fTeam + fPosition + fCollege + poly(Age,
##     3) + Height_i + Weight, data = ap_tibble)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -15845192  -4236590         0   2817577  26638013
##
## Coefficients:
##                                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   -28100952   15781292  -1.781 0.076031 .
## fTeamBoston Celtics            -2498579    3911629  -0.639 0.523493
## fTeamBrooklyn Nets              1208781    3717723   0.325 0.745313
## fTeamCharlotte Hornets         -2219790    3642960  -0.609 0.542785
## fTeamChicago Bulls              1652120    4025361   0.410 0.681800
## fTeamCleveland Cavaliers        2377524    3984428   0.597 0.551177
## fTeamDallas Mavericks          -3389325    3729024  -0.909 0.364166
```

```
## fTeamDenver Nuggets                437732    3812044   0.115 0.908662
## fTeamDetroit Pistons              -3846509    3809424  -1.010 0.313476
## fTeamGolden State Warriors         -350777    3887045  -0.090 0.928158
## fTeamHouston Rockets              -1858619    3759594  -0.494 0.621427
## fTeamIndiana Pacers               -1004796    3859340  -0.260 0.794778
## fTeamLos Angeles Clippers         -2114869    3932077  -0.538 0.591099
## fTeamLos Angeles Lakers            1093475    4154710   0.263 0.792594
## fTeamMemphis Grizzlies            -2076115    3907834  -0.531 0.595644
## fTeamMiami Heat                    -429517    4040691  -0.106 0.915420
## fTeamMilwaukee Bucks                377816    3924182   0.096 0.923367
## fTeamMinnesota Timberwolves        4431981    4114690   1.077 0.282338
## fTeamNew Orleans Pelicans          -385444    3657333  -0.105 0.916141
## fTeamNew York Knicks              -1171706    3729507  -0.314 0.753620
## fTeamOklahoma City Thunder        -3153191    3832208  -0.823 0.411300
## fTeamOrlando Magic                 -941755    3860819  -0.244 0.807463
## fTeamPhiladelphia Sixers            486633    3875890   0.126 0.900173
## fTeamPhoenix Suns                  1692378    3913939   0.432 0.665778
## fTeamPortland Trail Blazers       -5537907    4289388  -1.291 0.197721
## fTeamSacremento Kings              1268408    3926289   0.323 0.746889
## fTeamSan Antonio Spurs             -286506    3791591  -0.076 0.939819
## fTeamToronto Raptors               -262010    4164719  -0.063 0.949881
## fTeamUtah Jazz                     1601893    3992059   0.401 0.688521
## fTeamWashington Wizards           -2087478    3632563  -0.575 0.565975
## fPositionF                         2519006    4279585   0.589 0.556588
## fPositionG                         8219984    5088842   1.615 0.107349
## fPositionPF                        3291038    1886069   1.745 0.082073 .
## fPositionPG                       10784169    2920784   3.692 0.000266 ***
## fPositionSF                        6255406    2093384   2.988 0.003050 **
## fPositionSG                        6395862    2488767   2.570 0.010680 *
## fCollegeArizona                    1382765    5493872   0.252 0.801460
## fCollegeArizona State             10784722    7115422   1.516 0.130704
## fCollegeArkansas                   1450593    6511372   0.223 0.823867
## fCollegeAuburn                     1898033    7031083   0.270 0.787394
## fCollegeBaylor                    -3602280    6297436  -0.572 0.567756
## fCollegeBelmont                   -5083373   10466785  -0.486 0.627575
## fCollegeBoise State               -5279062   10640005  -0.496 0.620168
## fCollegeBoston College            -3404067   10626862  -0.320 0.748955
## fCollegeBowling Green              3047889   10717258   0.284 0.776317
## fCollegeBucknell                  -2129193   10726865  -0.198 0.842801
## fCollegeButler                     5005869    8183586   0.612 0.541225
## fCollegeBYU                       -7660288   10636835  -0.720 0.472011
## fCollegeCal Poly                  -5109108   10636425  -0.480 0.631352
## fCollegeCalifornia                21163722   10657701   1.986 0.048014 *
## fCollegeCharleston                -9169410   10749959  -0.853 0.394389
## fCollegeCleveland State           -5129372   10506415  -0.488 0.625773
## fCollegeColorado                   1849371    7069392   0.262 0.793816
## fCollegeConnecticut                2865171    6154223   0.466 0.641884
## fCollegeCreighton                 -1509364    8096986  -0.186 0.852255
## fCollegeDavidson                  33677639   10605701   3.175 0.001660 **
## fCollegeDayton                     2591182   10579730   0.245 0.806694
## fCollegeDePaul                    -4753693    8139829  -0.584 0.559678
## fCollegeDrexel                    -8446967   10639340  -0.794 0.427890
## fCollegeDuke                       3092084    4807875   0.643 0.520656
## fCollegeFlorida                   13470522    6446073   2.090 0.037526 *
```

```
## fCollegeFlorida State               1935365    5537669   0.349 0.726978
## fCollegeFresno State               28125947   10649255   2.641 0.008718 **
## fCollegeGeorge Washington          -7497793   10734801  -0.698 0.485459
## fCollegeGeorgetown                 -5582970    7052110  -0.792 0.429207
## fCollegeGeorgia                     2040386    7094103   0.288 0.773848
## fCollegeGeorgia Tech                -580477    7119767  -0.082 0.935077
## fCollegeGonzaga                     3777179    5786363   0.653 0.514427
## fCollegeHouston                    -4761057    8019032  -0.594 0.553169
## fCollegeIllinois                   -3488387    8502914  -0.410 0.681924
## fCollegeIndiana                     1007865    5784293   0.174 0.861799
## fCollegeIowa State                 -3623880    6161080  -0.588 0.556870
## fCollegeIUPUI                      -4038890   11705180  -0.345 0.730309
## fCollegeKansas                      4947024    5498897   0.900 0.369069
## fCollegeKansas State               -4989749    7051286  -0.708 0.479747
## fCollegeKentucky                    6494719    4782295   1.358 0.175510
## fCollegeLehigh                     27483171   10764435   2.553 0.011195 *
## fCollegeLiberty                    -2389168   10590315  -0.226 0.821674
## fCollegeLouisiana-Lafayette       -12350528   10641111  -1.161 0.246755
## fCollegeLouisville                  5014092    6222956   0.806 0.421061
## fCollegeLoyola (MD)                 4464526   10633872   0.420 0.674917
## fCollegeLSU                         1999235    6427567   0.311 0.755996
## fCollegeMarquette                   3292324    7175419   0.459 0.646702
## fCollegeMarshall                  -12040813   10696791  -1.126 0.261259
## fCollegeMaryland                   -2934526    6227120  -0.471 0.637822
## fCollegeMemphis                     4498849    6475068   0.695 0.487747
## fCollegeMiami (FL)                  -870338    8077425  -0.108 0.914270
## fCollegeMichigan                    3078492    5644098   0.545 0.585879
## fCollegeMichigan State              7111058    6257510   1.136 0.256739
## fCollegeMinnesota                   3041650   10619794   0.286 0.774769
## fCollegeMississippi State          -5835428   10679555  -0.546 0.585209
## fCollegeMissouri                   -1132507    7034778  -0.161 0.872217
## fCollegeMissouri State             -4390876   10661196  -0.412 0.680754
## fCollegeMurray State                 705079    8138762   0.087 0.931024
## fCollegenan                         3174190    4535979   0.700 0.484633
## fCollegeNebraska                   -1288031    8189270  -0.157 0.875133
## fCollegeNevada                     -5857444    8152967  -0.718 0.473071
## fCollegeNew Mexico                 -4463277   10769091  -0.414 0.678853
## fCollegeNew Mexico JC                564927   10879279   0.052 0.958623
## fCollegeNew Mexico State           16437669   10840045   1.516 0.130527
## fCollegeNorth Carolina             -1063109    5382619  -0.198 0.843570
## fCollegeNorth Carolina State        2000823   10621694   0.188 0.850719
## fCollegeNotre Dame                 -5636466   10622718  -0.531 0.596104
## fCollegeOhio                       -2697562   10627270  -0.254 0.799806
## fCollegeOhio State                  5798889    7152955   0.811 0.418213
## fCollegeOklahoma                      17897    7094417   0.003 0.997989
## fCollegeOklahoma State              4013545    8155318   0.492 0.622999
## fCollegeOld Dominion               -9205156   10704741  -0.860 0.390557
## fCollegeOle Miss                   -2656805   10650493  -0.249 0.803189
## fCollegeOregon                       856521    6129671   0.140 0.888969
## fCollegeOregon State               -5714923   10536958  -0.542 0.587986
## fCollegePenn State                 -5892811   11105678  -0.531 0.596099
## fCollegePittsburgh                  8694966   10721574   0.811 0.418052
## fCollegeProvidence                 -5989598   10598828  -0.565 0.572436
## fCollegePurdue                     -3314444   10820431  -0.306 0.759589
```

```
## fCollegeRadford                    -14426877   10659952  -1.353 0.177006
## fCollegeSaint Joseph's              -2965471    8376739  -0.354 0.723590
## fCollegeSaint Mary's                -6047256    8056433  -0.751 0.453503
## fCollegeSalt Lake CC UT            -10880073   10643457  -1.022 0.307535
## fCollegeSan Diego State              7854033    7132262   1.101 0.271736
## fCollegeSMU                         -5285879    7151073  -0.739 0.460408
## fCollegeSouth Carolina              -4521499   10443725  -0.433 0.665385
## fCollegeSt. John's                  -8794906   10660997  -0.825 0.410081
## fCollegeStanford                     1121244    5941628   0.189 0.850454
## fCollegeSyracuse                    -1418323    6229719  -0.228 0.820065
## fCollegeTCU                         -2697656    8177543  -0.330 0.741728
## fCollegeTennessee                    6738844    6249945   1.078 0.281842
## fCollegeTennessee State              9770533   10813158   0.904 0.366980
## fCollegeTexas                        7398399    5242145   1.411 0.159234
## fCollegeTexas A&M                    4934943    6604185   0.747 0.455530
## fCollegeTexas Tech                   2204694    8452618   0.261 0.794412
## fCollegeUC Santa Barbara            -8660385   10617693  -0.816 0.415376
## fCollegeUCLA                         8027049    5310660   1.511 0.131766
## fCollegeUNLV                         5032114    7306594   0.689 0.491565
## fCollegeUSC                          3799320    5468361   0.695 0.487756
## fCollegeUSC Upstate                 -7223806   10616061  -0.680 0.496764
## fCollegeUtah                         2909863    7074883   0.411 0.681164
## fCollegeUtah State                  -3429652   10601561  -0.324 0.746550
## fCollegeVanderbilt                   -894356    6466689  -0.138 0.890099
## fCollegeVillanova                    -527126    5426549  -0.097 0.922685
## fCollegeVirginia                      -97997    5698792  -0.017 0.986292
## fCollegeVirginia Commonwealth         258139   10403851   0.025 0.980222
## fCollegeVirginia Tech               -1184659   10271646  -0.115 0.908262
## fCollegeWake Forest                  5093695    6173462   0.825 0.410005
## fCollegeWashington                   1943710    5575400   0.349 0.727629
## fCollegeWashington State            15316326    8210495   1.865 0.063141 .
## fCollegeWeber State                30495429   10781106   2.829 0.005006 **
## fCollegeWest Virginia               -5746988    8089955  -0.710 0.478044
## fCollegeWestern Texas Coll. (J.C.)  -6269050   10547757  -0.594 0.552748
## fCollegeWichita State                4937906    8257823   0.598 0.550335
## fCollegeWisconsin                   -8412031    8439429  -0.997 0.319727
## fCollegeWyoming                       301299    8228168   0.037 0.970815
## fCollegeXavier                      -5822278    7941972  -0.733 0.464097
## fCollegeYale                        -5860643   10670185  -0.549 0.583260
## poly(Age, 3)1                       54655272   11709494   4.668 4.69e-06 ***
## poly(Age, 3)2                      -42509394   11928551  -3.564 0.000428 ***
## poly(Age, 3)3                      -24531140   11073435  -2.215 0.027526 *
## Height_i                              698756    1871492   0.373 0.709151
## Weight                                116620      37351   3.122 0.001978 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 9134000 on 286 degrees of freedom
## Multiple R-squared:  0.4502, Adjusted R-squared:  0.1465
## F-statistic: 1.482 on 158 and 286 DF,  p-value: 0.0021
```

The end result is that only `Age` has been misspecified, and has been re-specified as `poly(Age,3)`.

Reduced Model

```
summary(lm_log1 <- lm(log(Salary) ~ fTeam+fPosition+fCollege+poly(Age,3)+Height_i+Weight, data=ap_tibble
```

```
##
## Call:
## lm(formula = log(Salary) ~ fTeam + fPosition + fCollege + poly(Age,
##     3) + Height_i + Weight, data = ap_tibble)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.0695 -0.4836  0.0000  0.4824  2.0273
##
## Coefficients:
##                                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)                    12.043683   1.618465   7.441 1.17e-12 ***
## fTeamBoston Celtics            -0.374141   0.401161  -0.933 0.351789
## fTeamBrooklyn Nets             -0.340770   0.381275  -0.894 0.372199
## fTeamCharlotte Hornets         -0.233372   0.373607  -0.625 0.532702
## fTeamChicago Bulls              0.087408   0.412825   0.212 0.832467
## fTeamCleveland Cavaliers        0.313679   0.408627   0.768 0.443334
## fTeamDallas Mavericks          -0.400137   0.382434  -1.046 0.296310
## fTeamDenver Nuggets            -0.160452   0.390948  -0.410 0.681806
## fTeamDetroit Pistons           -0.419976   0.390679  -1.075 0.283286
## fTeamGolden State Warriors     -0.315033   0.398640  -0.790 0.430025
## fTeamHouston Rockets           -0.425153   0.385569  -1.103 0.271099
## fTeamIndiana Pacers            -0.054030   0.395798  -0.137 0.891514
## fTeamLos Angeles Clippers      -0.283448   0.403258  -0.703 0.482693
## fTeamLos Angeles Lakers        -0.558302   0.426090  -1.310 0.191149
## fTeamMemphis Grizzlies         -0.143422   0.400772  -0.358 0.720708
## fTeamMiami Heat                -0.389433   0.414397  -0.940 0.348135
## fTeamMilwaukee Bucks           -0.500471   0.402448  -1.244 0.214677
## fTeamMinnesota Timberwolves     0.320329   0.421986   0.759 0.448419
## fTeamNew Orleans Pelicans      -0.114140   0.375081  -0.304 0.761115
## fTeamNew York Knicks           -0.270026   0.382483  -0.706 0.480774
## fTeamOklahoma City Thunder     -0.344376   0.393016  -0.876 0.381635
## fTeamOrlando Magic             -0.002917   0.395950  -0.007 0.994127
## fTeamPhiladelphia Sixers       -0.256713   0.397496  -0.646 0.518909
## fTeamPhoenix Suns               0.134262   0.401398   0.334 0.738259
## fTeamPortland Trail Blazers    -0.746262   0.439902  -1.696 0.090893 .
## fTeamSacremento Kings          -0.030373   0.402664  -0.075 0.939925
## fTeamSan Antonio Spurs         -0.116766   0.388850  -0.300 0.764178
## fTeamToronto Raptors           -0.166230   0.427117  -0.389 0.697424
## fTeamUtah Jazz                 -0.055919   0.409409  -0.137 0.891455
## fTeamWashington Wizards        -0.359851   0.372541  -0.966 0.334892
## fPositionF                      0.026966   0.438897   0.061 0.951052
## fPositionG                      1.201822   0.521891   2.303 0.022007 *
## fPositionPF                     0.313371   0.193428   1.620 0.106314
## fPositionPG                     1.080926   0.299544   3.609 0.000363 ***
## fPositionSF                     0.669712   0.214689   3.119 0.001997 **
## fPositionSG                     0.745132   0.255238   2.919 0.003786 **
## fCollegeArizona                 0.085742   0.563429   0.152 0.879153
## fCollegeArizona State           0.325108   0.729729   0.446 0.656282
## fCollegeArkansas               -0.008287   0.667780  -0.012 0.990107
```

```
## fCollegeAuburn                  -0.115713   0.721079  -0.160 0.872623
## fCollegeBaylor                  -0.471312   0.645839  -0.730 0.466130
## fCollegeBelmont                 -1.090632   1.073431  -1.016 0.310476
## fCollegeBoise State             -0.544291   1.091196  -0.499 0.618302
## fCollegeBoston College          -0.078651   1.089848  -0.072 0.942520
## fCollegeBowling Green            0.731551   1.099119   0.666 0.506216
## fCollegeBucknell                -0.398495   1.100104  -0.362 0.717444
## fCollegeButler                  -0.268787   0.839275  -0.320 0.749004
## fCollegeBYU                     -1.080330   1.090871  -0.990 0.322846
## fCollegeCal Poly                -0.294131   1.090829  -0.270 0.787632
## fCollegeCalifornia               1.762453   1.093011   1.612 0.107961
## fCollegeCharleston              -1.337265   1.102472  -1.213 0.226142
## fCollegeCleveland State         -0.527030   1.077495  -0.489 0.625128
## fCollegeColorado                 0.432306   0.725008   0.596 0.551462
## fCollegeConnecticut              0.053908   0.631152   0.085 0.931993
## fCollegeCreighton               -0.277264   0.830394  -0.334 0.738704
## fCollegeDavidson                 1.750097   1.087678   1.609 0.108715
## fCollegeDayton                   0.574159   1.085014   0.529 0.597097
## fCollegeDePaul                  -0.901192   0.834788  -1.080 0.281254
## fCollegeDrexel                  -1.263824   1.091128  -1.158 0.247719
## fCollegeDuke                     0.260423   0.493076   0.528 0.597798
## fCollegeFlorida                  0.980413   0.661083   1.483 0.139165
## fCollegeFlorida State            0.100377   0.567921   0.177 0.859834
## fCollegeFresno State             1.408751   1.092144   1.290 0.198129
## fCollegeGeorge Washington       -1.274873   1.100918  -1.158 0.247826
## fCollegeGeorgetown              -0.802373   0.723236  -1.109 0.268180
## fCollegeGeorgia                  0.394645   0.727542   0.542 0.587941
## fCollegeGeorgia Tech             0.122449   0.730174   0.168 0.866939
## fCollegeGonzaga                  0.471640   0.593426   0.795 0.427404
## fCollegeHouston                 -1.017824   0.822399  -1.238 0.216869
## fCollegeIllinois                -0.740160   0.872024  -0.849 0.396712
## fCollegeIndiana                 -0.005835   0.593214  -0.010 0.992159
## fCollegeIowa State              -0.094649   0.631855  -0.150 0.881032
## fCollegeIUPUI                   -0.419290   1.200436  -0.349 0.727135
## fCollegeKansas                   0.287996   0.563945   0.511 0.609968
## fCollegeKansas State            -1.193704   0.723151  -1.651 0.099898 .
## fCollegeKentucky                 0.411688   0.490453   0.839 0.401944
## fCollegeLehigh                   2.108315   1.103957   1.910 0.057162 .
## fCollegeLiberty                 -0.911002   1.086100  -0.839 0.402292
## fCollegeLouisiana-Lafayette     -1.888017   1.091309  -1.730 0.084700 .
## fCollegeLouisville               0.440683   0.638201   0.691 0.490435
## fCollegeLoyola (MD)             -0.087411   1.090567  -0.080 0.936172
## fCollegeLSU                     -0.074724   0.659185  -0.113 0.909826
## fCollegeMarquette               -0.014981   0.735882  -0.020 0.983772
## fCollegeMarshall                -1.768418   1.097019  -1.612 0.108060
## fCollegeMaryland                -0.308302   0.638628  -0.483 0.629638
## fCollegeMemphis                  0.765476   0.664057   1.153 0.249985
## fCollegeMiami (FL)               0.194588   0.828388   0.235 0.814455
## fCollegeMichigan                 0.070056   0.578836   0.121 0.903753
## fCollegeMichigan State           0.586704   0.641745   0.914 0.361364
## fCollegeMinnesota               -0.463466   1.089123  -0.426 0.670763
## fCollegeMississippi State       -1.174394   1.095252  -1.072 0.284507
## fCollegeMissouri                -0.048929   0.721458  -0.068 0.945976
## fCollegeMissouri State          -0.567238   1.093369  -0.519 0.604302
```

