NHLR

Gao

2023-12-11

```
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.2     v readr     2.1.4
## v forcats   1.0.0     v stringr   1.5.0
## v ggplot2   3.4.3     v tibble    3.2.1
## v lubridate 1.9.2     v tidyr     1.3.0
## v purrr     1.0.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(tidymodels)
```

```
## -- Attaching packages --------------------------------------- tidymodels 1.1.1 --
## v broom        1.0.5     v rsample      1.2.0
## v dials        1.2.0     v tune         1.1.2
## v infer        1.0.5     v workflows    1.1.3
## v modeldata    1.2.0     v workflowsets 1.0.1
## v parsnip      1.1.1     v yardstick    1.2.0
## v recipes      1.0.8
## -- Conflicts ------------------------------------------ tidymodels_conflicts() --
## x scales::discard() masks purrr::discard()
## x dplyr::filter()   masks stats::filter()
## x recipes::fixed()  masks stringr::fixed()
## x dplyr::lag()      masks stats::lag()
## x yardstick::spec() masks readr::spec()
## x recipes::step()   masks stats::step()
## * Use tidymodels_prefer() to resolve common conflicts.
```

```
library(ggforce)
library(mctest)
library(olsrr)
```

```
##
## Attaching package: 'olsrr'
##
## The following object is masked from 'package:datasets':
##
##     rivers
```

```r
library(jtools)
```

```
##
## Attaching package: 'jtools'
##
## The following object is masked from 'package:yardstick':
##
##     get_weights
```

```r
library(ggcorrplot)
library(yardstick)
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
```

```r
library(moments)
library(GGally)
```

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

```r
library(psych)
```

```
##
## Attaching package: 'psych'
##
## The following object is masked from 'package:car':
##
##     logit
##
## The following objects are masked from 'package:scales':
##
##     alpha, rescale
##
## The following objects are masked from 'package:ggplot2':
##
##     %+%, alpha
```

```r
library(fastDummies)
```

```
## Thank you for using fastDummies!
## To acknowledge our work, please cite the package:
## Kaplan, J. & Schlegel, B. (2023). fastDummies: Fast Creation of Dummy (Binary) Columns and Rows from
```

```r
NHL <- read_csv("train.csv") %>% as_tibble()
```

```
## New names:
## Rows: 612 Columns: 154
## -- Column specification
## -------------------------------------------------------- Delimiter: "," chr
## (10): Born, City, Pr/St, Cntry, Nat, Hand, Last Name, First Name, Posit... dbl
## (144): Salary, Ht, Wt, DftYr, DftRd, Ovrl, GP, G, A, A1, A2, PTS, PM, E+...
## 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.
## * `TOI/GP` -> `TOI/GP...29`
## * `TOI/GP` -> `TOI/GP...30`
## * `iCF` -> `iCF...41`
## * `iCF` -> `iCF...42`
## * `iSF` -> `iSF...44`
## * `iSF` -> `iSF...45`
## * `iSF` -> `iSF...46`
## * `sDist` -> `sDist...52`
## * `sDist` -> `sDist...53`
## * `iHF` -> `iHF...55`
## * `iHF` -> `iHF...56`
## * `iGVA` -> `iGVA...60`
## * `iTKA` -> `iTKA...61`
## * `iBLK` -> `iBLK...62`
## * `iGVA` -> `iGVA...63`
## * `iTKA` -> `iTKA...64`
## * `iBLK` -> `iBLK...65`
## * `iFOW` -> `iFOW...67`
## * `iFOL` -> `iFOL...68`
## * `iFOW` -> `iFOW...69`
## * `iFOL` -> `iFOL...70`
```

```r
NHL <- na.omit(NHL)
summary(NHL)
```

```
##      Salary              Born               City              Pr/St
##  Min.   :  575000   Length:359         Length:359         Length:359
##  1st Qu.:  750000   Class :character   Class :character   Class :character
##  Median :  950000   Mode  :character   Mode  :character   Mode  :character
##  Mean   : 2456544
##  3rd Qu.: 3750000
##  Max.   :13800000
##     Cntry               Nat                 Ht              Wt
##  Length:359         Length:359         Min.   :67.00   Min.   :160
##  Class :character   Class :character   1st Qu.:72.00   1st Qu.:191
##  Mode  :character   Mode  :character   Median :73.00   Median :202
```

```
##                                     Mean   :73.06   Mean   :202
##                                     3rd Qu.:74.50   3rd Qu.:212
##                                     Max.   :78.00   Max.   :244
##      DftYr          DftRd            Ovrl            Hand
##  Min.   :1997   Min.   :1.000   Min.   :  1.00   Length:359
##  1st Qu.:2006   1st Qu.:1.000   1st Qu.: 18.00   Class :character
##  Median :2009   Median :2.000   Median : 51.00   Mode  :character
##  Mean   :2009   Mean   :2.811   Mean   : 69.91
##  3rd Qu.:2012   3rd Qu.:4.000   3rd Qu.:110.00
##  Max.   :2016   Max.   :9.000   Max.   :279.00
##   Last Name          First Name          Position            Team
##  Length:359         Length:359         Length:359         Length:359
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##        GP              G               A              A1
##  Min.   : 1.00   Min.   : 0.000   Min.   : 0.00   Min.   : 0.000
##  1st Qu.:26.50   1st Qu.: 1.000   1st Qu.: 2.00   1st Qu.: 1.000
##  Median :65.00   Median : 5.000   Median :11.00   Median : 5.000
##  Mean   :53.42   Mean   : 7.947   Mean   :13.35   Mean   : 7.362
##  3rd Qu.:79.00   3rd Qu.:12.500   3rd Qu.:21.00   3rd Qu.:11.000
##  Max.   :82.00   Max.   :44.000   Max.   :55.00   Max.   :36.000
##        A2              PTS              PM               E+/-
##  Min.   : 0.000   Min.   : 0.00   Min.   :-31.0000   Min.   :-19.00000
##  1st Qu.: 1.000   1st Qu.: 4.00   1st Qu.: -6.0000   1st Qu.: -3.20000
##  Median : 5.000   Median :16.00   Median : -1.0000   Median : -0.40000
##  Mean   : 5.986   Mean   :21.29   Mean   : -0.4401   Mean   : -0.05822
##  3rd Qu.: 9.000   3rd Qu.:35.00   3rd Qu.:  5.0000   3rd Qu.:  2.45000
##  Max.   :28.000   Max.   :89.00   Max.   : 34.0000   Max.   : 20.30000
##       PIM             Shifts            TOI              TOIX
##  Min.   :  0.00   Min.   :  13.0   Min.   :   429   Min.   :   7.2
##  1st Qu.: 10.00   1st Qu.: 460.5   1st Qu.: 20374   1st Qu.: 339.4
##  Median : 24.00   Median :1330.0   Median : 57408   Median : 952.4
##  Mean   : 28.57   Mean   :1171.1   Mean   : 53497   Mean   : 887.5
##  3rd Qu.: 38.00   3rd Qu.:1798.0   3rd Qu.: 83899   3rd Qu.:1387.2
##  Max.   :154.00   Max.   :2657.0   Max.   :133550   Max.   :2218.9
##   TOI/GP...29     TOI/GP...30         TOI%            IPP%
##  Min.   : 6.75   Min.   : 6.75   Min.   :13.10   Min.   :  0.00
##  1st Qu.:12.25   1st Qu.:12.19   1st Qu.:22.90   1st Qu.: 34.60
##  Median :15.42   Median :15.41   Median :27.40   Median : 54.80
##  Mean   :15.42   Mean   :15.40   Mean   :27.57   Mean   : 49.92
##  3rd Qu.:18.43   3rd Qu.:18.43   3rd Qu.:32.30   3rd Qu.: 67.60
##  Max.   :27.15   Max.   :27.12   Max.   :44.90   Max.   :100.00
##       SH%             SV%              PDO              F/60
##  Min.   : 0.000   Min.   :0.6670   Min.   : 750.0   Min.   : 0.000
##  1st Qu.: 6.300   1st Qu.:0.9040   1st Qu.: 978.0   1st Qu.: 1.685
##  Median : 8.000   Median :0.9160   Median : 997.0   Median : 2.270
##  Mean   : 7.723   Mean   :0.9151   Mean   : 992.3   Mean   : 2.270
##  3rd Qu.: 9.600   3rd Qu.:0.9270   3rd Qu.:1016.0   3rd Qu.: 2.980
##  Max.   :40.000   Max.   :1.0000   Max.   :1257.0   Max.   :10.780
##       A/60             Pct%             Diff            Diff/60
##  Min.   : 0.000   Min.   :  0.00   Min.   :-44.000   Min.   :-16.740
```

```
##  1st Qu.: 2.075   1st Qu.: 39.10   1st Qu.: -7.000   1st Qu.: -0.930
##  Median : 2.470   Median : 48.60   Median : -1.000   Median : -0.090
##  Mean   : 2.535   Mean   : 45.92   Mean   :  1.774   Mean   : -0.265
##  3rd Qu.: 2.865   3rd Qu.: 56.75   3rd Qu.: 10.000   3rd Qu.:  0.650
##  Max.   :16.740   Max.   :100.00   Max.   : 61.000   Max.   :  5.390
##     iCF...41         iCF...42          iFF           iSF...44
##  Min.   :  1.0   Min.   :  1.0   Min.   :  1.0   Min.   :  0.00
##  1st Qu.: 50.5   1st Qu.: 51.5   1st Qu.: 38.5   1st Qu.: 26.00
##  Median :156.0   Median :156.0   Median :116.0   Median : 82.00
##  Mean   :166.3   Mean   :166.4   Mean   :124.6   Mean   : 89.91
##  3rd Qu.:253.0   3rd Qu.:253.0   3rd Qu.:188.5   3rd Qu.:137.50
##  Max.   :509.0   Max.   :508.0   Max.   :404.0   Max.   :303.00
##     iSF...45         iSF...46          ixG              iSCF
##  Min.   :  0.00   Min.   :  0.00   Min.   : 0.000   Min.   :  0.00
##  1st Qu.: 26.00   1st Qu.: 26.00   1st Qu.: 1.900   1st Qu.:  3.50
##  Median : 82.00   Median : 82.00   Median : 5.900   Median : 13.00
##  Mean   : 90.12   Mean   : 90.14   Mean   : 8.025   Mean   : 26.57
##  3rd Qu.:138.00   3rd Qu.:138.00   3rd Qu.:12.100   3rd Qu.: 46.00
##  Max.   :302.00   Max.   :302.00   Max.   :33.000   Max.   :139.00
##       iRB              iRS              iDS          sDist...52
##  Min.   : 0.000   Min.   : 0.000   Min.   : 0.00   Min.   : 0.00
##  1st Qu.: 1.000   1st Qu.: 2.000   1st Qu.: 4.00   1st Qu.:27.10
##  Median : 4.000   Median : 6.000   Median :11.00   Median :31.60
##  Mean   : 6.396   Mean   : 7.735   Mean   :14.13   Mean   :36.08
##  3rd Qu.:10.000   3rd Qu.:12.000   3rd Qu.:21.00   3rd Qu.:47.80
##  Max.   :41.000   Max.   :32.000   Max.   :63.00   Max.   :77.50
##    sDist...53         Pass           iHF...55         iHF...56
##  Min.   : 0.00   Min.   :  0.00   Min.   :  0.00   Min.   :  0.00
##  1st Qu.:25.20   1st Qu.: 37.85   1st Qu.: 25.00   1st Qu.: 25.00
##  Median :29.10   Median :118.80   Median : 59.00   Median : 58.00
##  Mean   :33.40   Mean   :142.28   Mean   : 69.42   Mean   : 69.25
##  3rd Qu.:44.55   3rd Qu.:224.00   3rd Qu.: 94.00   3rd Qu.: 94.00
##  Max.   :65.50   Max.   :501.20   Max.   :364.00   Max.   :364.00
##       iHA              iHDf             iMiss         iGVA...60
##  Min.   :  0.00   Min.   :-114.000   Min.   :  0.0   Min.   :  0.00
##  1st Qu.: 26.50   1st Qu.: -17.000   1st Qu.: 12.0   1st Qu.:  6.50
##  Median : 62.00   Median :   1.000   Median : 33.0   Median : 22.00
##  Mean   : 62.97   Mean   :   6.279   Mean   : 34.8   Mean   : 24.99
##  3rd Qu.: 90.00   3rd Qu.:  22.500   3rd Qu.: 54.0   3rd Qu.: 39.00
##  Max.   :215.00   Max.   : 227.000   Max.   :109.0   Max.   :102.00
##    iTKA...61        iBLK...62        iGVA...63        iTKA...64
##  Min.   : 0.00   Min.   :  0.00   Min.   :  0.00   Min.   : 0.0
##  1st Qu.: 4.00   1st Qu.: 12.00   1st Qu.:  6.50   1st Qu.: 4.0
##  Median :16.00   Median : 29.00   Median : 22.00   Median :16.0
##  Mean   :19.56   Mean   : 44.34   Mean   : 24.91   Mean   :19.5
##  3rd Qu.:30.00   3rd Qu.: 61.50   3rd Qu.: 39.00   3rd Qu.:30.0
##  Max.   :96.00   Max.   :213.00   Max.   :102.00   Max.   :96.0
##    iBLK...65           BLK%          iFOW...67         iFOL...68
##  Min.   :  0.00   Min.   : 0.000   Min.   :   0.00   Min.   :  0.00
##  1st Qu.: 12.00   1st Qu.: 2.900   1st Qu.:   0.00   1st Qu.:  0.00
##  Median : 29.00   Median : 4.400   Median :   2.00   Median :  2.00
##  Mean   : 44.25   Mean   : 5.134   Mean   :  86.65   Mean   : 86.29
##  3rd Qu.: 61.50   3rd Qu.: 7.200   3rd Qu.:  42.00   3rd Qu.: 47.50
##  Max.   :213.00   Max.   :16.700   Max.   :1089.00   Max.   :906.00
```

```
##    iFOW...69         iFOL...70           FO%             %FOT
##  Min.   :   0.00   Min.   :  0.00   Min.   :  0.0   Min.   : 0.00
##  1st Qu.:   0.00   1st Qu.:  0.00   1st Qu.:  0.0   1st Qu.: 0.00
##  Median :   2.00   Median :  2.00   Median : 33.3   Median : 0.90
##  Mean   :  86.46   Mean   : 86.08   Mean   : 29.2   Mean   :19.31
##  3rd Qu.:  42.00   3rd Qu.: 47.50   3rd Qu.: 50.0   3rd Qu.:25.60
##  Max.   :1083.00   Max.   :906.00   Max.   :100.0   Max.   :99.20
##      dzFOW            dzFOL            nzFOW            nzFOL
##  Min.   :  0.00   Min.   :  0.00   Min.   :  0.00   Min.   :  0.00
##  1st Qu.:  0.00   1st Qu.:  0.00   1st Qu.:  0.00   1st Qu.:  0.00
##  Median :  0.00   Median :  0.00   Median :  0.00   Median :  0.00
##  Mean   : 28.69   Mean   : 29.02   Mean   : 27.58   Mean   : 27.75
##  3rd Qu.:  8.00   3rd Qu.: 11.00   3rd Qu.: 12.00   3rd Qu.: 13.00
##  Max.   :429.00   Max.   :344.00   Max.   :324.00   Max.   :326.00
##      ozFOW            ozFOL            FOW.Up           FOL.Up
##  Min.   :  0.00   Min.   :  0.00   Min.   :  0.0   Min.   :  0.0
##  1st Qu.:  0.00   1st Qu.:  0.00   1st Qu.:  0.0   1st Qu.:  0.0
##  Median :  1.00   Median :  1.00   Median :  0.0   Median :  0.0
##  Mean   : 30.36   Mean   : 29.49   Mean   : 26.4   Mean   : 25.6
##  3rd Qu.: 17.00   3rd Qu.: 19.00   3rd Qu.: 13.0   3rd Qu.: 14.0
##  Max.   :420.00   Max.   :390.00   Max.   :385.0   Max.   :287.0
##     FOW.Down         FOL.Down         FOW.Close        FOL.Close
##  Min.   :  0.00   Min.   :  0.00   Min.   :  0.00   Min.   :  0.00
##  1st Qu.:  0.00   1st Qu.:  0.00   1st Qu.:  0.00   1st Qu.:  0.00
##  Median :  1.00   Median :  1.00   Median :  1.00   Median :  2.00
##  Mean   : 28.86   Mean   : 29.32   Mean   : 53.86   Mean   : 53.52
##  3rd Qu.: 13.50   3rd Qu.: 17.00   3rd Qu.: 27.00   3rd Qu.: 30.00
##  Max.   :329.00   Max.   :302.00   Max.   :679.00   Max.   :549.00
##       OTG               1G              GWG              ENG
##  Min.   :0.0000   Min.   : 0.000   Min.   :0.000   Min.   :0.0000
##  1st Qu.:0.0000   1st Qu.: 0.000   1st Qu.:0.000   1st Qu.:0.0000
##  Median :0.0000   Median : 1.000   Median :1.000   Median :0.0000
##  Mean   :0.2201   Mean   : 1.501   Mean   :1.326   Mean   :0.3649
##  3rd Qu.:0.0000   3rd Qu.: 2.000   3rd Qu.:2.000   3rd Qu.:0.0000
##  Max.   :5.0000   Max.   :12.000   Max.   :9.000   Max.   :4.0000
##       PSG               PSA              G.Bkhd           G.Dflct
##  Min.   :0.00000   Min.   :0.00000   Min.   : 0.0000   Min.   :0.0000
##  1st Qu.:0.00000   1st Qu.:0.00000   1st Qu.: 0.0000   1st Qu.:0.0000
##  Median :0.00000   Median :0.00000   Median : 0.0000   Median :0.0000
##  Mean   :0.01393   Mean   :0.05571   Mean   : 0.7409   Mean   :0.2312
##  3rd Qu.:0.00000   3rd Qu.:0.00000   3rd Qu.: 1.0000   3rd Qu.:0.0000
##  Max.   :1.00000   Max.   :1.00000   Max.   :10.0000   Max.   :3.0000
##      G.Slap            G.Snap           G.Tip            G.Wrap
##  Min.   : 0.0000   Min.   : 0.000   Min.   :0.0000   Min.   :0.00000
##  1st Qu.: 0.0000   1st Qu.: 0.000   1st Qu.:0.0000   1st Qu.:0.00000
##  Median : 0.0000   Median : 0.000   Median :0.0000   Median :0.00000
##  Mean   : 0.9359   Mean   : 1.284   Mean   :0.8496   Mean   :0.08635
##  3rd Qu.: 1.0000   3rd Qu.: 2.000   3rd Qu.:1.0000   3rd Qu.:0.00000
##  Max.   :12.0000   Max.   :13.000   Max.   :9.0000   Max.   :2.00000
##      G.Wrst            CBar             Post             Over
##  Min.   : 0.000   Min.   :0.0000   Min.   :0.000   Min.   : 0.000
##  1st Qu.: 0.000   1st Qu.:0.0000   1st Qu.:0.000   1st Qu.: 1.000
##  Median : 2.000   Median :0.0000   Median :1.000   Median : 3.000
##  Mean   : 3.808   Mean   :0.3287   Mean   :1.457   Mean   : 3.437
```

```
##  3rd Qu.: 6.000   3rd Qu.:1.0000   3rd Qu.:2.000   3rd Qu.: 5.000
##  Max.   :21.000   Max.   :6.0000   Max.   :8.000   Max.   :18.000
##       Wide            S.Bkhd          S.Dflct           S.Slap
##  Min.   : 0.00   Min.   : 0.000   Min.   : 0.000   Min.   :  0.00
##  1st Qu.:10.00   1st Qu.: 1.000   1st Qu.: 0.000   1st Qu.:  2.00
##  Median :27.00   Median : 5.000   Median : 0.000   Median :  8.00
##  Mean   :29.58   Mean   : 7.284   Mean   : 1.231   Mean   : 16.18
##  3rd Qu.:45.50   3rd Qu.:12.000   3rd Qu.: 2.000   3rd Qu.: 21.50
##  Max.   :98.00   Max.   :44.000   Max.   :18.000   Max.   :141.00
##      S.Snap          S.Tip            S.Wrap           S.Wrst
##  Min.   : 0.0   Min.   : 0.000   Min.   :0.0000   Min.   :  0.00
##  1st Qu.: 3.0   1st Qu.: 0.000   1st Qu.:0.0000   1st Qu.: 12.50
##  Median :10.0   Median : 2.000   Median :0.0000   Median : 41.00
##  Mean   :14.2   Mean   : 4.454   Mean   :0.9638   Mean   : 45.81
##  3rd Qu.:20.0   3rd Qu.: 7.000   3rd Qu.:1.0000   3rd Qu.: 69.00
##  Max.   :77.0   Max.   :41.000   Max.   :9.0000   Max.   :182.00
##      iPenT           iPenD            iPENT           iPEND
##  Min.   : 0.00   Min.   : 0.000   Min.   : 0.00   Min.   : 0.000
##  1st Qu.: 4.00   1st Qu.: 2.000   1st Qu.: 4.00   1st Qu.: 2.000
##  Median :10.00   Median : 7.000   Median :10.00   Median : 6.000
##  Mean   :11.49   Mean   : 9.287   Mean   :10.93   Mean   : 7.919
##  3rd Qu.:16.00   3rd Qu.:14.000   3rd Qu.:16.00   3rd Qu.:12.000
##  Max.   :48.00   Max.   :47.000   Max.   :44.00   Max.   :35.000
##      iPenDf             NPD               Min             Maj
##  Min.   :-28.000   Min.   :-19.400   Min.   : 0.00   Min.   : 0.000
##  1st Qu.: -6.000   1st Qu.: -3.200   1st Qu.: 4.00   1st Qu.: 0.000
##  Median : -1.000   Median :  0.000   Median : 9.00   Median : 0.000
##  Mean   : -2.201   Mean   : -0.322   Mean   :10.12   Mean   : 1.114
##  3rd Qu.:  1.000   3rd Qu.:  3.000   3rd Qu.:15.00   3rd Qu.: 1.000
##  Max.   : 20.000   Max.   : 19.400   Max.   :39.00   Max.   :14.000
##      Match              Misc             Game               CF
##  Min.   :0.000000   Min.   :0.0000   Min.   :0.00000   Min.   :   8.0
##  1st Qu.:0.000000   1st Qu.:0.0000   1st Qu.:0.00000   1st Qu.: 287.5
##  Median :0.000000   Median :0.0000   Median :0.00000   Median : 813.0
##  Mean   :0.005571   Mean   :0.1727   Mean   :0.07242   Mean   : 825.9
##  3rd Qu.:0.000000   3rd Qu.:0.0000   3rd Qu.:0.00000   3rd Qu.:1283.0
##  Max.   :1.000000   Max.   :4.0000   Max.   :2.00000   Max.   :2308.0
##       CA               FF               FA               SF
##  Min.   :   6.0   Min.   :   5.0   Min.   :   5.0   Min.   :   4.0
##  1st Qu.: 306.0   1st Qu.: 203.0   1st Qu.: 228.5   1st Qu.: 146.0
##  Median : 863.0   Median : 603.0   Median : 645.0   Median : 441.0
##  Mean   : 812.9   Mean   : 615.6   Mean   : 604.7   Mean   : 443.5
##  3rd Qu.:1226.0   3rd Qu.: 957.5   3rd Qu.: 922.5   3rd Qu.: 692.5
##  Max.   :2009.0   Max.   :1668.0   Max.   :1510.0   Max.   :1181.0
##       SA              xGF              xGA             SCF
##  Min.   :   2.0   Min.   :  0.20   Min.   : 0.40   Min.   :  0.0
##  1st Qu.: 162.0   1st Qu.: 12.25   1st Qu.:13.80   1st Qu.: 39.0
##  Median : 469.0   Median : 37.90   Median :40.10   Median :124.0
##  Mean   : 434.4   Mean   : 39.66   Mean   :38.58   Mean   :131.7
##  3rd Qu.: 667.5   3rd Qu.: 62.15   3rd Qu.:58.75   3rd Qu.:206.0
##  Max.   :1073.0   Max.   :111.10   Max.   :97.20   Max.   :419.0
##       SCA              GF               GA              RBF
##  Min.   :  0.0   Min.   :  0.00   Min.   :  0.00   Min.   :  0.00
##  1st Qu.: 46.0   1st Qu.: 10.00   1st Qu.: 12.00   1st Qu.: 10.00
```

```
##  Median :131.0   Median : 35.00   Median : 39.00   Median : 28.00
##  Mean   :128.4   Mean   : 38.74   Mean   : 36.97   Mean   : 31.77
##  3rd Qu.:197.5   3rd Qu.: 64.50   3rd Qu.: 56.50   3rd Qu.: 48.00
##  Max.   :344.0   Max.   :120.00   Max.   :100.00   Max.   :110.00
##       RBA             RSF             RSA             DSF
##  Min.   : 0.00   Min.   :  0.0   Min.   :  0.00   Min.   :  0.00
##  1st Qu.:11.00   1st Qu.: 12.0   1st Qu.: 14.50   1st Qu.: 23.00
##  Median :29.00   Median : 37.0   Median : 39.00   Median : 68.00
##  Mean   :29.91   Mean   : 38.9   Mean   : 38.58   Mean   : 70.67
##  3rd Qu.:44.50   3rd Qu.: 59.0   3rd Qu.: 57.00   3rd Qu.:107.00
##  Max.   :95.00   Max.   :130.0   Max.   :112.00   Max.   :213.00
##       DSA             FOW             FOL              HF
##  Min.   :  0.00   Min.   :   4.0   Min.   :   4.0   Min.   :  0.0
##  1st Qu.: 26.50   1st Qu.: 142.5   1st Qu.: 152.5   1st Qu.:156.0
##  Median : 73.00   Median : 442.0   Median : 460.0   Median :350.0
##  Mean   : 68.49   Mean   : 437.8   Mean   : 434.6   Mean   :329.5
##  3rd Qu.:102.00   3rd Qu.: 678.5   3rd Qu.: 667.5   3rd Qu.:477.5
##  Max.   :185.00   Max.   :1257.0   Max.   :1196.0   Max.   :926.0
##        HA              GVA             TKA             PENT
##  Min.   :  2.0   Min.   :  0.0   Min.   :  0.00   Min.   :  0.00
##  1st Qu.:153.0   1st Qu.: 44.0   1st Qu.: 32.00   1st Qu.: 21.00
##  Median :336.0   Median :126.0   Median : 93.00   Median : 55.00
##  Mean   :318.8   Mean   :130.5   Mean   : 97.39   Mean   : 50.93
##  3rd Qu.:468.0   3rd Qu.:201.5   3rd Qu.:147.00   3rd Qu.: 76.00
##  Max.   :870.0   Max.   :388.0   Max.   :347.00   Max.   :122.00
##       PEND             OPS             DPS              PS
##  Min.   :  0.00   Min.   :-1.500   Min.   :-0.200   Min.   :-1.200
##  1st Qu.: 20.50   1st Qu.:-0.100   1st Qu.: 0.300   1st Qu.: 0.300
##  Median : 53.00   Median : 0.500   Median : 1.100   Median : 2.000
##  Mean   : 50.01   Mean   : 1.334   Mean   : 1.402   Mean   : 2.741
##  3rd Qu.: 75.00   3rd Qu.: 2.300   3rd Qu.: 2.000   3rd Qu.: 4.600
##  Max.   :127.00   Max.   :10.500   Max.   : 7.200   Max.   :12.600
##       OTOI              Grit            DAP              Pace
##  Min.   :  33.51   Min.   :  1.0   Min.   : 0.000   Min.   : 77.6
##  1st Qu.:1035.25   1st Qu.: 59.5   1st Qu.: 5.300   1st Qu.:104.8
##  Median :2604.66   Median :132.0   Median : 7.800   Median :109.1
##  Mean   :2116.05   Mean   :143.4   Mean   : 9.516   Mean   :109.1
##  3rd Qu.:3057.62   3rd Qu.:208.0   3rd Qu.:12.200   3rd Qu.:114.2
##  Max.   :3521.78   Max.   :622.0   Max.   :52.500   Max.   :175.7
##        GS              GS/G
##  Min.   :-3.50   Min.   :-0.5900
##  1st Qu.: 3.50   1st Qu.: 0.1400
##  Median :17.20   Median : 0.3000
##  Mean   :22.69   Mean   : 0.3372
##  3rd Qu.:37.45   3rd Qu.: 0.5100
##  Max.   :99.20   Max.   : 1.2600
```

```
cor(NHL$Salary, select_if(NHL, is.numeric))
```

```
##      Salary        Ht       Wt     DftYr      DftRd       Ovrl       GP
## [1,]      1 0.0725865 0.158679 -0.454342 -0.2368023 -0.2539748 0.469868
##              G         A        A1        A2       PTS        PM      E+/-
## [1,] 0.5826013 0.6609185 0.6366981 0.6143923 0.6698338 0.1734101 0.2815903
##            PIM    Shifts      TOI      TOIX TOI/GP...29 TOI/GP...30      TOI%
```

```
## [1,] 0.2606414 0.5712678 0.605303 0.6053201   0.6007812   0.6010984 0.5654077
##           IPP%       SH%         SV%       PDO      F/60        A/60      Pct%
## [1,] 0.1797133 0.2823685 -0.04531451 0.1820004 0.4131516 -0.01150073 0.2954794
##           Diff   Diff/60  iCF...41  iCF...42       iFF  iSF...44  iSF...45
## [1,] 0.4161073 0.2907968 0.6492011 0.6489927 0.6490971 0.6496799 0.6497235
##       iSF...46       ixG      iSCF       iRB       iRS       iDS sDist...52
## [1,] 0.6497467 0.5771281 0.4953506 0.4619221 0.5037382 0.5207104 0.02717304
##        sDist...53      Pass iHF...55  iHF...56       iHA        iHDf     iMiss
## [1,] -0.002805594 0.5879846 0.215743 0.2158166 0.3649198 -0.05564978 0.6184659
##      iGVA...60 iTKA...61 iBLK...62 iGVA...63 iTKA...64 iBLK...65        BLK%
## [1,] 0.5519523 0.4613922 0.3291048 0.5530128 0.4628361  0.330085 -0.03684297
##      iFOW...67 iFOL...68 iFOW...69 iFOL...70       FO%       %FOT     dzFOW
## [1,] 0.3069584  0.278771 0.3068316 0.2788238 0.0925531 0.06229918 0.2533886
##          dzFOL     nzFOW     nzFOL     ozFOW     ozFOL    FOW.Up   FOL.Up
## [1,] 0.2298358 0.2955186 0.2589247 0.3505631 0.3275519 0.2989825 0.268225
##       FOW.Down  FOL.Down FOW.Close FOL.Close       OTG        1G       GWG
## [1,] 0.3009973 0.2689279 0.3108253 0.2823277 0.3186809 0.5163133 0.5564102
##            ENG        PSG       PSA    G.Bkhd   G.Dflct    G.Slap    G.Snap
## [1,] 0.4295636 0.05974358 0.150269 0.2353363 0.2895829 0.4289538 0.4338371
##          G.Tip    G.Wrap    G.Wrst      CBar      Post      Over      Wide
## [1,] 0.3332158 0.1728281 0.5313882 0.2086992 0.4465628 0.4784401 0.6148983
##         S.Bkhd   S.Dflct    S.Slap    S.Snap     S.Tip    S.Wrap    S.Wrst
## [1,] 0.4234477 0.3474582 0.4240401 0.4872142 0.4196645 0.2069183 0.5948321
##         iPenT     iPenD     iPENT     iPEND      iPenDf       NPD       Min
## [1,] 0.359327 0.3668512 0.3749997 0.3621991 -0.04169453 0.1010064 0.4224469
##              Maj       Match       Misc        Game        CF        CA
## [1,] -0.02850292 -0.03829049 0.07485138 -0.03437022 0.6609512 0.5622878
##            FF        FA        SF        SA       xGF       xGA     SCF
## [1,] 0.6592779 0.5639558 0.6650839 0.5695632 0.6771599 0.5588539 0.67518
##            SCA        GF        GA       RBF       RBA      RSF       RSA
## [1,] 0.5530132 0.6820274 0.5710731 0.6170984 0.5018589 0.556302 0.5723369
##            DSF       DSA       FOW       FOL        HF        HA       GVA
## [1,] 0.6013619 0.5624003 0.6501889 0.6299849 0.4140283 0.5161623 0.5881052
##            TKA      PENT      PEND       OPS      DPS        PS      OTOI
## [1,] 0.5600872 0.5277816 0.5901456 0.6333474 0.428782 0.6601165 0.4367475
##           Grit         DAP      Pace        GS      GS/G
## [1,] 0.3176354 -0.02697638 0.2915016 0.6737828 0.6078714
```

```
NHL <- dummy_cols(NHL, select_columns = "Position", remove_first_dummy = TRUE)

model <- lm(Salary ~ GP + GS + PM + PIM + Wt + iHDf + nzFOL + nzFOW + Position_CD + Position_CLW + Posi
model
```

```
##
## Call:
## lm(formula = Salary ~ GP + GS + PM + PIM + Wt + iHDf + nzFOL +
##     nzFOW + Position_CD + Position_CLW + Position_CRW + Position_CLWRW +
##     Position_D + Position_LW + Position_LWRW + Position_RW, data = NHL)
##
## Coefficients:
##    (Intercept)              GP              GS              PM             PIM
##     -3450060.1         -6654.8         85395.8        -14366.6           565.3
##             Wt            iHDf           nzFOL           nzFOW     Position_CD
##        21695.1          2689.0        -16200.9         15434.3        428130.0
```

```
##   Position_CLW    Position_CRW  Position_CLWRW      Position_D     Position_LW
##      -540997.2         51321.3       -401640.5        174818.3       -125761.3
##  Position_LWRW     Position_RW
##        25434.0       -422465.0
```