```
## fCollegeMurray State               0.315173   0.834678   0.378 0.706009
## fCollegenan                        0.231327   0.465192   0.497 0.619379
## fCollegeNebraska                  -0.901567   0.839858  -1.073 0.283963
## fCollegeNevada                    -0.898709   0.836135  -1.075 0.283353
## fCollegeNew Mexico                -1.022391   1.104434  -0.926 0.355375
## fCollegeNew Mexico JC              0.410371   1.115735   0.368 0.713292
## fCollegeNew Mexico State           0.947580   1.111711   0.852 0.394726
## fCollegeNorth Carolina            -0.127039   0.552020  -0.230 0.818152
## fCollegeNorth Carolina State       0.326403   1.089318   0.300 0.764670
## fCollegeNotre Dame                -0.040278   1.089423  -0.037 0.970533
## fCollegeOhio                      -1.214985   1.089890  -1.115 0.265882
## fCollegeOhio State                 0.247982   0.733578   0.338 0.735578
## fCollegeOklahoma                  -0.044424   0.727575  -0.061 0.951356
## fCollegeOklahoma State             0.735074   0.836376   0.879 0.380204
## fCollegeOld Dominion              -1.077595   1.097835  -0.982 0.327144
## fCollegeOle Miss                  -0.211418   1.092271  -0.194 0.846659
## fCollegeOregon                     0.018247   0.628634   0.029 0.976864
## fCollegeOregon State              -1.060304   1.080628  -0.981 0.327327
## fCollegePenn State                -1.158480   1.138953  -1.017 0.309944
## fCollegePittsburgh                 0.883148   1.099561   0.803 0.422537
## fCollegeProvidence                -0.398284   1.086973  -0.366 0.714325
## fCollegePurdue                    -0.787739   1.109700  -0.710 0.478365
## fCollegeRadford                   -2.072153   1.093241  -1.895 0.059045 .
## fCollegeSaint Joseph's            -0.644945   0.859084  -0.751 0.453429
## fCollegeSaint Mary's              -0.894140   0.826235  -1.082 0.280082
## fCollegeSalt Lake CC UT           -1.376906   1.091550  -1.261 0.208184
## fCollegeSan Diego State            0.135275   0.731456   0.185 0.853408
## fCollegeSMU                       -0.750477   0.733385  -1.023 0.307028
## fCollegeSouth Carolina            -0.880228   1.071066  -0.822 0.411862
## fCollegeSt. John's                -0.781249   1.093349  -0.715 0.475472
## fCollegeStanford                   0.072780   0.609349   0.119 0.905011
## fCollegeSyracuse                  -0.484707   0.638895  -0.759 0.448678
## fCollegeTCU                       -0.855784   0.838656  -1.020 0.308390
## fCollegeTennessee                  0.442793   0.640969   0.691 0.490240
## fCollegeTennessee State            1.361532   1.108954   1.228 0.220546
## fCollegeTexas                      0.698902   0.537613   1.300 0.194644
## fCollegeTexas A&M                  0.457468   0.677298   0.675 0.499948
## fCollegeTexas Tech                -0.206779   0.866866  -0.239 0.811636
## fCollegeUC Santa Barbara          -1.173666   1.088908  -1.078 0.282014
## fCollegeUCLA                       0.630161   0.544640   1.157 0.248228
## fCollegeUNLV                       0.885205   0.749335   1.181 0.238457
## fCollegeUSC                        0.241331   0.560813   0.430 0.667284
## fCollegeUSC Upstate               -0.805572   1.088740  -0.740 0.459961
## fCollegeUtah                       0.577608   0.725571   0.796 0.426650
## fCollegeUtah State                -1.243961   1.087253  -1.144 0.253526
## fCollegeVanderbilt                -0.295474   0.663197  -0.446 0.656274
## fCollegeVillanova                 -0.139847   0.556525  -0.251 0.801774
## fCollegeVirginia                  -0.135298   0.584445  -0.231 0.817094
## fCollegeVirginia Commonwealth     -0.216397   1.066977  -0.203 0.839425
## fCollegeVirginia Tech             -0.266175   1.053418  -0.253 0.800699
## fCollegeWake Forest                0.320538   0.633125   0.506 0.613051
## fCollegeWashington                 0.116028   0.571790   0.203 0.839341
## fCollegeWashington State           0.675958   0.842035   0.803 0.422776
## fCollegeWeber State                1.868116   1.105667   1.690 0.092197 .
```

```
## fCollegeWest Virginia              -0.876868   0.829673  -1.057 0.291457
## fCollegeWestern Texas Coll. (J.C.) -1.266890   1.081735  -1.171 0.242507
## fCollegeWichita State               0.449096   0.846889   0.530 0.596323
## fCollegeWisconsin                  -1.327434   0.865514  -1.534 0.126210
## fCollegeWyoming                    -0.006288   0.843848  -0.007 0.994060
## fCollegeXavier                     -1.138664   0.814496  -1.398 0.163197
## fCollegeYale                       -1.059210   1.094291  -0.968 0.333891
## poly(Age, 3)1                       6.632580   1.200878   5.523 7.49e-08 ***
## poly(Age, 3)2                      -4.034700   1.223344  -3.298 0.001097 **
## poly(Age, 3)3                      -2.816061   1.135647  -2.480 0.013725 *
## Height_i                            0.067048   0.191933   0.349 0.727098
## Weight                              0.011685   0.003831   3.050 0.002500 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9368 on 286 degrees of freedom
## Multiple R-squared:  0.4646, Adjusted R-squared:  0.1688
## F-statistic: 1.571 on 158 and 286 DF,  p-value: 0.0005046
```

```
# Removal of `fTeam` due to no significance
summary(lm_log2 <- lm(log(Salary) ~ fPosition+fCollege+poly(Age,3)+Height_i+Weight,data=ap_tibble))
```

```
##
## Call:
## lm(formula = log(Salary) ~ fPosition + fCollege + poly(Age, 3) +
##     Height_i + Weight, data = ap_tibble)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -1.9859 -0.4699  0.0000  0.4992  1.8599
##
## Coefficients:
##                                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)                     12.117721   1.477341   8.202 6.06e-15 ***
## fPositionF                      -0.086967   0.403461  -0.216  0.82948
## fPositionG                       1.235310   0.483952   2.553  0.01117 *
## fPositionPF                      0.279807   0.185492   1.508  0.13244
## fPositionPG                      1.057613   0.275625   3.837  0.00015 ***
## fPositionSF                      0.635628   0.204997   3.101  0.00211 **
## fPositionSG                      0.688469   0.237414   2.900  0.00400 **
## fCollegeArizona                  0.055245   0.532422   0.104  0.91742
## fCollegeArizona State            0.025576   0.680079   0.038  0.97003
## fCollegeArkansas                -0.122212   0.621649  -0.197  0.84427
## fCollegeAuburn                  -0.046540   0.678701  -0.069  0.94537
## fCollegeBaylor                  -0.454477   0.589873  -0.770  0.44160
## fCollegeBelmont                 -0.768565   1.018843  -0.754  0.45120
## fCollegeBoise State             -0.415831   1.018326  -0.408  0.68330
## fCollegeBoston College          -0.311669   1.018865  -0.306  0.75988
## fCollegeBowling Green            0.691339   1.024226   0.675  0.50018
## fCollegeBucknell                -0.712422   1.024108  -0.696  0.48716
## fCollegeButler                  -0.362499   0.782809  -0.463  0.64363
## fCollegeBYU                     -1.558654   1.020159  -1.528  0.12755
## fCollegeCal Poly                -0.696183   1.018534  -0.684  0.49478
## fCollegeCalifornia               1.411555   1.023466   1.379  0.16881
## fCollegeCharleston              -1.376754   1.024445  -1.344  0.17995
```

```
## fCollegeCleveland State          -0.603581   1.019888  -0.592  0.55440
## fCollegeColorado                  0.205323   0.684289   0.300  0.76433
## fCollegeConnecticut              -0.061817   0.589238  -0.105  0.91651
## fCollegeCreighton                -0.519901   0.780406  -0.666  0.50578
## fCollegeDavidson                  1.502171   1.018014   1.476  0.14105
## fCollegeDayton                    0.304262   1.020250   0.298  0.76573
## fCollegeDePaul                   -1.212032   0.778966  -1.556  0.12072
## fCollegeDrexel                   -1.538127   1.019568  -1.509  0.13240
## fCollegeDuke                      0.053454   0.461872   0.116  0.90794
## fCollegeFlorida                   0.667880   0.611133   1.093  0.27529
## fCollegeFlorida State             0.107562   0.532929   0.202  0.84018
## fCollegeFresno State              1.211215   1.023660   1.183  0.23761
## fCollegeGeorge Washington        -1.441765   1.019703  -1.414  0.15838
## fCollegeGeorgetown               -1.046503   0.682489  -1.533  0.12619
## fCollegeGeorgia                   0.301886   0.677633   0.446  0.65626
## fCollegeGeorgia Tech              0.122146   0.680779   0.179  0.85772
## fCollegeGonzaga                   0.288661   0.551769   0.523  0.60123
## fCollegeHouston                  -0.960029   0.780881  -1.229  0.21983
## fCollegeIllinois                 -0.994444   0.803835  -1.237  0.21696
## fCollegeIndiana                  -0.370406   0.549223  -0.674  0.50054
## fCollegeIowa State               -0.233615   0.591569  -0.395  0.69318
## fCollegeIUPUI                    -0.882552   1.107211  -0.797  0.42600
## fCollegeKansas                   -0.004379   0.526047  -0.008  0.99336
## fCollegeKansas State             -1.287976   0.680876  -1.892  0.05946 .
## fCollegeKentucky                  0.158730   0.455085   0.349  0.72748
## fCollegeLehigh                    1.405990   1.019040   1.380  0.16865
## fCollegeLiberty                  -1.257512   1.019405  -1.234  0.21828
## fCollegeLouisiana-Lafayette      -1.763779   1.017260  -1.734  0.08392 .
## fCollegeLouisville                0.230565   0.593388   0.389  0.69787
## fCollegeLoyola (MD)              -0.182419   1.019218  -0.179  0.85807
## fCollegeLSU                      -0.121002   0.623830  -0.194  0.84633
## fCollegeMarquette                -0.152052   0.683998  -0.222  0.82423
## fCollegeMarshall                 -1.756584   1.026894  -1.711  0.08814 .
## fCollegeMaryland                 -0.271483   0.593567  -0.457  0.64772
## fCollegeMemphis                   0.592409   0.627057   0.945  0.34551
## fCollegeMiami (FL)               -0.024938   0.778373  -0.032  0.97446
## fCollegeMichigan                 -0.160240   0.531642  -0.301  0.76330
## fCollegeMichigan State            0.445161   0.589990   0.755  0.45110
## fCollegeMinnesota                -0.604685   1.017826  -0.594  0.55288
## fCollegeMississippi State        -1.169741   1.019252  -1.148  0.25199
## fCollegeMissouri                 -0.149374   0.679018  -0.220  0.82602
## fCollegeMissouri State           -0.913975   1.021617  -0.895  0.37167
## fCollegeMurray State              0.292069   0.778957   0.375  0.70795
## fCollegenan                       0.008729   0.433229   0.020  0.98394
## fCollegeNebraska                 -1.167982   0.779184  -1.499  0.13488
## fCollegeNevada                   -0.909498   0.779824  -1.166  0.24438
## fCollegeNew Mexico               -1.736878   1.018038  -1.706  0.08897 .
## fCollegeNew Mexico JC             0.253290   1.026353   0.247  0.80523
## fCollegeNew Mexico State          0.786111   1.034831   0.760  0.44803
## fCollegeNorth Carolina           -0.291903   0.509312  -0.573  0.56696
## fCollegeNorth Carolina State      0.293789   1.019026   0.288  0.77330
## fCollegeNotre Dame               -0.500569   1.019419  -0.491  0.62374
## fCollegeOhio                     -1.513938   1.014534  -1.492  0.13663
## fCollegeOhio State                0.209518   0.679142   0.309  0.75790
```

```
## fCollegeOklahoma                   -0.126917   0.678691  -0.187  0.85178
## fCollegeOklahoma State              0.372287   0.785870   0.474  0.63602
## fCollegeOld Dominion               -1.568101   1.021626  -1.535  0.12581
## fCollegeOle Miss                   -0.229161   1.018945  -0.225  0.82220
## fCollegeOregon                     -0.113425   0.589202  -0.193  0.84747
## fCollegeOregon State               -1.167058   1.023934  -1.140  0.25524
## fCollegePenn State                 -0.760438   1.079070  -0.705  0.48151
## fCollegePittsburgh                  0.756957   1.025777   0.738  0.46110
## fCollegeProvidence                 -0.776948   1.018884  -0.763  0.44630
## fCollegePurdue                     -1.169669   1.037993  -1.127  0.26066
## fCollegeRadford                    -1.979371   1.018938  -1.943  0.05296 .
## fCollegeSaint Joseph's             -0.938819   0.799722  -1.174  0.24131
## fCollegeSaint Mary's               -1.095724   0.778699  -1.407  0.16038
## fCollegeSalt Lake CC UT            -1.691322   1.016909  -1.663  0.09727 .
## fCollegeSan Diego State            -0.087486   0.677631  -0.129  0.89736
## fCollegeSMU                        -1.125113   0.683484  -1.646  0.10073
## fCollegeSouth Carolina             -1.027340   1.019405  -1.008  0.31433
## fCollegeSt. John's                 -0.789460   1.018580  -0.775  0.43889
## fCollegeStanford                   -0.182160   0.563671  -0.323  0.74678
## fCollegeSyracuse                   -0.671259   0.591894  -1.134  0.25762
## fCollegeTCU                        -1.088543   0.779655  -1.396  0.16364
## fCollegeTennessee                   0.185135   0.584538   0.317  0.75167
## fCollegeTennessee State             0.657758   1.022068   0.644  0.52033
## fCollegeTexas                       0.513432   0.505430   1.016  0.31049
## fCollegeTexas A&M                   0.171219   0.627040   0.273  0.78499
## fCollegeTexas Tech                 -0.300202   0.802715  -0.374  0.70867
## fCollegeUC Santa Barbara           -1.582938   1.018485  -1.554  0.12114
## fCollegeUCLA                        0.377604   0.504005   0.749  0.45429
## fCollegeUNLV                        0.701892   0.686767   1.022  0.30755
## fCollegeUSC                         0.200199   0.520737   0.384  0.70090
## fCollegeUSC Upstate                -0.809992   1.018855  -0.795  0.42721
## fCollegeUtah                        0.426715   0.681985   0.626  0.53197
## fCollegeUtah State                 -1.371865   1.019650  -1.345  0.17946
## fCollegeVanderbilt                 -0.423046   0.623086  -0.679  0.49767
## fCollegeVillanova                  -0.332992   0.522212  -0.638  0.52416
## fCollegeVirginia                   -0.359020   0.548623  -0.654  0.51333
## fCollegeVirginia Commonwealth      -0.367610   1.013399  -0.363  0.71704
## fCollegeVirginia Tech              -0.363104   1.018403  -0.357  0.72167
## fCollegeWake Forest                 0.276855   0.593225   0.467  0.64104
## fCollegeWashington                  0.110843   0.528198   0.210  0.83392
## fCollegeWashington State            0.206812   0.779871   0.265  0.79104
## fCollegeWeber State                 1.165131   1.016695   1.146  0.25267
## fCollegeWest Virginia              -1.176820   0.778427  -1.512  0.13159
## fCollegeWestern Texas Coll. (J.C.) -1.358568   1.024063  -1.327  0.18559
## fCollegeWichita State               0.449360   0.784443   0.573  0.56716
## fCollegeWisconsin                  -1.283548   0.804188  -1.596  0.11147
## fCollegeWyoming                    -0.374736   0.780720  -0.480  0.63157
## fCollegeXavier                     -1.233072   0.778434  -1.584  0.11419
## fCollegeYale                       -1.100493   1.019347  -1.080  0.28114
## poly(Age, 3)1                       6.266113   1.072683   5.842 1.29e-08 ***
## poly(Age, 3)2                      -4.591228   1.081594  -4.245 2.88e-05 ***
## poly(Age, 3)3                      -2.517846   1.054401  -2.388  0.01753 *
## Height_i                            0.074499   0.179522   0.415  0.67843
## Weight                              0.011134   0.003517   3.166  0.00170 **
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9199 on 315 degrees of freedom
## Multiple R-squared:  0.4313, Adjusted R-squared:  0.1985
## F-statistic: 1.852 on 129 and 315 DF,  p-value: 7.096e-06
```

```
summary(lm_log3 <- lm(log(Salary) ~ fPosition+poly(Age,3)+Height_i+Weight,data=ap_tibble))
```

```
##
## Call:
## lm(formula = log(Salary) ~ fPosition + poly(Age, 3) + Height_i +
##     Weight, data = ap_tibble)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.83140 -0.75071 -0.00053  0.68054  2.13922
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)   13.378512   1.245474  10.742  < 2e-16 ***
## fPositionF    -0.487400   0.342620  -1.423 0.155582
## fPositionG     0.737517   0.412604   1.787 0.074561 .
## fPositionPF    0.175011   0.164275   1.065 0.287310
## fPositionPG    0.709369   0.234428   3.026 0.002626 **
## fPositionSF    0.318113   0.181414   1.754 0.080221 .
## fPositionSG    0.403881   0.202681   1.993 0.046923 *
## poly(Age, 3)1  6.765514   0.956954   7.070 6.25e-12 ***
## poly(Age, 3)2 -3.106151   0.953222  -3.259 0.001208 **
## poly(Age, 3)3 -3.153080   0.943404  -3.342 0.000903 ***
## Height_i      -0.007768   0.157832  -0.049 0.960770
## Weight         0.008309   0.003119   2.664 0.008013 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9368 on 433 degrees of freedom
## Multiple R-squared:  0.1893, Adjusted R-squared:  0.1687
## F-statistic: 9.191 on 11 and 433 DF,  p-value: 7.444e-15
```

```
summary(lm_log4 <- lm(log(Salary) ~ fPosition+poly(Age,3)+Weight,data=ap_tibble))
```

```
##
## Call:
## lm(formula = log(Salary) ~ fPosition + poly(Age, 3) + Weight,
##     data = ap_tibble)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.83384 -0.75300  0.00348  0.68066  2.13764
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)   13.330870   0.782775  17.030  < 2e-16 ***
## fPositionF    -0.489098   0.340488  -1.436  0.15159
## fPositionG     0.737585   0.412128   1.790  0.07420 .
```

```
## fPositionPF    0.174562   0.163833   1.065  0.28725
## fPositionPG    0.711135   0.231400   3.073  0.00225 **
## fPositionSF    0.316997   0.179784   1.763  0.07857 .
## fPositionSG    0.403881   0.202448   1.995  0.04667 *
## poly(Age, 3)1  6.769471   0.952473   7.107 4.89e-12 ***
## poly(Age, 3)2 -3.110142   0.948675  -3.278  0.00113 **
## poly(Age, 3)3 -3.153257   0.942313  -3.346  0.00089 ***
## Weight         0.008296   0.003104   2.673  0.00781 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9357 on 434 degrees of freedom
## Multiple R-squared:  0.1893, Adjusted R-squared:  0.1706
## F-statistic: 10.13 on 10 and 434 DF,  p-value: 2.258e-15
```

```
anova(lm_log4,lm_log3,lm_log2,lm_log1)
```

```
## Analysis of Variance Table
##
## Model 1: log(Salary) ~ fPosition + poly(Age, 3) + Weight
## Model 2: log(Salary) ~ fPosition + poly(Age, 3) + Height_i + Weight
## Model 3: log(Salary) ~ fPosition + fCollege + poly(Age, 3) + Height_i +
##     Weight
## Model 4: log(Salary) ~ fTeam + fPosition + fCollege + poly(Age, 3) + Height_i +
##     Weight
##   Res.Df    RSS  Df Sum of Sq      F Pr(>F)
## 1    434 380.00
## 2    433 380.00   1     0.002 0.0024 0.9608
## 3    315 266.54 118   113.459 1.0957 0.2692
## 4    286 250.97  29    15.575 0.6120 0.9438
```

Stepwise Model Selection

```
summary(lm_step <- step(lm_logsm <- lm(log(Salary) ~ fTeam+fPosition+fCollege+poly(Age,3)+Height_i+Weigh
```

```
## Start:  AIC=63.13
## log(Salary) ~ fTeam + fPosition + fCollege + poly(Age, 3) + Height_i +
##     Weight
##
##                 Df Sum of Sq    RSS     AIC
## - fCollege     118   112.484 363.45  -8.079
## - fTeam         29    15.575 266.54  31.921
## - Height_i       1     0.107 251.08  61.317
## <none>                       250.97  63.127
## - Weight         1     8.165 259.13  75.375
## - fPosition      6    14.621 265.59  76.325
## - poly(Age, 3)   3    45.448 296.42 131.192
##
## Step:  AIC=-8.08
## log(Salary) ~ fTeam + fPosition + poly(Age, 3) + Height_i + Weight
##
##                Df Sum of Sq    RSS     AIC
## - fTeam        29    16.550 380.00 -46.264
## - Height_i      1     0.007 363.46 -10.070
## <none>                      363.45  -8.079
```

```
## - fPosition     6    15.007 378.46  -2.075
## - Weight        1     8.063 371.52  -0.316
## - poly(Age, 3)  3    65.521 428.97  59.678
##
## Step:  AIC=-46.26
## log(Salary) ~ fPosition + poly(Age, 3) + Height_i + Weight
##
##                Df Sum of Sq    RSS     AIC
## - Height_i      1     0.002 380.00 -48.261
## <none>                      380.00 -46.264
## - fPosition     6    13.866 393.87 -42.315
## - Weight        1     6.228 386.23 -41.030
## - poly(Age, 3)  3    62.593 442.60  15.589
##
## Step:  AIC=-48.26
## log(Salary) ~ fPosition + poly(Age, 3) + Weight
##
##                Df Sum of Sq    RSS     AIC
## <none>                      380.00 -48.261
## - fPosition     6    14.709 394.71 -43.361
## - Weight        1     6.254 386.26 -42.997
## - poly(Age, 3)  3    63.348 443.35  14.350
##
## Call:
## lm(formula = log(Salary) ~ fPosition + poly(Age, 3) + Weight,
##     data = ap_tibble)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.83384 -0.75300  0.00348  0.68066  2.13764
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)   13.330870   0.782775  17.030  < 2e-16 ***
## fPositionF    -0.489098   0.340488  -1.436  0.15159
## fPositionG     0.737585   0.412128   1.790  0.07420 .
## fPositionPF    0.174562   0.163833   1.065  0.28725
## fPositionPG    0.711135   0.231400   3.073  0.00225 **
## fPositionSF    0.316997   0.179784   1.763  0.07857 .
## fPositionSG    0.403881   0.202448   1.995  0.04667 *
## poly(Age, 3)1  6.769471   0.952473   7.107 4.89e-12 ***
## poly(Age, 3)2 -3.110142   0.948675  -3.278  0.00113 **
## poly(Age, 3)3 -3.153257   0.942313  -3.346  0.00089 ***
## Weight         0.008296   0.003104   2.673  0.00781 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9357 on 434 degrees of freedom
## Multiple R-squared:  0.1893, Adjusted R-squared:  0.1706
## F-statistic: 10.13 on 10 and 434 DF,  p-value: 2.258e-15
```

```
shapiro.test(resid(lm_log2))
```

```
##
```

```
##  Shapiro-Wilk normality test
##
## data:  resid(lm_log2)
## W = 0.9903, p-value = 0.004962
```

```
bptest(lm_log2)
```

```
##
##  studentized Breusch-Pagan test
##
## data:  lm_log2
## BP = 147.16, df = 129, p-value = 0.1308
```

```
shapiro.test(resid(lm_step))
```

```
##
##  Shapiro-Wilk normality test
##
## data:  resid(lm_step)
## W = 0.9816, p-value = 1.996e-05
```

```
bptest(lm_step)
```

```
##
##  studentized Breusch-Pagan test
##
## data:  lm_step
## BP = 47.163, df = 10, p-value = 8.819e-07
```

Logistic Regression

```
# Transforming Team,Position,College into factors
ap_tibble <- transform (
  ap_tibble,
  nTeam = as.numeric(fTeam),
  nPosition = as.numeric(fPosition),
  nCollege = as.numeric(fCollege),
  fSalary.Dummy = as.factor(Salary.Dummy)
)

#cross validation
set.seed(999)
n <-nrow(ap_tibble)
n
```

```
## [1] 445
```

```
floor(0.7*n)
```

```
## [1] 311
```

```
#randomly sample 70% of the rows

train <- sample(1:n, 311)

tn <- ap_tibble[train,]
test <- ap_tibble[-train,]
```

```
summary(glmFit <- train(fSalary.Dummy ~ nTeam+nPosition+nCollege+Age+Height_i+Weight, data=ap_tibble, m
```

```
##
## Call:
## NULL
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.8917  -0.8587  -0.6293   1.1236   2.1465
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept) -3.488752   2.432577  -1.434  0.15152
## nPosition    0.140870   0.069198   2.036  0.04178 *
## Age          0.154183   0.025267   6.102 1.05e-09 ***
## Height_i    -0.809923   0.355835  -2.276  0.02284 *
## Weight       0.015820   0.006056   2.612  0.00899 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 576.54  on 444  degrees of freedom
## Residual deviance: 521.62  on 440  degrees of freedom
## AIC: 531.62
##
## Number of Fisher Scoring iterations: 4
```

```
confusionMatrix(glmFit)
```

```
## Bootstrapped (25 reps) Confusion Matrix
##
## (entries are percentual average cell counts across resamples)
##
##           Reference
## Prediction    0    1
##          0 55.5 23.9
##          1  9.6 11.1
##
##  Accuracy (average) : 0.6657
```

```
summary(glmFit2 <- train(fSalary.Dummy ~ nTeam+nPosition+nCollege+poly(Age,3)+Height_i+Weight, data=ap_
```

```
##
## Call:
## NULL
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.7211  -0.8556  -0.5179   0.9954   2.3404
##
## Coefficients:
##                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)       0.11247    2.39580   0.047   0.9626
## nPosition         0.11246    0.07163   1.570   0.1164
```

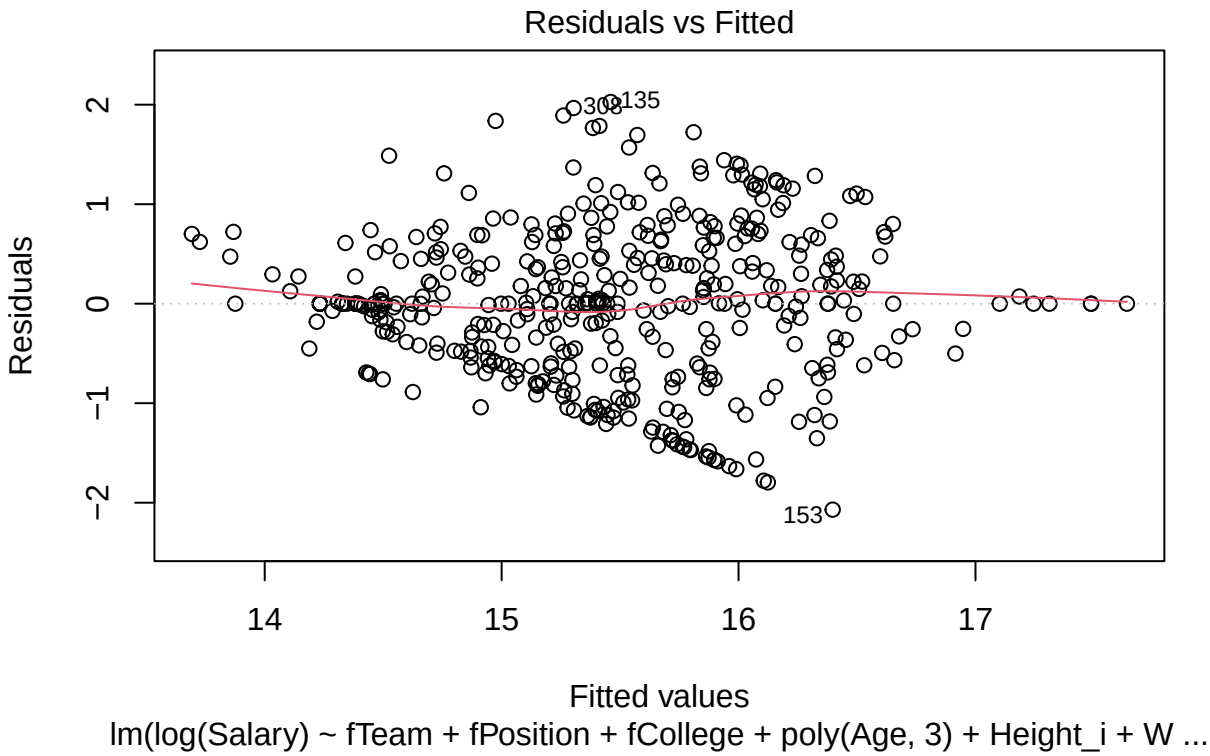
```
## `poly(Age, 3)1`  14.48770    2.78133   5.209 1.90e-07 ***
## `poly(Age, 3)2` -12.71575    2.84126  -4.475 7.63e-06 ***
## `poly(Age, 3)3`  -8.55996    3.49842  -2.447   0.0144 *
## Height_i         -0.69734    0.36772  -1.896   0.0579 .
## Weight            0.01433    0.00631   2.271   0.0232 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 576.54  on 444  degrees of freedom
## Residual deviance: 491.18  on 438  degrees of freedom
## AIC: 505.18
##
## Number of Fisher Scoring iterations: 4
```

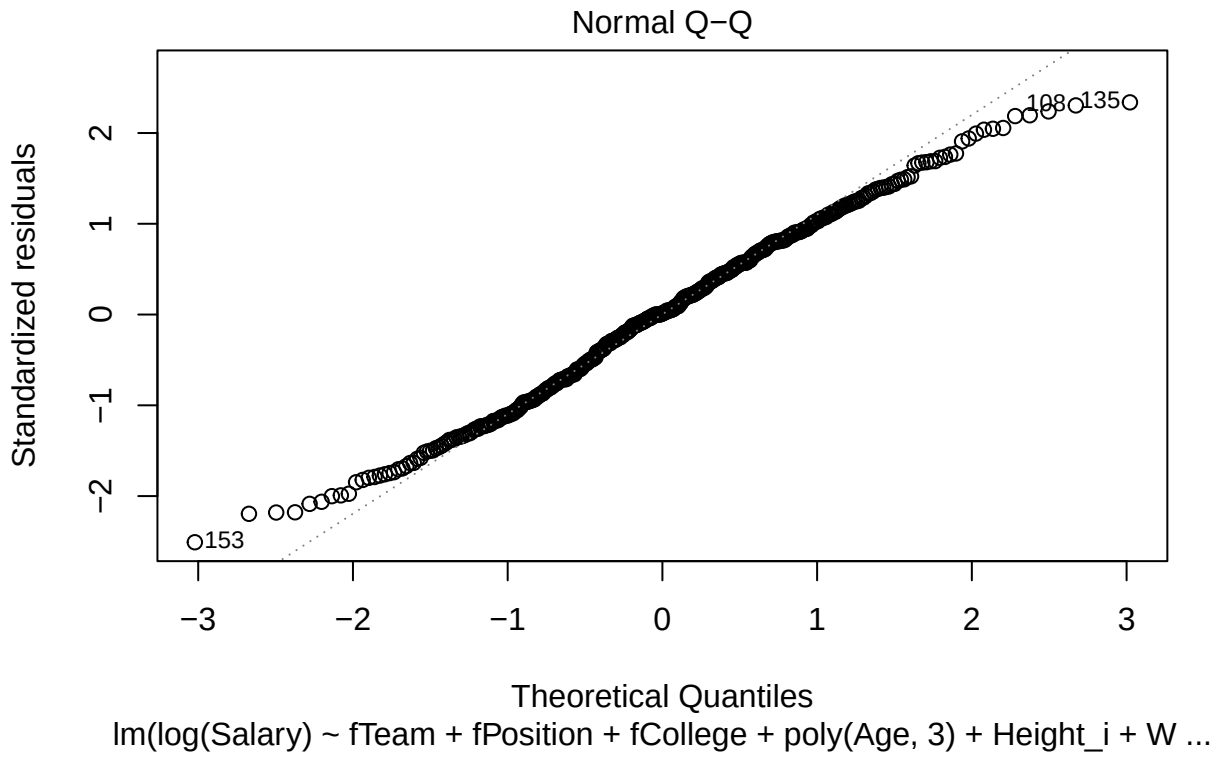
```
confusionMatrix(glmFit2)
```

```
## Bootstrapped (25 reps) Confusion Matrix
##
## (entries are percentual average cell counts across resamples)
##
##           Reference
## Prediction    0    1
##          0 52.7 17.7
##          1 12.3 17.3
##
##  Accuracy (average) : 0.6999
```

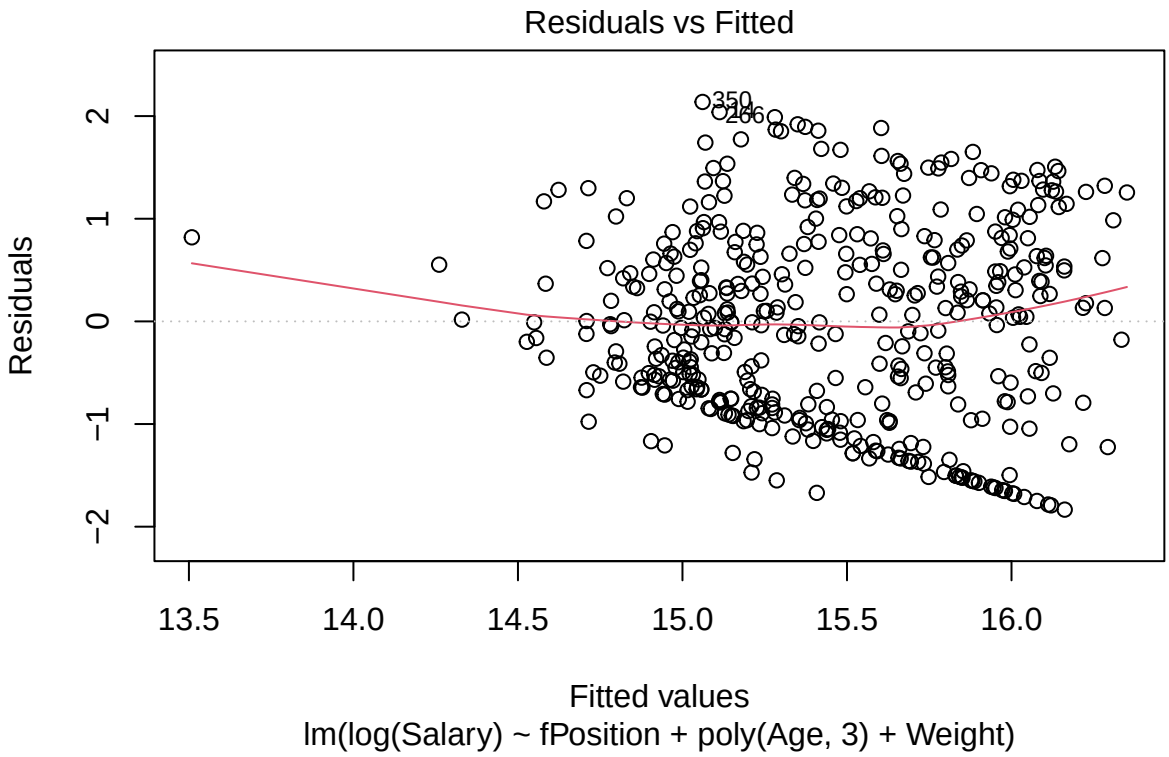
```
#comparing the plots
# Rename variables