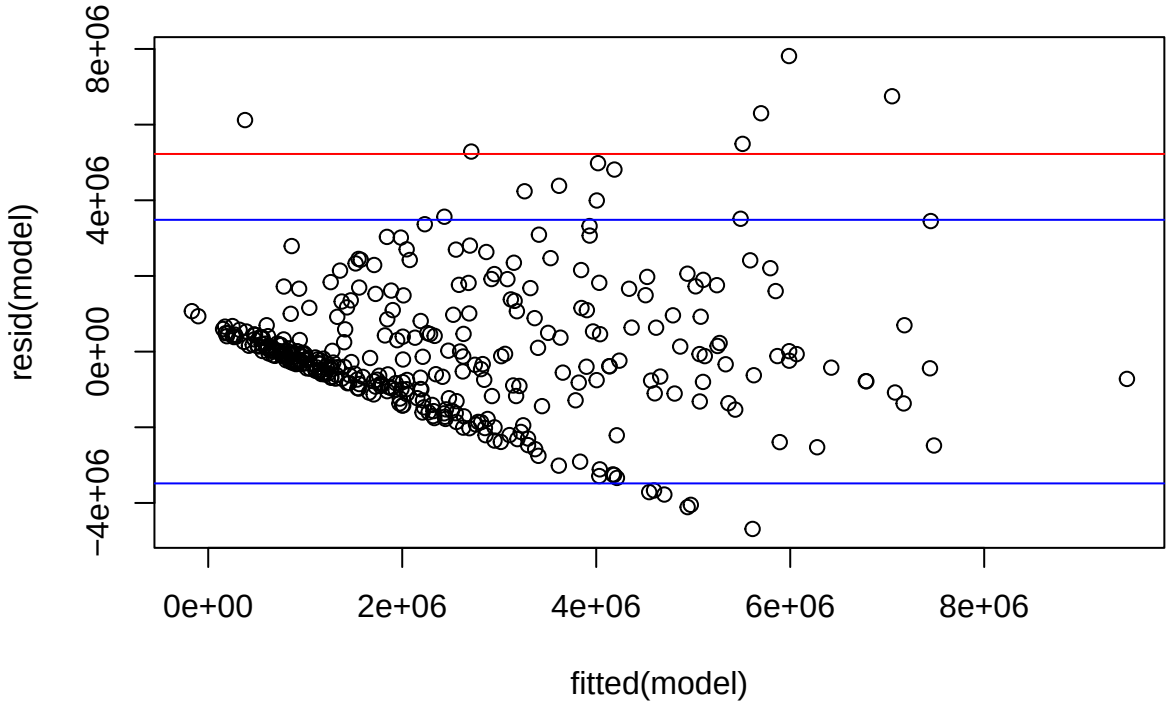
```
standard_error <- sqrt(deviance(model)/df.residual(model))
standard_error
```

```
## [1] 1741595
```

```
2*standard_error
```

```
## [1] 3483190
```

```
plot(fitted(model),resid(model))
abline(h=2*standard_error, col = "blue")
abline(h=-2*standard_error, col = "blue")
abline(h=3*standard_error, col = "red")
abline(h=-3*standard_error, col = "red")
```




```
res_pot_outliers <- NHL %>% filter(2*standard_error <= abs(resid(model)) & abs(resid(model)) < 3*standa
print(res_pot_outliers)
```

```
## # A tibble: 13 x 162
##     Salary Born    City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##      <dbl> <chr>   <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1  832500 95-04-~ Lond~ ON      CAN   CAN      72   223  2013     1     9 L
##  2 9000000 87-10-~ Madi~ WI      USA   USA      72   202  2006     1     5 R
##  3  925000 97-07-~ Gros~ MI      USA   USA      74   218  2015     1     8 L
##  4  925000 93-04-~ Pemb~ FL      USA   USA      71   180  2012     3    78 L
##  5 7500000 85-04-~ Edmo~ AB      CAN   CAN      75   219  2003     1     9 L
##  6 6000000 83-03-~ Kitc~ ON      CAN   CAN      72   202  2002     8   241 R
##  7 9000000 85-01-~ Madi~ WI      USA   USA      74   206  2003     1     7 L
##  8  925000 93-05-~ St. ~ AB      CAN   CAN      78   226  2012     3    86 R
##  9  925000 97-12-~ Scot~ AZ      USA   USA      74   202  2016     1     6 L
## 10 9000000 84-07-~ Minn~ MN      USA   USA      71   196  2003     1    17 L
## 11  832500 95-03-~ Ste-~ QC      CAN   CAN      71   188  2013     1     3 L
## 12 8000000 84-06-~ Bram~ ON      CAN   CAN      76   212  2002     1     1 L
## 13 8000000 88-04-~ St. ~ MN      USA   USA      72   218  2006     1     7 R
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, iCF...42 <dbl>,
## #   iFF <dbl>, iSF...44 <dbl>, iSF...45 <dbl>, iSF...46 <dbl>, ixG <dbl>, ...
```

```
res_outliers <- NHL %>% filter(abs(resid(model)) >= 3*standard_error)
print(res_pot_outliers)
```

```
## # A tibble: 13 x 162
##     Salary Born    City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##      <dbl> <chr>   <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1  832500 95-04-~ Lond~ ON      CAN   CAN      72   223  2013     1     9 L
##  2 9000000 87-10-~ Madi~ WI      USA   USA      72   202  2006     1     5 R
##  3  925000 97-07-~ Gros~ MI      USA   USA      74   218  2015     1     8 L
##  4  925000 93-04-~ Pemb~ FL      USA   USA      71   180  2012     3    78 L
##  5 7500000 85-04-~ Edmo~ AB      CAN   CAN      75   219  2003     1     9 L
##  6 6000000 83-03-~ Kitc~ ON      CAN   CAN      72   202  2002     8   241 R
##  7 9000000 85-01-~ Madi~ WI      USA   USA      74   206  2003     1     7 L
##  8  925000 93-05-~ St. ~ AB      CAN   CAN      78   226  2012     3    86 R
##  9  925000 97-12-~ Scot~ AZ      USA   USA      74   202  2016     1     6 L
## 10 9000000 84-07-~ Minn~ MN      USA   USA      71   196  2003     1    17 L
## 11  832500 95-03-~ Ste-~ QC      CAN   CAN      71   188  2013     1     3 L
## 12 8000000 84-06-~ Bram~ ON      CAN   CAN      76   212  2002     1     1 L
## 13 8000000 88-04-~ St. ~ MN      USA   USA      72   218  2006     1     7 R
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, iCF...42 <dbl>,
## #   iFF <dbl>, iSF...44 <dbl>, iSF...45 <dbl>, iSF...46 <dbl>, ixG <dbl>, ...
```

```
h <- 2*(9+1)/359
h
```

```
## [1] 0.05571031
```

```
leverage<-hatvalues(model)
sort(round(leverage,4))
```

```
##    264    253    216    183    268    247    198    270    214    204    260
## 0.0104 0.0108 0.0119 0.0124 0.0124 0.0126 0.0128 0.0128 0.0129 0.0130 0.0130
##    208    243    180    207    226    194    154    178    196    175    173
## 0.0134 0.0134 0.0138 0.0139 0.0139 0.0140 0.0146 0.0146 0.0146 0.0148 0.0150
##    235    217    236    223    211    252    213    245    256    227    174
## 0.0155 0.0156 0.0158 0.0159 0.0160 0.0160 0.0162 0.0163 0.0164 0.0165 0.0166
##    149    234    239    261    150    262    182    225    195    164    201
## 0.0167 0.0169 0.0169 0.0169 0.0172 0.0177 0.0178 0.0179 0.0181 0.0182 0.0182
##    251    159    176    185    189    165    255    147    169    257    265
## 0.0182 0.0184 0.0184 0.0184 0.0184 0.0189 0.0191 0.0195 0.0195 0.0195 0.0195
##    179    258    155    238    263    172    190    168    209    241    203
## 0.0197 0.0197 0.0200 0.0201 0.0201 0.0203 0.0203 0.0207 0.0212 0.0212 0.0217
##     22    191    222    145    250    160    249    161    272    199    206
## 0.0219 0.0219 0.0220 0.0225 0.0225 0.0230 0.0231 0.0232 0.0235 0.0237 0.0239
##    240    187    156    181     97     58    224     68    202    248     86
## 0.0239 0.0241 0.0245 0.0250 0.0253 0.0257 0.0257 0.0261 0.0261 0.0261 0.0262
##     95    146    212     51    242    266     40     71     89     85    158
## 0.0262 0.0264 0.0264 0.0265 0.0266 0.0267 0.0272 0.0273 0.0273 0.0276 0.0282
##    171    218    200    186    197    210    215    229     21      8     46
## 0.0282 0.0284 0.0285 0.0287 0.0287 0.0290 0.0293 0.0296 0.0302 0.0303 0.0303
##     93    151    184    188      5     53    205    101    237    335     15
## 0.0304 0.0304 0.0304 0.0305 0.0307 0.0308 0.0309 0.0311 0.0311 0.0314 0.0316
##     35    157    244     72    353     49    273     81    167     64    267
## 0.0316 0.0317 0.0318 0.0319 0.0319 0.0320 0.0323 0.0324 0.0324 0.0325 0.0325
##     27     65      7    347    269    221    231      1     74    153     37
## 0.0326 0.0326 0.0327 0.0327 0.0328 0.0331 0.0331 0.0333 0.0333 0.0334 0.0336
##     79     32     84    232     30    342     29    328     26     11    333
## 0.0337 0.0338 0.0338 0.0339 0.0343 0.0344 0.0345 0.0346 0.0347 0.0350 0.0351
##    336     39    177     31     18     45     80     43    102    228     50
## 0.0351 0.0352 0.0352 0.0355 0.0357 0.0358 0.0359 0.0362 0.0364 0.0364 0.0366
##    166    352    340    348     17    230    162    329      2    338    358
## 0.0367 0.0367 0.0368 0.0369 0.0371 0.0372 0.0373 0.0373 0.0375 0.0379 0.0385
##    259     14    285    331    280    220     56    345    325    301     62
## 0.0386 0.0389 0.0392 0.0393 0.0394 0.0395 0.0397 0.0399 0.0400 0.0401 0.0403
##    330    296    289    152     20     54     99     82    276    246    290
## 0.0403 0.0406 0.0410 0.0411 0.0413 0.0414 0.0415 0.0416 0.0416 0.0420 0.0420
##    332    343      9    274    281    300    295    287    298     28    359
## 0.0420 0.0420 0.0421 0.0422 0.0422 0.0422 0.0424 0.0425 0.0428 0.0430 0.0432
##    351    148    163    271     12     91     19     76     44    354    279
## 0.0433 0.0435 0.0438 0.0438 0.0440 0.0440 0.0442 0.0442 0.0444 0.0447 0.0449
##     67     63    254    334    283     13     60    288     48     87     94
## 0.0450 0.0451 0.0453 0.0458 0.0459 0.0460 0.0462 0.0465 0.0466 0.0469 0.0469
##    193    341    119    278     38    123     69    337     16     78    138
## 0.0469 0.0469 0.0472 0.0473 0.0476 0.0479 0.0482 0.0488 0.0489 0.0491 0.0492
##    299    303     92    233     96    293    327     66     36     88    170
## 0.0492 0.0492 0.0501 0.0505 0.0508 0.0511 0.0514 0.0515 0.0516 0.0518 0.0519
##    355    356    134    297    320    133    142     33    127    292    304
## 0.0519 0.0521 0.0526 0.0534 0.0537 0.0538 0.0540 0.0541 0.0542 0.0549 0.0553
##    275    319     55    100    144     77    312    129    126    357    291
```

```
## 0.0555 0.0557 0.0562 0.0564 0.0567 0.0568 0.0568 0.0569 0.0570 0.0570 0.0575
##    316    309    350    310      4     75    143    314     90     61    346
## 0.0578 0.0582 0.0587 0.0589 0.0591 0.0592 0.0592 0.0597 0.0604 0.0606 0.0606
##    141    192    344    118    120    313     42    305    139    323      3
## 0.0610 0.0612 0.0612 0.0623 0.0624 0.0624 0.0626 0.0632 0.0635 0.0650 0.0652
##    122    308    121    282    318    349    339      6    135     73    306
## 0.0660 0.0662 0.0663 0.0666 0.0670 0.0683 0.0684 0.0689 0.0689 0.0691 0.0695
##    284    108    131     47    116    302    112    109    307     70    114
## 0.0696 0.0704 0.0706 0.0714 0.0721 0.0726 0.0734 0.0749 0.0751 0.0752 0.0754
##    124    113    110    294    130    117    115    104    140    107     23
## 0.0755 0.0760 0.0768 0.0778 0.0784 0.0807 0.0812 0.0823 0.0824 0.0825 0.0842
##    311    103    106    324    326     57    317    111    277    321    136
## 0.0850 0.0858 0.0869 0.0876 0.0887 0.0893 0.0900 0.0901 0.0903 0.0908 0.0925
##    286    128    137    315     34    105     83     24     98    132    219
## 0.0942 0.0967 0.0983 0.0983 0.1017 0.1063 0.1095 0.1146 0.1162 0.1172 0.1187
##    322     59     10     25    125     41     52
## 0.1214 0.1269 0.1400 0.1402 0.1716 0.2605 1.0000
```

```
leverage_outliers <- NHL %>% filter(leverage > h)
leverage_outliers
```

```
## # A tibble: 93 x 162
##      Salary Born   City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##       <dbl> <chr>  <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1  1000000 88-03~ Bran~ MB      CAN   CAN      72   200  2006     3    66 R
##  2   925000 96-06~ Holl~ ON      CAN   CAN      73   186  2014     1     4 L
##  3  6000000 90-09~ Miss~ ON      CAN   CAN      73   211  2009     1     1 L
##  4 10900000 87-08~ Cole~ NS      CAN   CAN      71   200  2005     1     1 L
##  5  2075000 91-12~ St. ~ ON      CAN   CAN      75   226  2010     1    21 L
##  6  7000000 85-12~ Queb~ QC      CAN   USA      72   202  2005     2    44 L
##  7  5000000 93-03~ Kitc~ ON      CAN   CAN      75   207  2011     1     7 R
##  8   925000 96-10~ Nort~ MA      USA   USA      74   196  2015     1     2 R
##  9  8750000 85-07~ Anci~ QC      CAN   CAN      73   195  2003     2    45 R
## 10  1100000 92-11~ Otta~ ON      CAN   CAN      70   180  2011     4    96 R
## # i 83 more rows
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, ...
```

```
t <- qt(df =  359 - 9 - 2, 0.95)
t
```

```
## [1] 1.649244
```

```
jackknife <- rstudent(model)
sort(round(jackknife, 4))
```

```
##     188     277      36     273     291     193      96     282     153     166
## -2.7595 -2.4562 -2.4408 -2.2173 -2.2088 -2.1708 -1.9759 -1.9366 -1.9287 -1.9143
```

```
##     261     254      34     212     136      98     205     167      12     141
## -1.8080 -1.7771 -1.7678 -1.6064 -1.5266 -1.5190 -1.5067 -1.4453 -1.4067 -1.3954
##       5     343     230     317     312     354      42      13     118     105
## -1.3940 -1.3583 -1.3459 -1.3329 -1.3056 -1.2991 -1.2601 -1.1910 -1.1874 -1.1834
##     342     255     178     323     355     245      64     198     172     151
## -1.1744 -1.1718 -1.1154 -1.1069 -1.0964 -1.0758 -1.0393 -1.0280 -1.0189 -1.0047
##     232     256      79     226      51      72     154     242     162     260
## -0.9999 -0.9868 -0.9501 -0.9431 -0.9362 -0.9360 -0.9097 -0.9091 -0.8968 -0.8818
##     112      77     335      53     258     339     220     270     359     249
## -0.8782 -0.8517 -0.8314 -0.8281 -0.8168 -0.8144 -0.7986 -0.7920 -0.7732 -0.7604
##     303     210     310      69     351      73     108     117      80     211
## -0.7588 -0.7496 -0.7340 -0.7237 -0.7224 -0.6988 -0.6988 -0.6632 -0.6555 -0.6541
##     327     131     290     221      43     170     294     197     239     213
## -0.6499 -0.6430 -0.6351 -0.6099 -0.5881 -0.5845 -0.5837 -0.5802 -0.5751 -0.5716
##     164     223       4     299     194     233     301     302     219     275
## -0.5605 -0.5576 -0.5544 -0.5441 -0.5436 -0.5346 -0.5330 -0.5326 -0.5091 -0.5029
##     243     329     143     322       2     321      60      41     130     122
## -0.5012 -0.5009 -0.4901 -0.4901 -0.4882 -0.4845 -0.4816 -0.4813 -0.4660 -0.4656
##     196      92     346     135     307       3     169     168     150     344
## -0.4520 -0.4507 -0.4463 -0.4455 -0.4445 -0.4405 -0.4271 -0.4160 -0.4124 -0.4075
##     216     280      19     201     247     349      90      33     326     179
## -0.3994 -0.3915 -0.3872 -0.3869 -0.3839 -0.3787 -0.3696 -0.3688 -0.3587 -0.3579
##     126     234      28     206     353     123     330     110     189     251
## -0.3549 -0.3483 -0.3474 -0.3393 -0.3380 -0.3368 -0.3353 -0.3317 -0.3316 -0.3134
##      38     314     127     182     207     276     158      87     121     285
## -0.3082 -0.2995 -0.2911 -0.2826 -0.2714 -0.2714 -0.2693 -0.2653 -0.2617 -0.2593
##       6     278     106     227      68     246     257      16     304     236
## -0.2515 -0.2472 -0.2412 -0.2381 -0.2361 -0.2342 -0.2320 -0.2284 -0.2268 -0.2246
##     316     308     133     333     175     263      50      81      37       8
## -0.2058 -0.1985 -0.1949 -0.1927 -0.1909 -0.1878 -0.1825 -0.1782 -0.1759 -0.1723
##     250     298     324      46     149     292     142     202      17      58
## -0.1681 -0.1670 -0.1655 -0.1610 -0.1534 -0.1415 -0.1392 -0.1388 -0.1384 -0.1380
##      29     195      18      94     305     337     295     289     208     148
## -0.1365 -0.1359 -0.1334 -0.1221 -0.1217 -0.1203 -0.1188 -0.1095 -0.1076 -0.0989
##     159     183      23       7     225     132     311     191      27     274
## -0.0958 -0.0894 -0.0818 -0.0786 -0.0746 -0.0727 -0.0707 -0.0698 -0.0655 -0.0649
##     181     296      49     199     352     173      57     124     334      62
## -0.0531 -0.0514 -0.0511 -0.0486 -0.0483 -0.0429 -0.0399 -0.0389 -0.0382 -0.0381
##     174      75     345      32     144      95     119     128     265      85
## -0.0348 -0.0347 -0.0310 -0.0279 -0.0267 -0.0258 -0.0186  0.0021  0.0043  0.0058
##     155     111     177      40     134     287      63      21     336      76
##  0.0059  0.0066  0.0099  0.0118  0.0120  0.0126  0.0145  0.0219  0.0230  0.0461
##     138     145      15     113     340      25     203      30     129      11
##  0.0493  0.0508  0.0586  0.0597  0.0793  0.0828  0.0862  0.0881  0.0916  0.0933
##     348     267     338     328      88      26     152     204      83     146
##  0.1015  0.1057  0.1095  0.1161  0.1242  0.1246  0.1334  0.1435  0.1569  0.1757
##     103      39      67     224      35     306     116      61      93     288
##  0.1837  0.1881  0.1904  0.2139  0.2160  0.2173  0.2195  0.2264  0.2268  0.2270
##     209     115     120     313     347     331     222      45      86       1
##  0.2286  0.2302  0.2413  0.2422  0.2423  0.2428  0.2483  0.2581  0.2600  0.2624
##      56     184     114      78     252     101      71      91     156      82
##  0.2624  0.2696  0.2745  0.2751  0.2836  0.2842  0.2848  0.2907  0.3093  0.3114
##     235     104      84      54      48      74      89      70     125      20
##  0.3400  0.3450  0.3483  0.3705  0.3728  0.3849  0.3926  0.4159  0.4394  0.4742
```

```
##     214     192     253     100      65     248     357      97     262     272
##  0.4930  0.5238  0.5304  0.5449  0.5453  0.5574  0.5752  0.5806  0.5840  0.6198
##      66     190     318     283     160     297     268     217      44     341
##  0.6296  0.6354  0.6518  0.6768  0.6788  0.6827  0.7645  0.7841  0.7873  0.8113
##     147     200     165     171     315     269     107     356     286      31
##  0.8619  0.8683  0.8838  0.9318  0.9757  0.9800  0.9969  0.9988  1.0022  1.0086
##     332     320     241      24     157     266      59     244     293     102
##  1.0093  1.0419  1.0541  1.0716  1.0723  1.1043  1.1180  1.1195  1.1297  1.1556
##     185     161       9      55     284     180      14     163     237     350
##  1.1887  1.1973  1.2574  1.2753  1.3140  1.3252  1.3668  1.3811  1.4183  1.4357
##     187     279     140     238     240     215     309     109      22     231
##  1.4382  1.4418  1.4483  1.5301  1.5704  1.5794  1.6624  1.6697  1.7553  1.7764
##     218      99     176     229     264     139      10     319     228     325
##  1.7924  1.8187  1.9310  1.9710  2.0678  2.0937  2.1481  2.3761  2.4982  2.5899
##     281     271     300     186     358     259     137      47
##  2.8527  2.9579  3.1425  3.2433  3.6479  3.7598  4.1786  4.8029
```

```
jackknife_outliers <- NHL %>% filter(jackknife > t | jackknife < -t)
jackknife_outliers
```

```
## # A tibble: 35 x 162
##      Salary Born   City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##       <dbl> <chr>  <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1 10900000 87-08~ Cole~ NS      CAN   CAN      71   200  2005     1     1 L
##  2  5000000 87-01~ St. ~ MB      CAN   CAN      72   196  2005     5   132 L
##  3   925000 96-10~ Nort~ MA      USA   USA      74   196  2015     1     2 R
##  4   832500 95-04~ Lond~ ON      CAN   CAN      72   223  2013     1     9 L
##  5 13800000 88-04~ Winn~ MB      CAN   CAN      74   201  2006     1     3 L
##  6   875000 93-02~ Vict~ QC      CAN   CAN      73   193  2011     1    26 L
##  7  6500000 84-03~ Winn~ MB      CAN   SWE      72   211  2002     1    24 L
##  8  3650000 89-10~ Edmo~ AB      CAN   CAN      69   175  2008     1    26 L
##  9 13800000 88-11~ Buff~ NY      USA   USA      71   177  2007     1     1 L
## 10  9000000 87-10~ Madi~ WI      USA   USA      72   202  2006     1     5 R
## # i 25 more rows
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, ...
```

```
cookCV <- 4/359
cookCV
```

```
## [1] 0.01114206
```

```
cook <- cooks.distance(model)
sort(round(cook, 4))
```

```
##      7     11     15     17     18     21     23     26     27     29     30
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##     32     40     46     49     57     58     62     63     75     76     85
```

```
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##     88     94     95    111    113    119    124    128    129    132    134
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    138    144    145    146    148    149    152    155    159    173    174
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    175    177    181    183    191    195    199    202    203    204    208
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    225    236    250    263    265    267    274    287    289    295    296
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    311    328    334    336    337    338    340    345    348    352      1
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0001
##      8     25     35     37     39     45     50     67     68     71     81
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##     86     93    133    142    156    158    182    184    189    207    209
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##    216    222    224    227    234    235    246    247    251    252    257
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##    288    292    298    305    331    333    347     16     56     61     78
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0002 0.0002 0.0002 0.0002
##     82     83     87     91    101    103    116    120    150    168    169
## 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002
##    179    194    196    201    206    214    243    253    276    278    285
## 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002
##    304    306    308    313    316    324    353      6     28     38     54
## 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0003 0.0003 0.0003 0.0003
##     74     84     89    106    115    121    123    127    164    213    223
## 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003
##    239    314    330     19     48    114    126    211    262    268    280
## 0.0003 0.0003 0.0003 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004
##      2     33     90     97    110    190    248    270    272     20     65
## 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0006 0.0006
##     92    104    160    197    217    260    329    344    349     60    154
## 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0007 0.0007
##    226    301    326      3     43     70    198    221    249    258    346
## 0.0007 0.0007 0.0007 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008
##     80    122    135    143    147    165    233    275    299    307    100
## 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0010
##    210    256    290      4    130    170    178    192    245    357     53
## 0.0010 0.0010 0.0010 0.0011 0.0011 0.0011 0.0011 0.0011 0.0011 0.0012 0.0013
##     66    172    200    242    283    302    327    335     51    180    241
## 0.0013 0.0013 0.0013 0.0013 0.0013 0.0013 0.0013 0.0013 0.0014 0.0014 0.0014
##    321    351    171    220    297     69    185    255    359     44     72
## 0.0014 0.0014 0.0015 0.0015 0.0015 0.0016 0.0016 0.0016 0.0016 0.0017 0.0017
##    294     79    162    303    318    131    151    269    341    161    266
## 0.0017 0.0018 0.0018 0.0018 0.0018 0.0019 0.0019 0.0019 0.0019 0.0020 0.0020
##    310    322     64     73    219    232     31    108    157    117    125
## 0.0020 0.0020 0.0021 0.0021 0.0021 0.0021 0.0022 0.0022 0.0022 0.0023 0.0024
##    244     77    264    332    238    339    342    102    187    356    261
## 0.0024 0.0026 0.0026 0.0026 0.0028 0.0029 0.0029 0.0030 0.0030 0.0032 0.0033
##    240      5    112    320    237    355     13     22    293      9    167
## 0.0035 0.0036 0.0036 0.0036 0.0038 0.0039 0.0040 0.0040 0.0040 0.0041 0.0041
##    176    212    230    205     14    215    354    343     41    323    163
## 0.0041 0.0041 0.0041 0.0042 0.0044 0.0044 0.0046 0.0047 0.0048 0.0050 0.0051
##     12    107    118    218     55    279    312    286    315     42    231
```

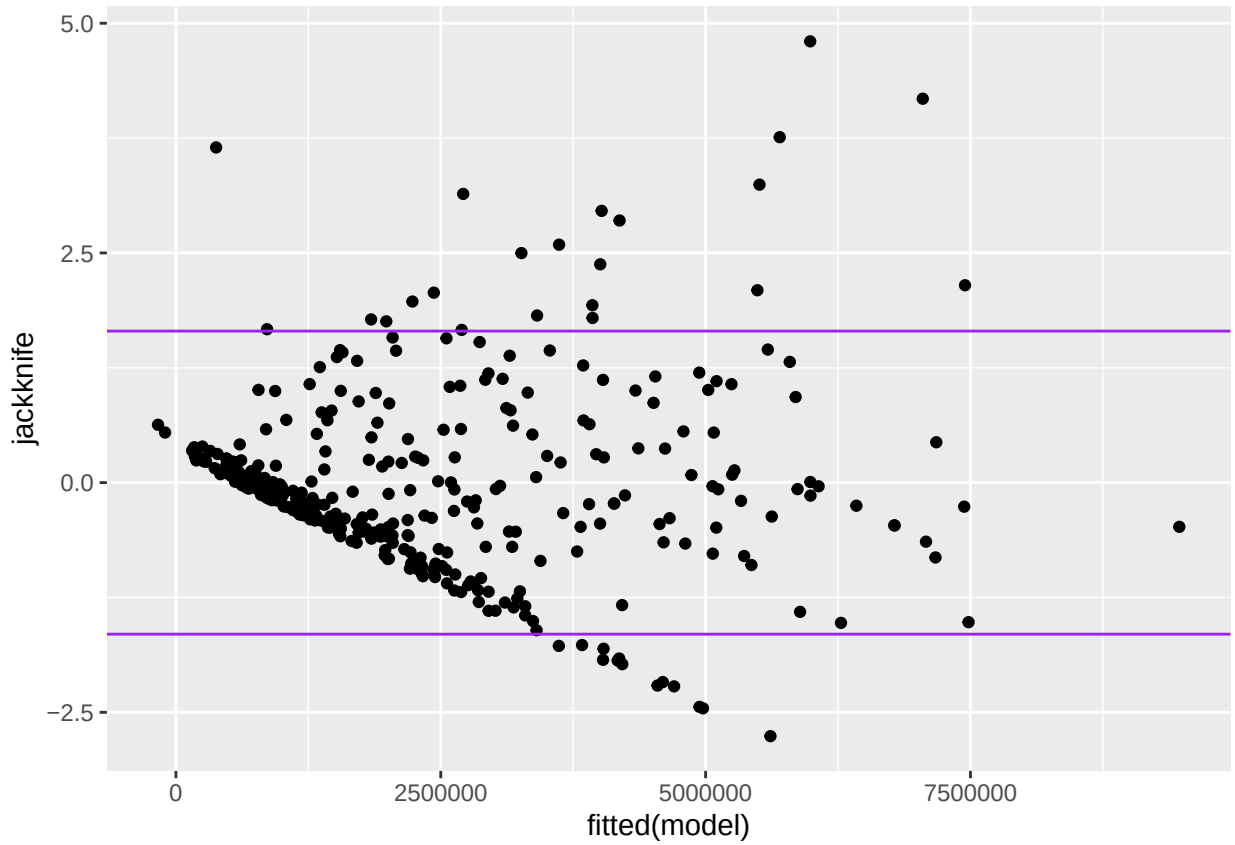
```
## 0.0053 0.0053 0.0055 0.0055 0.0057 0.0057 0.0060 0.0061 0.0061 0.0062 0.0063
##    229    141    153    350    284    166     99     24    254    273    105
## 0.0069 0.0074 0.0075 0.0075 0.0076 0.0082 0.0084 0.0087 0.0088 0.0095 0.0098
##    309    317     59    140     96    109    193    228    188    136    282
## 0.0100 0.0103 0.0107 0.0110 0.0122 0.0132 0.0135 0.0137 0.0138 0.0139 0.0156
##    325    139    291     98    186     36    319     34    281    271    300
## 0.0162 0.0173 0.0173 0.0178 0.0178 0.0188 0.0193 0.0207 0.0207 0.0231 0.0249
##    358    259    277     10     47    137
## 0.0303 0.0322 0.0347 0.0437 0.0980 0.1068
```

```
cook_outliers <- NHL %>% filter(cook > cookCV)
cook_outliers
```

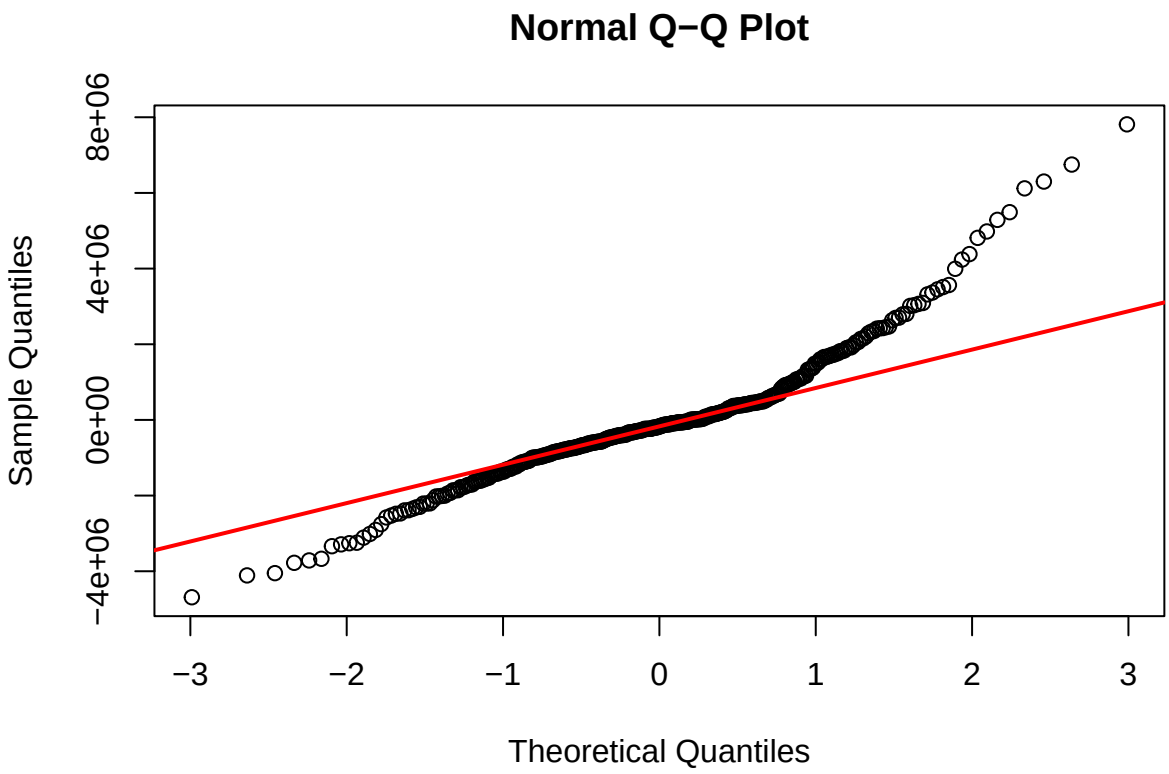
```
## # A tibble: 24 x 162
##      Salary Born   City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##       <dbl> <chr>  <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1 10900000 87-08~ Cole~ NS      CAN   CAN      71   200  2005     1     1 L
##  2   925000 96-10~ Nort~ MA      USA   USA      74   196  2015     1     2 R
##  3   832500 95-04~ Lond~ ON      CAN   CAN      72   223  2013     1     9 L
##  4 13800000 88-04~ Winn~ MB      CAN   CAN      74   201  2006     1     3 L
##  5   875000 93-02~ Vict~ QC      CAN   CAN      73   193  2011     1    26 L
##  6  5000000 88-05~ Hali~ NS      CAN   CAN      69   181  2006     3    71 L
##  7  3650000 89-10~ Edmo~ AB      CAN   CAN      69   175  2008     1    26 L
##  8  3750000 93-07~ Pitt~ PA      USA   USA      70   182  2011     3    64 R
##  9 13800000 88-11~ Buff~ NY      USA   USA      71   177  2007     1     1 L
## 10  9000000 87-10~ Madi~ WI      USA   USA      72   202  2006     1     5 R
## # i 14 more rows
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, ...
```

```
ggplot(NHL, aes(x = fitted(model), y = jackknife)) + geom_point()+ geom_hline(yintercept = t, col = "pu
```

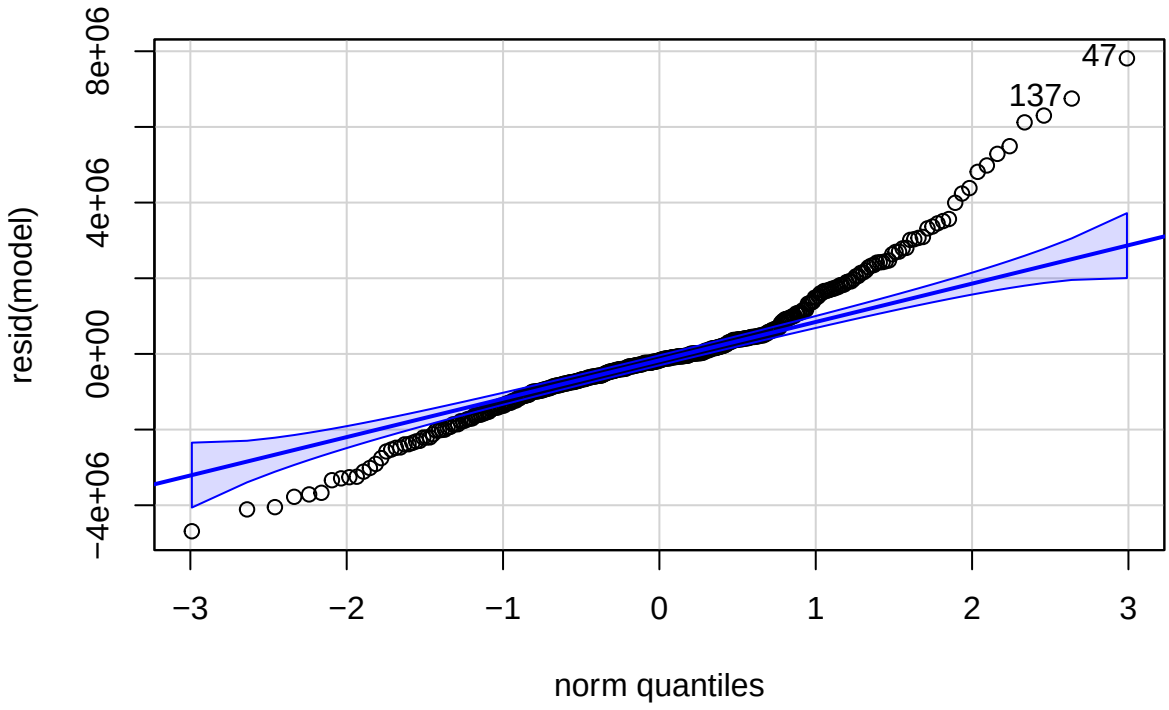
```
## Warning: Removed 1 rows containing missing values (`geom_point()`).
```




```
qqnorm(resid(model))
qqline(resid(model), col = "red", lwd = 2)
```




```
qqPlot(resid(model))
```




```
## [1]  47 137
```

```
skewness(jackknife)
```

```
## [1] NaN
```

```
kurtosis(jackknife)
```

```
## [1] NaN
```

```
ols_vif_tol(model)
```

```
##         Variables  Tolerance       VIF
## 1              GP 0.32530307  3.074056
## 2              GS 0.33739699  2.963868
## 3              PM 0.83670390  1.195166
## 4             PIM 0.44604534  2.241925
## 5              Wt 0.78070556  1.280893
## 6            iHDf 0.56448288  1.771533
## 7           nzFOL 0.05681488 17.601023
## 8           nzFOW 0.05846768 17.103466
## 9     Position_CD 0.96845535  1.032572
## 10   Position_CLW 0.51962206  1.924476
```

```
## 11   Position_CRW 0.67122489  1.489814
## 12 Position_CLWRW 0.66995728  1.492632
## 13     Position_D 0.27757891  3.602579
## 14    Position_LW 0.52569223  1.902254
## 15  Position_LWRW 0.58763057  1.701749
## 16    Position_RW 0.49775543  2.009019
```

```
eigprop(model)
```

```
##
## Call:
## eigprop(mod = model)
##
##    Eigenvalues      CI (Intercept)     GP     GS     PM    PIM     Wt   iHDf
## 1       5.6564  1.0000      0.0001 0.0021 0.0038 0.0000 0.0044 0.0001 0.0005
## 2       1.8655  1.7413      0.0001 0.0002 0.0008 0.0016 0.0034 0.0001 0.0194
## 3       1.3501  2.0469      0.0000 0.0002 0.0041 0.1826 0.0020 0.0000 0.1299
## 4       1.0542  2.3164      0.0000 0.0000 0.0003 0.1263 0.0007 0.0000 0.0348
## 5       1.0108  2.3656      0.0000 0.0002 0.0010 0.0003 0.0001 0.0000 0.0000
## 6       1.0089  2.3679      0.0000 0.0000 0.0003 0.0010 0.0015 0.0000 0.0000
## 7       1.0004  2.3779      0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
## 8       1.0000  2.3783      0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
## 9       0.9023  2.5037      0.0000 0.0001 0.0053 0.2810 0.0008 0.0000 0.0006
## 10      0.8038  2.6527      0.0001 0.0000 0.0011 0.1153 0.0141 0.0001 0.2767
## 11      0.7166  2.8096      0.0000 0.0000 0.0001 0.0672 0.0000 0.0000 0.0061
## 12      0.3286  4.1491      0.0016 0.0155 0.1306 0.1517 0.1234 0.0015 0.0238
## 13      0.1560  6.0224      0.0000 0.0024 0.3644 0.0315 0.6183 0.0000 0.4358
## 14      0.0655  9.2896      0.0069 0.1762 0.0204 0.0044 0.0529 0.0060 0.0069
## 15      0.0542 10.2133      0.0055 0.7821 0.4601 0.0295 0.1649 0.0054 0.0000
## 16      0.0245 15.1952      0.0001 0.0202 0.0075 0.0052 0.0065 0.0001 0.0025
## 17      0.0022 50.8512      0.9854 0.0006 0.0002 0.0023 0.0069 0.9866 0.0629
##     nzFOL  nzFOW Position_CD Position_CLW Position_CRW Position_CLWRW
## 1  0.0006 0.0006      0.0000       0.0023       0.0021          0.0007
## 2  0.0067 0.0072      0.0001       0.0047       0.0233          0.0017
## 3  0.0005 0.0006      0.0001       0.0002       0.0062          0.0029
## 4  0.0000 0.0001      0.0088       0.0813       0.0593          0.0472
## 5  0.0000 0.0000      0.2844       0.0020       0.0139          0.1924
## 6  0.0000 0.0000      0.0677       0.0782       0.0570          0.3250
## 7  0.0000 0.0000      0.1047       0.0807       0.0865          0.0110
## 8  0.0000 0.0000      0.4803       0.0012       0.0009          0.0009
## 9  0.0000 0.0001      0.0083       0.0002       0.0473          0.0000
## 10 0.0004 0.0007      0.0039       0.0034       0.0308          0.0168
## 11 0.0057 0.0061      0.0002       0.1872       0.3437          0.0007
## 12 0.0045 0.0044      0.0081       0.0115       0.0035          0.0238
## 13 0.0006 0.0006      0.0001       0.0108       0.0112          0.0110
## 14 0.0013 0.0249      0.0168       0.4729       0.2258          0.3302
## 15 0.0059 0.0000      0.0123       0.0548       0.0719          0.0260
## 16 0.9732 0.9547      0.0001       0.0001       0.0130          0.0032
## 17 0.0005 0.0001      0.0040       0.0085       0.0034          0.0065
##    Position_D Position_LW Position_LWRW Position_RW
## 1      0.0014      0.0010        0.0010      0.0010
## 2      0.0092      0.0101        0.0093      0.0078
## 3      0.0184      0.0335        0.0186      0.0004
## 4      0.0033      0.0076        0.0035      0.1435
```

```
## 5      0.0105      0.0551        0.0945      0.0030
## 6      0.0013      0.0214        0.0466      0.0000
## 7      0.0217      0.0001        0.0430      0.1590
## 8      0.0002      0.0820        0.1745      0.0046
## 9      0.0182      0.1826        0.0466      0.0285
## 10     0.0079      0.0520        0.0702      0.0473
## 11     0.0097      0.0001        0.0004      0.0097
## 12     0.0112      0.0128        0.0420      0.0066
## 13     0.0142      0.0003        0.0019      0.0001
## 14     0.7556      0.4274        0.3926      0.4961
## 15     0.0916      0.1056        0.0496      0.0861
## 16     0.0157      0.0053        0.0051      0.0055
## 17     0.0098      0.0031        0.0005      0.0006
##
## ================================
## Row 15==> GP, proportion 0.782132 >= 0.50
## Row 13==> PIM, proportion 0.618316 >= 0.50
## Row 17==> Wt, proportion 0.986597 >= 0.50
## Row 16==> nzFOL, proportion 0.973174 >= 0.50
## Row 16==> nzFOW, proportion 0.954652 >= 0.50
## Row 14==> Position_D, proportion 0.755555 >= 0.50
```

```
ols_step_forward_p(model)
```

```
##
##                                 Selection Summary
## ------------------------------------------------------------------------------------------
##         Variable                        Adj.
## Step      Entered       R-Square     R-Square      C(p)          AIC             RMSE
## ------------------------------------------------------------------------------------------
##    1    GS                0.4540       0.4525    27.1705    11365.1352    1801945.3109
##    2    Wt                0.4811       0.4781    10.2252    11348.8823    1759179.4048
##    3    Position_CLW      0.4889       0.4846     6.7203    11345.3998    1748254.9274
##    4    Position_RW       0.4922       0.4865     6.4045    11345.0682    1745046.4442
##    5    iHDf              0.4941       0.4870     7.0724    11345.7201    1744238.3455
##    6    GP                0.4965       0.4879     7.4011    11346.0214    1742586.7942
##    7    PM                0.4983       0.4883     8.1385    11346.7329    1741938.5202
##    8    Position_D        0.5002       0.4888     8.8278    11347.3904    1741166.5170
## ------------------------------------------------------------------------------------------
```

```
ols_step_backward_p(model)
```

```
##
##
##                                Elimination Summary
## ------------------------------------------------------------------------------------------
##         Variable                        Adj.
## Step      Removed       R-Square     R-Square      C(p)          AIC             RMSE
## ------------------------------------------------------------------------------------------
##    1    Position_LWRW       0.5114       0.490    15.0025    11353.2687    1739060.5871
##    2    PIM                 0.5114       0.4915   13.0139    11351.2807    1736560.1588
##    3    Position_CRW        0.5113       0.4929   11.0241    11349.2914    1734067.2801
##    4    Position_CD         0.5113       0.4943    9.0780    11347.3480    1731696.0967
```

```
##    5    Position_LW          0.511       0.4955     7.2296    11345.5070    1729582.0861
##    6    Position_CLWRW       0.5102      0.4961     5.8561    11344.1636    1728675.4796
##    7    Position_RW          0.5087       0.496     4.9078    11343.2632    1728842.6744
## ----------------------------------------------------------------------------------------
```

```
ols_step_both_p(model)
```

```
##
##                                  Stepwise Selection Summary
## ---------------------------------------------------------------------------------------------------
##                          Added/                   Adj.
## Step      Variable      Removed     R-Square    R-Square     C(p)         AIC            RMSE
## ---------------------------------------------------------------------------------------------------
##    1         GS         addition       0.454       0.452    27.1700    11365.1352    1801945.3109
##    2         Wt         addition       0.481       0.478    10.2250    11348.8823    1759179.4048
##    3    Position_CLW    addition       0.489       0.485     6.7200    11345.3998    1748254.9274
## ---------------------------------------------------------------------------------------------------
```

```
ols_step_best_subset(model)
```

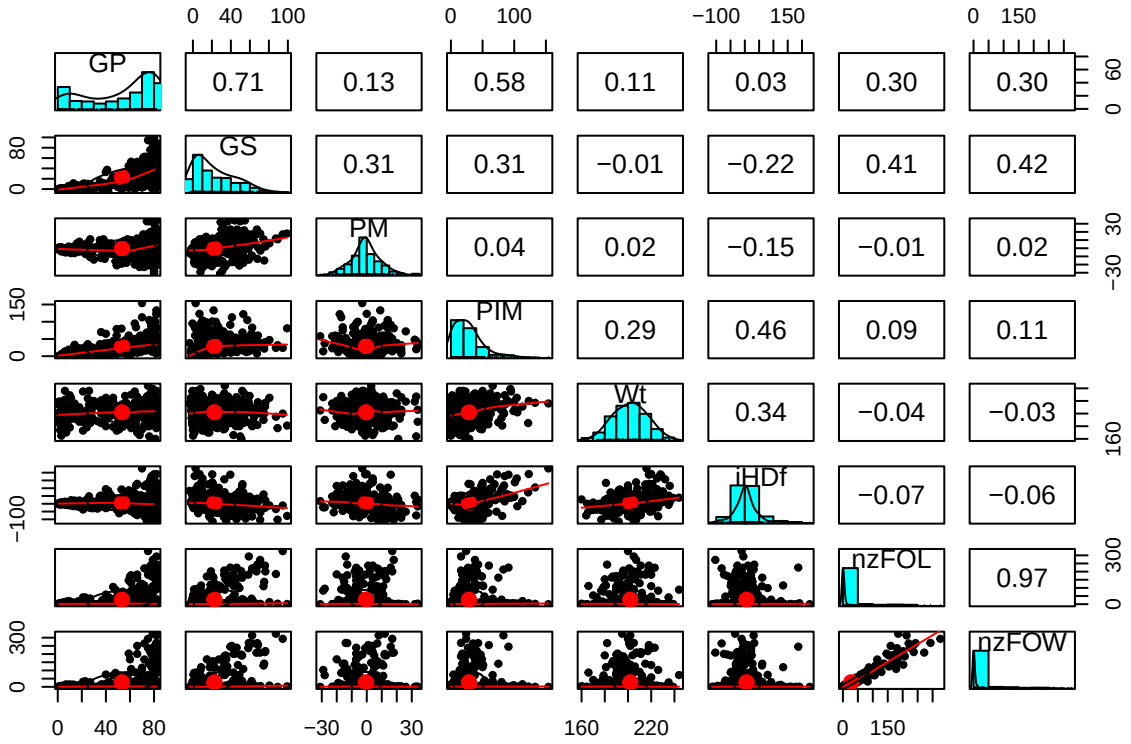
```
##                                                                  Best Subsets Regression
## ---------------------------------------------------------------------------------------------------------------------
## Model Index    Predictors
## ---------------------------------------------------------------------------------------------------------------------
##      1         GS
##      2         GS Wt
##      3         GS Wt Position_CLW
##      4         GS Wt nzFOL nzFOW
##      5         GS Wt nzFOL nzFOW Position_CLW
##      6         GS Wt nzFOL nzFOW Position_CLW Position_RW
##      7         GS PM Wt nzFOL nzFOW Position_CLW Position_RW
##      8         GS PM Wt nzFOL nzFOW Position_CLW Position_CLWRW Position_RW
##      9         GP GS PM Wt iHDf nzFOL nzFOW Position_CLW Position_D
##     10         GP GS PM Wt iHDf nzFOL nzFOW Position_CLW Position_D Position_RW
##     11         GP GS PM Wt iHDf nzFOL nzFOW Position_CLW Position_CLWRW Position_D Position_RW
##     12         GP GS PM Wt iHDf nzFOL nzFOW Position_CLW Position_CLWRW Position_D Position_LW Positi
##     13         GP GS PM Wt iHDf nzFOL nzFOW Position_CD Position_CLW Position_CLWRW Position_D Positi
##     14         GP GS PM Wt iHDf nzFOL nzFOW Position_CD Position_CLW Position_CRW Position_CLWRW Posi
##     15         GP GS PM PIM Wt iHDf nzFOL nzFOW Position_CD Position_CLW Position_CRW Position_CLWRW
##     16         GP GS PM PIM Wt iHDf nzFOL nzFOW Position_CD Position_CLW Position_CRW Position_CLWRW
## ---------------------------------------------------------------------------------------------------------------------
##
##                                                                Subsets Regression Summary
## ---------------------------------------------------------------------------------------------------------------------
##                        Adj.        Pred
## Model    R-Square    R-Square    R-Square      C(p)         AIC           SBIC          SBC
## ---------------------------------------------------------------------------------------------------------------------
##   1        0.4540      0.4525       0.446    27.1705    11365.1352    10346.0875    11376.7852    1.
##   2        0.4811      0.4781      0.4699    10.2252    11348.8823    10330.0144    11364.4156    1.
##   3        0.4889      0.4846      0.4764     6.7203    11345.3998    10326.6305    11364.8164    1.
##   4        0.4943      0.4886      0.4748     4.9300    11343.5757    10324.9207    11366.8756    1.
##   5        0.4999      0.4928      0.4791     3.0116    11341.5789    10323.0879    11368.7622    1.
##   6        0.5030      0.4945      0.4791     2.8672    11341.3727    10323.0208    11372.4393     1
```

```
##   7        0.5055      0.4956      0.4769     3.1354    11341.5810    10323.3750    11376.5309    1.0
##   8        0.5070      0.4957      0.4767     4.0737    11342.4782    10324.4035    11381.3114    1.0
##   9        0.5087      0.4960      0.4747     4.9078    11343.2632    10325.3392    11385.9798    1.0
##  10        0.5102      0.4961      0.4732     5.8561    11344.1636    10326.3972    11390.7635    1.0
##  11        0.5110      0.4955      0.4721     7.2296    11345.5070    10327.8804    11395.9902    1.0
##  12        0.5113      0.4943      0.4687     9.0780    11347.3480    10329.8314    11401.7145    1.0
##  13        0.5113      0.4929        -Inf    11.0241    11349.2914    10331.8783    11407.5412    1.0
##  14        0.5114      0.4915        -Inf    13.0139    11351.2807    10333.9679    11413.4139     1
##  15        0.5114      0.4900        -Inf    15.0025    11353.2687    10336.0563    11419.2852     1
##  16        0.5114      0.4885        -Inf    17.0000    11355.2661    10338.1534    11425.1659    1.0
## ----------------------------------------------------------------------------------------------------
## AIC: Akaike Information Criteria
##  SBIC: Sawa's Bayesian Information Criteria
##  SBC: Schwarz Bayesian Criteria
##  MSEP: Estimated error of prediction, assuming multivariate normality
##  FPE: Final Prediction Error
##  HSP: Hocking's Sp
##  APC: Amemiya Prediction Criteria
```

```
NHL2 <- select(NHL,c(GP,GS, PM, PIM, Wt, iHDf, nzFOL, nzFOW))
NHL2
```

```
## # A tibble: 359 x 8
##       GP    GS    PM   PIM    Wt  iHDf nzFOL nzFOW
##    <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
##  1    10   2.1    -3     2   178    -7    17    13
##  2    68   5.7   -12    29   204    16    70    86
##  3    65   7.8   -16    84   200   118     7     9
##  4    81  21.6   -16    75   186    61   163   141
##  5    70  29.3   -15    25   196    29   108   105
##  6    77  75.9     4    38   211   -26   237   212
##  7    12   3.3     1     2   195     3     0     0
##  8     9   2.2     0     9   199     1    19    13
##  9    46  21.1    -5    14   179    -5   106    70
## 10    75  94.6    17    24   200   -11   326   293
## # i 349 more rows
```

```
pairs.panels(NHL2)
```




```
model2 <- lm(Salary ~ GS + Wt + iHDf + GP + PM + Position_CD + Position_CLW + Position_CRW + Position_CL
model2
```

```
##
## Call:
## lm(formula = Salary ~ GS + Wt + iHDf + GP + PM + Position_CD +
##     Position_CLW + Position_CRW + Position_CLWRW + Position_D +
##     Position_LW + Position_LWRW + Position_RW, data = NHL)
##
## Coefficients:
##    (Intercept)              GS              Wt            iHDf              GP
##       -3455138           86695           21532            3361           -7212
##             PM     Position_CD    Position_CLW    Position_CRW  Position_CLWRW
##         -12405          445563         -589433          139216         -400945
##     Position_D     Position_LW   Position_LWRW     Position_RW
##         231137          -93524           59180         -399269
```