plot(lm_log1, 1:2)
```

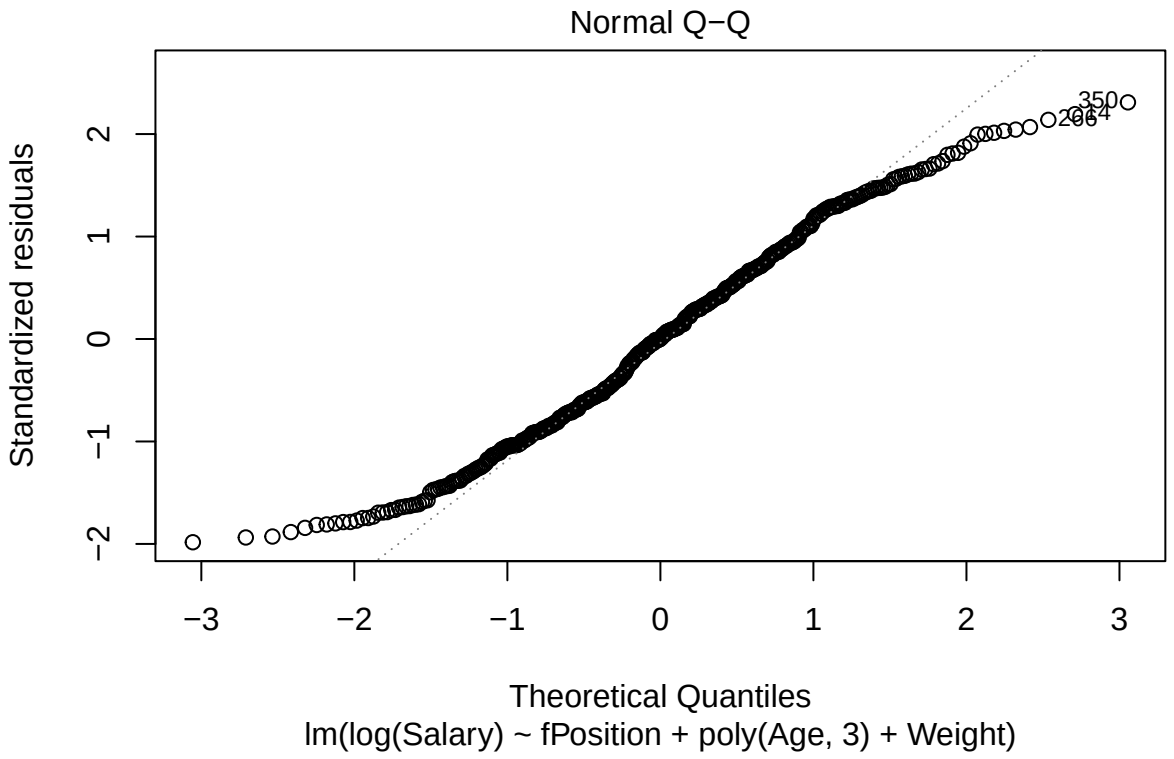
```
## Warning: not plotting observations with leverage one:
##   1, 27, 46, 69, 74, 77, 85, 102, 104, 122, 133, 137, 138, 141, 190, 217, 223, 227, 231, 241, 249, 25
```


Residuals vs Fitted
Residuals
Fitted values
lm(log(Salary) ~ fTeam + fPosition + fCollege + poly(Age, 3) + Height_i + W ...
135
153
2
1
0
−1
−2
14
15
16
17

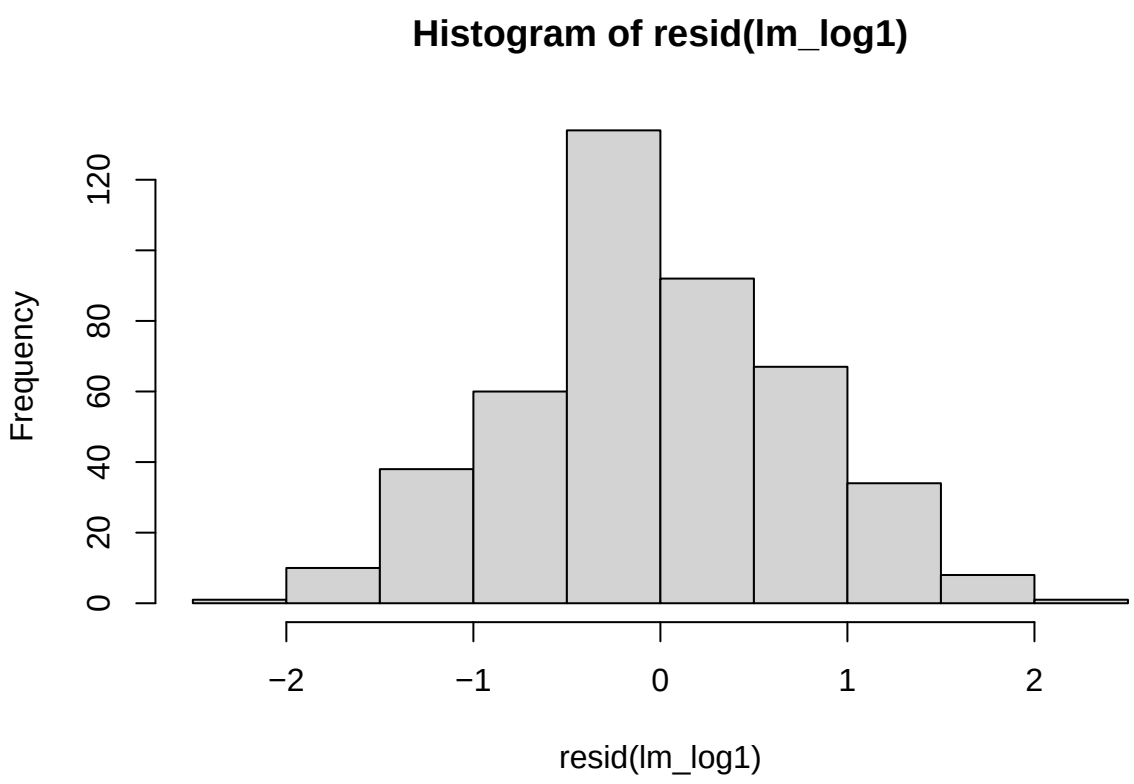



```
plot(lm_log4, 1:2)
```

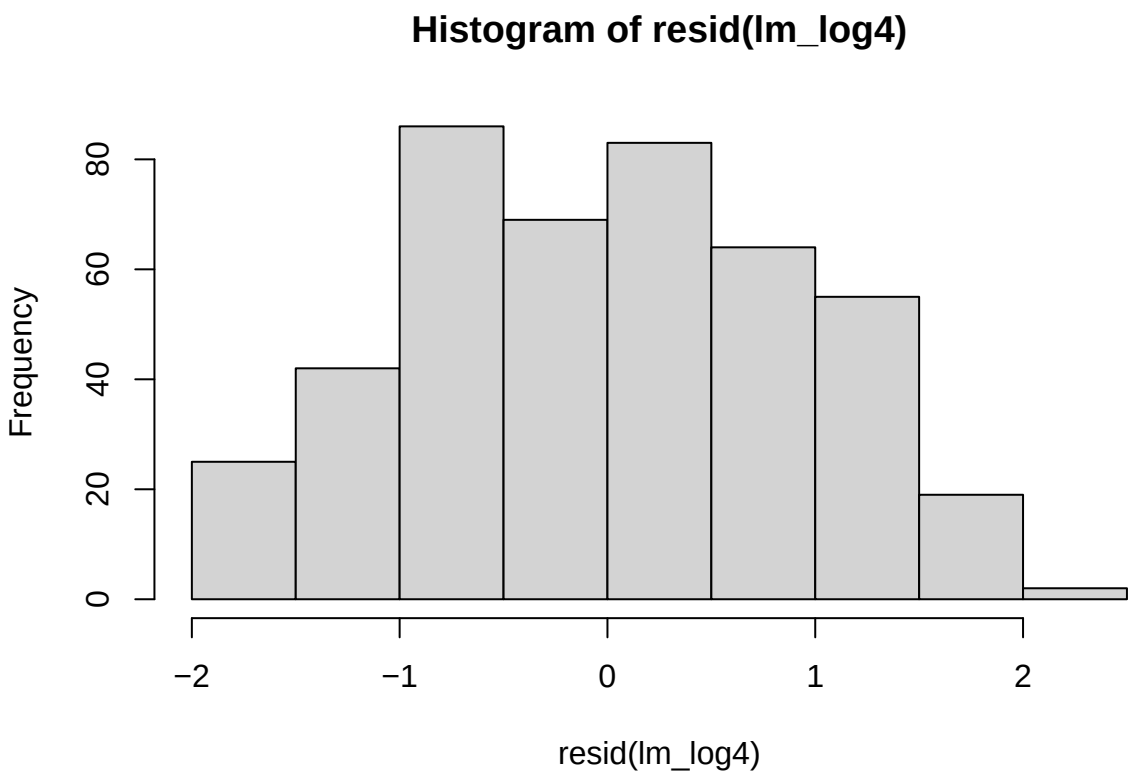

Residuals vs Fitted
Residuals
Fitted values
lm(log(Salary) ~ fPosition + poly(Age, 3) + Weight)
350
166
2
1
0
−1
−2
13.5
14.0
14.5
15.0
15.5
16.0



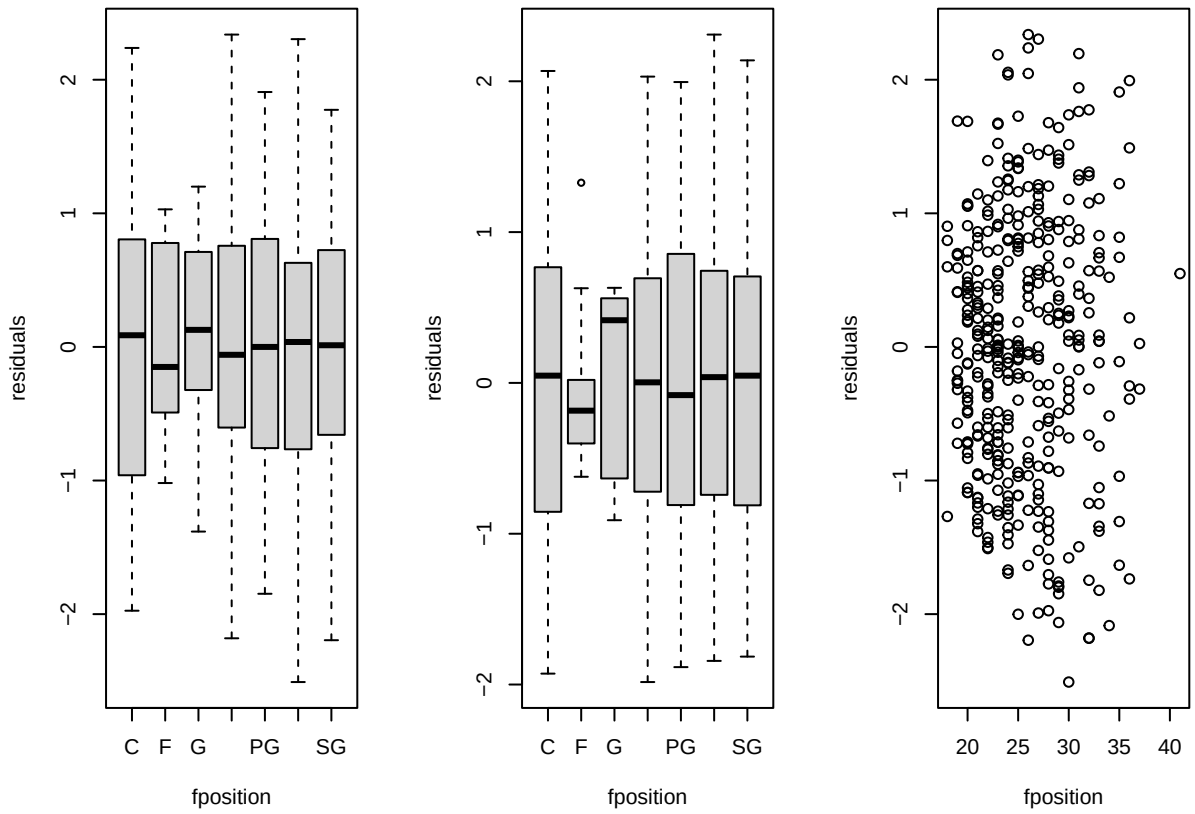

```
hist(resid(lm_log1))
```



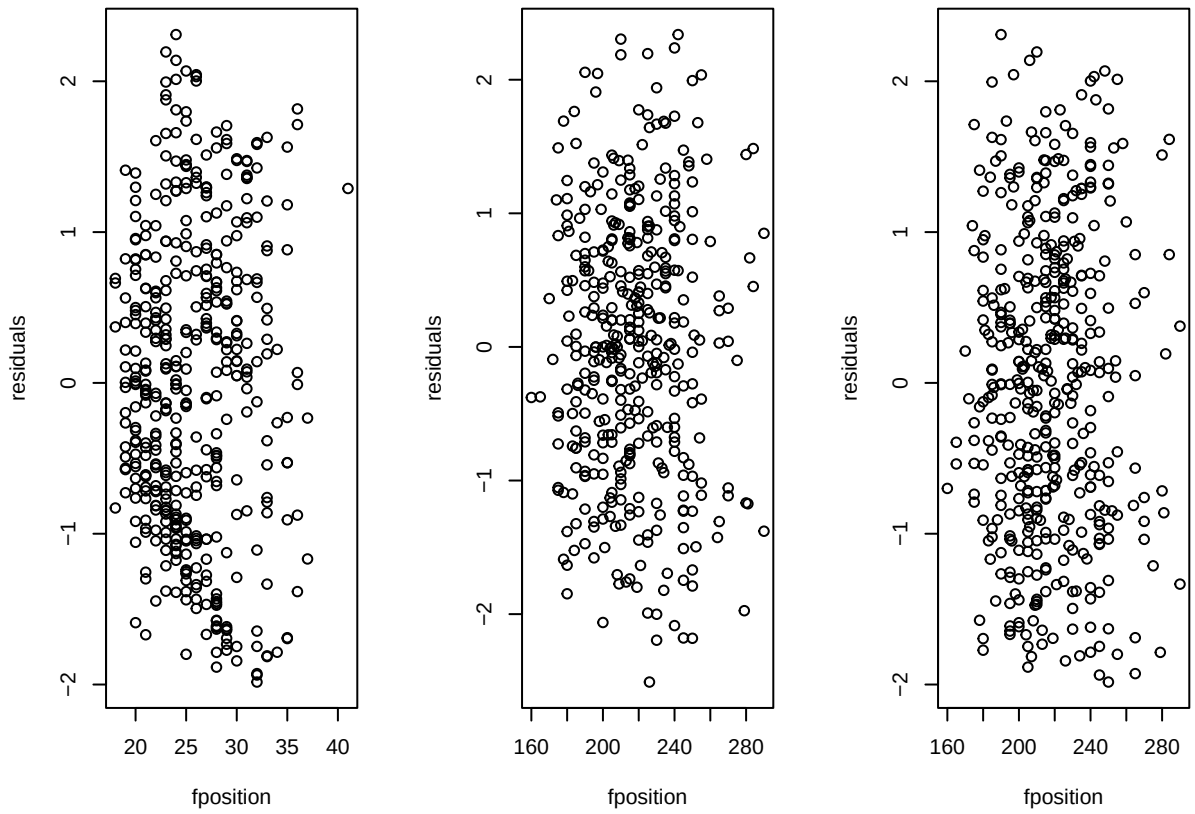

```
hist(resid(lm_log4))
```



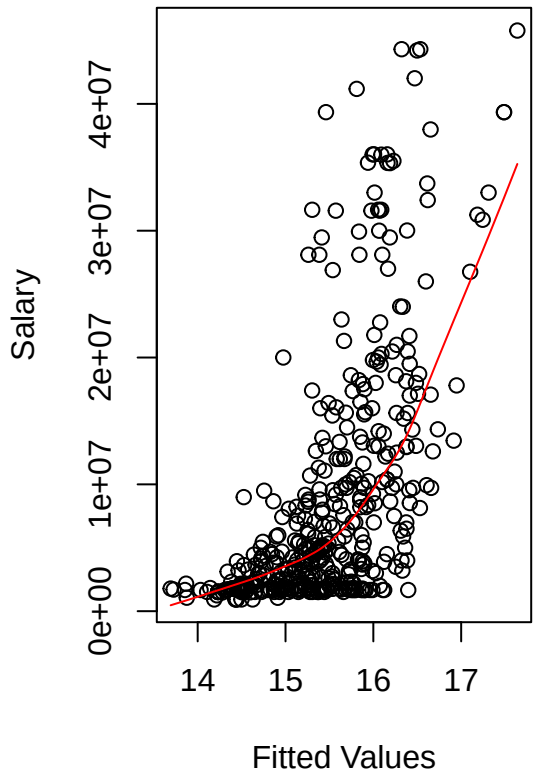

```
par(mfrow=c(1,3), mar=c(4.5, 4.5, 2, 2))

plot(ap_tibble$fPosition, rstandard(lm_log1), xlab ="fposition", ylab = "residuals")
plot(ap_tibble$fPosition, rstandard(lm_log4), xlab ="fposition", ylab = "residuals")

plot(ap_tibble$Age, rstandard(lm_log1), xlab ="fposition", ylab = "residuals")
```

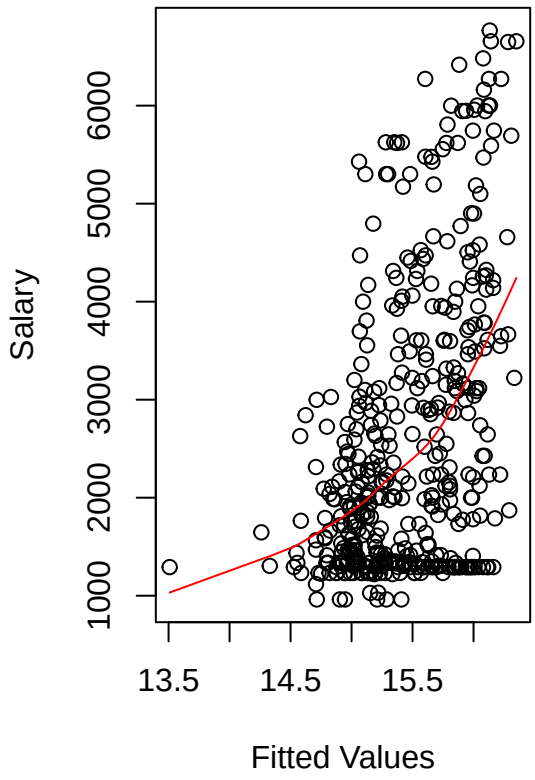



```
plot(ap_tibble$Age, rstandard(lm_log4), xlab ="fposition", ylab = "residuals")

plot(ap_tibble$Weight, rstandard(lm_log1), xlab ="fposition", ylab = "residuals")
plot(ap_tibble$Weight, rstandard(lm_log4), xlab ="fposition", ylab = "residuals")
```

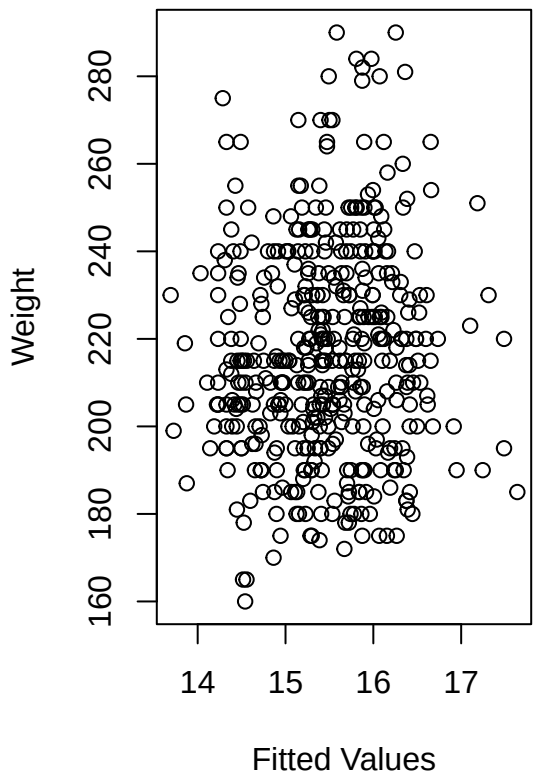


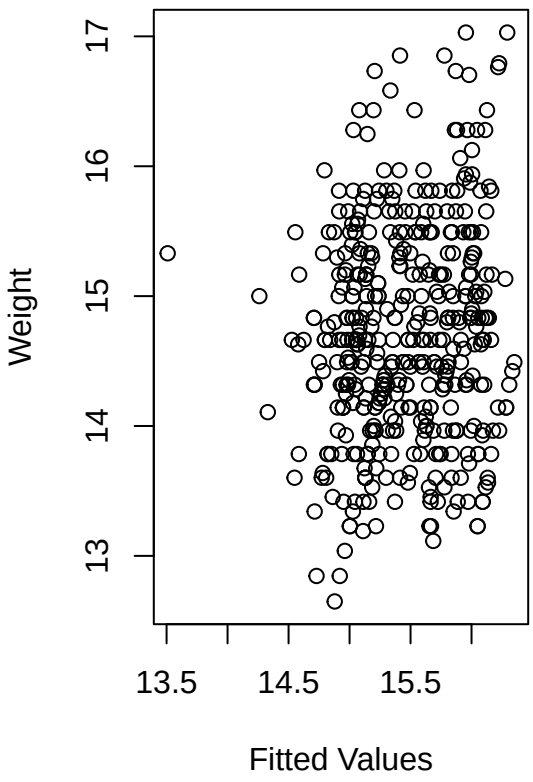

```
#normality check
par(mfrow=c(1,2), mar=c(4.5, 4.5, 2, 2))
plot(predict(lm_log1), ap_tibble$Salary,
       xlab = "Fitted Values", ylab = "Salary")
abline()
lines(lowess(predict(lm_log1), ap_tibble$Salary), col='red')

plot(predict(lm_log4), sqrt(ap_tibble$Salary),
       xlab = "Fitted Values", ylab = "Salary")
lines(lowess(predict(lm_log4), sqrt(ap_tibble$Salary)), col='red')
```



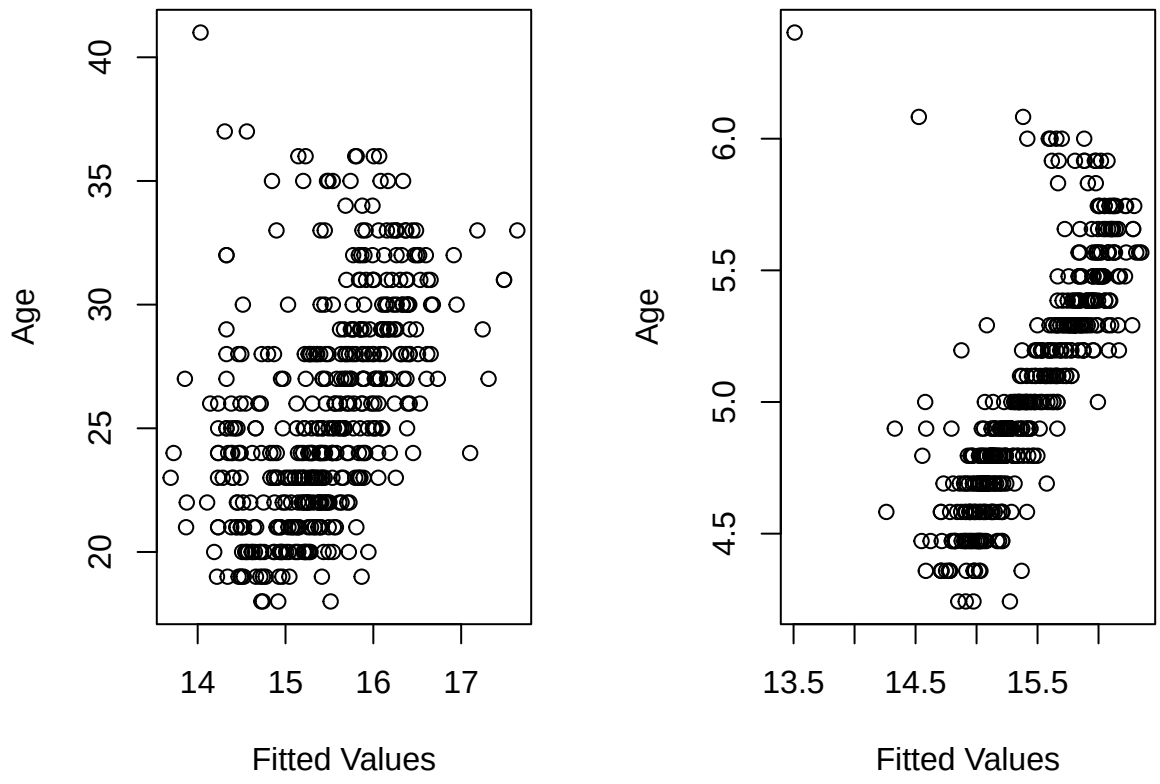



```
plot(predict(lm_log1), ap_tibble$Weight,
     xlab = "Fitted Values", ylab = "Weight")

plot(predict(lm_log4), sqrt(ap_tibble$Weight),
     xlab = "Fitted Values", ylab = "Weight")
```






```
plot(predict(lm_log1), ap_tibble$Age,
     xlab = "Fitted Values", ylab = "Age")

plot(predict(lm_log4), sqrt(ap_tibble$Age),
     xlab = "Fitted Values", ylab = "Age")
```



Model Checking

Outliers

```
# Remove outliers & high leverage from data
ap_cl_f_wo <- ap_tibble[-which(abs(rstandard(lm_step)) > 2
                               | hatvalues(lm_step) > .1),]
```

```
summary(lm1_wo <- lm(log(Salary) ~ fTeam+fPosition+fCollege+poly(Age,3)+Height_i+Weight,
                     data=ap_cl_f_wo))
```

```
##
## Call:
## lm(formula = log(Salary) ~ fTeam + fPosition + fCollege + poly(Age,
##     3) + Height_i + Weight, data = ap_cl_f_wo)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.1397 -0.4790  0.0000  0.4899  1.8739
##
## Coefficients:
##                                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)                    11.7791977  1.5959108   7.381 2.03e-12 ***
## fTeamBoston Celtics            -0.5393965  0.4118931  -1.310 0.191481
## fTeamBrooklyn Nets             -0.3305199  0.3713975  -0.890 0.374308
## fTeamCharlotte Hornets         -0.1739976  0.3602481  -0.483 0.629499
```

```
## fTeamChicago Bulls                0.0635036  0.4042121   0.157 0.875282
## fTeamCleveland Cavaliers          0.3361198  0.4050216   0.830 0.407353
## fTeamDallas Mavericks            -0.6163239  0.3751462  -1.643 0.101592
## fTeamDenver Nuggets              -0.2030649  0.3782618  -0.537 0.591831
## fTeamDetroit Pistons             -0.4397854  0.3773732  -1.165 0.244911
## fTeamGolden State Warriors       -0.5778167  0.4059471  -1.423 0.155802
## fTeamHouston Rockets             -0.4902463  0.3719001  -1.318 0.188568
## fTeamIndiana Pacers              -0.1031768  0.3817314  -0.270 0.787150
## fTeamLos Angeles Clippers        -0.2210872  0.3890599  -0.568 0.570340
## fTeamLos Angeles Lakers          -0.6982741  0.4349105  -1.606 0.109562
## fTeamMemphis Grizzlies           -0.3109094  0.3994209  -0.778 0.437027
## fTeamMiami Heat                  -0.7020907  0.4114268  -1.706 0.089091 .
## fTeamMilwaukee Bucks             -0.7726938  0.4003687  -1.930 0.054680 .
## fTeamMinnesota Timberwolves       0.1953093  0.4216583   0.463 0.643606
## fTeamNew Orleans Pelicans        -0.2379120  0.3748767  -0.635 0.526210
## fTeamNew York Knicks             -0.2534616  0.3763232  -0.674 0.501203
## fTeamOklahoma City Thunder       -0.4049589  0.3824510  -1.059 0.290632
## fTeamOrlando Magic               -0.0683007  0.3815633  -0.179 0.858073
## fTeamPhiladelphia Sixers         -0.2655867  0.3895609  -0.682 0.495987
## fTeamPhoenix Suns                -0.0011708  0.4047239  -0.003 0.997694
## fTeamPortland Trail Blazers      -0.7465743  0.4245698  -1.758 0.079829 .
## fTeamSacremento Kings             0.0318074  0.3945302   0.081 0.935804
## fTeamSan Antonio Spurs           -0.1293054  0.3745541  -0.345 0.730199
## fTeamToronto Raptors             -0.0124533  0.4406227  -0.028 0.977474
## fTeamUtah Jazz                   -0.0003289  0.4024707  -0.001 0.999349
## fTeamWashington Wizards          -0.3672619  0.3591758  -1.023 0.307471
## fPositionPF                       0.4247647  0.1914246   2.219 0.027336 *
## fPositionPG                       1.2774752  0.2955907   4.322 2.19e-05 ***
## fPositionSF                       0.7334905  0.2106636   3.482 0.000582 ***
## fPositionSG                       0.9755366  0.2543788   3.835 0.000157 ***
## fCollegeArizona                   0.1523401  0.5555321   0.274 0.784126
## fCollegeArizona State             0.2338294  0.7042212   0.332 0.740122
## fCollegeArkansas                  0.0378729  0.6476039   0.058 0.953409
## fCollegeAuburn                   -0.1784902  0.6957118  -0.257 0.797719
## fCollegeBaylor                   -0.5222221  0.6278505  -0.832 0.406292
## fCollegeBelmont                  -1.1098313  1.0368488  -1.070 0.285418
## fCollegeBoise State              -0.2810676  1.0578421  -0.266 0.790678
## fCollegeBoston College           -0.2711400  1.0499872  -0.258 0.796429
## fCollegeBowling Green             0.7262524  1.0606648   0.685 0.494123
## fCollegeBucknell                 -0.3558443  1.0612991  -0.335 0.737671
## fCollegeButler                   -0.3365202  0.8092456  -0.416 0.677860
## fCollegeBYU                      -0.8632846  1.0563565  -0.817 0.414532
## fCollegeCal Poly                 -0.1783480  1.0500395  -0.170 0.865259
## fCollegeCalifornia                1.8511441  1.0598734   1.747 0.081870 .
## fCollegeCharleston               -1.4382428  1.0684892  -1.346 0.179436
## fCollegeCleveland State          -0.6110414  1.0374950  -0.589 0.556391
## fCollegeColorado                  0.3701865  0.7000433   0.529 0.597383
## fCollegeConnecticut              -0.0357990  0.6106987  -0.059 0.953299
## fCollegeCreighton                -0.2554259  0.8003035  -0.319 0.749856
## fCollegeDavidson                  1.9398140  1.0585913   1.832 0.068007 .
## fCollegeDayton                    0.6210884  1.0486310   0.592 0.554165
## fCollegeDePaul                   -0.7118328  0.8096993  -0.879 0.380126
## fCollegeDrexel                   -1.0903740  1.0578095  -1.031 0.303582
## fCollegeDuke                      0.0651937  0.4844321   0.135 0.893048
```

```
## fCollegeFlorida                    0.9908595  0.6469161   1.532 0.126798
## fCollegeFlorida State              0.0700704  0.5512542   0.127 0.898949
## fCollegeFresno State               1.1909302  1.0528841   1.131 0.259030
## fCollegeGeorge Washington         -1.3026513  1.0723350  -1.215 0.225531
## fCollegeGeorgetown                -0.5715929  0.7048359  -0.811 0.418117
## fCollegeGeorgia                    0.3924855  0.7041831   0.557 0.577750
## fCollegeGeorgia Tech               0.1761395  0.7065353   0.249 0.803322
## fCollegeGonzaga                    0.4847763  0.5751350   0.843 0.400049
## fCollegeHouston                   -1.1227212  0.7941859  -1.414 0.158631
## fCollegeIllinois                  -1.5087994  1.0526543  -1.433 0.152943
## fCollegeIndiana                   -0.0032225  0.5744873  -0.006 0.995529
## fCollegeIowa State                -0.0199612  0.6415514  -0.031 0.975202
## fCollegeKansas                     0.0265974  0.5752924   0.046 0.963159
## fCollegeKansas State              -1.1844075  0.6977239  -1.698 0.090770 .
## fCollegeKentucky                   0.2844623  0.4780613   0.595 0.552329
## fCollegeLehigh                     2.0429998  1.0629476   1.922 0.055676 .
## fCollegeLiberty                   -0.9269506  1.0473142  -0.885 0.376919
## fCollegeLouisiana-Lafayette       -1.7593571  1.0582728  -1.662 0.097599 .
## fCollegeLouisville                 0.4637780  0.6175574   0.751 0.453326
## fCollegeLoyola (MD)               -0.0141200  1.0542243  -0.013 0.989324
## fCollegeLSU                       -0.0865207  0.6394517  -0.135 0.892474
## fCollegeMarquette                  0.2107798  0.7127502   0.296 0.767670
## fCollegeMarshall                  -1.8800821  1.0609209  -1.772 0.077523 .
## fCollegeMaryland                  -0.2157877  0.6506138  -0.332 0.740402
## fCollegeMemphis                    1.0272661  0.6925148   1.483 0.139160
## fCollegeMiami (FL)                 0.2304093  0.8006953   0.288 0.773754
## fCollegeMichigan                   0.2150105  0.5608070   0.383 0.701735
## fCollegeMichigan State             0.6840266  0.6229508   1.098 0.273182
## fCollegeMinnesota                 -0.2475194  1.0554207  -0.235 0.814761
## fCollegeMississippi State         -1.2517796  1.0568824  -1.184 0.237313
## fCollegeMissouri                  -0.0279019  0.6977023  -0.040 0.968130
## fCollegeMissouri State            -0.4958923  1.0559280  -0.470 0.639008
## fCollegeMurray State               0.4975385  0.8093310   0.615 0.539246
## fCollegenan                        0.1798764  0.4506371   0.399 0.690097
## fCollegeNebraska                  -0.8963405  0.8151654  -1.100 0.272513
## fCollegeNevada                    -0.8312788  0.8089590  -1.028 0.305079
## fCollegeNew Mexico                -0.9670665  1.0633218  -0.909 0.363925
## fCollegeNew Mexico JC              0.3451578  1.0884386   0.317 0.751408
## fCollegeNew Mexico State           0.7275715  1.0816742   0.673 0.501766
## fCollegeNorth Carolina            -0.0877460  0.5332940  -0.165 0.869435
## fCollegeNorth Carolina State       0.4452804  1.0487248   0.425 0.671478
## fCollegeNotre Dame                 0.1455667  1.0540693   0.138 0.890266
## fCollegeOhio                      -1.2606605  1.0511879  -1.199 0.231493
## fCollegeOhio State                 0.3016359  0.7102582   0.425 0.671411
## fCollegeOklahoma                  -0.1490039  0.7028404  -0.212 0.832268
## fCollegeOklahoma State             0.6748970  0.8095165   0.834 0.405199
## fCollegeOld Dominion              -0.8945644  1.0657649  -0.839 0.402022
## fCollegeOle Miss                  -0.2997999  1.0555320  -0.284 0.776611
## fCollegeOregon                     0.1726480  0.6089412   0.284 0.776998
## fCollegeOregon State              -1.0483486  1.0428320  -1.005 0.315674
## fCollegePittsburgh                 1.0005420  1.0645945   0.940 0.348159
## fCollegeProvidence                -0.2693593  1.0535391  -0.256 0.798403
## fCollegePurdue                    -0.7162766  1.0757346  -0.666 0.506087
## fCollegeRadford                   -2.0962804  1.0536562  -1.990 0.047671 *
```

```
## fCollegeSaint Joseph's             -1.3464206  1.0512933  -1.281 0.201409
## fCollegeSaint Mary's               -0.9181562  0.7981416  -1.150 0.251030
## fCollegeSalt Lake CC UT            -1.1399288  1.0590357  -1.076 0.282735
## fCollegeSan Diego State             0.0991510  0.7086451   0.140 0.888832
## fCollegeSMU                        -0.5725004  0.7111157  -0.805 0.421499
## fCollegeSouth Carolina             -0.8609753  1.0323397  -0.834 0.405030
## fCollegeSt. John's                 -0.7810305  1.0538784  -0.741 0.459288
## fCollegeStanford                    0.2310066  0.5906767   0.391 0.696046
## fCollegeSyracuse                   -0.3807328  0.6205544  -0.614 0.540048
## fCollegeTCU                        -0.7173919  0.8108158  -0.885 0.377078
## fCollegeTennessee                   0.3893596  0.6217869   0.626 0.531726
## fCollegeTennessee State             1.3681412  1.0678449   1.281 0.201237
## fCollegeTexas                       0.7140150  0.5213325   1.370 0.171972
## fCollegeTexas A&M                   0.6343792  0.6545300   0.969 0.333323
## fCollegeTexas Tech                 -0.8134292  1.0533638  -0.772 0.440672
## fCollegeUC Santa Barbara           -0.8584267  1.0549003  -0.814 0.416518
## fCollegeUCLA                        0.7497652  0.5273326   1.422 0.156258
## fCollegeUNLV                        0.9858305  0.7265290   1.357 0.175966
## fCollegeUSC                         0.2821557  0.5443195   0.518 0.604637
## fCollegeUSC Upstate                -0.7379822  1.0478384  -0.704 0.481871
## fCollegeUtah                        0.6303246  0.6998579   0.901 0.368594
## fCollegeUtah State                 -1.1151941  1.0526581  -1.059 0.290379
## fCollegeVanderbilt                 -0.2613473  0.6405825  -0.408 0.683615
## fCollegeVillanova                   0.0902803  0.5483647   0.165 0.869356
## fCollegeVirginia                   -0.0704476  0.5646633  -0.125 0.900808
## fCollegeVirginia Commonwealth      -0.1914164  1.0270818  -0.186 0.852298
## fCollegeVirginia Tech              -0.1755801  1.0158853  -0.173 0.862913
## fCollegeWake Forest                 0.2961353  0.6171933   0.480 0.631759
## fCollegeWashington                  0.1707733  0.5541155   0.308 0.758179
## fCollegeWashington State            0.6906445  0.8151584   0.847 0.397619
## fCollegeWeber State                 1.7767243  1.0646036   1.669 0.096317 .
## fCollegeWest Virginia              -0.9605252  0.8014206  -1.199 0.231782
## fCollegeWestern Texas Coll. (J.C.) -1.3441585  1.0441243  -1.287 0.199094
## fCollegeWichita State               0.4124782  0.8241941   0.500 0.617165
## fCollegeWisconsin                  -1.6875448  1.0653374  -1.584 0.114376
## fCollegeWyoming                    -0.0526230  0.8144087  -0.065 0.948529
## fCollegeXavier                     -0.9931141  0.7852655  -1.265 0.207095
## fCollegeYale                       -1.1484477  1.0592025  -1.084 0.279236
## poly(Age, 3)1                       7.0833306  1.1536748   6.140 3.01e-09 ***
## poly(Age, 3)2                      -1.9400855  1.1821414  -1.641 0.101950
## poly(Age, 3)3                      -2.7813226  1.1184886  -2.487 0.013510 *
## Height_i                           -0.0062739  0.1918515  -0.033 0.973937
## Weight                              0.0146404  0.0038146   3.838 0.000155 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9006 on 265 degrees of freedom
## Multiple R-squared:  0.4979, Adjusted R-squared:  0.2061
## F-statistic: 1.706 on 154 and 265 DF,  p-value: 7.106e-05
```

```
summary(lm1_wo_step <- step(lm1_wo))
```

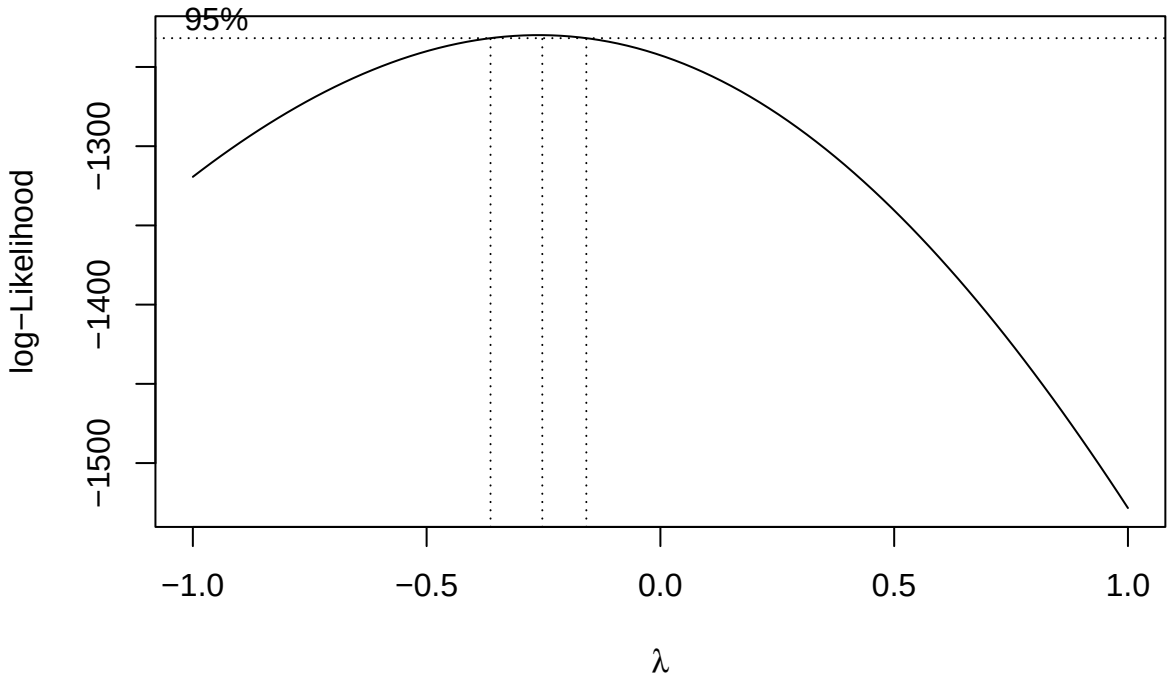
```
## Start:  AIC=28.6
## log(Salary) ~ fTeam + fPosition + fCollege + poly(Age, 3) + Height_i +
##     Weight
```