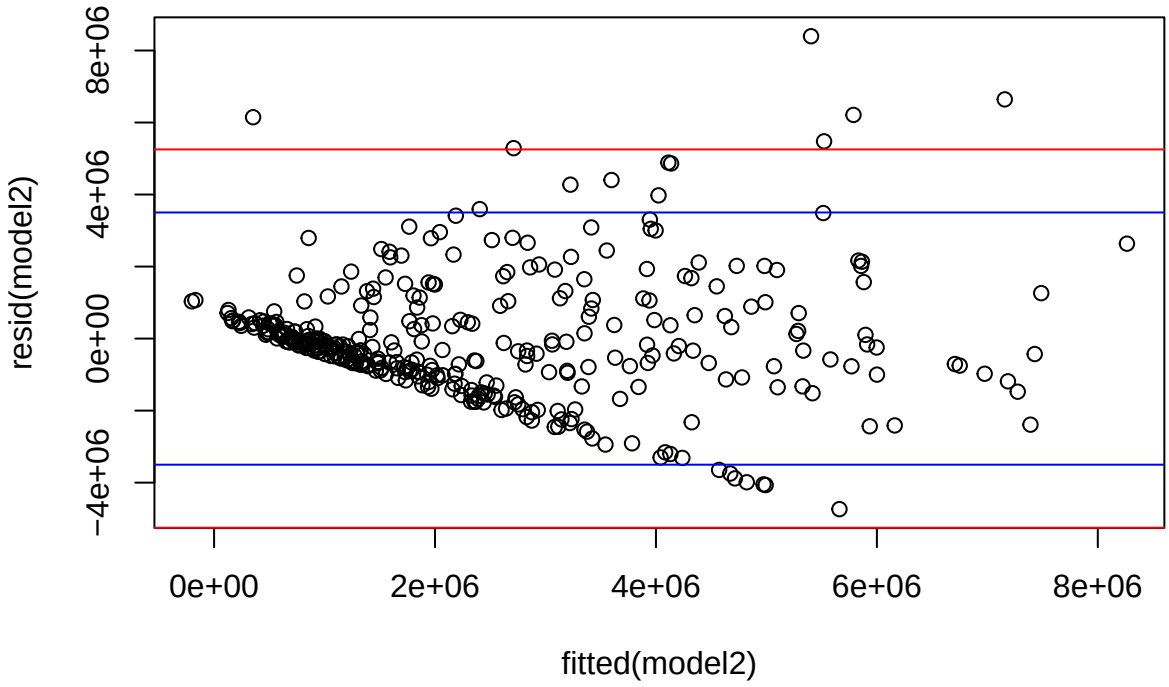
```
standard_error2 <- sqrt(deviance(model2)/df.residual(model2))
standard_error2
```

```
## [1] 1750959
```

```
2*standard_error2
```

```
## [1] 3501919
```

```r
plot(fitted(model2),resid(model2))
abline(h=2*standard_error2, col = "blue")
abline(h=-2*standard_error2, col = "blue")
abline(h=3*standard_error2, col = "red")
abline(h=-3*standard_error2, col = "red")
```




```r
res_pot_outliers2 <- NHL %>% filter(2*standard_error2 <= abs(resid(model2)) & abs(resid(model2)) < 3*sta
print(res_pot_outliers2)
```

```
## # A tibble: 13 x 162
##     Salary Born    City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##      <dbl> <chr>   <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1  925000 96-10-~ Nort~ MA      USA   USA      74   196  2015     1     2 R
##  2  832500 95-04-~ Lond~ ON      CAN   CAN      72   223  2013     1     9 L
##  3  925000 97-07-~ Gros~ MI      USA   USA      74   218  2015     1     8 L
##  4  925000 93-04-~ Pemb~ FL      USA   USA      71   180  2012     3    78 L
##  5 7500000 85-04-~ Edmo~ AB      CAN   CAN      75   219  2003     1     9 L
##  6 6000000 83-03-~ Kitc~ ON      CAN   CAN      72   202  2002     8   241 R
##  7 9000000 85-01-~ Madi~ WI      USA   USA      74   206  2003     1     7 L
##  8  925000 93-05-~ St. ~ AB      CAN   CAN      78   226  2012     3    86 R
##  9  925000 97-12-~ Scot~ AZ      USA   USA      74   202  2016     1     6 L
## 10 9000000 84-07-~ Minn~ MN      USA   USA      71   196  2003     1    17 L
## 11  832500 95-03-~ Ste-~ QC      CAN   CAN      71   188  2013     1     3 L
## 12 8000000 84-06-~ Bram~ ON      CAN   CAN      76   212  2002     1     1 L
## 13 8000000 88-04-~ St. ~ MN      USA   USA      72   218  2006     1     7 R
```

```
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, iCF...42 <dbl>,
## #   iFF <dbl>, iSF...44 <dbl>, iSF...45 <dbl>, iSF...46 <dbl>, ixG <dbl>, ...
```

```
res_outliers2 <- NHL %>% filter(abs(resid(model2)) >= 3*standard_error2)
print(res_outliers2)
```

```
## # A tibble: 6 x 162
##     Salary Born    City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##      <dbl> <chr>   <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
## 1 13800000 88-04-~ Winn~ MB      CAN   CAN      74   201  2006     1     3 L
## 2 13800000 88-11-~ Buff~ NY      USA   USA      71   177  2007     1     1 L
## 3 11000000 89-05-~ Toro~ ON      CAN   CAN      72   210  2007     2    43 R
## 4 12000000 85-08-~ Sica~ BC      CAN   CAN      76   232  2003     2    49 R
## 5  8000000 85-12-~ Mapl~ BC      CAN   CAN      75   200  2004     1     4 L
## 6  6500000 85-03-~ Roch~ NY      USA   USA      70   187  2004     4   127 R
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, iCF...42 <dbl>,
## #   iFF <dbl>, iSF...44 <dbl>, iSF...45 <dbl>, iSF...46 <dbl>, ixG <dbl>, ...
```

```
h2 <- 2*(6+1)/359
h2
```

```
## [1] 0.03899721
```

```
leverage2 <- hatvalues(model2)
sort(round(leverage2,4))
```

```
##    197    243    253    264    216    198    183    214    196    247    174
## 0.0093 0.0093 0.0100 0.0100 0.0106 0.0108 0.0114 0.0116 0.0118 0.0118 0.0119
##    268    204    225    260    270    180    208    154    207    226    175
## 0.0120 0.0122 0.0125 0.0125 0.0125 0.0126 0.0126 0.0128 0.0131 0.0131 0.0133
##    156    194    249    173    252    213    235    178    211    236    223
## 0.0136 0.0137 0.0137 0.0138 0.0139 0.0141 0.0141 0.0142 0.0145 0.0148 0.0151
##    261    217    228    227    149    161    239    150    165    184    245
## 0.0151 0.0153 0.0153 0.0156 0.0157 0.0157 0.0158 0.0159 0.0160 0.0160 0.0160
##    256    176    234    182    195    185    201    251    159    164    172
## 0.0161 0.0162 0.0164 0.0167 0.0168 0.0169 0.0169 0.0169 0.0170 0.0170 0.0172
##    189    262    255    187    203    257    155    241    265    179    263
## 0.0172 0.0173 0.0175 0.0176 0.0182 0.0184 0.0185 0.0185 0.0185 0.0187 0.0187
##    218    238    258    169    147    168    190    191    209     22    145
## 0.0188 0.0188 0.0188 0.0190 0.0194 0.0196 0.0196 0.0201 0.0206 0.0207 0.0209
##    250    231    206    222    272    160    199     58    151     68    242
## 0.0209 0.0210 0.0212 0.0212 0.0212 0.0219 0.0219 0.0221 0.0222 0.0226 0.0226
```

```
##     24     73    181    248    212    240    188     49     51     46     85
## 0.0228 0.0231 0.0232 0.0232 0.0233 0.0233 0.0236 0.0238 0.0240 0.0242 0.0244
##     14    158      7    266     21    146    224     53    202     97      9
## 0.0245 0.0246 0.0248 0.0248 0.0249 0.0250 0.0250 0.0251 0.0251 0.0252 0.0254
##      8    171     86     95     96     15    186    200     38     71     87
## 0.0255 0.0255 0.0256 0.0256 0.0257 0.0258 0.0258 0.0258 0.0259 0.0260 0.0260
##     89     37     63     29     18     40     50     27     80     43     30
## 0.0260 0.0261 0.0261 0.0264 0.0266 0.0271 0.0271 0.0272 0.0272 0.0273 0.0274
##     35     64     32     45    210     79     26    215      5    230     11
## 0.0276 0.0277 0.0279 0.0281 0.0282 0.0283 0.0284 0.0285 0.0287 0.0288 0.0290
##     72     19     48    229     84    101    102      1     93     78     83
## 0.0290 0.0291 0.0292 0.0292 0.0293 0.0293 0.0293 0.0294 0.0294 0.0297 0.0298
##    167    267     61    205     31     81    273    335    162    244    353
## 0.0300 0.0302 0.0303 0.0304 0.0305 0.0305 0.0306 0.0307 0.0309 0.0309 0.0309
##    166    237    269     75    157    153    342     65     20    347      2
## 0.0310 0.0310 0.0310 0.0313 0.0314 0.0315 0.0318 0.0319 0.0320 0.0320 0.0323
##     62    221    232     74    329    259    177     54     99     17     39
## 0.0324 0.0326 0.0327 0.0329 0.0329 0.0330 0.0332 0.0333 0.0338 0.0340 0.0341
##    328    333    336    152    352     36     28     67     16     47     82
## 0.0341 0.0341 0.0342 0.0344 0.0344 0.0349 0.0350 0.0350 0.0351 0.0352 0.0353
##     91    340     44    220    348    358    332    233     34     12    280
## 0.0353 0.0356 0.0358 0.0358 0.0358 0.0363 0.0364 0.0365 0.0366 0.0367 0.0368
##    338     13     56    301    285    331    343     57     94    345    293
## 0.0368 0.0371 0.0371 0.0374 0.0375 0.0378 0.0378 0.0385 0.0386 0.0388 0.0391
##    325     42    330    354    355     60    296    289      4    276    359
## 0.0391 0.0393 0.0397 0.0398 0.0398 0.0399 0.0401 0.0402 0.0407 0.0407 0.0407
##     92    271    281    287    274    124    295    246    290    300    341
## 0.0409 0.0409 0.0409 0.0409 0.0411 0.0414 0.0414 0.0415 0.0415 0.0417 0.0417
##    254    298    148    299    351    163     66    100     76    139      6
## 0.0418 0.0418 0.0425 0.0427 0.0427 0.0429 0.0432 0.0432 0.0434 0.0434 0.0438
##     69     55    123    283    279    193    288    357    334      3    119
## 0.0441 0.0443 0.0444 0.0444 0.0447 0.0449 0.0449 0.0449 0.0450 0.0451 0.0452
##    286    326    125    133    138    278     90    277    303    327     33
## 0.0452 0.0452 0.0453 0.0458 0.0465 0.0466 0.0470 0.0470 0.0470 0.0470 0.0474
##    350    134    337    127     25     88    297    118    144    346    356
## 0.0474 0.0475 0.0477 0.0481 0.0486 0.0488 0.0489 0.0500 0.0502 0.0505 0.0511
##    130    132    142    170    320    292     77    344    141     41    275
## 0.0514 0.0514 0.0514 0.0517 0.0517 0.0519 0.0520 0.0520 0.0523 0.0526 0.0527
##    291    304    129    319    126    128    312    310    294    143    121
## 0.0529 0.0529 0.0530 0.0530 0.0535 0.0548 0.0548 0.0550 0.0554 0.0555 0.0572
##    316    135    309    314    313    120    284    318    305    192    307
## 0.0574 0.0580 0.0581 0.0581 0.0598 0.0600 0.0600 0.0605 0.0606 0.0611 0.0614
##    323    349     70    282    308    339    122    140    136    131    306
## 0.0615 0.0617 0.0619 0.0620 0.0626 0.0629 0.0636 0.0641 0.0644 0.0669 0.0670
##    324     10    108    302    137     23    116     98    311    114    112
## 0.0676 0.0685 0.0691 0.0699 0.0703 0.0711 0.0715 0.0720 0.0724 0.0726 0.0731
##    113    109    110    107    321    219    117    115    104    106    322
## 0.0739 0.0745 0.0753 0.0759 0.0761 0.0764 0.0769 0.0784 0.0786 0.0804 0.0820
##    103     59    111    315    317    105     52
## 0.0836 0.0839 0.0856 0.0857 0.0883 0.1058 1.0000
```

```
leverage_outliers2 <- NHL %>% filter(leverage2 > h2)
leverage_outliers2
```

```
## # A tibble: 140 x 162
##      Salary Born   City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##       <dbl> <chr>  <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1  1000000 88-03~ Bran~ MB      CAN   CAN      72   200  2006     3    66 R
##  2   925000 96-06~ Holl~ ON      CAN   CAN      73   186  2014     1     4 L
##  3  6000000 90-09~ Miss~ ON      CAN   CAN      73   211  2009     1     1 L
##  4 10900000 87-08~ Cole~ NS      CAN   CAN      71   200  2005     1     1 L
##  5  2075000 91-12~ St. ~ ON      CAN   CAN      75   226  2010     1    21 L
##  6  5000000 93-03~ Kitc~ ON      CAN   CAN      75   207  2011     1     7 R
##  7   832500 95-04~ St-L~ QC      CAN   CAN      77   235  2013     1    21 L
##  8  8750000 85-07~ Anci~ QC      CAN   CAN      73   195  2003     2    45 R
##  9  1100000 92-11~ Otta~ ON      CAN   CAN      70   180  2011     4    96 R
## 10   925000 97-01~ Bost~ MA      USA   USA      72   183  2015     1    21 R
## # i 130 more rows
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, ...
```

```
t2 <- qt(df =  359 - 6 - 2, 0.95)
t2
```

```
## [1] 1.649206
```

```
jackknife2 <- rstudent(model2)
sort(round(jackknife2, 4))
```

```
##     188     277      34      36     291     273     193     282     153     166
## -2.7636 -2.3960 -2.3715 -2.3343 -2.2926 -2.1859 -2.1422 -1.9624 -1.9223 -1.8666
##     261     254      96     212     205     167      13     136       5      12
## -1.8236 -1.7219 -1.6875 -1.6067 -1.5015 -1.4685 -1.4274 -1.4261 -1.4242 -1.4194
##      98     317     343     141     312     230     354     105     255      64
## -1.4193 -1.3920 -1.3672 -1.3369 -1.3199 -1.2969 -1.2716 -1.1897 -1.1793 -1.1651
##     118     342     355     178     245     323     198      51     256     172
## -1.1608 -1.1510 -1.1330 -1.1274 -1.0526 -1.0435 -1.0185 -1.0158 -1.0099 -1.0085
##      77     151      42     232     226     242     154      72     260      79
## -0.9825 -0.9661 -0.9502 -0.9394 -0.9164 -0.9147 -0.9090 -0.9089 -0.8912 -0.8831
##     162      69     339     112     258     335     359     108     210     220
## -0.8800 -0.8721 -0.8699 -0.8352 -0.8238 -0.8070 -0.7879 -0.7863 -0.7774 -0.7715
##     270       4     249      53     303     351     310     131     211     327
## -0.7680 -0.7673 -0.7499 -0.7491 -0.7320 -0.7104 -0.7089 -0.7011 -0.6672 -0.6628
##     117     290      43     221     170     239      25      80       6     213
## -0.6407 -0.6367 -0.6351 -0.6091 -0.5970 -0.5858 -0.5854 -0.5811 -0.5694 -0.5657
##     223     197     302     299      38     194     164     301     294     233
## -0.5643 -0.5625 -0.5620 -0.5429 -0.5390 -0.5341 -0.5282 -0.5248 -0.5221 -0.5209
##     219     143     243      33     275     329     128     196     322     132
## -0.5187 -0.5178 -0.4959 -0.4816 -0.4811 -0.4734 -0.4632 -0.4575 -0.4574 -0.4510
##     321      60      83     130     307     168     344     150     122     127
## -0.4486 -0.4448 -0.4441 -0.4392 -0.4234 -0.4223 -0.4193 -0.4188 -0.4163 -0.4018
##     346      92     201     169     349     216     280       3     126      68
## -0.3960 -0.3950 -0.3939 -0.3938 -0.3899 -0.3892 -0.3846 -0.3816 -0.3774 -0.3729
```

```
##     133     179     123     247     326     353      90     234     189     206
## -0.3689 -0.3644 -0.3609 -0.3582 -0.3548 -0.3479 -0.3387 -0.3365 -0.3356 -0.3216
##     251       2     110     330     314     182      28     158     246     207
## -0.3169 -0.3153 -0.3147 -0.3006 -0.2888 -0.2880 -0.2804 -0.2794 -0.2731 -0.2702
##     276     121     285     227      63     304     257     278     236      61
## -0.2682 -0.2520 -0.2496 -0.2494 -0.2420 -0.2417 -0.2400 -0.2335 -0.2235 -0.2161
##      46       8     316     263     308     135      19     106     333     175
## -0.2117 -0.2073 -0.2073 -0.1991 -0.1968 -0.1947 -0.1943 -0.1940 -0.1928 -0.1893
##      73      75     298     149      37     195      50      17      81     292
## -0.1830 -0.1583 -0.1556 -0.1523 -0.1499 -0.1499 -0.1487 -0.1478 -0.1461 -0.1453
##     324     250      29     305     202     295      18      87     134     159
## -0.1375 -0.1235 -0.1234 -0.1208 -0.1196 -0.1092 -0.1091 -0.1085 -0.1041 -0.1026
##     337      16     289     311     208     191      49     183      58     225
## -0.1004 -0.0985 -0.0964 -0.0959 -0.0935 -0.0933 -0.0928 -0.0918 -0.0798 -0.0702
##     181     148     199       7     274      27      78      94      32     173
## -0.0628 -0.0608 -0.0608 -0.0568 -0.0536 -0.0519 -0.0515 -0.0466 -0.0443 -0.0439
##     296     144      95     174     352     138     345     334     142      40
## -0.0432 -0.0418 -0.0342 -0.0338 -0.0300 -0.0270 -0.0227 -0.0213 -0.0168 -0.0060
##     155     119     177     336     265     287     145      62      21     111
## -0.0038 -0.0034  0.0026  0.0244  0.0255  0.0281  0.0413  0.0507  0.0576  0.0615
##     129      15      76     203     113     340     267      85      11     348
##  0.0626  0.0655  0.0710  0.0738  0.0869  0.0892  0.0933  0.0941  0.1051  0.1099
##      30     338     152     204     328      39      26      23     101      48
##  0.1123  0.1140  0.1235  0.1366  0.1507  0.1509  0.1533  0.1568  0.1764  0.1838
##     103     224      88     120     146     114     306     116     288      82
##  0.1987  0.1987  0.2082  0.2089  0.2151  0.2186  0.2192  0.2234  0.2272  0.2328
##      84      35     347     209       1      67     331     252      71     313
##  0.2355  0.2359  0.2394  0.2425  0.2454  0.2488  0.2516  0.2602  0.2696  0.2713
##      86     222     115      93      45     156     184      56     235     104
##  0.2736  0.2777  0.2878  0.2914  0.2942  0.2952  0.2992  0.3305  0.3360  0.3483
##      91      54     124      57      74      70      89     192     214     248
##  0.3525  0.3632  0.3783  0.4117  0.4120  0.4452  0.4592  0.4916  0.4946  0.5117
##     253     357     100      97     262      65     190      44      66     272
##  0.5264  0.5315  0.5888  0.5966  0.5971  0.5996  0.6103  0.6227  0.6239  0.6452
##     283     160     318     297      20      41     268     341     217     200
##  0.6506  0.6662  0.6705  0.6848  0.6930  0.7401  0.7554  0.7700  0.7970  0.8386
##     107     147     165     315       9     171     269     286     356      55
##  0.8594  0.8753  0.8754  0.8965  0.9012  0.9074  0.9563  0.9813  0.9951  1.0150
##     320     332     241     157     266     293     244      59     161      31
##  1.0161  1.0190  1.0648  1.0792  1.1018  1.1161  1.1476  1.1532  1.1618  1.1715
##     125     185     102     284     140      14     163     180     350     237
##  1.1803  1.1862  1.2254  1.2589  1.2804  1.3054  1.3260  1.3260  1.3665  1.4010
##     187     279     238      10     240     215     309     109      22     218
##  1.4109  1.4552  1.5377  1.5632  1.5840  1.6184  1.6506  1.6629  1.7109  1.7365
##      24      99     231     176     229     139     264     319     228     325
##  1.7658  1.7988  1.8000  1.9102  1.9859  2.0447  2.0734  2.3491  2.4783  2.5860
##     281     271     300     186     358     259     137      47
##  2.8653  2.8803  3.1241  3.2123  3.6390  3.6724  4.0198  5.0523
```

```
jackknife_outliers2 <- NHL %>% filter(jackknife2 > t2 | jackknife2 < -t2)
jackknife_outliers2
```

```
## # A tibble: 35 x 162
##      Salary Born   City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
```

```
##       <dbl> <chr>  <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1  5000000 87-01~ St. ~ MB      CAN   CAN      72   196  2005     5   132 L
##  2  7000000 85-12~ Queb~ QC      CAN   USA      72   202  2005     2    44 L
##  3   925000 96-10~ Nort~ MA      USA   USA      74   196  2015     1     2 R
##  4   832500 95-04~ Lond~ ON      CAN   CAN      72   223  2013     1     9 L
##  5 13800000 88-04~ Winn~ MB      CAN   CAN      74   201  2006     1     3 L
##  6   875000 93-02~ Vict~ QC      CAN   CAN      73   193  2011     1    26 L
##  7  6500000 84-03~ Winn~ MB      CAN   SWE      72   211  2002     1    24 L
##  8  3650000 89-10~ Edmo~ AB      CAN   CAN      69   175  2008     1    26 L
##  9 13800000 88-11~ Buff~ NY      USA   USA      71   177  2007     1     1 L
## 10  9000000 87-10~ Madi~ WI      USA   USA      72   202  2006     1     5 R
## # i 25 more rows
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, ...
```

```
cookCV2 <- 4/359
cookCV2
```

```
## [1] 0.01114206
```

```
cook2 <- cooks.distance(model2)
sort(round(cook2, 4))
```

```
##      7     11     15     16     18     21     26     27     29     30     32
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##     37     40     49     50     58     62     76     78     81     85     87
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##     94     95    111    113    119    129    134    138    142    144    145
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    148    149    152    155    159    173    174    175    177    181    183
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    191    195    199    202    203    204    208    225    250    265    267
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    274    287    289    295    296    334    336    337    338    340    345
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    348    352      1      8     17     19     23     35     39     46     48
## 0.0000 0.0000 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##     61     63     71     73     75     82     84     86    101    146    156
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##    158    182    184    189    207    209    216    222    224    227    234
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##    235    236    247    251    252    257    263    292    298    305    311
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##    324    328    333    347      2     28     45     67     68     88     93
## 0.0001 0.0001 0.0001 0.0001 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002
##    106    120    135    150    169    179    196    197    201    206    214
## 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002
##    243    246    253    276    278    285    288    304    306    308    316
## 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002
```

```
##    331     54     56     91    103    114    116    121    164    168    194
## 0.0002 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003
##    213    223    313    330    353     74     83     89     90    123    124
## 0.0003 0.0003 0.0003 0.0003 0.0003 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004
##    239    248    262    280    314    326      3     57     92    115    133
## 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004 0.0005 0.0005 0.0005 0.0005 0.0005
##    190    211    268    270    329     38     60    110    126    127    249
## 0.0005 0.0005 0.0005 0.0005 0.0005 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006
##    272    346     80     97    104    130    160    217    233    260    344
## 0.0006 0.0006 0.0007 0.0007 0.0007 0.0007 0.0007 0.0007 0.0007 0.0007 0.0007
##    349     33     43     65    122    132    154    198    226    301    307
## 0.0007 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008
##     70    128    165    221    258    275    299     44     53    357      6
## 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0010 0.0010 0.0010 0.0011
##     20    100    143    147    192    294    256    321     25     66    172
## 0.0011 0.0011 0.0011 0.0011 0.0011 0.0011 0.0012 0.0012 0.0013 0.0013 0.0013
##    178    200    210    245    290    322    170    242    283      9    151
## 0.0013 0.0013 0.0013 0.0013 0.0013 0.0013 0.0014 0.0014 0.0014 0.0015 0.0015
##    161    171    241    327    335     79    180    219    220    351    185
## 0.0015 0.0015 0.0015 0.0015 0.0015 0.0016 0.0016 0.0016 0.0016 0.0016 0.0017
##    297    302      4     51     72    162    255    341    303    359    232
## 0.0017 0.0017 0.0018 0.0018 0.0018 0.0018 0.0018 0.0018 0.0019 0.0019 0.0021
##    269    310    318     41    266    117     69    131    187     42    157
## 0.0021 0.0021 0.0021 0.0022 0.0022 0.0024 0.0025 0.0025 0.0025 0.0026 0.0027
##     64    332     14    244     31    264    342    102    238    108    286
## 0.0028 0.0028 0.0030 0.0030 0.0031 0.0031 0.0031 0.0032 0.0032 0.0033 0.0033
##     55    230    261    293    339     77    355    356    112    320    218
## 0.0034 0.0036 0.0036 0.0036 0.0036 0.0038 0.0038 0.0038 0.0039 0.0040 0.0041
##      5    107    176    240     22    212    237    125    167    354    231
## 0.0043 0.0043 0.0043 0.0043 0.0044 0.0044 0.0045 0.0047 0.0047 0.0048 0.0049
##    205    118    323     24    343     96    315     12    215     13    163
## 0.0050 0.0051 0.0051 0.0052 0.0052 0.0053 0.0054 0.0055 0.0055 0.0056 0.0056
##    350    228    141    279    284    312    166     99    140    229    153
## 0.0066 0.0067 0.0070 0.0071 0.0072 0.0072 0.0079 0.0080 0.0080 0.0084 0.0085
##     59    254    136    273     98    105    309     10    188    139    317
## 0.0087 0.0092 0.0100 0.0106 0.0111 0.0119 0.0120 0.0128 0.0129 0.0134 0.0134
##     36     34    193    109    282    186    325    277    291    319    281
## 0.0139 0.0151 0.0152 0.0158 0.0180 0.0190 0.0191 0.0199 0.0207 0.0218 0.0245
##    271    300    259    358     47    137
## 0.0248 0.0296 0.0317 0.0344 0.0622 0.0836
```

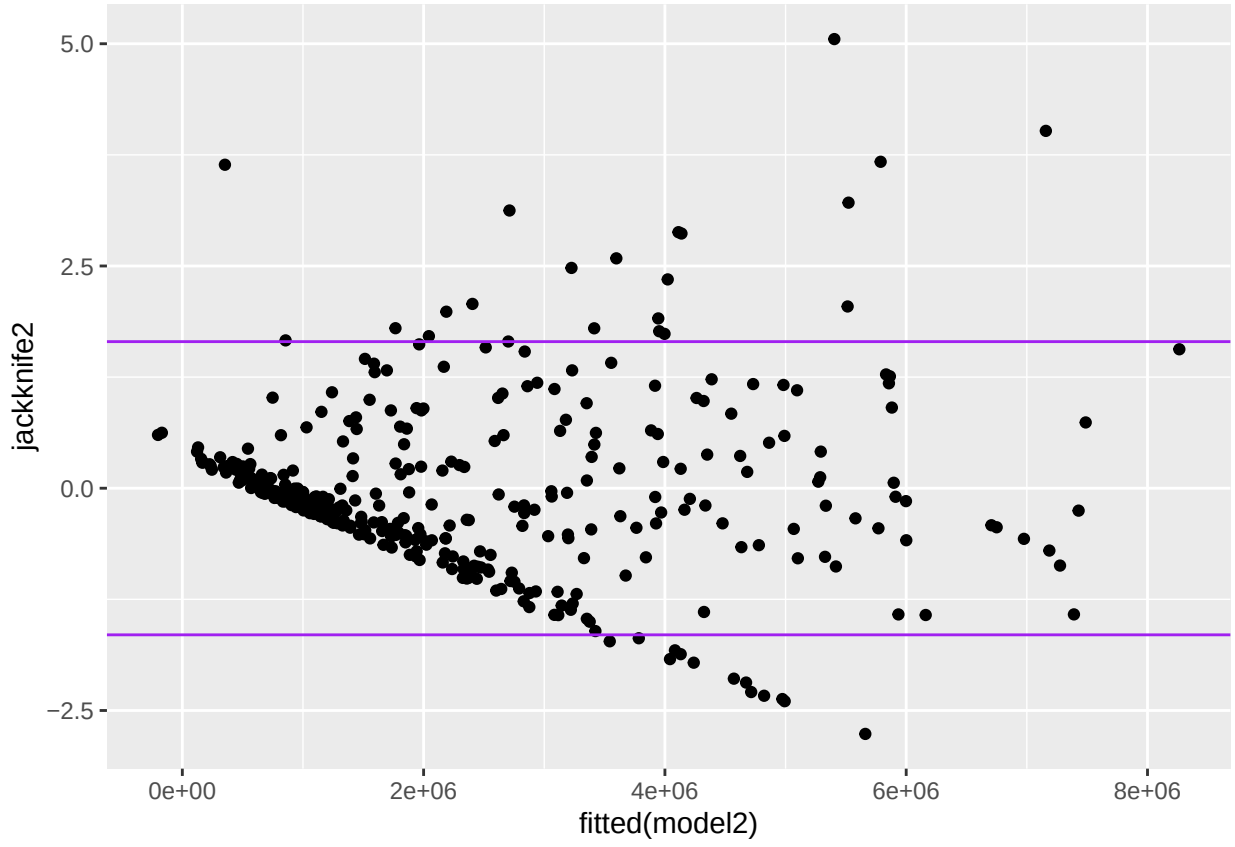
```
cook_outliers2 <- NHL %>% filter(cook2 > cookCV2)
cook_outliers2
```

```
## # A tibble: 23 x 162
##      Salary Born   City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##       <dbl> <chr>  <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1 10900000 87-08~ Cole~ NS      CAN   CAN      71   200  2005     1     1 L
##  2   925000 96-10~ Nort~ MA      USA   USA      74   196  2015     1     2 R
##  3   832500 95-04~ Lond~ ON      CAN   CAN      72   223  2013     1     9 L
##  4 13800000 88-04~ Winn~ MB      CAN   CAN      74   201  2006     1     3 L
##  5  1300000 89-04~ Otta~ ON      CAN   CAN      69   160  2007     6   179 L
##  6  3650000 89-10~ Edmo~ AB      CAN   CAN      69   175  2008     1    26 L
##  7 13800000 88-11~ Buff~ NY      USA   USA      71   177  2007     1     1 L
```

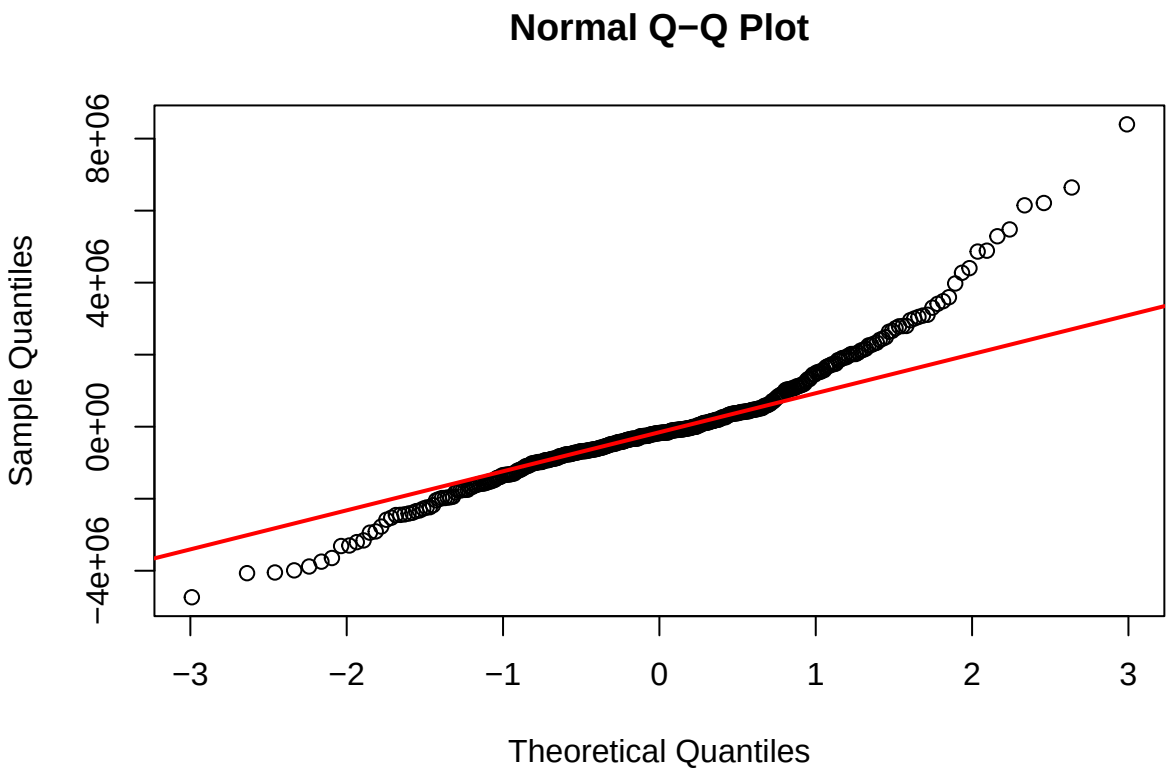
```
##  8  9000000 87-10~ Madi~ WI      USA   USA      72   202  2006     1     5 R
##  9 11000000 89-05~ Toro~ ON      CAN   CAN      72   210  2007     2    43 R
## 10   925000 97-07~ Gros~ MI      USA   USA      74   218  2015     1     8 L
## # i 13 more rows
## # i 150 more variables: 'Last Name' <chr>, 'First Name' <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, 'E+/-' <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   'TOI/GP...29' <dbl>, 'TOI/GP...30' <dbl>, 'TOI%' <dbl>, 'IPP%' <dbl>,
## #   'SH%' <dbl>, 'SV%' <dbl>, PDO <dbl>, 'F/60' <dbl>, 'A/60' <dbl>,
## #   'Pct%' <dbl>, Diff <dbl>, 'Diff/60' <dbl>, iCF...41 <dbl>, ...
```

```r
ggplot(NHL, aes(x = fitted(model2), y = jackknife2)) + geom_point()+ geom_hline(yintercept = t2, col =
```

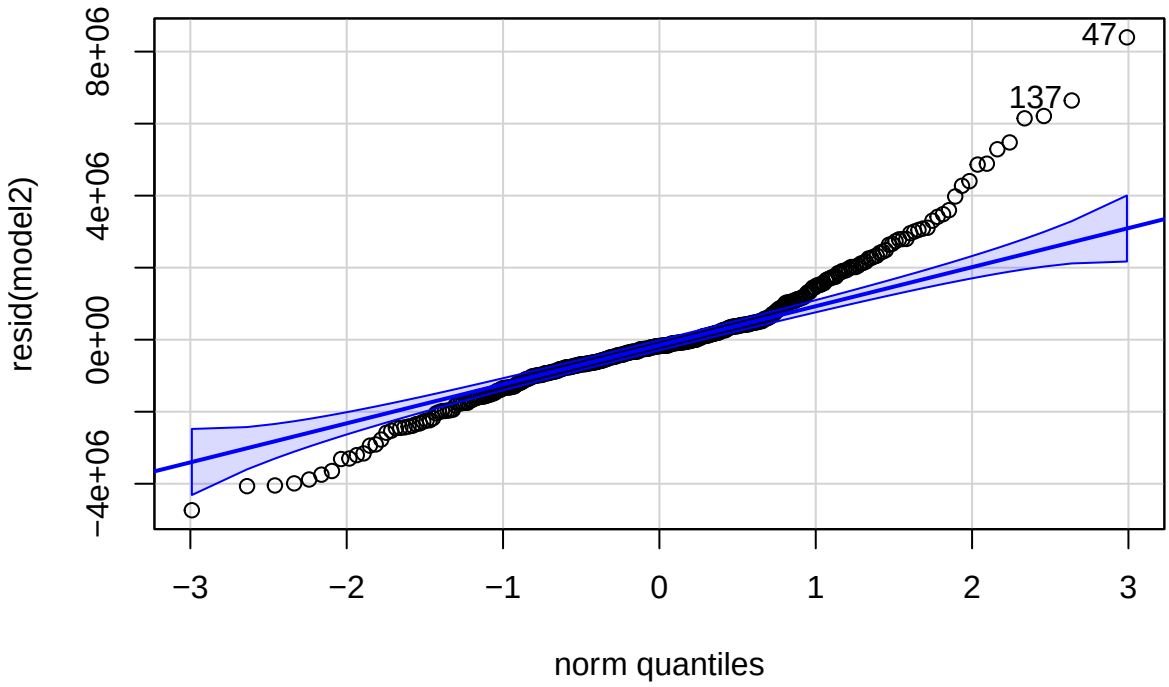
```
## Warning: Removed 1 rows containing missing values ('geom_point()').
```




```r
qqnorm(resid(model2))
qqline(resid(model2), col = "red", lwd = 2)
```




```
qqPlot(resid(model2))
```




```
## [1]  47 137
```

```
skewness(jackknife2)
```

```
## [1] NaN
```

```
kurtosis(jackknife2)
```

```
## [1] NaN
```

```
ols_vif_tol(model2)
```

```
##         Variables Tolerance      VIF
## 1              GS 0.3687451 2.711900
## 2              Wt 0.7929157 1.261168
## 3            iHDf 0.7352171 1.360143
## 4              GP 0.4179533 2.392612
## 5              PM 0.8535418 1.171589
## 6     Position_CD 0.9734760 1.027247
## 7    Position_CLW 0.5769079 1.733379
## 8    Position_CRW 0.6918443 1.445412
## 9  Position_CLWRW 0.7925824 1.261698
## 10     Position_D 0.4184927 2.389528
```

```
## 11    Position_LW 0.6632397 1.507751
## 12  Position_LWRW 0.7268771 1.375748
## 13    Position_RW 0.6428804 1.555499
```

```
eigprop(model2)
```

```
##
## Call:
## eigprop(mod = model2)
##
##    Eigenvalues      CI (Intercept)     GS     Wt   iHDf     GP     PM
## 1       4.3967  1.0000      0.0002 0.0064 0.0002 0.0008 0.0044 0.0000
## 2       1.3557  1.8009      0.0000 0.0060 0.0000 0.1987 0.0001 0.1924
## 3       1.0658  2.0311      0.0000 0.0002 0.0000 0.0432 0.0000 0.1262
## 4       1.0206  2.0755      0.0000 0.0038 0.0000 0.0025 0.0001 0.0042
## 5       1.0031  2.0936      0.0000 0.0001 0.0000 0.0000 0.0002 0.0000
## 6       1.0001  2.0968      0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
## 7       1.0000  2.0968      0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
## 8       1.0000  2.0968      0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
## 9       0.8984  2.2122      0.0000 0.0073 0.0000 0.0061 0.0001 0.2520
## 10      0.7520  2.4179      0.0000 0.0006 0.0000 0.4934 0.0000 0.2288
## 11      0.3469  3.5603      0.0010 0.2285 0.0009 0.0542 0.0315 0.1442
## 12      0.0940  6.8390      0.0076 0.0679 0.0072 0.0023 0.0161 0.0185
## 13      0.0645  8.2551      0.0028 0.6784 0.0027 0.0879 0.9470 0.0315
## 14      0.0022 44.6381      0.9883 0.0009 0.9890 0.1110 0.0004 0.0021
##    Position_CD Position_CLW Position_CRW Position_CLWRW Position_D Position_LW
## 1       0.0000       0.0039       0.0028         0.0020     0.0047      0.0025
## 2       0.0001       0.0019       0.0003         0.0004     0.0072      0.0681
## 3       0.0001       0.1669       0.0021         0.0355     0.0081      0.0002
## 4       0.1030       0.0001       0.1955         0.0843     0.0710      0.0358
## 5       0.2362       0.0044       0.2253         0.0201     0.0029      0.0547
## 6       0.3994       0.0411       0.0746         0.0504     0.0242      0.0239
## 7       0.0433       0.0263       0.0383         0.3753     0.0003      0.0689
## 8       0.1775       0.1080       0.0138         0.1297     0.0096      0.0202
## 9       0.0044       0.0008       0.0157         0.0023     0.0409      0.2484
## 10      0.0003       0.0611       0.0002         0.0084     0.0027      0.0362
## 11      0.0046       0.0731       0.0759         0.0632     0.0143      0.0343
## 12      0.0205       0.5006       0.3089         0.2141     0.8053      0.3891
## 13      0.0061       0.0005       0.0411         0.0012     0.0001      0.0158
## 14      0.0045       0.0113       0.0053         0.0130     0.0087      0.0019
##    Position_LWRW Position_RW
## 1         0.0024      0.0029
## 2         0.0366      0.0015
## 3         0.0018      0.1794
## 4         0.0215      0.0361
## 5         0.1792      0.0001
## 6         0.0003      0.1119
## 7         0.1577      0.0019
## 8         0.1106      0.1025
## 9         0.0813      0.0252
## 10        0.0377      0.0644
## 11        0.0616      0.0224
## 12        0.3090      0.4437
## 13        0.0000      0.0082
```

```
## 14        0.0001      0.0000
##
## ================================
## Row 13==> GS, proportion 0.678401 >= 0.50
## Row 14==> Wt, proportion 0.988967 >= 0.50
## Row 13==> GP, proportion 0.947009 >= 0.50
## Row 12==> Position_CLW, proportion 0.500612 >= 0.50
## Row 12==> Position_D, proportion 0.805286 >= 0.50
```

```
ols_step_forward_p(model2)
```

```
##
##                                 Selection Summary
## ------------------------------------------------------------------------------------------
##         Variable                    Adj.
## Step      Entered       R-Square    R-Square     C(p)         AIC            RMSE
## ------------------------------------------------------------------------------------------
##    1    GS                0.4540      0.4525    23.0936    11365.1352    1801945.3109
##    2    Wt                0.4811      0.4781     6.3504    11348.8823    1759179.4048
##    3    Position_CLW      0.4889      0.4846     2.9042    11345.3998    1748254.9274
##    4    Position_RW       0.4922      0.4865     2.6132    11345.0682    1745046.4442
##    5    iHDf              0.4941      0.4870     3.2952    11345.7201    1744238.3455
##    6    GP                0.4965      0.4879     3.6417    11346.0214    1742586.7942
##    7    PM                0.4983      0.4883     4.3927    11346.7329    1741938.5202
##    8    Position_D        0.5002      0.4888     5.0960    11347.3904    1741166.5170
## ------------------------------------------------------------------------------------------
```

```
ols_step_backward_p(model2)
```

```
##
##
##                                 Elimination Summary
## ------------------------------------------------------------------------------------------
##         Variable                    Adj.
## Step      Removed         R-Square    R-Square     C(p)         AIC            RMSE
## ------------------------------------------------------------------------------------------
##    1    Position_LWRW       0.5018      0.4845    12.0164    11354.2689    1748468.8164
##    2    Position_CD         0.5017      0.4859    10.0756    11352.3304    1746097.3016
##    3    Position_CRW        0.5015      0.4872     8.1601    11350.4184    1743800.3113
##    4    Position_LW         0.5013      0.4885     6.3204    11348.5850    1741704.3497
##    5    Position_CLWRW      0.5002      0.4888     5.0960    11347.3904    1741166.5170
## ------------------------------------------------------------------------------------------
```

```
ols_step_both_p(model2)
```

```
##
##                                 Stepwise Selection Summary
## ------------------------------------------------------------------------------------------------------
##                          Added/                   Adj.
## Step      Variable      Removed     R-Square    R-Square     C(p)         AIC            RMSE
## ------------------------------------------------------------------------------------------------------
##    1         GS         addition       0.454       0.452    23.0940    11365.1352    1801945.3109
```

```
##    2         Wt         addition       0.481       0.478     6.3500    11348.8823    1759179.4048
##    3    Position_CLW    addition       0.489       0.485     2.9040    11345.3998    1748254.9274
## ----------------------------------------------------------------------------------------------
```

```
ols_step_best_subset(model2)
```

```
##                                                    Best Subsets Regression
## ---------------------------------------------------------------------------------------------------------
## Model Index    Predictors
## ---------------------------------------------------------------------------------------------------------
##      1         GS
##      2         GS Wt
##      3         GS Wt Position_CLW
##      4         GS Wt Position_CLW Position_RW
##      5         GS Wt iHDf Position_CLW Position_RW
##      6         GS Wt iHDf GP Position_CLW Position_RW
##      7         GS Wt iHDf GP PM Position_CLW Position_D
##      8         GS Wt iHDf GP PM Position_CLW Position_D Position_RW
##      9         GS Wt iHDf GP PM Position_CLW Position_CLWRW Position_D Position_RW
##     10         GS Wt iHDf GP PM Position_CLW Position_CLWRW Position_D Position_LW Position_RW
##     11         GS Wt iHDf GP PM Position_CLW Position_CRW Position_CLWRW Position_D Position_LW Posi
##     12         GS Wt iHDf GP PM Position_CD Position_CLW Position_CRW Position_CLWRW Position_D Posi
##     13         GS Wt iHDf GP PM Position_CD Position_CLW Position_CRW Position_CLWRW Position_D Posi
## ---------------------------------------------------------------------------------------------------------
##
##                                                          Subsets Regression Summary
## ---------------------------------------------------------------------------------------------------------
##                         Adj.        Pred
## Model    R-Square    R-Square    R-Square     C(p)         AIC           SBIC          SBC          1.
## ---------------------------------------------------------------------------------------------------------
##   1        0.4540      0.4525       0.446    23.0936    11365.1352    10346.1303    11376.7852    1.
##   2        0.4811      0.4781      0.4699     6.3504    11348.8823    10330.0786    11364.4156    1.
##   3        0.4889      0.4846      0.4764     2.9042    11345.3998    10326.7167    11364.8164    1.
##   4        0.4922      0.4865      0.4767     2.6132    11345.0682    10326.4795    11368.3681    1.
##   5        0.4941      0.4870      0.4751     3.2952    11345.7201    10327.2191    11372.9033    1.
##   6        0.4965      0.4879      0.4756     3.6417    11346.0214    10327.6378    11377.0880    1.
##   7        0.4983      0.4883       0.473     4.3802    11346.7200    10328.4551    11381.6699    1.
##   8        0.5002      0.4888       0.472     5.0960    11347.3904    10329.2609    11386.2236    1.
##   9        0.5013      0.4885      0.4714     6.3204    11348.5850    10330.5763    11391.3015    1.
##  10        0.5015      0.4872      0.4677     8.1601    11350.4184    10332.4994    11397.0182    1.
##  11        0.5017      0.4859      0.4646    10.0756    11352.3304    10334.4978    11402.8136    1.
##  12        0.5018      0.4845        -Inf    12.0164    11354.2689    10336.5215    11408.6354    1.
##  13        0.5018      0.4830        -Inf    14.0000    11356.2518    10338.5869    11414.5016    1.
## ---------------------------------------------------------------------------------------------------------
## AIC: Akaike Information Criteria
##  SBIC: Sawa's Bayesian Information Criteria
##  SBC: Schwarz Bayesian Criteria
##  MSEP: Estimated error of prediction, assuming multivariate normality
##  FPE: Final Prediction Error
##  HSP: Hocking's Sp
##  APC: Amemiya Prediction Criteria
```

```
model3 <- lm(Salary ~ GS + Wt + Position_CD + Position_CLW + Position_CRW + Position_CLWRW + Position_D
model3
```

```
##
## Call:
## lm(formula = Salary ~ GS + Wt + Position_CD + Position_CLW +
##     Position_CRW + Position_CLWRW + Position_D + Position_LW +
##     Position_LWRW + Position_RW, data = NHL)
##
## Coefficients:
##    (Intercept)              GS              Wt     Position_CD     Position_CLW
##       -4008930           76227           23787          573275         -619389
##   Position_CRW  Position_CLWRW      Position_D     Position_LW   Position_LWRW
##         235044         -390007          136463          -14554           75323
##    Position_RW
##        -402641
```