```
##
##                 Df Sum of Sq    RSS     AIC
## - fCollege     116   106.409 321.33 -34.476
## - fTeam         29    19.384 234.30   6.868
## - Height_i       1     0.001 214.92  26.600
## <none>                       214.92  28.598
## - Weight         1    11.946 226.86  49.319
## - fPosition      4    16.150 231.07  51.029
## - poly(Age, 3)   3    40.015 254.93  94.312
##
## Step:  AIC=-34.48
## log(Salary) ~ fTeam + fPosition + poly(Age, 3) + Height_i + Weight
##
##                Df Sum of Sq    RSS     AIC
## - fTeam        29    20.264 341.59 -66.791
## - Height_i      1     0.138 321.46 -36.296
## <none>                       321.33 -34.476
## - fPosition     4    12.632 333.96 -26.282
## - Weight        1    10.009 331.33 -23.594
## - poly(Age, 3)  3    69.177 390.50  41.415
##
## Step:  AIC=-66.79
## log(Salary) ~ fPosition + poly(Age, 3) + Height_i + Weight
##
##                Df Sum of Sq    RSS     AIC
## - Height_i      1     0.118 341.71 -68.646
## <none>                       341.59 -66.791
## - fPosition     4    11.510 353.10 -60.872
## - Weight        1     7.947 349.54 -59.132
## - poly(Age, 3)  3    63.697 405.29  -0.977
##
## Step:  AIC=-68.65
## log(Salary) ~ fPosition + poly(Age, 3) + Weight
##
##                Df Sum of Sq    RSS     AIC
## <none>                       341.71 -68.646
## - fPosition     4    12.582 354.29 -61.459
## - Weight        1     7.833 349.54 -61.127
## - poly(Age, 3)  3    64.650 406.36  -1.869
##
## Call:
## lm(formula = log(Salary) ~ fPosition + poly(Age, 3) + Weight,
##     data = ap_cl_f_wo)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -1.8899 -0.7047  0.0319  0.6788  1.9272
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)   12.961870   0.780418  16.609  < 2e-16 ***
## fPositionPF    0.234813   0.162588   1.444 0.149439
## fPositionPG    0.851080   0.229742   3.705 0.000241 ***
```

```
## fPositionSF    0.364046   0.177851   2.047 0.041302 *
## fPositionSG    0.516664   0.201353   2.566 0.010643 *
## poly(Age, 3)1  7.244927   0.929501   7.794 5.36e-14 ***
## poly(Age, 3)2 -1.482737   0.922096  -1.608 0.108601
## poly(Age, 3)3 -3.428536   0.913288  -3.754 0.000199 ***
## Weight         0.009496   0.003094   3.069 0.002287 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9118 on 411 degrees of freedom
## Multiple R-squared:  0.2017, Adjusted R-squared:  0.1861
## F-statistic: 12.98 on 8 and 411 DF,  p-value: < 2.2e-16
```

Box Cox

```
boxcox(lm1,lambda=seq(-1, 1, by=0.05))
```




```
BoxCoxTrans(ap_tibble$Salary)
```

```
## Box-Cox Transformation
##
## 445 data points used to estimate Lambda
##
## Input data summary:
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
##   925258  1802057  4447896  8813696 12000000 45780966
##
```

```
## Largest/Smallest: 49.5
## Sample Skewness: 1.75
##
## Estimated Lambda: -0.2
## With fudge factor, Lambda = 0 will be used for transformations
```

```
# Performing
summary(lm_trans_step <- step(lm1_trans <- lm(log(Salary)~fTeam + fPosition + fCollege + poly(Age,3) + H
```

```
## Start:  AIC=63.13
## log(Salary) ~ fTeam + fPosition + fCollege + poly(Age, 3) + Height_i +
##     Weight
##
##                 Df Sum of Sq    RSS     AIC
## - fCollege     118   112.484 363.45  -8.079
## - fTeam         29    15.575 266.54  31.921
## - Height_i       1     0.107 251.08  61.317
## <none>                       250.97  63.127
## - Weight         1     8.165 259.13  75.375
## - fPosition      6    14.621 265.59  76.325
## - poly(Age, 3)   3    45.448 296.42 131.192
##
## Step:  AIC=-8.08
## log(Salary) ~ fTeam + fPosition + poly(Age, 3) + Height_i + Weight
##
##                Df Sum of Sq    RSS     AIC
## - fTeam        29    16.550 380.00 -46.264
## - Height_i      1     0.007 363.46 -10.070
## <none>                      363.45  -8.079
## - fPosition     6    15.007 378.46  -2.075
## - Weight        1     8.063 371.52  -0.316
## - poly(Age, 3)  3    65.521 428.97  59.678
##
## Step:  AIC=-46.26
## log(Salary) ~ fPosition + poly(Age, 3) + Height_i + Weight
##
##                Df Sum of Sq    RSS     AIC
## - Height_i      1     0.002 380.00 -48.261
## <none>                      380.00 -46.264
## - fPosition     6    13.866 393.87 -42.315
## - Weight        1     6.228 386.23 -41.030
## - poly(Age, 3)  3    62.593 442.60  15.589
##
## Step:  AIC=-48.26
## log(Salary) ~ fPosition + poly(Age, 3) + Weight
##
##                Df Sum of Sq    RSS     AIC
## <none>                      380.00 -48.261
## - fPosition     6    14.709 394.71 -43.361
## - Weight        1     6.254 386.26 -42.997
## - poly(Age, 3)  3    63.348 443.35  14.350
```

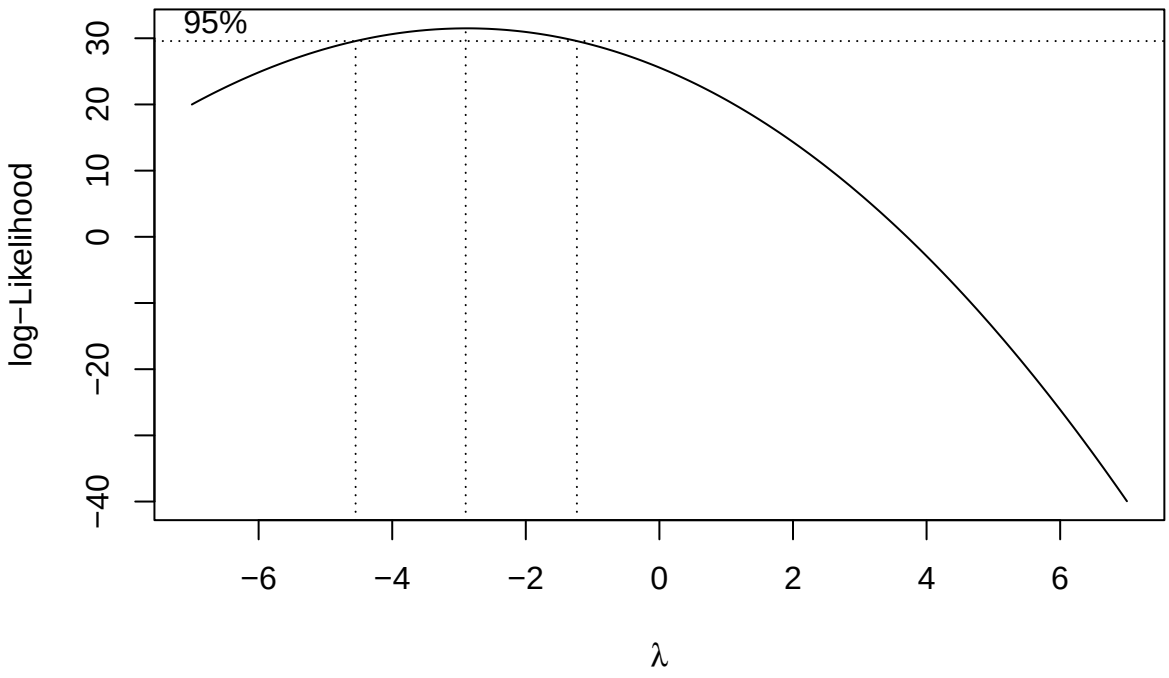
```
##
## Call:
## lm(formula = log(Salary) ~ fPosition + poly(Age, 3) + Weight,
```

```
##     data = ap_tibble)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.83384 -0.75300  0.00348  0.68066  2.13764
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)   13.330870   0.782775  17.030  < 2e-16 ***
## fPositionF    -0.489098   0.340488  -1.436  0.15159
## fPositionG     0.737585   0.412128   1.790  0.07420 .
## fPositionPF    0.174562   0.163833   1.065  0.28725
## fPositionPG    0.711135   0.231400   3.073  0.00225 **
## fPositionSF    0.316997   0.179784   1.763  0.07857 .
## fPositionSG    0.403881   0.202448   1.995  0.04667 *
## poly(Age, 3)1  6.769471   0.952473   7.107 4.89e-12 ***
## poly(Age, 3)2 -3.110142   0.948675  -3.278  0.00113 **
## poly(Age, 3)3 -3.153257   0.942313  -3.346  0.00089 ***
## Weight         0.008296   0.003104   2.673  0.00781 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9357 on 434 degrees of freedom
## Multiple R-squared:  0.1893, Adjusted R-squared:  0.1706
## F-statistic: 10.13 on 10 and 434 DF,  p-value: 2.258e-15
```

Box-Cox w/o outliers and high leverage

Very poor results compared to keeping the high leverage points and the outliers.

```
boxcox(lm1_wo,lambda=seq(-7, 7, by=0.05))
```




```
BoxCoxTrans(ap_cl_f_wo$Salary)
```

```
## Box-Cox Transformation
##
## 420 data points used to estimate Lambda
##
## Input data summary:
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
##   925258  1824003  4405020  8530876 10820081 45780966
##
## Largest/Smallest: 49.5
## Sample Skewness: 1.86
##
## Estimated Lambda: -0.2
## With fudge factor, Lambda = 0 will be used for transformations
```

```
summary(lm_wo_step_trans <- step(lm1_wo_trans <- lm(log(Salary)~fTeam + fPosition + fCollege + poly(Age
```

```
## Start:  AIC=28.6
## log(Salary) ~ fTeam + fPosition + fCollege + poly(Age, 3) + Height_i +
##     Weight
##
##                 Df Sum of Sq    RSS     AIC
## - fCollege     116   106.409 321.33 -34.476
## - fTeam         29    19.384 234.30   6.868
## - Height_i       1     0.001 214.92  26.600
## <none>                       214.92  28.598
```

```
## - Weight         1    11.946 226.86  49.319
## - fPosition      4    16.150 231.07  51.029
## - poly(Age, 3)   3    40.015 254.93  94.312
##
## Step:  AIC=-34.48
## log(Salary) ~ fTeam + fPosition + poly(Age, 3) + Height_i + Weight
##
##                Df Sum of Sq    RSS     AIC
## - fTeam        29    20.264 341.59 -66.791
## - Height_i      1     0.138 321.46 -36.296
## <none>                      321.33 -34.476
## - fPosition     4    12.632 333.96 -26.282
## - Weight        1    10.009 331.33 -23.594
## - poly(Age, 3)  3    69.177 390.50  41.415
##
## Step:  AIC=-66.79
## log(Salary) ~ fPosition + poly(Age, 3) + Height_i + Weight
##
##                Df Sum of Sq    RSS     AIC
## - Height_i      1     0.118 341.71 -68.646
## <none>                      341.59 -66.791
## - fPosition     4    11.510 353.10 -60.872
## - Weight        1     7.947 349.54 -59.132
## - poly(Age, 3)  3    63.697 405.29  -0.977
##
## Step:  AIC=-68.65
## log(Salary) ~ fPosition + poly(Age, 3) + Weight
##
##                Df Sum of Sq    RSS     AIC
## <none>                      341.71 -68.646
## - fPosition     4    12.582 354.29 -61.459
## - Weight        1     7.833 349.54 -61.127
## - poly(Age, 3)  3    64.650 406.36  -1.869
##
## Call:
## lm(formula = log(Salary) ~ fPosition + poly(Age, 3) + Weight,
##     data = ap_cl_f_wo)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -1.8899 -0.7047  0.0319  0.6788  1.9272
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)   12.961870   0.780418  16.609  < 2e-16 ***
## fPositionPF    0.234813   0.162588   1.444 0.149439
## fPositionPG    0.851080   0.229742   3.705 0.000241 ***
## fPositionSF    0.364046   0.177851   2.047 0.041302 *
## fPositionSG    0.516664   0.201353   2.566 0.010643 *
## poly(Age, 3)1  7.244927   0.929501   7.794 5.36e-14 ***
## poly(Age, 3)2 -1.482737   0.922096  -1.608 0.108601
## poly(Age, 3)3 -3.428536   0.913288  -3.754 0.000199 ***
## Weight         0.009496   0.003094   3.069 0.002287 **
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9118 on 411 degrees of freedom
## Multiple R-squared:  0.2017, Adjusted R-squared:  0.1861
## F-statistic: 12.98 on 8 and 411 DF,  p-value: < 2.2e-16
```

Comparing Models

```
performance::compare_performance(lm_log1,lm_log2,lm_log3,lm_step, rank = TRUE)
```

```
## # Comparison of Model Performance Indices
##
## Name    | Model |    R2 | R2 (adj.) |  RMSE | Sigma | AIC weights | BIC weights | Performance-Score
## ---------------------------------------------------------------------------------------------------
## lm_log2 |    lm | 0.431 |     0.198 | 0.774 | 0.920 |     < 0.001 |     < 0.001 |            62.45%
## lm_step |    lm | 0.189 |     0.171 | 0.924 | 0.936 |       0.731 |       0.955 |            35.46%
## lm_log1 |    lm | 0.465 |     0.169 | 0.751 | 0.937 |     < 0.001 |     < 0.001 |            33.43%
## lm_log3 |    lm | 0.189 |     0.169 | 0.924 | 0.937 |       0.269 |       0.045 |             6.93%
```

```
anova(lm_trans_step,lm1_trans)
```

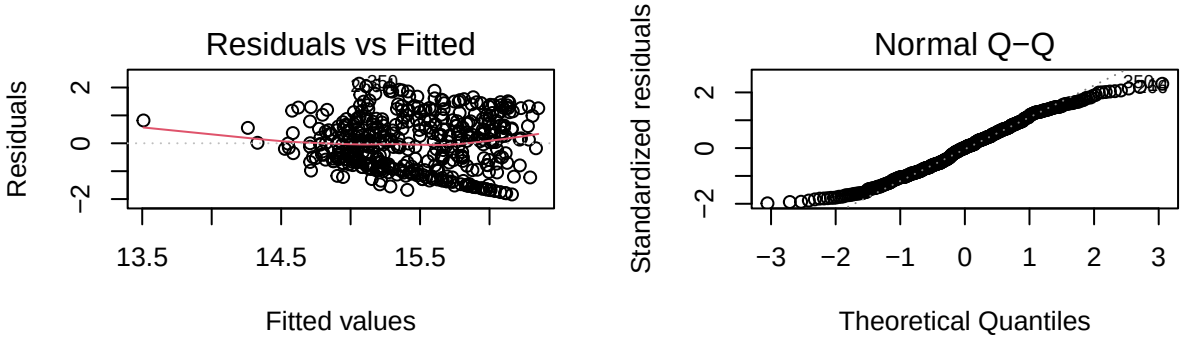
```
## Analysis of Variance Table
##
## Model 1: log(Salary) ~ fPosition + poly(Age, 3) + Weight
## Model 2: log(Salary) ~ fTeam + fPosition + fCollege + poly(Age, 3) + Height_i +
##     Weight
##   Res.Df    RSS  Df Sum of Sq      F Pr(>F)
## 1    434 380.00
## 2    286 250.97 148    129.04 0.9936 0.5119
```

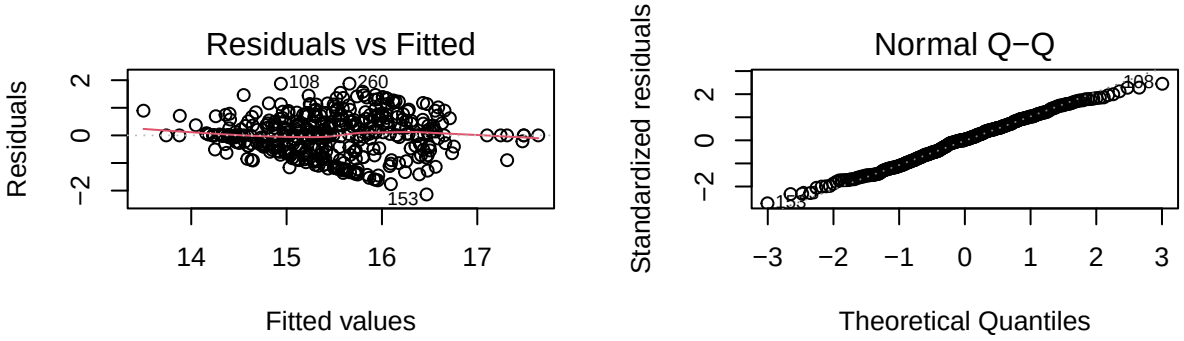
```
compare_performance(lm1_wo,lm_wo_step_trans, rank = TRUE)
```

```
## # Comparison of Model Performance Indices
##
## Name             | Model |    R2 | R2 (adj.) |  RMSE | Sigma | AIC weights | BIC weights | Performanc
## ---------------------------------------------------------------------------------------------------
## lm1_wo           |    lm | 0.498 |     0.206 | 0.715 | 0.901 |     < 0.001 |     < 0.001 |
## lm_wo_step_trans |    lm | 0.202 |     0.186 | 0.902 | 0.912 |        1.00 |        1.00 |
```

```
par(mfrow=c(2,2))
plot(lm_step,1:2)
plot(lm1_wo_trans,1:2)
```

```
## Warning: not plotting observations with leverage one:
##   15, 43, 63, 67, 77, 78, 95, 113, 124, 128, 177, 210, 213, 217, 226, 234, 239, 252, 254, 259, 265, 
```





VIF

```
round(vif(lm_step),2)
```

```
##              GVIF Df GVIF^(1/(2*Df))
## fPosition    2.97  6            1.09
## poly(Age, 3) 1.08  3            1.01
## Weight       2.89  1            1.70
```