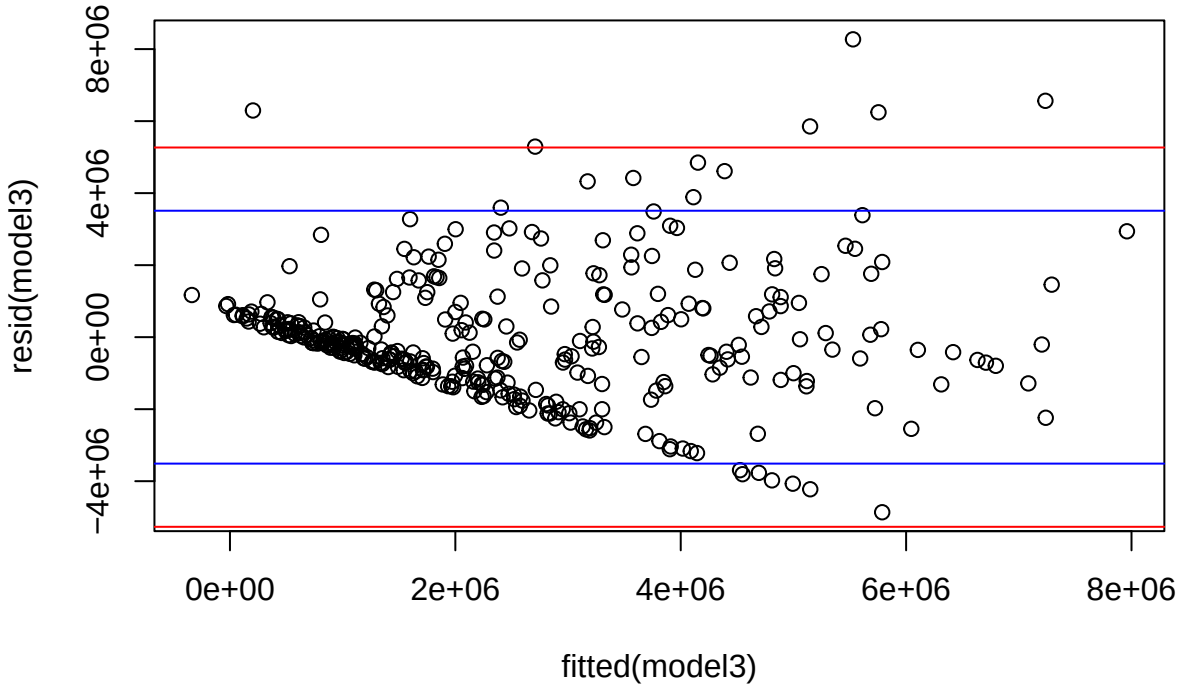
```
standard_error3 <- sqrt(deviance(model3)/df.residual(model3))
standard_error3
```

```
## [1] 1755832
```

```
2*standard_error3
```

```
## [1] 3511665
```

```
plot(fitted(model3),resid(model3))
abline(h=2*standard_error3, col = "blue")
abline(h=-2*standard_error3, col = "blue")
abline(h=3*standard_error3, col = "red")
abline(h=-3*standard_error3, col = "red")
```




```
res_pot_outliers3 <- NHL %>% filter(2*standard_error3 <= abs(resid(model3)) & abs(resid(model3)) < 3*sta
print(res_pot_outliers3)
```

```
## # A tibble: 13 x 162
##     Salary Born    City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##      <dbl> <chr>   <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1  925000 96-10-~ Nort~ MA      USA   USA      74   196  2015     1     2 R
##  2  832500 95-04-~ Lond~ ON      CAN   CAN      72   223  2013     1     9 L
##  3  742500 94-05-~ Denv~ CO      USA   USA      74   205  2012     4   120 L
##  4  925000 97-07-~ Gros~ MI      USA   USA      74   218  2015     1     8 L
##  5 7500000 85-04-~ Edmo~ AB      CAN   CAN      75   219  2003     1     9 L
##  6 6000000 83-03-~ Kitc~ ON      CAN   CAN      72   202  2002     8   241 R
##  7 9000000 85-01-~ Madi~ WI      USA   USA      74   206  2003     1     7 L
##  8  925000 93-05-~ St. ~ AB      CAN   CAN      78   226  2012     3    86 R
##  9  925000 97-12-~ Scot~ AZ      USA   USA      74   202  2016     1     6 L
## 10 9000000 84-07-~ Minn~ MN      USA   USA      71   196  2003     1    17 L
## 11  832500 95-03-~ Ste-~ QC      CAN   CAN      71   188  2013     1     3 L
## 12 8000000 84-06-~ Bram~ ON      CAN   CAN      76   212  2002     1     1 L
## 13 8000000 88-04-~ St. ~ MN      USA   USA      72   218  2006     1     7 R
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, iCF...42 <dbl>,
## #   iFF <dbl>, iSF...44 <dbl>, iSF...45 <dbl>, iSF...46 <dbl>, ixG <dbl>, ...
```

```
res_outliers3 <- NHL %>% filter(abs(resid(model3)) >= 3*standard_error3)
print(res_outliers3)
```

```
## # A tibble: 6 x 162
##     Salary Born    City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##      <dbl> <chr>   <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
## 1 13800000 88-04-~ Winn~ MB      CAN   CAN      74   201  2006     1     3 L
## 2 13800000 88-11-~ Buff~ NY      USA   USA      71   177  2007     1     1 L
## 3 11000000 89-05-~ Toro~ ON      CAN   CAN      72   210  2007     2    43 R
## 4 12000000 85-08-~ Sica~ BC      CAN   CAN      76   232  2003     2    49 R
## 5  8000000 85-12-~ Mapl~ BC      CAN   CAN      75   200  2004     1     4 L
## 6  6500000 85-03-~ Roch~ NY      USA   USA      70   187  2004     4   127 R
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, iCF...42 <dbl>,
## #   iFF <dbl>, iSF...44 <dbl>, iSF...45 <dbl>, iSF...46 <dbl>, ixG <dbl>, ...
```

```
h3 <- 2*(3+1)/359
h3
```

```
## [1] 0.02228412
```

```
leverage3 <- hatvalues(model3)
sort(round(leverage3,4))
```

```
##    215    226    232    241    252    197    264    146    151    225    247
## 0.0078 0.0078 0.0078 0.0078 0.0078 0.0079 0.0079 0.0080 0.0080 0.0080 0.0080
##    256    213    198    249    254    238    164    174    194    231    211
## 0.0081 0.0082 0.0083 0.0083 0.0083 0.0084 0.0085 0.0085 0.0085 0.0086 0.0087
##    180    184    196    243    272    209    237    250    169    217    185
## 0.0088 0.0088 0.0088 0.0088 0.0088 0.0089 0.0089 0.0089 0.0090 0.0090 0.0091
##    253    270    167    230    214    260    223    191    201    234    255
## 0.0091 0.0091 0.0093 0.0093 0.0094 0.0094 0.0096 0.0097 0.0098 0.0098 0.0098
##    207    216    183    150    176    189    236    251    263    148    166
## 0.0099 0.0099 0.0100 0.0101 0.0101 0.0101 0.0101 0.0101 0.0101 0.0103 0.0103
##    228    261    257    179    163    165    178    258    268    168    205
## 0.0103 0.0103 0.0105 0.0106 0.0107 0.0107 0.0107 0.0107 0.0107 0.0108 0.0108
##    227    245    156    204    219    229    233    190    208    154    175
## 0.0108 0.0108 0.0110 0.0110 0.0110 0.0110 0.0111 0.0113 0.0113 0.0114 0.0114
##    173    239    271    222    147    155    182    262    195    202    153
## 0.0115 0.0115 0.0115 0.0116 0.0118 0.0118 0.0118 0.0119 0.0120 0.0120 0.0122
##    160    159    187    172    145    152    242    161    235    149    269
## 0.0123 0.0129 0.0129 0.0130 0.0133 0.0133 0.0136 0.0137 0.0139 0.0140 0.0140
##    220    162    186    218    248    199    206    240    265    246    212
## 0.0144 0.0146 0.0147 0.0148 0.0150 0.0151 0.0152 0.0152 0.0154 0.0156 0.0158
##    266    158    181    244    203    170    273    200    188     51     20
## 0.0158 0.0161 0.0164 0.0165 0.0166 0.0173 0.0173 0.0179 0.0189 0.0197 0.0198
##     22      5     79     73     38     43     44     69     14     83      3
## 0.0198 0.0199 0.0200 0.0201 0.0203 0.0207 0.0207 0.0207 0.0208 0.0208 0.0210
```

```
##     68     28     40     75    210     94     58     62      4     24      2
## 0.0210 0.0212 0.0212 0.0213 0.0213 0.0214 0.0215 0.0215 0.0216 0.0218 0.0219
##     63      7    224     46     88    171      8     53     49     86    193
## 0.0219 0.0220 0.0220 0.0221 0.0221 0.0221 0.0222 0.0224 0.0225 0.0226 0.0226
##     37     39     95     29     85     60    221     27     55     21     78
## 0.0227 0.0227 0.0227 0.0228 0.0229 0.0231 0.0231 0.0232 0.0232 0.0233 0.0233
##     15     26     32     89    267     67     56     72    259     64     18
## 0.0234 0.0234 0.0234 0.0234 0.0234 0.0235 0.0237 0.0239 0.0239 0.0240 0.0241
##     96     16     66     74     99      9     71     30     48     93     70
## 0.0241 0.0242 0.0242 0.0243 0.0245 0.0246 0.0246 0.0247 0.0248 0.0248 0.0249
##     11     35     42     61     97     17    157     34     50     19     84
## 0.0250 0.0250 0.0250 0.0250 0.0250 0.0251 0.0252 0.0253 0.0253 0.0255 0.0255
##     87     80    177     65      1     45     59    100    101     81    102
## 0.0255 0.0264 0.0267 0.0271 0.0274 0.0275 0.0275 0.0280 0.0282 0.0284 0.0286
##    335    347    344    351     47    353     91     54     31     82    350
## 0.0286 0.0286 0.0287 0.0289 0.0292 0.0292 0.0293 0.0294 0.0296 0.0298 0.0305
##    333    336    326    343     36    329    342    357    328    348     23
## 0.0309 0.0309 0.0310 0.0310 0.0311 0.0313 0.0313 0.0313 0.0315 0.0316 0.0319
##     92    340     76    332    338    352     12    325    345    355    331
## 0.0319 0.0319 0.0320 0.0321 0.0322 0.0324 0.0326 0.0326 0.0326 0.0327 0.0330
##    303    330     57    279    294    290    300    301     25    358    276
## 0.0333 0.0334 0.0336 0.0336 0.0336 0.0338 0.0343 0.0344 0.0345 0.0346 0.0347
##    293    280    295    298    354    285    349    289    274    334    286
## 0.0352 0.0353 0.0354 0.0356 0.0356 0.0357 0.0357 0.0358 0.0360 0.0361 0.0364
##     13    283    287    275    118    296    356    359    192    297    341
## 0.0365 0.0365 0.0367 0.0370 0.0373 0.0377 0.0378 0.0378 0.0380 0.0385 0.0386
##      6    124    288    135    346    302    281    299     90    337    278
## 0.0387 0.0388 0.0389 0.0392 0.0392 0.0394 0.0396 0.0399 0.0401 0.0403 0.0408
##    127    128     33    133    123    132    139    277    125    282    142
## 0.0409 0.0409 0.0412 0.0412 0.0413 0.0420 0.0420 0.0426 0.0428 0.0429 0.0430
##    119    141    138    292     41    327    134    291    140    126    312
## 0.0433 0.0442 0.0443 0.0444 0.0453 0.0453 0.0455 0.0458 0.0463 0.0472 0.0478
##    316    131    144    318    320    136    143    122    319    130    309
## 0.0478 0.0484 0.0484 0.0487 0.0487 0.0489 0.0490 0.0492 0.0497 0.0501 0.0503
##    129    284    304     10    310    305    314     77    315    121    308
## 0.0506 0.0508 0.0508 0.0510 0.0510 0.0512 0.0512 0.0516 0.0525 0.0533 0.0546
##    339    307     98    313    120    317    322    306    311    323    324
## 0.0551 0.0554 0.0562 0.0569 0.0577 0.0584 0.0589 0.0592 0.0592 0.0601 0.0637
##    137    321    112    108    113    107    110    116    114    104    109
## 0.0640 0.0651 0.0673 0.0676 0.0685 0.0695 0.0698 0.0700 0.0706 0.0725 0.0732
##    115    117    111    103    106    105     52
## 0.0732 0.0738 0.0767 0.0778 0.0790 0.0851 1.0000
```

```
leverage_outliers3 <- NHL %>% filter(leverage3 > h3)
leverage_outliers3
```

```
## # A tibble: 209 x 162
##      Salary Born   City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##       <dbl> <chr>  <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1   925000 93-04~ Peta~ ON      CAN   CAN      68   178  2011     7   201 L
##  2  6000000 90-09~ Miss~ ON      CAN   CAN      73   211  2009     1     1 L
##  3  3500000 80-02~ Mont~ QC      CAN   CAN      72   179  1998     2    45 L
##  4 10900000 87-08~ Cole~ NS      CAN   CAN      71   200  2005     1     1 L
##  5   667500 97-01~ Saul~ ON      CAN   CAN      71   185  2015     3    67 R
```

```
##  6  3500000 84-10~ Thun~ ON      CAN   CAN      76   208  2003     1     2 L
##  7   667500 96-03~ Calg~ AB      CAN   CAN      70   166  2014     3    79 R
##  8   700000 90-12~ Vaug~ ON      CAN   CAN      70   193  2009     5   147 L
##  9  3750000 92-12~ Phoe~ AZ      USA   CAN      75   211  2011     1     8 L
## 10   600000 93-04~ Bram~ ON      CAN   CAN      77   212  2011     7   191 L
## # i 199 more rows
## # i 150 more variables: 'Last Name' <chr>, 'First Name' <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, 'E+/-' <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   'TOI/GP...29' <dbl>, 'TOI/GP...30' <dbl>, 'TOI%' <dbl>, 'IPP%' <dbl>,
## #   'SH%' <dbl>, 'SV%' <dbl>, PDO <dbl>, 'F/60' <dbl>, 'A/60' <dbl>,
## #   'Pct%' <dbl>, Diff <dbl>, 'Diff/60' <dbl>, iCF...41 <dbl>, ...
```

```
t3 <- qt(df =  359 - 3 - 2, 0.95)
t3
```

```
## [1] 1.649169
```

```
jackknife3 <- rstudent(model3)
sort(round(jackknife3, 4))
```

```
##     188     277     273      36     153      34     291     193     261     282
## -2.8239 -2.4769 -2.3533 -2.3156 -2.1929 -2.1856 -2.1652 -1.8611 -1.8173 -1.8066
##     205      96     166     317     230     141     254      12      13     167
## -1.7870 -1.7557 -1.6566 -1.5788 -1.5405 -1.4934 -1.4847 -1.4768 -1.4687 -1.4313
##     212     354     343      98       5     312     355     151     255     105
## -1.4263 -1.3779 -1.3751 -1.3139 -1.2996 -1.2331 -1.2283 -1.2140 -1.1930 -1.1929
##     342     118      64     136      51     323     198     245      42      77
## -1.1787 -1.1634 -1.1550 -1.1530 -1.1168 -1.0909 -1.0900 -1.0862 -1.0354 -1.0158
##     178     226     112     172     232     256     260     258     154      72
## -1.0095 -0.9849 -0.9847 -0.9505 -0.9438 -0.9354 -0.9120 -0.9008 -0.8740 -0.8651
##     303     233     249      53     359     335     210     270     108     294
## -0.8553 -0.8494 -0.8372 -0.8009 -0.7924 -0.7860 -0.7838 -0.7798 -0.7674 -0.7606
##      69      25      43     339     128     310     213     242      79     117
## -0.7601 -0.7599 -0.7522 -0.7520 -0.7254 -0.7234 -0.7217 -0.7185 -0.7099 -0.7025
##     162     321     239     290       4     327     351     211      38      80
## -0.6988 -0.6790 -0.6583 -0.6551 -0.6541 -0.6528 -0.6488 -0.6213 -0.6188 -0.6179
##     346     307      83     220      33     329     127     143     299     221
## -0.5999 -0.5760 -0.5750 -0.5735 -0.5634 -0.5485 -0.5477 -0.5351 -0.5290 -0.5287
##     197     164     246     330     223     243     234     194       6     135
## -0.5024 -0.4997 -0.4860 -0.4763 -0.4744 -0.4702 -0.4664 -0.4654 -0.4617 -0.4613
##     148     353     123     133     131     170     302      68      28     301
## -0.4461 -0.4325 -0.4249 -0.4137 -0.4129 -0.4129 -0.4092 -0.4088 -0.4065 -0.4037
##     126     216     247     275       2     326     130      75      61     158
## -0.3954 -0.3916 -0.3906 -0.3904 -0.3900 -0.3825 -0.3696 -0.3611 -0.3593 -0.3574
##      92     169     132     150     196     349     276      17      94     344
## -0.3570 -0.3501 -0.3442 -0.3425 -0.3423 -0.3391 -0.3389 -0.3378 -0.3310 -0.3275
##     110     168     202     280      63      16     304     201     227     333
## -0.3256 -0.3186 -0.3105 -0.3073 -0.3055 -0.2965 -0.2898 -0.2880 -0.2824 -0.2722
##     278     179     314     106     285     324     250     122     189      19
## -0.2721 -0.2705 -0.2704 -0.2581 -0.2543 -0.2503 -0.2461 -0.2432 -0.2351 -0.2338
##      73      46     219     251     311      90       3     191     207     142
## -0.2326 -0.2304 -0.2211 -0.2178 -0.2077 -0.2008 -0.1972 -0.1799 -0.1787 -0.1783
```

```
##     206     182       8     134      60      88      81     236     298     195
## -0.1734 -0.1707 -0.1682 -0.1682 -0.1576 -0.1542 -0.1529 -0.1388 -0.1306 -0.1280
##     322      50     257     121      62     144     295     337      87     352
## -0.1258 -0.1238 -0.1204 -0.1192 -0.1123 -0.1085 -0.1044 -0.1041 -0.1029 -0.0979
##     175     208      29     289      37      18      49     316     305     263
## -0.0967 -0.0961 -0.0940 -0.0912 -0.0900 -0.0894 -0.0881 -0.0865 -0.0794 -0.0790
##      78     149      58     174     274     296     225     308     183     119
## -0.0722 -0.0712 -0.0681 -0.0609 -0.0502 -0.0422 -0.0406 -0.0342 -0.0308 -0.0284
##       7     173     138      39     159     334      40     345      27     287
## -0.0222 -0.0170 -0.0127 -0.0065 -0.0032  0.0059  0.0103  0.0141  0.0184  0.0200
##      32     336     292     199      23      95     203     181     146      85
##  0.0321  0.0352  0.0392  0.0531  0.0568  0.0608  0.0652  0.0667  0.0707  0.0782
##     265     129     101     155     222      21      76      15     328     111
##  0.0791  0.0869  0.1006  0.1046  0.1108  0.1162  0.1198  0.1206  0.1305  0.1313
##     116     340     348     177      48     113      11     184     204      82
##  0.1518  0.1520  0.1537  0.1580  0.1636  0.1659  0.1676  0.1698  0.1724  0.1762
##     145     338      30     267      26      91      84     224     288     103
##  0.1766  0.1898  0.1901  0.2150  0.2209  0.2213  0.2239  0.2347  0.2395  0.2405
##     313     192     120     209     347      86     252     114     306     331
##  0.2431  0.2466  0.2542  0.2801  0.2845  0.2862  0.2914  0.2929  0.2981  0.3000
##       1      45      35      71      54     235     156      56      93     115
##  0.3113  0.3201  0.3204  0.3333  0.3356  0.3453  0.3504  0.3514  0.3584  0.3634
##      67      89     214     152     104     272     190     124     297     262
##  0.3636  0.3723  0.3996  0.4087  0.4193  0.4393  0.4576  0.4688  0.4855  0.4865
##     248      74      66     253     283      20      57      70      97     217
##  0.4948  0.4982  0.5283  0.5303  0.5384  0.5475  0.5505  0.5573  0.6048  0.6239
##     100     357      65     341      44     200     269     268     318     160
##  0.6427  0.6506  0.6754  0.6820  0.6828  0.6829  0.6890  0.7167  0.7290  0.7457
##     107      41     356     320     157       9     165     147     315     185
##  0.7784  0.8497  0.9143  0.9208  0.9329  0.9471  0.9485  0.9679  0.9752  0.9849
##     266     171     293     286     241      31     163     332     244     102
##  1.0048  1.0135  1.0284  1.0861  1.0912  1.1062  1.1097  1.1415  1.1464  1.1943
##     125     161     279      14     180      55      59     215     237     284
##  1.2159  1.2457  1.2463  1.2782  1.2808  1.3006  1.3236  1.3771  1.4046  1.4365
##     140     350     187     238      99     240     229     109      10      22
##  1.4826  1.5026  1.5457  1.5703  1.6677  1.6722  1.6764  1.6857  1.7240  1.7292
##     218     309      24     231     139     176     264     319     228     325
##  1.7457  1.7708  1.7872  1.8810  1.9795  2.0066  2.0660  2.2848  2.4951  2.5806
##     271     281     300     186     259     358     137      47
##  2.6642  2.8455  3.1047  3.4088  3.6639  3.7158  3.9441  4.9392
```

```
jackknife_outliers3 <- NHL %>% filter(jackknife3 > t3 | jackknife3 < -t3)
jackknife_outliers3
```

```
## # A tibble: 37 x 162
##      Salary Born   City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##       <dbl> <chr>  <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1 10900000 87-08~ Cole~ NS      CAN   CAN      71   200  2005     1     1 L
##  2  5000000 87-01~ St. ~ MB      CAN   CAN      72   196  2005     5   132 L
##  3  7000000 85-12~ Queb~ QC      CAN   USA      72   202  2005     2    44 L
##  4   925000 96-10~ Nort~ MA      USA   USA      74   196  2015     1     2 R
##  5   832500 95-04~ Lond~ ON      CAN   CAN      72   223  2013     1     9 L
##  6 13800000 88-04~ Winn~ MB      CAN   CAN      74   201  2006     1     3 L
##  7   875000 93-02~ Vict~ QC      CAN   CAN      73   193  2011     1    26 L
```

```
##  8  6500000 84-03~ Winn~ MB      CAN   SWE      72   211  2002     1    24 L
##  9  3650000 89-10~ Edmo~ AB      CAN   CAN      69   175  2008     1    26 L
## 10 13800000 88-11~ Buff~ NY      USA   USA      71   177  2007     1     1 L
## # i 27 more rows
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, ...
```

```
cookCV3 <- 4/359
cookCV3
```

```
## [1] 0.01114206
```

```
cook3 <- cooks.distance(model3)
sort(round(cook3, 4))
```

```
##      7     15     18     21     23     27     29     32     37     39     40
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##     49     50     58     62     76     78     85     87     88     95    101
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    119    129    138    145    146    149    155    159    173    174    175
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    181    182    183    184    191    195    199    203    204    206    207
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    208    219    222    225    236    250    251    257    263    265    274
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    287    289    292    295    296    305    308    316    334    336    337
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    345    352      3      8     11     19     26     30     46     48     60
## 0.0000 0.0000 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##     73     81     82     84     91    111    121    134    142    144    150
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##    156    168    169    177    179    189    196    201    202    209    214
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##    216    224    227    247    252    267    298    322    328    338    340
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##    348      1     16     35     63     86     90     94    113    116    148
## 0.0001 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002
##    152    158    164    190    192    194    197    223    234    235    243
## 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002
##    253    272    285    288    311    333    347      2     17     28     45
## 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0003 0.0003 0.0003 0.0003
##     54     56     61     67     68     71     75     89     93    122    170
## 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003
##    211    217    246    248    262    278    280    313    331    344     92
## 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0004
##    103    120    213    220    276    304    314    324    326    349    106
## 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004 0.0005
##    132    239    249    268    270    275    301    306    353     20     66
## 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0006 0.0006
```

```
##     74     83    114    160    221    232    242    269    302     38     70
## 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0007 0.0007
##    110    123    126    130    133    162    226    233    256    260    330
## 0.0007 0.0007 0.0007 0.0007 0.0007 0.0007 0.0007 0.0007 0.0007 0.0007 0.0007
##      6    124    131    135    154    185    200    258      4     44     79
## 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0008 0.0009 0.0009 0.0009
##     80     97    165    198    241    297    329     57    115    147    178
## 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0010 0.0010 0.0010 0.0010
##    283     43     69    100    151    172    299    351     33     65    127
## 0.0010 0.0011 0.0011 0.0011 0.0011 0.0011 0.0011 0.0011 0.0012 0.0012 0.0012
##    163    210    245    357     53    104    143    180    255    346    215
## 0.0012 0.0012 0.0012 0.0012 0.0013 0.0013 0.0013 0.0013 0.0013 0.0013 0.0014
##    290    266    237     72    167    254    335    341    294    307    327
## 0.0014 0.0015 0.0016 0.0017 0.0017 0.0017 0.0017 0.0017 0.0018 0.0018 0.0018
##     25    238    128    157    161    230    244      9    171    359     51
## 0.0019 0.0019 0.0020 0.0020 0.0020 0.0020 0.0020 0.0021 0.0021 0.0022 0.0023
##    303     42    318    166    310    187    229    231    321     64    212
## 0.0023 0.0025 0.0025 0.0026 0.0026 0.0028 0.0028 0.0028 0.0029 0.0030 0.0030
##    339    356      5     41    205    261    264     14     31    293     55
## 0.0030 0.0030 0.0031 0.0031 0.0031 0.0031 0.0031 0.0032 0.0034 0.0035 0.0036
##    117    176    102    108    240    320    332    107    218    286    342
## 0.0036 0.0037 0.0038 0.0039 0.0039 0.0039 0.0039 0.0041 0.0041 0.0041 0.0041
##     59    355    118    315    279     77    153     22    343    228    125
## 0.0045 0.0046 0.0048 0.0048 0.0049 0.0051 0.0054 0.0055 0.0055 0.0058 0.0060
##    136     99     24    112    350    354     12     96    312    323    193
## 0.0062 0.0063 0.0064 0.0064 0.0064 0.0064 0.0067 0.0069 0.0069 0.0069 0.0072
##     13    271    273     98    141    140    284     34    105    282    188
## 0.0074 0.0074 0.0088 0.0093 0.0093 0.0097 0.0100 0.0111 0.0120 0.0132 0.0137
##    317     10    309    186     36    139    325    291    109    277    319
## 0.0140 0.0145 0.0150 0.0153 0.0155 0.0155 0.0201 0.0202 0.0203 0.0245 0.0245
##    259    281    300    358     47    137
## 0.0289 0.0297 0.0304 0.0434 0.0626 0.0928
```

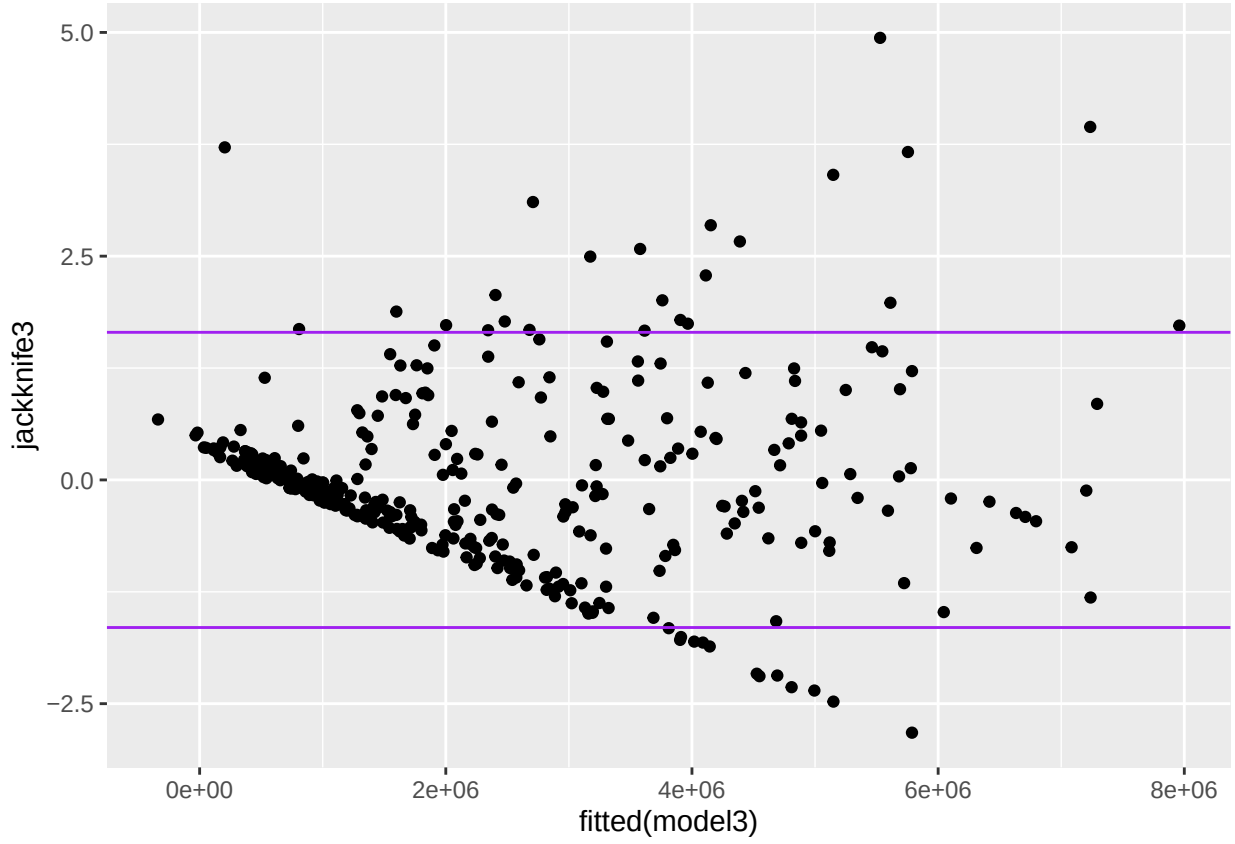
```
cook_outliers3 <- NHL %>% filter(cook3 > cookCV3)
cook_outliers3
```

```
## # A tibble: 20 x 162
##      Salary Born   City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##       <dbl> <chr>  <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1 10900000 87-08~ Cole~ NS      CAN   CAN      71   200  2005     1     1 L
##  2   832500 95-04~ Lond~ ON      CAN   CAN      72   223  2013     1     9 L
##  3 13800000 88-04~ Winn~ MB      CAN   CAN      74   201  2006     1     3 L
##  4  1300000 89-04~ Otta~ ON      CAN   CAN      69   160  2007     6   179 L
##  5  3650000 89-10~ Edmo~ AB      CAN   CAN      69   175  2008     1    26 L
##  6 13800000 88-11~ Buff~ NY      USA   USA      71   177  2007     1     1 L
##  7  9000000 87-10~ Madi~ WI      USA   USA      72   202  2006     1     5 R
##  8 11000000 89-05~ Toro~ ON      CAN   CAN      72   210  2007     2    43 R
##  9   925000 97-07~ Gros~ MI      USA   USA      74   218  2015     1     8 L
## 10 12000000 85-08~ Sica~ BC      CAN   CAN      76   232  2003     2    49 R
## 11   925000 97-12~ Scot~ AZ      USA   USA      74   202  2016     1     6 L
## 12  9000000 84-07~ Minn~ MN      USA   USA      71   196  2003     1    17 L
## 13   925000 95-12~ Oran~ ON      CAN   CAN      74   232  2014     1    10 L
## 14   832500 95-03~ Ste-~ QC      CAN   CAN      71   188  2013     1     3 L
## 15  8000000 85-12~ Mapl~ BC      CAN   CAN      75   200  2004     1     4 L
```

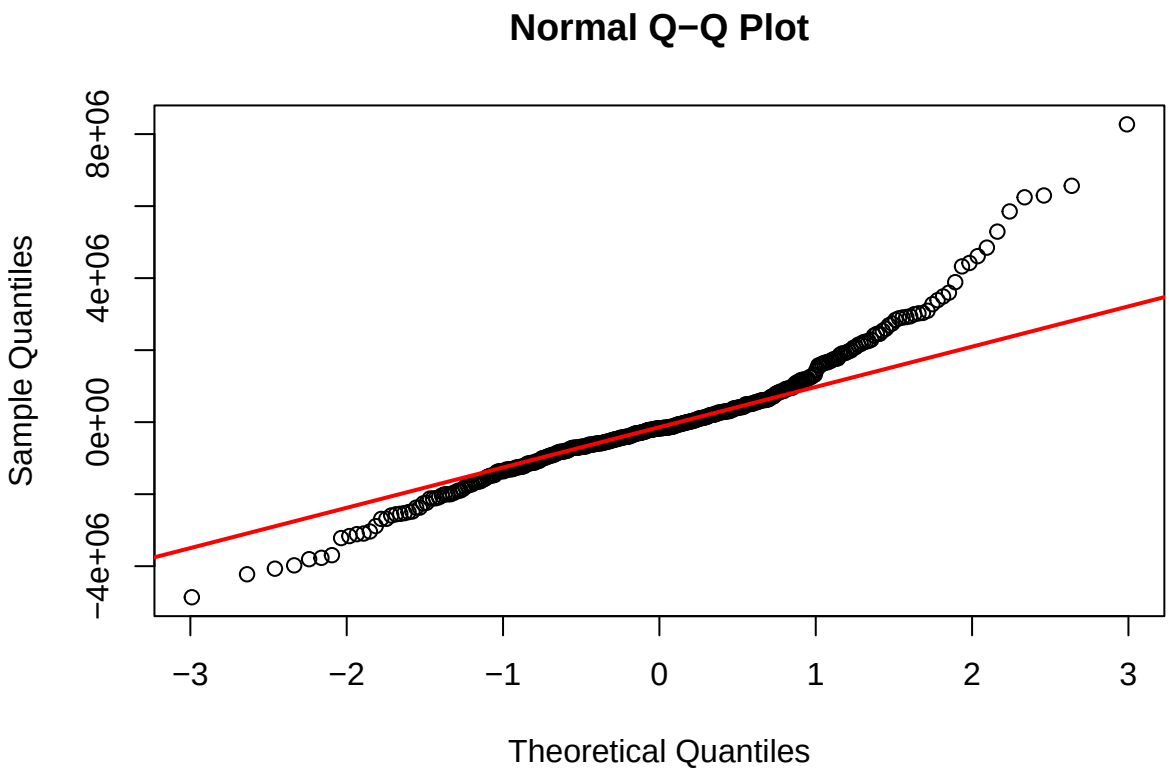
```
## 16  5500000 87-02~ Musk~ MI      USA   USA      74   218  2005     2    42 L
## 17  2000000 92-01~ Newp~ CA      USA   USA      71   187  2010     2    59 L
## 18  8000000 84-06~ Bram~ ON      CAN   CAN      76   212  2002     1     1 L
## 19  8000000 88-04~ St. ~ MN      USA   USA      72   218  2006     1     7 R
## 20  6500000 85-03~ Roch~ NY      USA   USA      70   187  2004     4   127 R
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, iCF...42 <dbl>,
## #   iFF <dbl>, iSF...44 <dbl>, iSF...45 <dbl>, iSF...46 <dbl>, ixG <dbl>, ...
```

```
ggplot(NHL, aes(x = fitted(model3), y = jackknife3)) + geom_point()+ geom_hline(yintercept = t3, col =
```

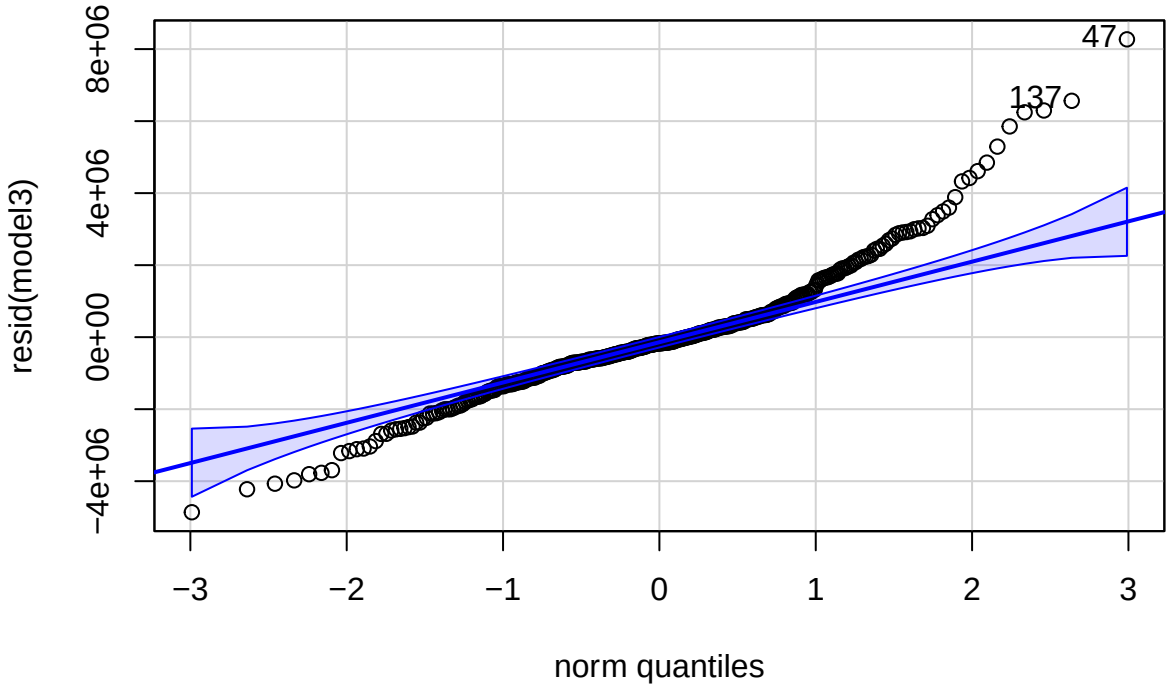
```
## Warning: Removed 1 rows containing missing values (`geom_point()`).
```




```
qqnorm(resid(model3))
qqline(resid(model3), col = "red", lwd = 2)
```




```
qqPlot(resid(model3))
```




```
## [1]  47 137
```

```
skewness(jackknife3)
```

```
## [1] NaN
```

```
kurtosis(jackknife3)
```

```
## [1] NaN
```

```
ols_vif_tol(model3)
```

```
##         Variables Tolerance      VIF
## 1              GS 0.9614386 1.040108
## 2              Wt 0.9100763 1.098809
## 3     Position_CD 0.9777502 1.022756
## 4    Position_CLW 0.5847306 1.710189
## 5    Position_CRW 0.7006192 1.427309
## 6  Position_CLWRW 0.7998962 1.250162
## 7      Position_D 0.4282661 2.334997
## 8     Position_LW 0.6719400 1.488228
## 9   Position_LWRW 0.7442691 1.343600
## 10    Position_RW 0.6507281 1.536740
```

```
eigprop(model3)
```

```
##
## Call:
## eigprop(mod = model3)
##
##    Eigenvalues      CI (Intercept)     GS     Wt Position_CD Position_CLW
## 1       3.4957  1.0000      0.0004 0.0255 0.0004      0.0001       0.0063
## 2       1.0242  1.8475      0.0000 0.0128 0.0000      0.0609       0.0471
## 3       1.0001  1.8696      0.0000 0.0000 0.0000      0.4815       0.1409
## 4       1.0000  1.8697      0.0000 0.0000 0.0000      0.0143       0.0220
## 5       1.0000  1.8697      0.0000 0.0000 0.0000      0.0040       0.0001
## 6       1.0000  1.8697      0.0000 0.0000 0.0000      0.1403       0.1071
## 7       1.0000  1.8697      0.0000 0.0000 0.0000      0.0004       0.0534
## 8       1.0000  1.8697      0.0000 0.0000 0.0000      0.2684       0.0416
## 9       0.3833  3.0199      0.0006 0.9293 0.0006      0.0030       0.0486
## 10      0.0942  6.0912      0.0095 0.0325 0.0091      0.0225       0.5226
## 11      0.0025 37.2980      0.9895 0.0000 0.9899      0.0046       0.0102
##    Position_CRW Position_CLWRW Position_D Position_LW Position_LWRW Position_RW
## 1        0.0049         0.0031     0.0080      0.0042        0.0036      0.0048
## 2        0.2018         0.1205     0.0666      0.0401        0.0008      0.0045
## 3        0.0432         0.0249     0.0029      0.0167        0.0612      0.0011
## 4        0.0001         0.0408     0.0556      0.3578        0.0509      0.0187
## 5        0.0403         0.0014     0.0382      0.0000        0.0036      0.4623
## 6        0.0052         0.2489     0.0010      0.0001        0.2076      0.0062
## 7        0.0151         0.1366     0.0000      0.1356        0.3265      0.0034
## 8        0.2580         0.1402     0.0008      0.0082        0.0005      0.0259
## 9        0.0753         0.0463     0.0091      0.0042        0.0159      0.0133
## 10       0.3537         0.2279     0.8096      0.4259        0.3265      0.4585
## 11       0.0025         0.0094     0.0082      0.0073        0.0028      0.0014
##
## ================================
## Row 9==> GS, proportion 0.929275 >= 0.50
## Row 11==> Wt, proportion 0.989877 >= 0.50
## Row 10==> Position_CLW, proportion 0.522633 >= 0.50
## Row 10==> Position_D, proportion 0.809633 >= 0.50
```

```
ols_step_forward_p(model3)
```

```
##
##                                 Selection Summary
## ------------------------------------------------------------------------------------------
##         Variable                        Adj.
## Step       Entered        R-Square    R-Square     C(p)         AIC            RMSE
## ------------------------------------------------------------------------------------------
##    1    GS                  0.4540      0.4525    20.9978    11365.1352    1801945.3109
##    2    Wt                  0.4811      0.4781     4.3585    11348.8823    1759179.4048
##    3    Position_CLW        0.4889      0.4846     0.9425    11345.3998    1748254.9274
##    4    Position_RW         0.4922      0.4865     0.6642    11345.0682    1745046.4442
##    5    Position_CLWRW      0.4938      0.4866     1.5845    11345.9580    1744816.4395
## ------------------------------------------------------------------------------------------
```

```
ols_step_backward_p(model3)
```

```
##
##
##                                 Elimination Summary
## ----------------------------------------------------------------------------------------
##         Variable                      Adj.
## Step       Removed       R-Square    R-Square     C(p)        AIC            RMSE
## ----------------------------------------------------------------------------------------
##    1    Position_LW         0.4946      0.4816    9.0013    11353.3568    1753318.2850
##    2    Position_LWRW       0.4946       0.483    7.0365    11351.3931    1750900.2967
##    3    Position_CD         0.4944      0.4844    5.1376    11349.4975    1748658.4451
##    4    Position_D          0.4941      0.4854    3.4020    11347.7700    1746835.5999
##    5    Position_CRW        0.4938      0.4866    1.5845    11345.9580    1744816.4395
## ----------------------------------------------------------------------------------------
```

```
ols_step_both_p(model3)
```

```
##
##                                  Stepwise Selection Summary
## ----------------------------------------------------------------------------------------------------
##                           Added/                   Adj.
## Step      Variable       Removed     R-Square    R-Square     C(p)         AIC            RMSE
## ----------------------------------------------------------------------------------------------------
##    1         GS          addition       0.454       0.452    20.9980    11365.1352    1801945.3109
##    2         Wt          addition       0.481       0.478     4.3590    11348.8823    1759179.4048
##    3    Position_CLW     addition       0.489       0.485     0.9430    11345.3998    1748254.9274
## ----------------------------------------------------------------------------------------------------
```

```
ols_step_best_subset(model3)
```

```
##                                                Best Subsets Regression
## ----------------------------------------------------------------------------------------------------
## Model Index    Predictors
## ----------------------------------------------------------------------------------------------------
##      1         GS
##      2         GS Wt
##      3         GS Wt Position_CLW
##      4         GS Wt Position_CLW Position_RW
##      5         GS Wt Position_CLW Position_CLWRW Position_RW
##      6         GS Wt Position_CLW Position_CRW Position_CLWRW Position_RW
##      7         GS Wt Position_CLW Position_CRW Position_CLWRW Position_D Position_RW
##      8         GS Wt Position_CD Position_CLW Position_CRW Position_CLWRW Position_D Position_RW
##      9         GS Wt Position_CD Position_CLW Position_CRW Position_CLWRW Position_D Position_LWRW Po
##     10         GS Wt Position_CD Position_CLW Position_CRW Position_CLWRW Position_D Position_LW Posi
## ----------------------------------------------------------------------------------------------------
##
##                                                        Subsets Regression Summary
## ----------------------------------------------------------------------------------------------------
##                        Adj.        Pred
## Model    R-Square    R-Square    R-Square     C(p)         AIC           SBIC          SBC
## ----------------------------------------------------------------------------------------------------
```

```
##   1        0.4540      0.4525       0.446    20.9978    11365.1352    10346.1524    11376.7852    1.1
##   2        0.4811      0.4781      0.4699     4.3585    11348.8823    10330.1120    11364.4156    1.1
##   3        0.4889      0.4846      0.4764     0.9425    11345.3998    10326.7615    11364.8164    1.0
##   4        0.4922      0.4865      0.4767     0.6642    11345.0682    10326.5359    11368.3681    1.0
##   5        0.4938      0.4866      0.4766     1.5845    11345.9580    10327.5169    11373.1412    1.0
##   6        0.4941      0.4854      0.4738     3.4020    11347.7700    10329.3961    11378.8365    1.0
##   7        0.4944      0.4844       0.471     5.1376    11349.4975    10331.1969    11384.4474    1.0
##   8        0.4946      0.4830        -Inf     7.0365    11351.3931    10333.1603    11390.2264    1.1
##   9        0.4946      0.4816        -Inf     9.0013    11353.3568    10335.1891    11396.0734    1.1
##  10        0.4946      0.4801        -Inf    11.0000    11355.3555    10337.2510    11401.9554    1.1
## ----------------------------------------------------------------------------------------------------
## AIC: Akaike Information Criteria
##  SBIC: Sawa's Bayesian Information Criteria
##  SBC: Schwarz Bayesian Criteria
##  MSEP: Estimated error of prediction, assuming multivariate normality
##  FPE: Final Prediction Error
##  HSP: Hocking's Sp
##  APC: Amemiya Prediction Criteria
```

```
model4 <- lm(Salary ~ GS + Wt + iHDf + GP + PM, data = NHL)
model4
```

```
##
## Call:
## lm(formula = Salary ~ GS + Wt + iHDf + GP + PM, data = NHL)
##
## Coefficients:
## (Intercept)           GS           Wt         iHDf           GP           PM
##    -4287614        85185        25692         2733        -7517       -10305
```

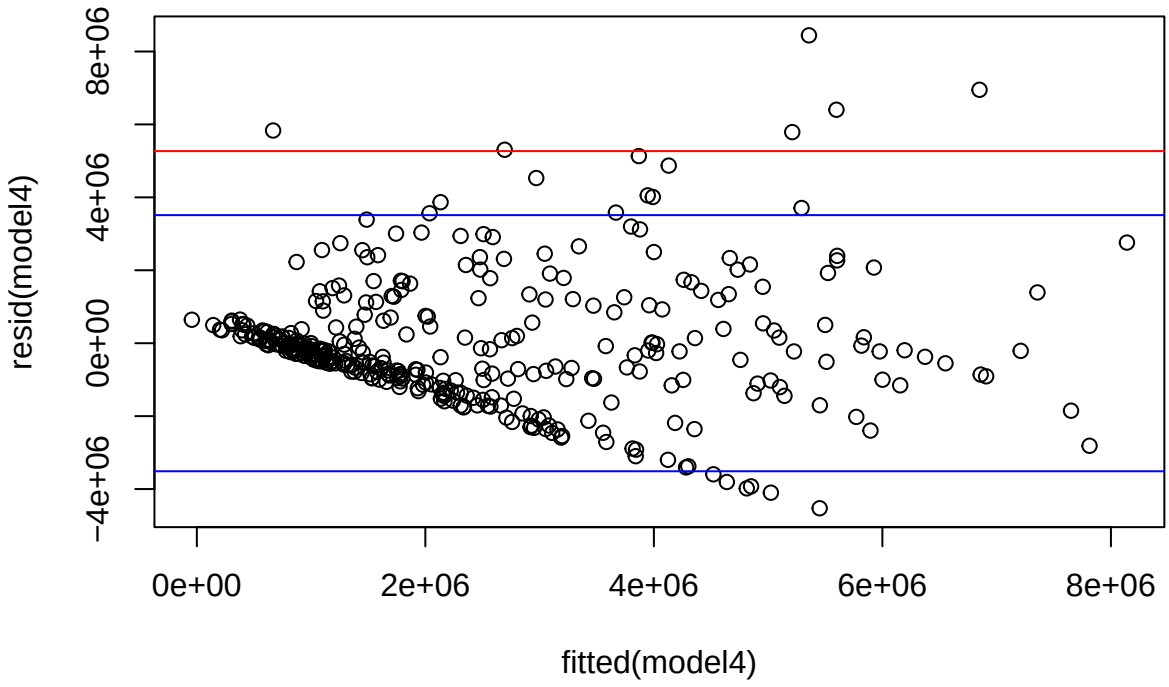
```
standard_error4 <- sqrt(deviance(model4)/df.residual(model4))
standard_error4
```

```
## [1] 1756011
```

```
2*standard_error4
```

```
## [1] 3512022
```

```
plot(fitted(model4),resid(model4))
abline(h=2*standard_error4, col = "blue")
abline(h=-2*standard_error4, col = "blue")
abline(h=3*standard_error4, col = "red")
abline(h=-3*standard_error4, col = "red")
```




```
res_pot_outliers4 <- NHL %>% filter(2*standard_error4 <= abs(resid(model4)) & abs(resid(model4)) < 3*sta
print(res_pot_outliers4)
```

```
## # A tibble: 15 x 162
##     Salary Born    City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##      <dbl> <chr>   <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1  925000 96-10-~ Nort~ MA      USA   USA      74   196  2015     1     2 R
##  2  832500 95-04-~ Lond~ ON      CAN   CAN      72   223  2013     1     9 L
##  3 9000000 87-10-~ Madi~ WI      USA   USA      72   202  2006     1     5 R
##  4 7250000 87-04-~ Mont~ QC      CAN   CAN      72   201  2005     3    62 R
##  5  925000 97-07-~ Gros~ MI      USA   USA      74   218  2015     1     8 L
##  6 7500000 85-04-~ Edmo~ AB      CAN   CAN      75   219  2003     1     9 L
##  7 5600000 83-09-~ Edmo~ AB      CAN   CAN      76   221  2002     1     3 L
##  8 6000000 83-03-~ Kitc~ ON      CAN   CAN      72   202  2002     8   241 R
##  9 9000000 85-01-~ Madi~ WI      USA   USA      74   206  2003     1     7 L
## 10  925000 93-05-~ St. ~ AB      CAN   CAN      78   226  2012     3    86 R
## 11  925000 97-12-~ Scot~ AZ      USA   USA      74   202  2016     1     6 L
## 12 9000000 84-07-~ Minn~ MN      USA   USA      71   196  2003     1    17 L
## 13  832500 95-03-~ Ste-~ QC      CAN   CAN      71   188  2013     1     3 L
## 14 8000000 84-06-~ Bram~ ON      CAN   CAN      76   212  2002     1     1 L
## 15 8000000 88-04-~ St. ~ MN      USA   USA      72   218  2006     1     7 R
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
```

```
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, iCF...42 <dbl>,
## #   iFF <dbl>, iSF...44 <dbl>, iSF...45 <dbl>, iSF...46 <dbl>, ixG <dbl>, ...
```

```
res_outliers4 <- NHL %>% filter(abs(resid(model4)) >= 3*standard_error4)
print(res_outliers4)
```

```
## # A tibble: 6 x 162
##     Salary Born    City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##      <dbl> <chr>   <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
## 1 13800000 88-04-~ Winn~ MB      CAN   CAN      74   201  2006     1     3 L
## 2 13800000 88-11-~ Buff~ NY      USA   USA      71   177  2007     1     1 L
## 3 11000000 89-05-~ Toro~ ON      CAN   CAN      72   210  2007     2    43 R
## 4 12000000 85-08-~ Sica~ BC      CAN   CAN      76   232  2003     2    49 R
## 5  8000000 85-12-~ Mapl~ BC      CAN   CAN      75   200  2004     1     4 L
## 6  6500000 85-03-~ Roch~ NY      USA   USA      70   187  2004     4   127 R
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, iCF...42 <dbl>,
## #   iFF <dbl>, iSF...44 <dbl>, iSF...45 <dbl>, iSF...46 <dbl>, ixG <dbl>, ...
```

```
h4 <- 2*(5+1)/359
h4
```

```
## [1] 0.03342618
```

```
leverage4 <- hatvalues(model4)
sort(round(leverage4,4))
```

```
##    197    335     22     58    342     97    264    243     87     24    353
## 0.0040 0.0040 0.0041 0.0050 0.0050 0.0052 0.0052 0.0053 0.0054 0.0055 0.0055
##     51    253    196    320    156    116    293    183    329    333     71
## 0.0059 0.0059 0.0060 0.0060 0.0062 0.0063 0.0063 0.0067 0.0067 0.0068 0.0069
##    260    285     95    108    319     86    175    134    216    127    207
## 0.0069 0.0069 0.0070 0.0071 0.0071 0.0072 0.0072 0.0073 0.0073 0.0074 0.0074
##    214    304     14     46     73    225    270    174    235    328    347
## 0.0074 0.0074 0.0075 0.0075 0.0075 0.0075 0.0075 0.0076 0.0076 0.0076 0.0076
##     43    208     68    281    161    106    198    247    352     38    194
## 0.0077 0.0077 0.0078 0.0079 0.0080 0.0081 0.0081 0.0081 0.0081 0.0084 0.0085
##    252    314    173    204     49    119    149    180     89    268    336
## 0.0085 0.0085 0.0086 0.0086 0.0087 0.0087 0.0087 0.0088 0.0089 0.0089 0.0089
##    123    133    178    176      7     81    154    249    310     93     85
## 0.0090 0.0090 0.0090 0.0091 0.0093 0.0093 0.0093 0.0093 0.0093 0.0094 0.0096
##      8     50     63    276     21    142    182    226    245    301    261
## 0.0097 0.0097 0.0097 0.0097 0.0098 0.0098 0.0098 0.0098 0.0098 0.0098 0.0099
##    340     18    279      9    280     40    211    236    287    299     29
## 0.0099 0.0100 0.0100 0.0101 0.0101 0.0102 0.0102 0.0102 0.0102 0.0102 0.0103
##    159    223     96    102    332    348    358     15     37    228    290
## 0.0103 0.0104 0.0105 0.0105 0.0105 0.0105 0.0105 0.0106 0.0106 0.0106 0.0106
```

```
##     48    227    256    141    213    300    354     31    255    274     53
## 0.0108 0.0108 0.0108 0.0109 0.0109 0.0110 0.0110 0.0111 0.0111 0.0111 0.0112
##    195    338      5    164    305    150    295     78    107    289    325
## 0.0112 0.0112 0.0113 0.0113 0.0113 0.0114 0.0114 0.0115 0.0115 0.0115 0.0115
##    104    201    206    112    117    251    265    139    165     79    330
## 0.0116 0.0117 0.0117 0.0118 0.0118 0.0118 0.0118 0.0119 0.0119 0.0120 0.0120
##    124    155    238    115    331     27    187    189    297    298     20
## 0.0121 0.0121 0.0121 0.0122 0.0122 0.0123 0.0123 0.0123 0.0123 0.0124 0.0125
##    128     72    138     17    277     30    283    296      2    241    263
## 0.0125 0.0126 0.0126 0.0127 0.0127 0.0128 0.0128 0.0128 0.0129 0.0129 0.0129
##    341     32     35     45    184    351     19    217    257     74     83
## 0.0129 0.0131 0.0131 0.0131 0.0132 0.0132 0.0133 0.0133 0.0133 0.0134 0.0134
##    323    345    145    239    118    185    288     26    169    172    234
## 0.0134 0.0134 0.0135 0.0135 0.0136 0.0136 0.0136 0.0137 0.0137 0.0138 0.0139
##     91     80    303     39     64    114    179    203    199     11     65
## 0.0140 0.0141 0.0141 0.0142 0.0142 0.0142 0.0142 0.0142 0.0143 0.0144 0.0145
##    312    343    218    262    359    109    168    191     28    103    181
## 0.0146 0.0146 0.0148 0.0148 0.0149 0.0150 0.0150 0.0150 0.0151 0.0151 0.0151
##    135      1    209    231    147    171    313    101    113     52     61
## 0.0152 0.0153 0.0153 0.0153 0.0154 0.0154 0.0154 0.0155 0.0156 0.0157 0.0157
##    355     84    258     36     99    126    144     75    242    125    306
## 0.0157 0.0158 0.0158 0.0159 0.0159 0.0160 0.0160 0.0161 0.0162 0.0164 0.0164
##    186    110    222    248     16    286    190    307    212    316     54
## 0.0165 0.0166 0.0167 0.0168 0.0169 0.0170 0.0171 0.0172 0.0173 0.0173 0.0175
##    143    278     62    158    309     67    160     57    250     76     44
## 0.0176 0.0176 0.0178 0.0178 0.0178 0.0179 0.0179 0.0182 0.0183 0.0185 0.0186
##    334     94    272    240     12    308    210     47    291    151    327
## 0.0186 0.0187 0.0187 0.0190 0.0192 0.0192 0.0193 0.0195 0.0197 0.0199 0.0199
##    188     56    294    318    356    266    129    200    267    346     42
## 0.0200 0.0201 0.0202 0.0202 0.0202 0.0204 0.0205 0.0206 0.0208 0.0211 0.0212
##     34    337     13    132    146    224    244    326      4    357    177
## 0.0213 0.0215 0.0216 0.0217 0.0219 0.0219 0.0219 0.0220 0.0221 0.0221 0.0222
##     82    202    130    162    350     60    292    311    166    152    111
## 0.0223 0.0223 0.0225 0.0225 0.0225 0.0228 0.0235 0.0235 0.0237 0.0238 0.0241
##    324    157     90    167    237     92      3     33     77    215    230
## 0.0241 0.0242 0.0243 0.0243 0.0243 0.0249 0.0250 0.0254 0.0257 0.0260 0.0266
##     55      6    100    275    220    205    229    120    232    259    273
## 0.0267 0.0271 0.0272 0.0274 0.0277 0.0280 0.0280 0.0281 0.0282 0.0286 0.0291
##     66    344    153    221    193    269    121    321     69     25    254
## 0.0292 0.0292 0.0293 0.0293 0.0294 0.0297 0.0306 0.0307 0.0311 0.0318 0.0324
##     88    140    233    284     41    339    271    282    322    317    136
## 0.0329 0.0351 0.0355 0.0359 0.0363 0.0367 0.0371 0.0375 0.0378 0.0382 0.0383
##    122    349    246    148    163    131    137    170    302     70     23
## 0.0388 0.0390 0.0398 0.0400 0.0403 0.0419 0.0437 0.0439 0.0458 0.0469 0.0492
##    315    105     10    192     98     59    219
## 0.0495 0.0508 0.0512 0.0530 0.0546 0.0595 0.0648
```

```
leverage_outliers4 <- NHL %>% filter(leverage4 > h4)
leverage_outliers4
```

```
## # A tibble: 28 x 162
##      Salary Born   City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##       <dbl> <chr>  <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1 10900000 87-08~ Cole~ NS      CAN   CAN      71   200  2005     1     1 L
```

```
##  2  2075000 91-12~ St. ~ ON      CAN   CAN      75   226  2010     1    21 L
##  3  8750000 85-07~ Anci~ QC      CAN   CAN      73   195  2003     2    45 R
##  4  5850000 86-04~ Anch~ AK      USA   USA      74   218  2004     2    60 L
##  5  1300000 81-06~ Sudb~ ON      CAN   CAN      71   181  1999     5   128 L
##  6  5000000 88-05~ Hali~ NS      CAN   CAN      69   181  2006     3    71 L
##  7  1300000 89-04~ Otta~ ON      CAN   CAN      69   160  2007     6   179 L
##  8  6000000 84-07~ Plov~ WI      USA   USA      71   190  2003     7   205 R
##  9  6000000 92-01~ Bram~ ON      CAN   CAN      73   200  2010     1     2 R
## 10  3750000 93-07~ Pitt~ PA      USA   USA      70   182  2011     3    64 R
## # i 18 more rows
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, ...
```

```
t4 <- qt(df =  359 - 5 - 2, 0.95)
t4
```

```
## [1] 1.649194
```

```
jackknife4 <- rstudent(model4)
sort(round(jackknife4, 4))
```

```
##     188     277      36      34     291     273     282      96     193     153
## -2.6253 -2.3645 -2.2988 -2.2731 -2.2010 -2.0879 -1.9679 -1.9582 -1.8552 -1.7966
##     166     261      98     343     254     212     354      64      12     205
## -1.6867 -1.6572 -1.6516 -1.5572 -1.5013 -1.4655 -1.4107 -1.4104 -1.3793 -1.3678
##      77     355       5     342      13     167     317     105     141     312
## -1.3605 -1.3524 -1.3311 -1.3147 -1.3030 -1.3029 -1.2703 -1.2445 -1.2374 -1.2011
##     230     136      72      79      69     339     335      53     178     255
## -1.1757 -1.1747 -1.1710 -1.1449 -1.1143 -1.0741 -1.0036 -1.0012 -0.9938 -0.9821
##     118     359     112      51     108     172     198     323     351     256
## -0.9810 -0.9769 -0.9767 -0.9760 -0.9304 -0.9126 -0.9004 -0.8910 -0.8734 -0.8707
##     245      42     151     117      80     154     327     232     242     226
## -0.8557 -0.8531 -0.8319 -0.8262 -0.8235 -0.8014 -0.7888 -0.7806 -0.7805 -0.7781
##      83     303     260     329     258     162     290      90      60      68
## -0.7533 -0.7436 -0.7149 -0.7045 -0.7036 -0.6925 -0.6859 -0.6659 -0.6656 -0.6509
##       4      92      43     270     349     310     220     344     249      25
## -0.6495 -0.6383 -0.6160 -0.6053 -0.5986 -0.5977 -0.5899 -0.5835 -0.5803 -0.5788
##     346     302     353     210     326      33     221     294      63     211
## -0.5788 -0.5728 -0.5686 -0.5607 -0.5594 -0.5573 -0.5519 -0.5501 -0.5486 -0.5478
##       6     301     299     131     239     275      61     330      38      81
## -0.5236 -0.5201 -0.5059 -0.4999 -0.4963 -0.4922 -0.4910 -0.4878 -0.4837 -0.4810
##      73     143     321      75      87     110     223     233     170     106
## -0.4765 -0.4688 -0.4650 -0.4494 -0.4452 -0.4452 -0.4446 -0.4386 -0.4366 -0.4361
##     280     213     307     197      94     337     194     128      58      78
## -0.4279 -0.4177 -0.4079 -0.4077 -0.4014 -0.3933 -0.3924 -0.3891 -0.3828 -0.3799
##     333     243     164      95     276     278     126     130     168     219
## -0.3643 -0.3605 -0.3496 -0.3440 -0.3374 -0.3357 -0.3225 -0.3174 -0.3158 -0.3141
##      76     150     196     334       3     127     132       2     352     285
## -0.3131 -0.3043 -0.3040 -0.2984 -0.2961 -0.2946 -0.2938 -0.2836 -0.2814 -0.2811
```

```
##     345     216     201     322      28     179     123     133      62     314
## -0.2790 -0.2715 -0.2695 -0.2652 -0.2570 -0.2568 -0.2457 -0.2405 -0.2382 -0.2303
##     169     247     122     234     189     336     298       8     246     251
## -0.2267 -0.2188 -0.2166 -0.2156 -0.2154 -0.2133 -0.2126 -0.1986 -0.1932 -0.1926
##      85      17     289      46     295      50     304     324      37     348
## -0.1853 -0.1682 -0.1675 -0.1669 -0.1666 -0.1623 -0.1540 -0.1450 -0.1385 -0.1332
##     292      29     308      19     182     257     207     121     340      18
## -0.1302 -0.1298 -0.1298 -0.1287 -0.1268 -0.1239 -0.1238 -0.1215 -0.1214 -0.1169
##      16     111     206     274      88     236     227     316     296     305
## -0.1156 -0.1118 -0.1114 -0.1097 -0.1090 -0.1027 -0.1016 -0.0949 -0.0925 -0.0923
##     101     338     158     135     263      49      71     113      86      93
## -0.0904 -0.0869 -0.0789 -0.0688 -0.0678 -0.0655 -0.0512 -0.0454 -0.0443 -0.0414
##       7     311     328      27     175      84     103      67     134      32
## -0.0392 -0.0383 -0.0383 -0.0293 -0.0291 -0.0285 -0.0231 -0.0209 -0.0196 -0.0193
##     287      91      82     250     195     202     116     149      40     331
## -0.0187 -0.0157 -0.0094  0.0006  0.0024  0.0068  0.0109  0.0213  0.0279  0.0351
##     183     347      56     159     208     148     142     191     114      21
##  0.0429  0.0471  0.0511  0.0564  0.0584  0.0693  0.0740  0.0803  0.0805  0.0821
##     138     119     115      15      54     225      57      74     144     173
##  0.0824  0.0827  0.0842  0.0859  0.0874  0.0875  0.0932  0.0949  0.1013  0.1028
##     199     181     174     104      11      23      89     155      30      39
##  0.1052  0.1095  0.1135  0.1337  0.1400  0.1400  0.1430  0.1435  0.1541  0.1582
##      26     288     203     145     265     129     177      70      48     204
##  0.1760  0.1900  0.1991  0.2000  0.2027  0.2039  0.2139  0.2230  0.2238  0.2466
##      97     224      35     267     100      52     306       1      65     152
##  0.2590  0.2632  0.2768  0.2852  0.2887  0.2967  0.2987  0.3003  0.3023  0.3133
##     357      66      45     146     313     120     209     252     184     222
##  0.3248  0.3440  0.3543  0.3544  0.3707  0.3713  0.4033  0.4165  0.4283  0.4478
##     156     235     124     341     283     107     214     253     297     248
##  0.4830  0.5103  0.5306  0.5894  0.5959  0.6400  0.6464  0.6550  0.6621  0.6809
##      44     192     262     190      20     318     160     272      55      41
##  0.6942  0.7006  0.7079  0.7231  0.7305  0.7437  0.7531  0.7696  0.7758  0.8076
##     332     356      59     268     102     217     315     286       9     165
##  0.8144  0.8398  0.8427  0.8643  0.8854  0.9058  0.9540  0.9591  0.9725  0.9752
##     147     200     320     269     293     171      31     350     284     241
##  0.9836  1.0004  1.0180  1.0347  1.0911  1.1058  1.1552  1.1636  1.2038  1.2302
##     266     157     125     185     161      14     244     279     140     163
##  1.2435  1.2849  1.3055  1.3271  1.3370  1.3495  1.3609  1.3837  1.3906  1.4293
##      99     180     109     187     237      10     309     240     238      22
##  1.4371  1.4616  1.4683  1.5249  1.5852  1.6171  1.6763  1.6956  1.7183  1.7360
##     215      24     218     231     176     229     139     264     325     319
##  1.7398  1.7879  1.8420  1.9524  2.0585  2.0678  2.1346  2.2200  2.3105  2.3312
##     228     281     271     300     186     358     259     137      47
##  2.6145  2.8114  3.0118  3.0743  3.3727  3.3882  3.7676  4.1387  5.0191
```

```
jackknife_outliers4 <- NHL %>% filter(jackknife4 > t4 | jackknife4 < -t4)
jackknife_outliers4
```

```
## # A tibble: 36 x 162
##      Salary Born   City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##       <dbl> <chr>  <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1  5000000 87-01~ St. ~ MB      CAN   CAN      72   196  2005     5   132 L
##  2  7000000 85-12~ Queb~ QC      CAN   USA      72   202  2005     2    44 L
##  3   925000 96-10~ Nort~ MA      USA   USA      74   196  2015     1     2 R
```

```
##  4   832500 95-04~ Lond~ ON      CAN   CAN      72   223  2013     1     9 L
##  5 13800000 88-04~ Winn~ MB      CAN   CAN      74   201  2006     1     3 L
##  6   875000 93-02~ Vict~ QC      CAN   CAN      73   193  2011     1    26 L
##  7  5000000 88-05~ Hali~ NS      CAN   CAN      69   181  2006     3    71 L
##  8 13800000 88-11~ Buff~ NY      USA   USA      71   177  2007     1     1 L
##  9  9000000 87-10~ Madi~ WI      USA   USA      72   202  2006     1     5 R
## 10   742500 94-05~ Denv~ CO      USA   USA      74   205  2012     4   120 L
## # i 26 more rows
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, ...
```

```
cookCV4 <- 4/359
cookCV4
```

```
## [1] 0.01114206
```

```
cook4 <- cooks.distance(model4)
sort(round(cook4, 4))
```

```
##      7     11     15     16     18     19     21     27     29     32     37
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##     40     46     49     50     54     56     57     67     71     74     82
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##     84     86     89     91     93    101    103    104    113    114    115
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    116    119    134    135    138    142    144    148    149    155    158
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    159    173    174    175    181    182    183    191    195    199    202
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    206    207    208    225    227    236    250    257    263    274    287
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    296    304    305    311    316    328    331    338    340    347    348
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##      8     17     26     30     39     48     58     85     88     95     97
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##    111    121    123    127    129    133    145    169    189    196    197
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##    201    203    204    216    234    243    247    251    265    285    288
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##    289    292    295    298    308    314    324    336    352      1      2
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0002 0.0002
##     23     28     35     52     62     65     87    150    156    164    177
## 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002
##    179    194    252    276    306    333    345     38     45     73     76
## 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0003 0.0003 0.0003 0.0003
##     78    106    122    126    128    132    168    213    223    224    235
## 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003
##    246    267    278    280    334    353      3     70     81    100    130
## 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0004 0.0004 0.0004 0.0004 0.0004
```