```
round(vif(lm_trans_step),2)
```

```
##              GVIF Df GVIF^(1/(2*Df))
## fPosition    2.97  6            1.09
## poly(Age, 3) 1.08  3            1.01
## Weight       2.89  1            1.70
```

ROC/AUC

```
set.seed(999)
n <-nrow(ap_tibble)
n
```

```
## [1] 445
```

```
floor(0.7*n)
```

```
## [1] 311
```

```r
#randomly sample 70% of the rows

train <- sample(1:n, 311)

glm_train <- glm(fSalary.Dummy ~ poly(Age,3), data=ap_tibble, subset = train, family =  binomial)

summary(glm_train)
```

```
##
## Call:
## glm(formula = fSalary.Dummy ~ poly(Age, 3), family = binomial,
##     data = ap_tibble, subset = train)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.4051  -0.9020  -0.5366   1.0295   2.1421
##
## Coefficients:
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -0.7633     0.1370  -5.572 2.52e-08 ***
## poly(Age, 3)1  14.5161     3.2290   4.496 6.94e-06 ***
## poly(Age, 3)2 -11.6621     3.3093  -3.524 0.000425 ***
## poly(Age, 3)3  -7.5367     3.9924  -1.888 0.059061 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 402.90  on 310  degrees of freedom
## Residual deviance: 353.92  on 307  degrees of freedom
## AIC: 361.92
##
## Number of Fisher Scoring iterations: 5
```

```r
ap_test <- ap_tibble[-train,]
head(ap_test)
```

```
##               Name           Team Position Age Height Height_i Weight
## 1     Jaylen Brown Boston Celtics       SG  24  6' 6"     6.60    223
## 2        Kris Dunn Boston Celtics       PG  27  6' 3"     6.30    205
## 3   Carsen Edwards Boston Celtics       PG  23 5' 11"     5.11    200
## 12 Dennis Schroder Boston Celtics       PG  27  6' 3"     6.30    172
## 15  Grant Williams Boston Celtics       PF  22  6' 6"     6.60    236
## 20 Nicolas Claxton  Brooklyn Nets       PF  22 6' 11"     6.11    215
##       College   Salary          fTeam fPosition   fCollege Salary.Dummy nTeam
## 1  California 26758928 Boston Celtics        SG California            1     2
## 2  Providence  5005350 Boston Celtics        PG Providence            0     2
## 3      Purdue  1782621 Boston Celtics        PG     Purdue            0     2
## 12        nan  5890000 Boston Celtics        PG        nan            0     2
## 15  Tennessee  2617800 Boston Celtics        PF  Tennessee            0     2
## 20    Georgia  1782621  Brooklyn Nets        PF    Georgia            0     3
##    nPosition nCollege fSalary.Dummy
## 1          7       15             1
## 2          5       79             0
```

```
## 3          5       80             0
## 12         5       60             0
## 15         4       92             0
## 20         4       31             0
```

```
probs_test <- predict(glm_train, newdata = ap_test,
                      type = "response")

head(probs_test)
```

```
##         1         2         3        12        15        20
## 0.2669248 0.4783374 0.2101948 0.4783374 0.1660439 0.1660439
```

```
length(probs_test)
```

```
## [1] 134
```

```
preds_test <- rep(0,12)
preds_test[probs_test > 0.5] <- 1

length(probs_test)
```

```
## [1] 134
```

```
length(preds_test)
```

```
## [1] 134
```

```
head(probs_test)
```

```
##         1         2         3        12        15        20
## 0.2669248 0.4783374 0.2101948 0.4783374 0.1660439 0.1660439
```

```
head(preds_test)
```

```
## [1] 0 0 0 0 0 0
```

```
tb1<- table(prediction = preds_test, actual = ap_test$fSalary.Dummy)
addmargins(tb1)
```

```
##           actual
## prediction  0  1 Sum
##        0    9  1  10
##        1   13 23  36
##        Sum 22 24  46
```

```
#Accuracy
(tb1[1,1] + tb1[2,2]) / 1206
```

```
## [1] 0.026534
```

```
#Sensitivity
tb1 / 786
```

```
##           actual
## prediction           0           1
##          0 0.011450382 0.001272265
##          1 0.016539440 0.029262087
```

```
#Specificity
tb1[1,1] / 148
```

```
## [1] 0.06081081
```

```
library(pROC)
```

```
## Type 'citation("pROC")' for a citation.
```

```
##
## Attaching package: 'pROC'
```

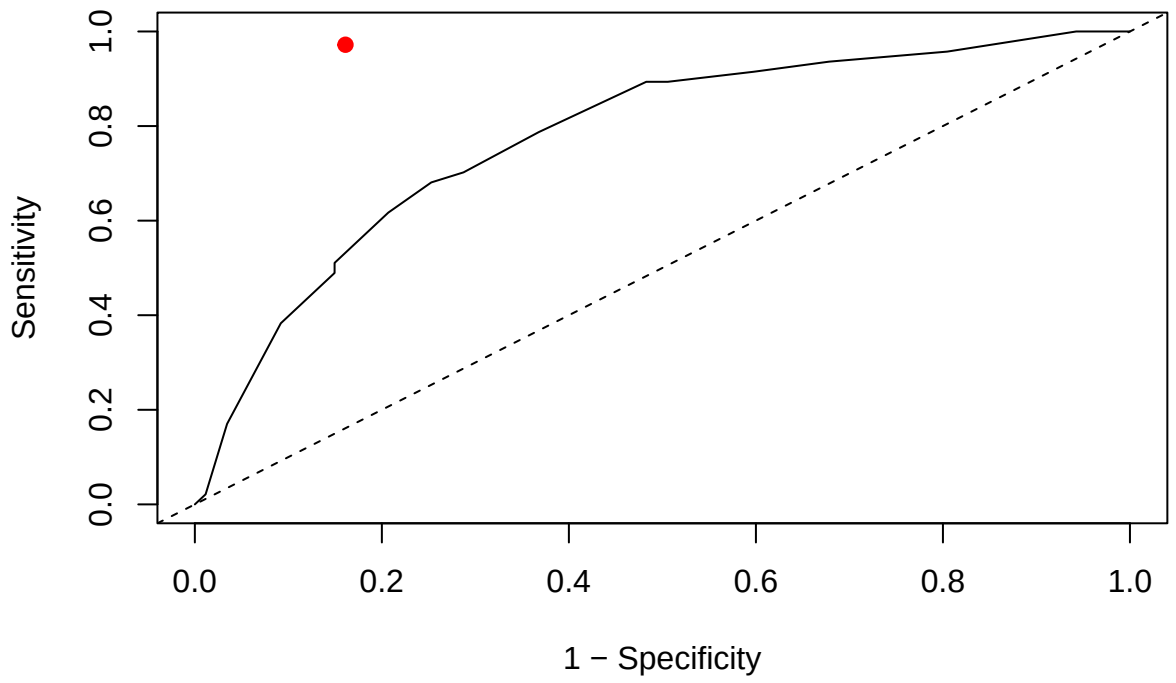
```
## The following objects are masked from 'package:stats':
##
##     cov, smooth, var
```

```
roc_reduced <- roc(ap_test$fSalary.Dummy, probs_test)
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
plot(1 - roc_reduced$specificities, roc_reduced$sensitivities, type="l",
       xlab = "1 - Specificity", ylab = "Sensitivity")
# plot red point corresponding to 0.5 threshold:
points(x = 24/149, y = 763/785, col="red", pch=19)
abline(0, 1, lty=2)
```




```
set.seed(999)
n <-nrow(ap_tibble)
n
```

```
## [1] 445
```

```
floor(0.7*n)
```

```
## [1] 311
```

```
#randomly sample 70% of the rows

train <- sample(1:n, 311)

glm_train <- glm(fSalary.Dummy ~ nTeam+nPosition+nCollege+poly(Age,3)+Height_i+Weight, data=ap_tibble, s

summary(glm_train)
```

```
##
## Call:
## glm(formula = fSalary.Dummy ~ nTeam + nPosition + nCollege +
##     poly(Age, 3) + Height_i + Weight, family = binomial, data = ap_tibble,
##     subset = train)
##
## Deviance Residuals:
##    Min      1Q  Median      3Q     Max
## -1.870  -0.859  -0.544   1.020   2.315
##
## Coefficients:
##                 Estimate Std. Error z value Pr(>|z|)
## (Intercept)     2.457222   2.940932   0.836  0.40342
## nTeam           0.002887   0.015193   0.190  0.84927
## nPosition       0.093441   0.085938   1.087  0.27690
## nCollege       -0.002086   0.004161  -0.501  0.61611
## poly(Age, 3)1  14.104543   3.292754   4.284 1.84e-05 ***
## poly(Age, 3)2 -10.679886   3.375668  -3.164  0.00156 **
## poly(Age, 3)3  -7.100286   4.090237  -1.736  0.08258 .
## Height_i       -1.049339   0.463863  -2.262  0.02369 *
## Weight          0.014863   0.007629   1.948  0.05138 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 402.90  on 310  degrees of freedom
## Residual deviance: 346.19  on 302  degrees of freedom
## AIC: 364.19
##
## Number of Fisher Scoring iterations: 5
```

```
ap_test <- ap_tibble[-train,]
head(ap_test)
```

```
##               Name           Team Position Age Height Height_i Weight
## 1     Jaylen Brown Boston Celtics       SG  24  6' 6"     6.60    223
## 2        Kris Dunn Boston Celtics       PG  27  6' 3"     6.30    205
## 3   Carsen Edwards Boston Celtics       PG  23 5' 11"     5.11    200
## 12 Dennis Schroder Boston Celtics       PG  27  6' 3"     6.30    172
## 15  Grant Williams Boston Celtics       PF  22  6' 6"     6.60    236
## 20 Nicolas Claxton  Brooklyn Nets       PF  22 6' 11"     6.11    215
##       College   Salary          fTeam fPosition   fCollege Salary.Dummy nTeam
```

```
## 1  California 26758928 Boston Celtics        SG California            1     2
## 2  Providence  5005350 Boston Celtics        PG Providence            0     2
## 3      Purdue  1782621 Boston Celtics        PG     Purdue            0     2
## 12        nan  5890000 Boston Celtics        PG        nan            0     2
## 15  Tennessee  2617800 Boston Celtics        PF  Tennessee            0     2
## 20    Georgia  1782621  Brooklyn Nets        PF    Georgia            0     3
##    nPosition nCollege fSalary.Dummy
## 1          7       15             1
## 2          5       79             0
## 3          5       80             0
## 12         5       60             0
## 15         4       92             0
## 20         4       31             0
```

```
probs_test <- predict(glm_train, newdata = ap_test,
                      type = "response")

head(probs_test)
```

```
##         1         2         3        12        15        20
## 0.3155917 0.4580423 0.4574399 0.3499949 0.1693730 0.2213408
```

```
length(probs_test)
```

```
## [1] 134
```

```
preds_test <- rep(0,12)
preds_test[probs_test > 0.5] <- 1

length(probs_test)
```

```
## [1] 134
```

```
length(preds_test)
```

```
## [1] 134
```

```
head(probs_test)
```

```
##         1         2         3        12        15        20
## 0.3155917 0.4580423 0.4574399 0.3499949 0.1693730 0.2213408
```

```
head(preds_test)
```

```
## [1] 0 0 0 0 0 0
```

```
tb2<- table(prediction = preds_test, actual = ap_test$fSalary.Dummy)
addmargins(tb2)
```

```
##           actual
## prediction  0  1 Sum
##        0    8  2  10
##        1   12 24  36
##        Sum 20 26  46
```

```
#Accuracy
(tb2[1,1] + tb2[2,2]) / 1206
```

```
## [1] 0.026534
```

```
#Sensitivity
tb2[2,2] / 786
```

```
## [1] 0.03053435
```

```
#Specificity
tb2[1,1] / 148
```

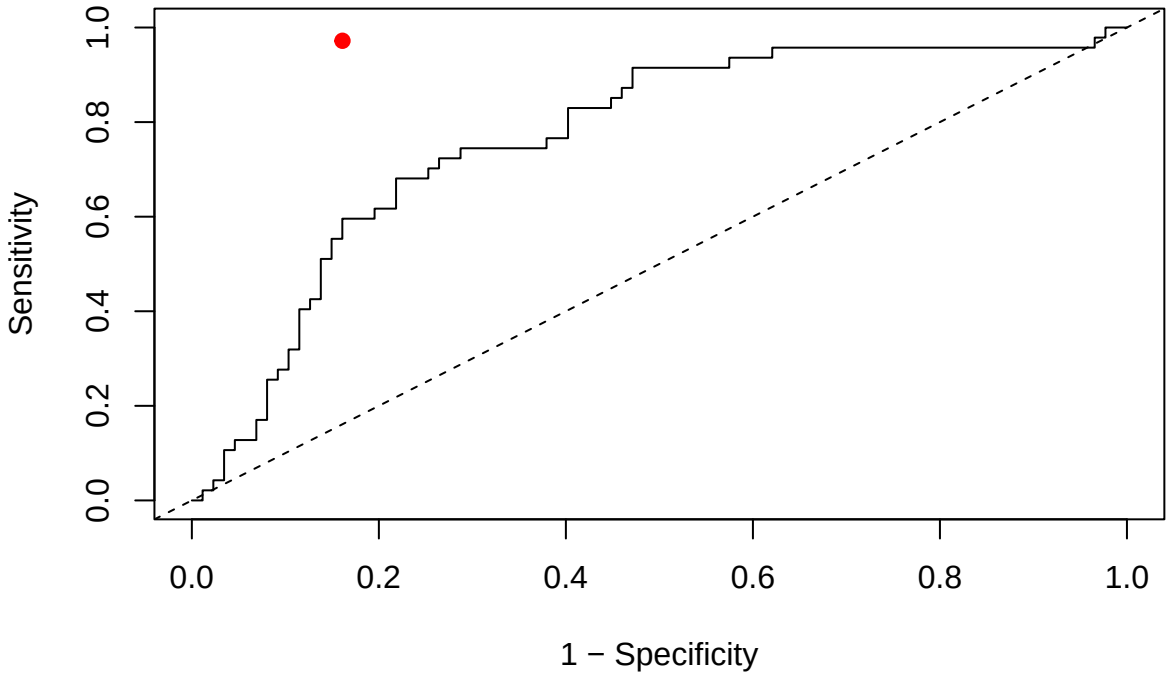
```
## [1] 0.05405405
```

```
library(pROC)
roc_full <- roc(ap_test$fSalary.Dummy, probs_test)
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
plot(1 - roc_full$specificities, roc_full$sensitivities, type="l",
       xlab = "1 - Specificity", ylab = "Sensitivity")
# plot red point corresponding to 0.5 threshold:
points(x = 24/149, y = 763/785, col="red", pch=19)
abline(0, 1, lty=2)
```




```
auc(roc_full)
```

```
## Area under the curve: 0.7674
```

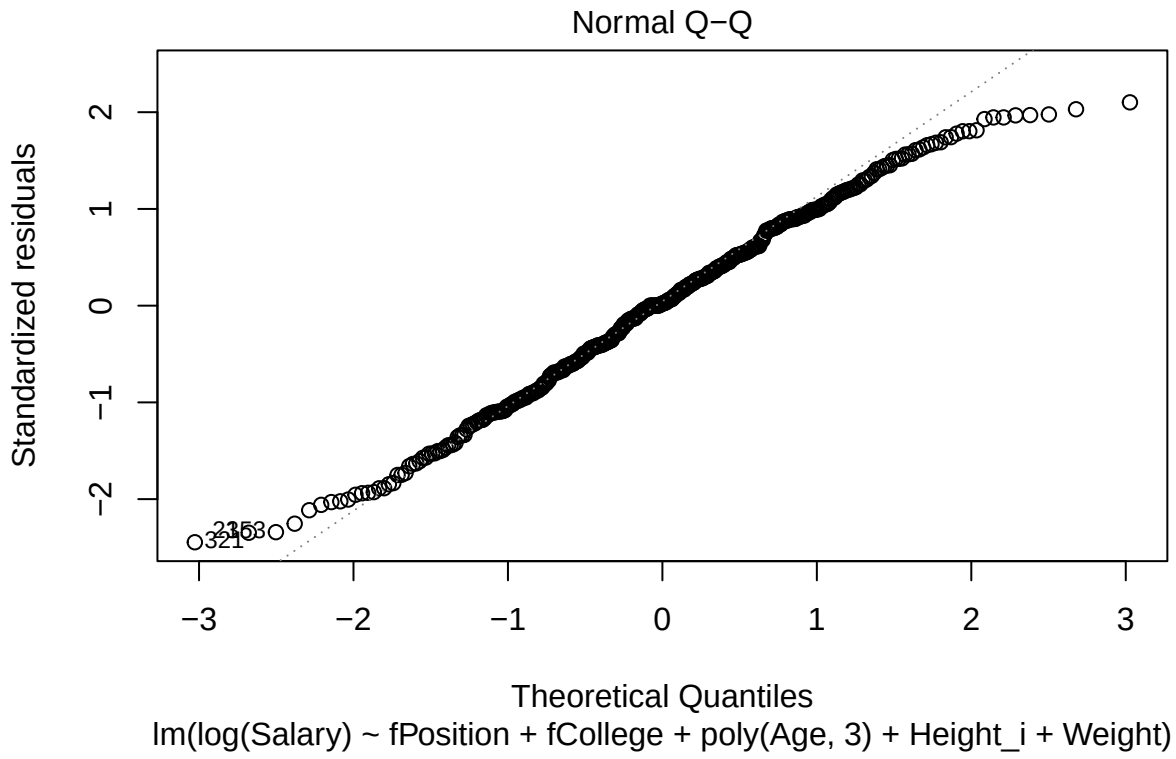
```
auc(roc_reduced)
```

```
## Area under the curve: 0.7762
```

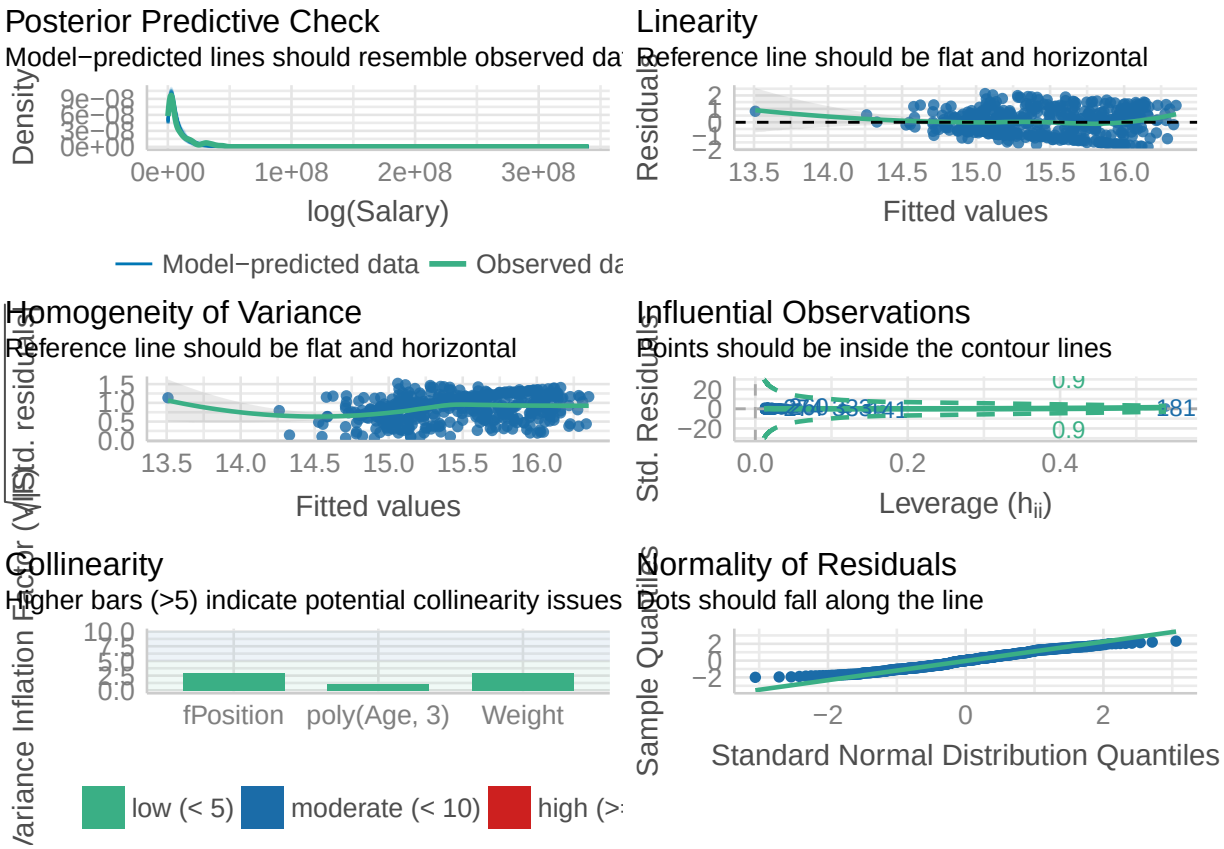
Plots

```
plot(lm_log2, 1:2)
```

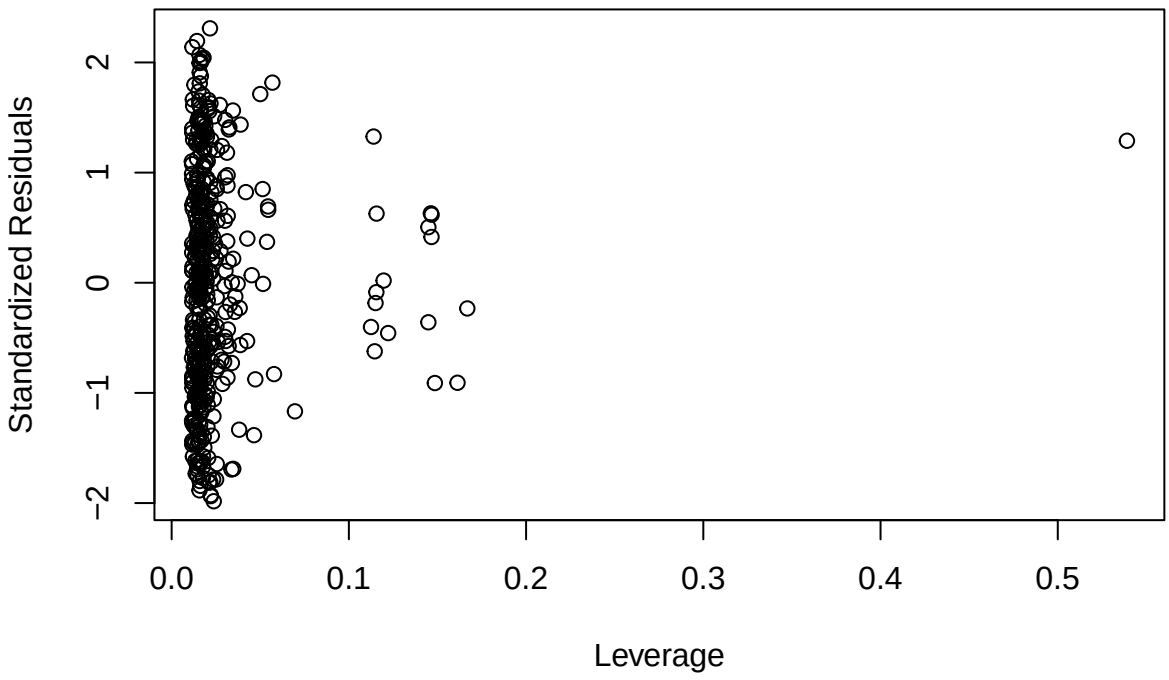
```
## Warning: not plotting observations with leverage one:
##   27, 46, 69, 74, 77, 85, 102, 104, 133, 137, 138, 141, 190, 217, 227, 231, 241, 249, 254, 269, 282,
```



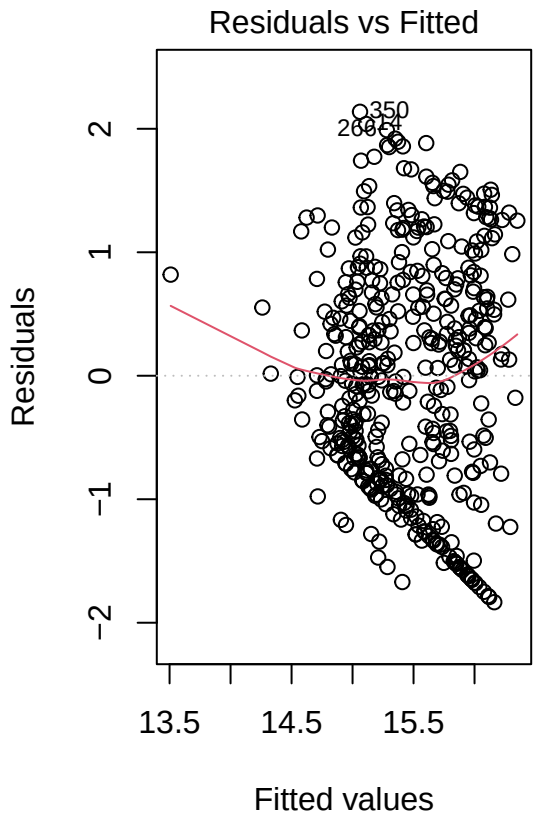

```
check_model(lm_log4)
```

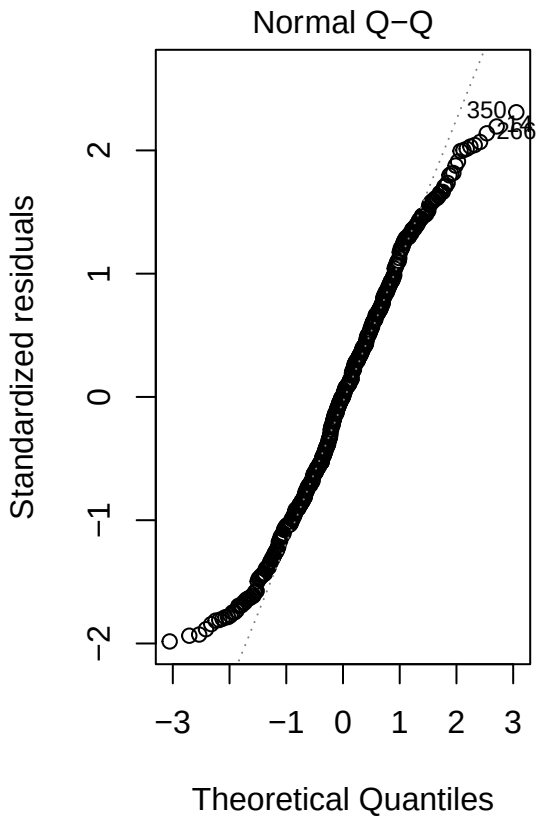



```
plot(hatvalues(lm_step), rstandard(lm_trans_step),xlab='Leverage', ylab='Standardized Residuals')
```

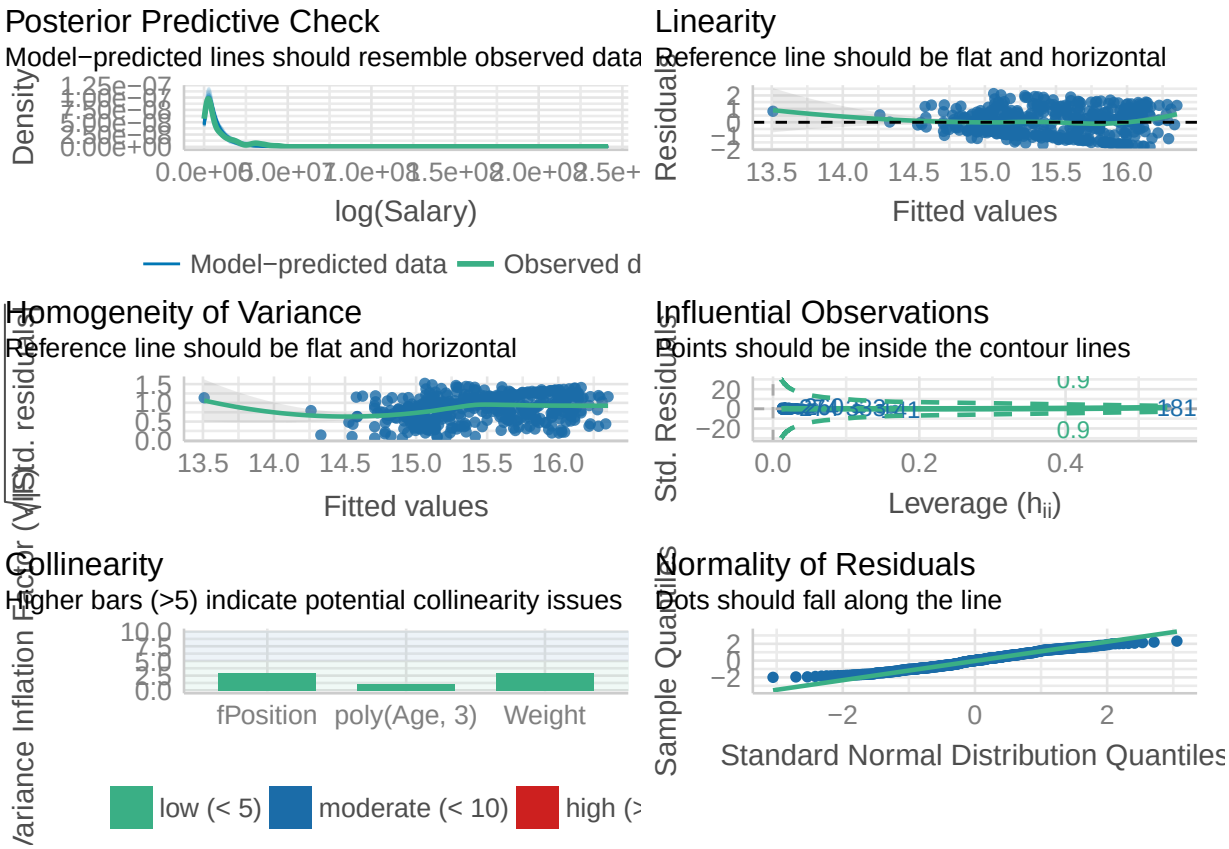



```
par(mfrow=c(1,2), mar=c(4.5, 4.5, 2, 2))
plot(lm_step, 1:2)
```






```
performance::check_model(lm_step)
```



Final Model - Change

$$\widehat{log(Salary)} = 13.330870 - 0.489098(fPositionF) + 0.73758(fPositionG)$$
$$+ 0.174562(fPositionPF) + 0.711135(fPositionPG)$$
$$+ 0.316997(fPositionSF) + 0.403881(fPositionSG)$$
$$+ 6.769471(Age) - 3.110142(Age)^2 - 3.153257(Age)^3 + 0.008296(Weight)$$

Prediction

```
# Steph Curry, Age = 34, Weight = 185, fPosition = PG, Salary = 45780966
newdata <- data.frame(fPosition='PG', Age=34, Weight = 185)
exp(predict(lm_trans_step, newdata, type='response'))
```

```
##       1
## 9417917
```

```
# Miles McBride Age = 20, Weight = 200, fPosition = PG, Salary = 925258
newdata <- data.frame(fPosition='PG', Age=20, Weight = 200)
exp(predict(lm_trans_step, newdata, type='response'))
```

```
##       1
## 4033461
```

```
newdata <- data.frame(fPosition=ap_tibble$fPosition, Age=ap_tibble$Age, Weight = ap_tibble$Weight)
exp(predict(lm_trans_step, newdata, type='response'))
```

```
##        1        2        3        4        5        6        7        8
```

```
##  4984308  8537257  4995094  2096032  6411921  7581163  3537132  3215994
##        9       10       11       12       13       14       15       16
##  6130537  4792147  6023740  6492755  9668497  3659307  3572870  3334280
##       17       18       19       20       21       22       23       24
##  6544753  4349617  6344794  3001652  3488085  9613913 10445453 10243254
##       25       26       27       28       29       30       31       32
##  8787662  9782022  4098449  8691070  9735534  5568847  3374611  3202418
##       33       34       35       36       37       38       39       40
##  6318667  3478931  9119907  9857477  4956691  3228654  3461139  4033461
##       41       42       43       44       45       46       47       48
##  4748071  3068207  6390165  3418300 11798381  3448000  6643243 10172390
##       49       50       51       52       53       54       55       56
##  7543747  8710380  7810515  8144495  7397451  2493543  4187434  4033461
##       57       58       59       60       61       62       63       64
##  4292953  3557067  3320515  8841498  4298707  4152841  1560487  4923749
##       65       66       67       68       69       70       71       72
##  4353689  3402350  5947200  3663361  5385604  2887368  8623718  4059532
##       73       74       75       76       77       78       79       80
##  5484426 10504758  3591998  5875679  5511577  7857625  4597446  3652850
##       81       82       83       84       85       86       87       88
##  3461139  5363253  9390844  3097476  9600161  4102384  5308460  8918911
##       89       90       91       92       93       94       95       96
##  4040480  2671086  3504438  6544753  3941167  4163656 10259389  4563090
##       97       98       99      100      101      102      103      104
##  2243245  3346367  6241896 10434012  4171798  2162760  4130727  3984114
##      105      106      107      108      109      110      111      112
##  3461139  4730899  3735171  6000120  3869584  5206636  4364772 11040561
##      113      114      115      116      117      118      119      120
##  3936446  3808902  4919026  8463813  8996403  2998965  3370109  3659307
##      121      122      123      124      125      126      127      128
## 11715032  8860864  3790666  6739013  2442713  6352569  6278845  6808475
##      129      130      131      132      133      134      135      136
##  9384586  5170057  6137715  4717492  7330729  4589586  5979852  8048625
##      137      138      139      140      141      142      143      144
##  5767607  7298787  4222316  4130727  8709163 12108208  7238490 11142797
##      145      146      147      148      149      150      151      152
##  8934675  3760504  5881458  8852333  5604945  3904882  8781433  8836347
##      153      154      155      156      157      158      159      160
##  9236121  3381255  4144188  3189861  3153131  3548355  6375131  6621600
##      161      162      163      164      165      166      167      168
##  3839690  3416832  2730311  4144188  3540182  9637449  4668977  2738395
##      169      170      171      172      173      174      175      176
##  4459222  3044575  4783954  8928341  3563065  5544203  9339986  2442713
##      177      178      179      180      181      182      183      184
##  3746230  4339986 10045595  8415937   735930  4040480  9063810 10021062
##      185      186      187      188      189      190      191      192
##  3461139  8352929  6821923  5284690  6574131  6344794  4569882  3718827
##      193      194      195      196      197      198      199      200
##  3172385  3978305  9384586  5382302  3278009  5767607  3746230 11050744
##      201      202      203      204      205      206      207      208
##  3715281  8534317  3092094  3210407  3994490  2954833  7178691  7641185
##      209      210      211      212      213      214      215      216
##  4095146  7002243 10430511  2951213  6907417  3746230  5604945  4944707
##      217      218      219      220      221      222      223      224
```

```
##  4292953  3607718  5792848  8637499  2546162  8909954 10147833  8711984
##      225      226      227      228      229      230      231      232
##  2037101  2992018  7359586  3739688  3229094  5275005  8835913  3171724
##      233      234      235      236      237      238      239      240
##  6107839  9675387  6691406  4747086  2760224  8848571  9595456  7673710
##      241      242      243      244      245      246      247      248
## 10085139  7626396 12413322  2624297  4904505  9159819  4664265  9236325
##      249      250      251      252      253      254      255      256
##  4069257  4452937  3832196  4787387  5910384  7631975  8359455  8957654
##      257      258      259      260      261      262      263      264
##  5998659  3933066  7889616  7901517  3673711  6821304  7937203 11798381
##      265      266      267      268      269      270      271      272
##  3713961  4328714  4609671  9080936  4648070  4648070  7504863 10086993
##      273      274      275      276      277      278      279      280
##  6795174  6290415  7113098  7857625  5893075  3790666  2789052  3543354
##      281      282      283      284      285      286      287      288
##  8459369  4152841  4410655  3718827  7330729  7996142  5377220  3790666
##      289      290      291      292      293      294      295      296
##  5148578  6847918  4029196  5206636  2730311  8485854  3796378  3004185
##      297      298      299      300      301      302      303      304
##  5697531  5839699  7759482  8132505  6302770  5813418  6357532  2966465
##      305      306      307      308      309      310      311      312
##  7166115  8308450 11907371  4939395  7555403  2894473  9980858  3338040
##      313      314      315      316      317      318      319      320
##  3005662  9827078  2455790  7330729  3079970  7270168  3175529  2631131
##      321      322      323      324      325      326      327      328
##  5486897  7273145  5069977 12620990  3499562  7755311  2671086  7082949
##      329      330      331      332      333      334      335      336
##  4160501  5263969  3708440  4465027  2145859  3489231  6137715  5069977
##      337      338      339      340      341      342      343      344
##  3673711  4863988  3653254  2882127  3431819  3233184  2602617  3829293
##      345      346      347      348      349      350      351      352
##  3413220  7110186  6011865  2441512  6089736  3475219  3320515  3144826
##      353      354      355      356      357      358      359      360
##  2698595  3975812  3255549  8147618  6060887  8585714  4943602  7621049
##      361      362      363      364      365      366      367      368
##  4422304  4756336  7060572  5067693  3352191  3718827  4917277  8459369
##      369      370      371      372      373      374      375      376
##  4743807  4525823  2814889  3080982  3097476  3446057  7538375  8984175
##      377      378      379      380      381      382      383      384
##  6358691  2441512 10591991  5089871  4292953  4960001  8497847  7324633
##      385      386      387      388      389      390      391      392
##  3017054  7115295  6268464  6341936  3286666  3910394  7499004  3697493
##      393      394      395      396      397      398      399      400
##  9735534  3346367  5950552  2082604  3361355  3751517  5560618  3785139
##      401      402      403      404      405      406      407      408
##  5986853  4639869  2631708  1672339  6293891  3461139  9296626  3187880
##      409      410      411      412      413      414      415      416
##  3112081  3951200  3278009  3360611  7555403  2156909  3341650  3146177
##      417      418      419      420      421      422      423      424
##  5287646  2458447  6956407  3097476 11144300  3352191  6902024  6498495
##      425      426      427      428      429      430      431      432
##  7822693  8486073  7032887  2847477  7657825  6302770  4016256  9870085
##      433      434      435      436      437      438      439      440
```

```
##  5617233  2971628  9701211  9339986  9565003  8101351  3814278  9977678
##      441      442      443      444      445
##  5284690  6681975  4328714  2661191  9934743
```

Conclusion

Given that the estimated/predicted salaries are way way off, and that the adjusted R^2 of the `lm_step_trans` is only 0.171, there are obviously other predictors responsible for the majority of variance in the salaries of NBA players, most likely factors such as points scored, assists, rebounds, etc.

It was never expected that non-skill factors would be responsible for explaining the majority of Salary variance.