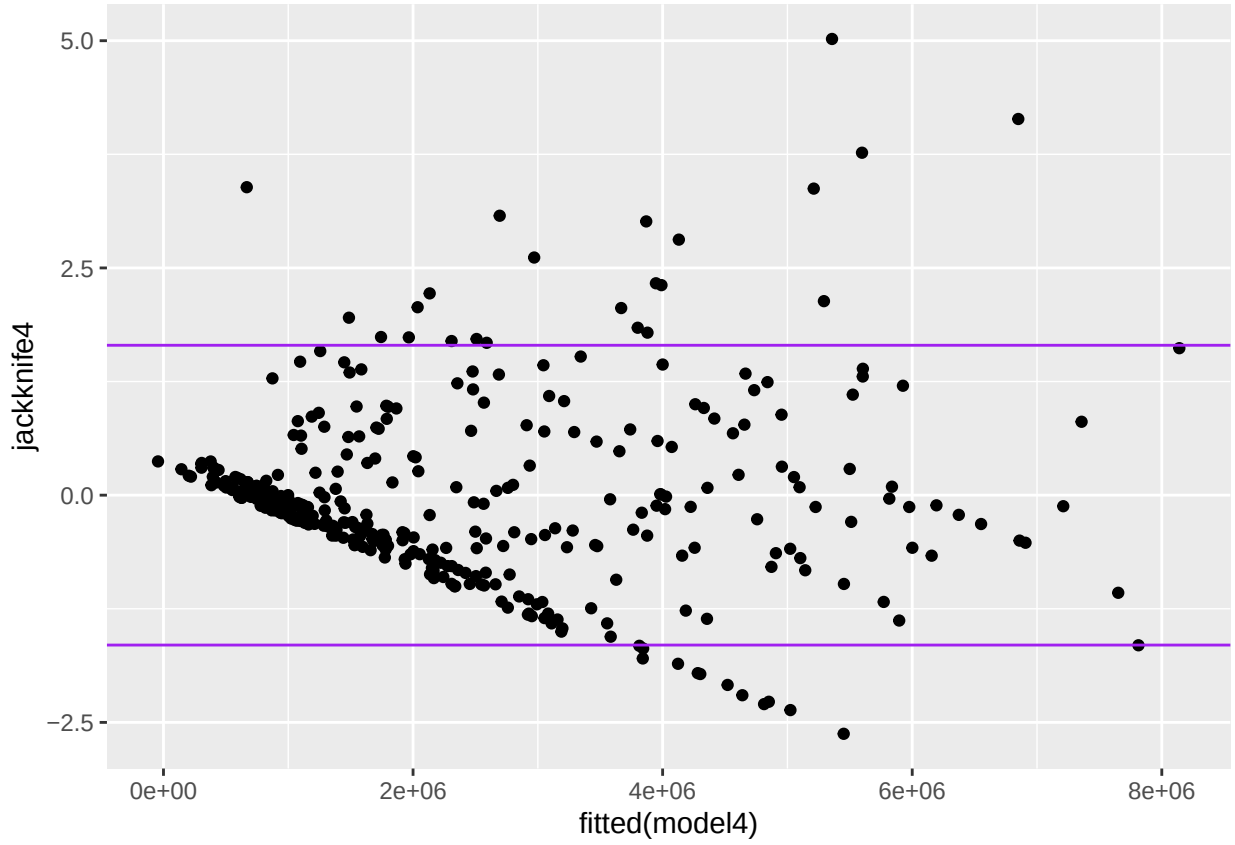
```
##    152    184    209    253    299    301    313    357     43     63     94
## 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004 0.0005 0.0005 0.0005
##    146    211    214    249    270    307    322    330     61     66     68
## 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0006 0.0006 0.0006
##     75    110    124    222    239    260    310    329    337    120    143
## 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0007 0.0007
##    335    107    283    290    341     51    297    108    154    210    226
## 0.0007 0.0008 0.0008 0.0008 0.0008 0.0009 0.0009 0.0010 0.0010 0.0010 0.0010
##    294    320     20    198    219    268    275    321    233    245    326
## 0.0010 0.0010 0.0011 0.0011 0.0011 0.0011 0.0011 0.0011 0.0012 0.0012 0.0012
##    332    346      6     83    248    258    262    293    303     33    102
## 0.0012 0.0012 0.0013 0.0013 0.0013 0.0013 0.0013 0.0013 0.0013 0.0014 0.0014
##    117    256    342     44    170    178    190    221      4      9     80
## 0.0014 0.0014 0.0014 0.0015 0.0015 0.0015 0.0015 0.0015 0.0016 0.0016 0.0016
##     60     92    160    220    242    344    351     25     90    131    162
## 0.0017 0.0017 0.0017 0.0017 0.0017 0.0017 0.0017 0.0018 0.0018 0.0018 0.0018
##    217    255    323     53    112    165    172    272    318     22    327
## 0.0018 0.0018 0.0018 0.0019 0.0019 0.0019 0.0019 0.0019 0.0019 0.0020 0.0021
##    118     14    151    161    349    356    359     31    147     42     79
## 0.0022 0.0023 0.0023 0.0024 0.0024 0.0024 0.0024 0.0025 0.0025 0.0026 0.0026
##    302    286     55    141     24     72    232    180    171    279    241
## 0.0026 0.0027 0.0028 0.0028 0.0029 0.0029 0.0030 0.0031 0.0032 0.0032 0.0033
##      5    200    312    354     41    185    264    192    261    125     64
## 0.0034 0.0035 0.0036 0.0037 0.0041 0.0041 0.0042 0.0046 0.0046 0.0047 0.0048
##    187    355    350    266     99    109    269    343    238     12     13
## 0.0048 0.0049 0.0052 0.0053 0.0055 0.0055 0.0055 0.0059 0.0060 0.0062 0.0062
##    212    230    176    319     69     96    157    244    167    339     59
## 0.0063 0.0063 0.0064 0.0064 0.0066 0.0067 0.0068 0.0069 0.0070 0.0073 0.0075
##    315     77    218    309    139    205    284    136    240    231    281
## 0.0079 0.0081 0.0084 0.0084 0.0090 0.0090 0.0090 0.0092 0.0092 0.0098 0.0102
##    325    237    317    166    140    277    228    254    215    105     36
## 0.0102 0.0104 0.0107 0.0115 0.0117 0.0118 0.0120 0.0125 0.0134 0.0138 0.0141
##    163    291    153    300    193     34    358    229    273    188     10
## 0.0143 0.0160 0.0162 0.0171 0.0173 0.0185 0.0197 0.0203 0.0216 0.0231 0.0234
##    282     98    186    271    259     47    137
## 0.0249 0.0261 0.0308 0.0570 0.0670 0.0782 0.1247
```

```
cook_outliers4 <- NHL %>% filter(cook4 > cookCV4)
cook_outliers4
```

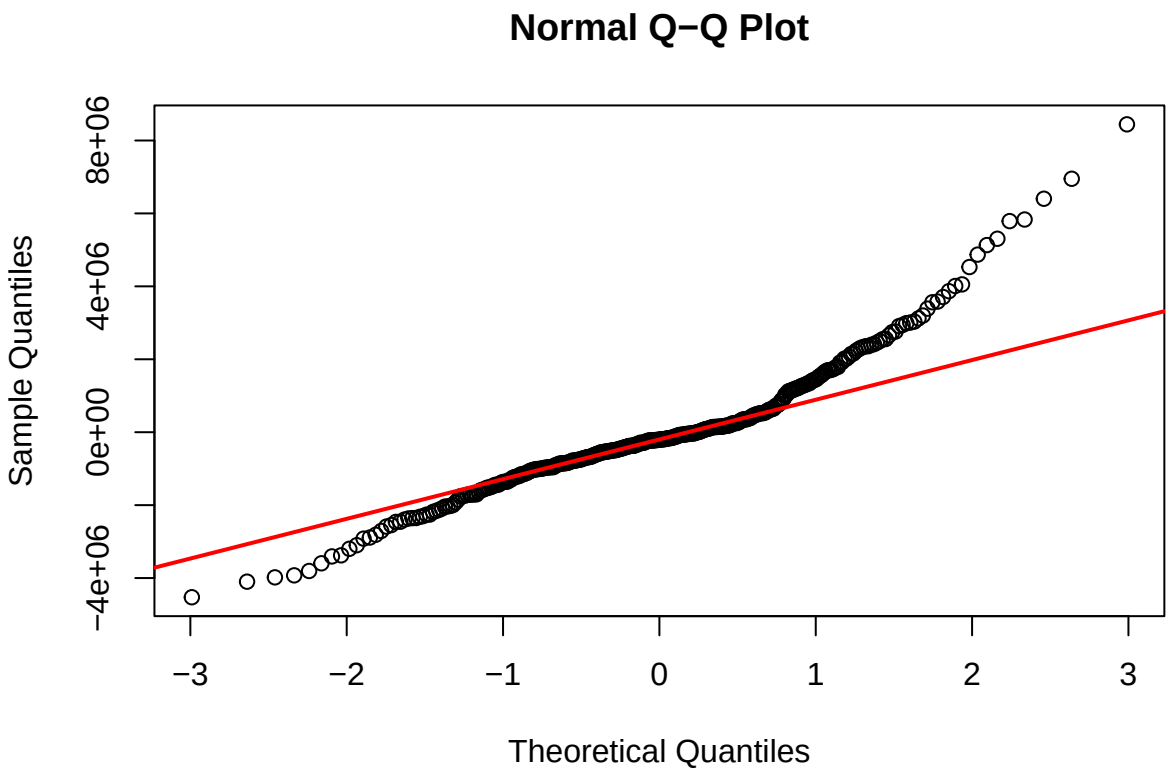
```
## # A tibble: 26 x 162
##      Salary Born   City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##       <dbl> <chr>  <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1 10900000 87-08~ Cole~ NS      CAN   CAN      71   200  2005     1     1 L
##  2   925000 96-10~ Nort~ MA      USA   USA      74   196  2015     1     2 R
##  3   832500 95-04~ Lond~ ON      CAN   CAN      72   223  2013     1     9 L
##  4 13800000 88-04~ Winn~ MB      CAN   CAN      74   201  2006     1     3 L
##  5  5000000 88-05~ Hali~ NS      CAN   CAN      69   181  2006     3    71 L
##  6  1300000 89-04~ Otta~ ON      CAN   CAN      69   160  2007     6   179 L
##  7 13800000 88-11~ Buff~ NY      USA   USA      71   177  2007     1     1 L
##  8  8000000 84-05~ Minn~ MN      USA   USA      75   221  2003     2    62 R
##  9   742500 94-05~ Denv~ CO      USA   USA      74   205  2012     4   120 L
## 10  5500000 80-09~ San ~ CA      USA   USA      75   219  2000     1    18 L
## # i 16 more rows
```

```
## # i 150 more variables: 'Last Name' <chr>, 'First Name' <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, 'E+/-' <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   'TOI/GP...29' <dbl>, 'TOI/GP...30' <dbl>, 'TOI%' <dbl>, 'IPP%' <dbl>,
## #   'SH%' <dbl>, 'SV%' <dbl>, PDO <dbl>, 'F/60' <dbl>, 'A/60' <dbl>,
## #   'Pct%' <dbl>, Diff <dbl>, 'Diff/60' <dbl>, iCF...41 <dbl>, ...
```

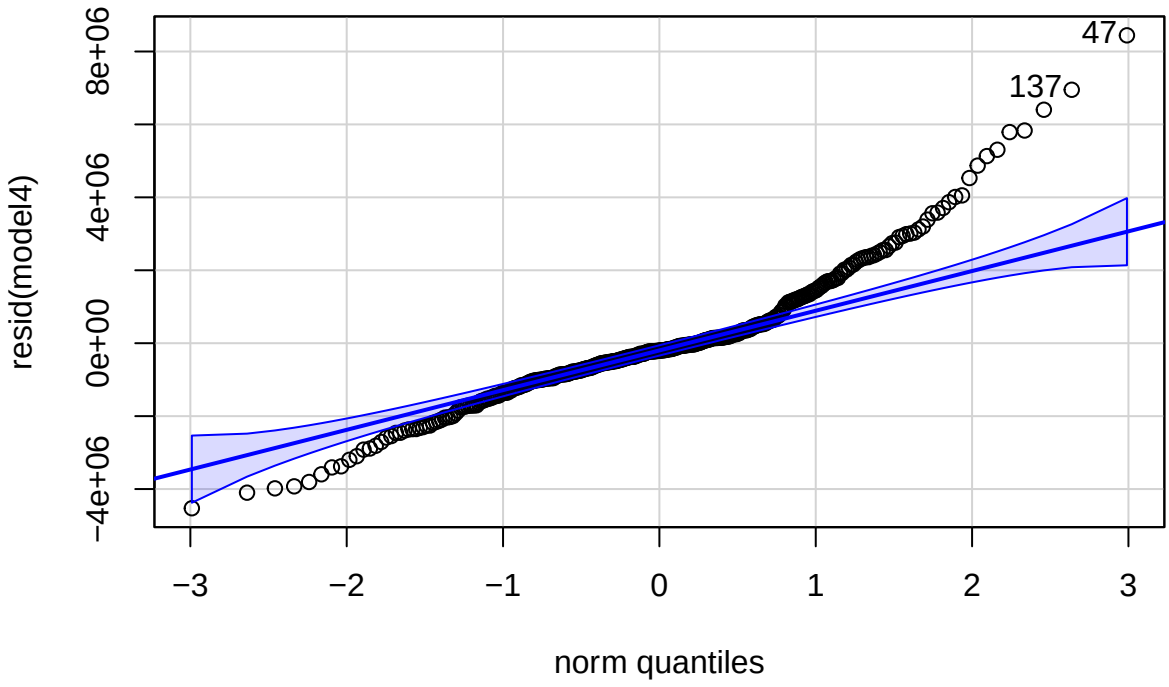
```
ggplot(NHL, aes(x = fitted(model4), y = jackknife4)) + geom_point()+ geom_hline(yintercept = t4, col =
```




```
qqnorm(resid(model4))
qqline(resid(model4), col = "red", lwd = 2)
```




```
qqPlot(resid(model4))
```




```
## [1]  47 137
```

```
skewness(jackknife4)
```

```
## [1] 1.105766
```

```
kurtosis(jackknife4)
```

```
## [1] 6.239913
```

```
ols_vif_tol(model4)
```

```
##   Variables Tolerance      VIF
## 1        GS 0.3994503 2.503440
## 2        Wt 0.8671789 1.153165
## 3      iHDf 0.7841169 1.275320
## 4        GP 0.4441506 2.251489
## 5        PM 0.8817350 1.134128
```

```
eigprop(model4)
```

```
##
```

```
## Call:
## eigprop(mod = model4)
##
##   Eigenvalues      CI (Intercept)     GS     Wt   iHDf     GP     PM
## 1      3.5545  1.0000      0.0004 0.0115 0.0003 0.0011 0.0073 0.0001
## 2      1.2219  1.7056      0.0000 0.0096 0.0000 0.2745 0.0000 0.3532
## 3      0.8338  2.0647      0.0000 0.0001 0.0000 0.4912 0.0000 0.4881
## 4      0.3185  3.3405      0.0030 0.2870 0.0029 0.0521 0.0193 0.1237
## 5      0.0690  7.1774      0.0024 0.6914 0.0022 0.0752 0.9719 0.0286
## 6      0.0024 38.5510      0.9942 0.0004 0.9946 0.1059 0.0015 0.0064
##
## ================================
## Row 5==> GS, proportion 0.691449 >= 0.50
## Row 6==> Wt, proportion 0.994554 >= 0.50
## Row 5==> GP, proportion 0.971910 >= 0.50
```

```
ols_step_forward_p(model4)
```

```
##
##                                Selection Summary
## ------------------------------------------------------------------------------------
##         Variable                  Adj.
## Step    Entered     R-Square    R-Square     C(p)          AIC             RMSE
## ------------------------------------------------------------------------------------
##    1    GS             0.4540      0.4525    20.9212    11365.1352    1801945.3109
##    2    Wt             0.4811      0.4781     4.2858    11348.8823    1759179.4048
##    3    GP             0.4829      0.4786     4.9834    11349.5713    1758441.6609
##    4    iHDf           0.4856      0.4798     5.1791    11349.7471    1756455.3684
##    5    PM             0.4873      0.4800     6.0000    11350.5500    1756011.1787
## ------------------------------------------------------------------------------------
```

```
ols_step_backward_p(model4)
```

```
## [1] "No variables have been removed from the model."
```

```
ols_step_both_p(model4)
```

```
##
##                                  Stepwise Selection Summary
## ------------------------------------------------------------------------------------------------
##                       Added/                   Adj.
## Step    Variable     Removed     R-Square    R-Square     C(p)          AIC             RMSE
## ------------------------------------------------------------------------------------------------
##    1       GS       addition       0.454       0.452    20.9210    11365.1352    1801945.3109
##    2       Wt       addition       0.481       0.478     4.2860    11348.8823    1759179.4048
## ------------------------------------------------------------------------------------------------
```

```
ols_step_best_subset(model4)
```

```
##     Best Subsets Regression
## --------------------------------
```

```
## Model Index    Predictors
## ------------------------------
##      1         GS
##      2         GS Wt
##      3         GS Wt GP
##      4         GS Wt iHDf GP
##      5         GS Wt iHDf GP PM
## ------------------------------
##
##                                                                  Subsets Regression Summary
## ----------------------------------------------------------------------------------------------------------------
##                        Adj.        Pred
## Model    R-Square    R-Square    R-Square     C(p)          AIC           SBIC          SBC
## ----------------------------------------------------------------------------------------------------------------
##   1        0.4540      0.4525       0.446    20.9212    11365.1352    10346.1533    11376.7852    1.
##   2        0.4811      0.4781      0.4699     4.2858    11348.8823    10330.1132    11364.4156    1.
##   3        0.4829      0.4786      0.4696     4.9834    11349.5713    10330.8411    11368.9879    1.
##   4        0.4856      0.4798       0.469     5.1791    11349.7471    10331.0850    11373.0470     1
##   5        0.4873      0.4800      0.4664     6.0000    11350.5500    10331.9555    11377.7332    1.
## ----------------------------------------------------------------------------------------------------------------
## AIC: Akaike Information Criteria
##  SBIC: Sawa's Bayesian Information Criteria
##  SBC: Schwarz Bayesian Criteria
##  MSEP: Estimated error of prediction, assuming multivariate normality
##  FPE: Final Prediction Error
##  HSP: Hocking's Sp
##  APC: Amemiya Prediction Criteria
```

```
model5 <- lm(Salary ~ GS + Wt, data = NHL)
model5
```

```
##
## Call:
## lm(formula = Salary ~ GS + Wt, data = NHL)
##
## Coefficients:
## (Intercept)           GS           Wt
##    -4662102        75325        26773
```

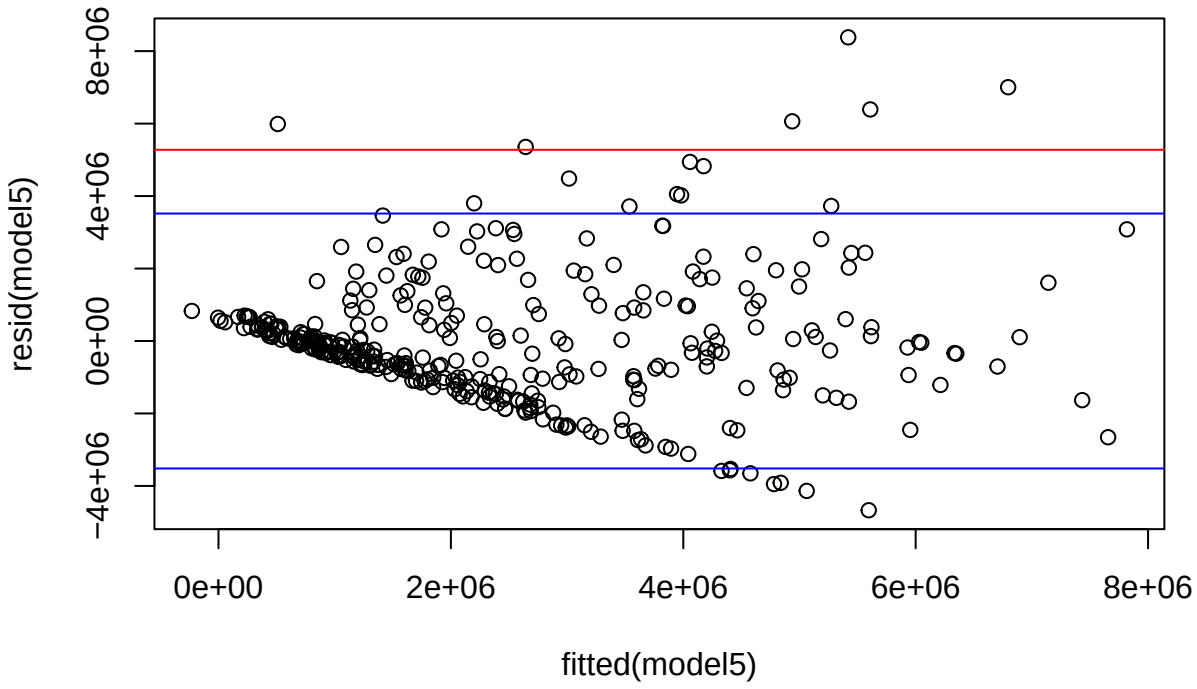
```
standard_error5 <- sqrt(deviance(model5)/df.residual(model5))
standard_error5
```

```
## [1] 1759179
```

```
2*standard_error5
```

```
## [1] 3518359
```

```
plot(fitted(model5),resid(model5))
abline(h=2*standard_error5, col = "blue")
abline(h=-2*standard_error5, col = "blue")
abline(h=3*standard_error5, col = "red")
abline(h=-3*standard_error5, col = "red")
```




```
res_pot_outliers5 <- NHL %>% filter(2*standard_error5 <= abs(resid(model5)) & abs(resid(model5)) < 3*sta
print(res_pot_outliers5)
```

```
## # A tibble: 16 x 162
##      Salary Born    City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##       <dbl> <chr>   <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1  925000 96-10-~ Nort~ MA      USA   USA      74   196  2015     1     2 R
##  2  832500 95-04-~ Lond~ ON      CAN   CAN      72   223  2013     1     9 L
##  3  875000 93-02-~ Vict~ QC      CAN   CAN      73   193  2011     1    26 L
##  4 9000000 87-10-~ Madi~ WI      USA   USA      72   202  2006     1     5 R
##  5  742500 94-05-~ Denv~ CO      USA   USA      74   205  2012     4   120 L
##  6 7250000 87-04-~ Mont~ QC      CAN   CAN      72   201  2005     3    62 R
##  7  925000 97-07-~ Gros~ MI      USA   USA      74   218  2015     1     8 L
##  8 7500000 85-04-~ Edmo~ AB      CAN   CAN      75   219  2003     1     9 L
##  9 6000000 83-03-~ Kitc~ ON      CAN   CAN      72   202  2002     8   241 R
## 10 9000000 85-01-~ Madi~ WI      USA   USA      74   206  2003     1     7 L
## 11  925000 93-05-~ St. ~ AB      CAN   CAN      78   226  2012     3    86 R
## 12  925000 97-12-~ Scot~ AZ      USA   USA      74   202  2016     1     6 L
## 13 9000000 84-07-~ Minn~ MN      USA   USA      71   196  2003     1    17 L
## 14  832500 95-03-~ Ste-~ QC      CAN   CAN      71   188  2013     1     3 L
## 15 8000000 84-06-~ Bram~ ON      CAN   CAN      76   212  2002     1     1 L
## 16 8000000 88-04-~ St. ~ MN      USA   USA      72   218  2006     1     7 R
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
```

```
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, iCF...42 <dbl>,
## #   iFF <dbl>, iSF...44 <dbl>, iSF...45 <dbl>, iSF...46 <dbl>, ixG <dbl>, ...
```

```
res_outliers5 <- NHL %>% filter(abs(resid(model5)) >= 3*standard_error5)
print(res_outliers5)
```

```
## # A tibble: 6 x 162
##     Salary Born    City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##      <dbl> <chr>   <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
## 1 13800000 88-04-~ Winn~ MB      CAN   CAN      74   201  2006     1     3 L
## 2 13800000 88-11-~ Buff~ NY      USA   USA      71   177  2007     1     1 L
## 3 11000000 89-05-~ Toro~ ON      CAN   CAN      72   210  2007     2    43 R
## 4 12000000 85-08-~ Sica~ BC      CAN   CAN      76   232  2003     2    49 R
## 5  8000000 85-12-~ Mapl~ BC      CAN   CAN      75   200  2004     1     4 L
## 6  6500000 85-03-~ Roch~ NY      USA   USA      70   187  2004     4   127 R
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, iCF...42 <dbl>,
## #   iFF <dbl>, iSF...44 <dbl>, iSF...45 <dbl>, iSF...46 <dbl>, ixG <dbl>, ...
```

```
h5 <- 2*(2+1)/359
h5
```

```
## [1] 0.01671309
```

```
leverage5 <- hatvalues(model5)
sort(round(leverage5,4))
```

```
##     51    151    249    316     83    213    238    264    300    351    215
## 0.0028 0.0028 0.0028 0.0028 0.0029 0.0029 0.0029 0.0029 0.0029 0.0029 0.0030
##    335    347     43     73     94    232    254    303    344    226    252
## 0.0030 0.0030 0.0031 0.0031 0.0031 0.0031 0.0031 0.0031 0.0031 0.0032 0.0032
##    185    241    279    294    312     22    197    260    293      5     20
## 0.0033 0.0033 0.0033 0.0033 0.0033 0.0034 0.0034 0.0034 0.0034 0.0035 0.0035
##    107    118    146    164    191    272     79    194    255    270    353
## 0.0035 0.0035 0.0035 0.0035 0.0035 0.0035 0.0036 0.0036 0.0036 0.0036 0.0036
##    214    225    247    290    301    318    230     38    256    237      3
## 0.0037 0.0037 0.0037 0.0037 0.0037 0.0037 0.0038 0.0039 0.0039 0.0040 0.0041
##     63    127    148    174    176    198     58    108    231    245     28
## 0.0041 0.0041 0.0041 0.0041 0.0041 0.0041 0.0042 0.0042 0.0042 0.0042 0.0043
##     40     44     95    169    333      2    205    211    156    250    320
## 0.0043 0.0043 0.0044 0.0044 0.0044 0.0045 0.0045 0.0045 0.0046 0.0046 0.0046
##    342     24    135    196    253    310    180    184    243     78     14
## 0.0046 0.0047 0.0047 0.0047 0.0047 0.0047 0.0048 0.0048 0.0048 0.0049 0.0050
##     69     97    133    167    209    222    285     39     62    207    217
## 0.0050 0.0050 0.0050 0.0050 0.0050 0.0050 0.0050 0.0051 0.0051 0.0051 0.0051
##    227    350     29     68     87    261    314      8     86    116    276
```

```
## 0.0051 0.0051 0.0052 0.0052 0.0053 0.0053 0.0053 0.0054 0.0054 0.0054 0.0054
##    336    128    328      7     75    123    295    326    343    201    223
## 0.0054 0.0055 0.0055 0.0056 0.0056 0.0056 0.0056 0.0056 0.0056 0.0057 0.0057
##    263    271    304    319    119    286     37     71    142    166    183
## 0.0057 0.0057 0.0057 0.0057 0.0058 0.0058 0.0059 0.0059 0.0059 0.0059 0.0059
##    208    297    298    329    332    338    340      4    112    251    357
## 0.0059 0.0059 0.0059 0.0059 0.0059 0.0059 0.0059 0.0060 0.0060 0.0060 0.0060
##     93     99    173    189    216    234    274    305    348     16     46
## 0.0061 0.0061 0.0061 0.0061 0.0061 0.0061 0.0061 0.0061 0.0061 0.0062 0.0062
##     67    153    202    236    287    309    150    182    195     18    175
## 0.0062 0.0062 0.0062 0.0062 0.0062 0.0062 0.0063 0.0063 0.0063 0.0064 0.0064
##    228    280    281     17     56    283    330     88    155    163    299
## 0.0064 0.0064 0.0064 0.0065 0.0065 0.0065 0.0065 0.0066 0.0066 0.0066 0.0066
##     49    134    190    257    141     50     81    233    289    352     89
## 0.0067 0.0067 0.0067 0.0067 0.0068 0.0069 0.0069 0.0069 0.0069 0.0069 0.0070
##    103    178    179    331     27     85     15     21    104    124    165
## 0.0070 0.0070 0.0070 0.0070 0.0071 0.0071 0.0072 0.0072 0.0072 0.0072 0.0072
##    168    235    258    268    325    345     66    355     32     55     74
## 0.0072 0.0072 0.0072 0.0072 0.0072 0.0072 0.0073 0.0073 0.0074 0.0074 0.0074
##    159    161    229    288     26     48    204    219     53     59    106
## 0.0074 0.0074 0.0074 0.0074 0.0075 0.0075 0.0075 0.0075 0.0076 0.0076 0.0076
##    126    145    149    154    158    138    248     60    239    354    358
## 0.0077 0.0078 0.0079 0.0079 0.0079 0.0080 0.0080 0.0081 0.0081 0.0081 0.0081
##    152    244    315    206    115    147    262     34    113    275     96
## 0.0082 0.0082 0.0082 0.0083 0.0084 0.0084 0.0084 0.0086 0.0086 0.0086 0.0087
##     91    186    143    160    162    199    265    296     19     30    220
## 0.0089 0.0089 0.0090 0.0090 0.0090 0.0090 0.0092 0.0092 0.0093 0.0093 0.0093
##    266      9     64     72    187     11     70     76     35     42    172
## 0.0093 0.0094 0.0094 0.0094 0.0094 0.0095 0.0095 0.0095 0.0096 0.0096 0.0097
##    200    277    313    102    356    181    117    242    269    349     52
## 0.0097 0.0098 0.0098 0.0099 0.0100 0.0101 0.0102 0.0103 0.0103 0.0103 0.0104
##     31     84     61    110    132    334    341    291    139    218     23
## 0.0105 0.0105 0.0106 0.0106 0.0106 0.0106 0.0106 0.0107 0.0110 0.0111 0.0112
##    302     65    308    346    114    317    359     36    306    322    203
## 0.0112 0.0114 0.0114 0.0114 0.0115 0.0115 0.0115 0.0116 0.0117 0.0117 0.0118
##    210    246    100    307    323     47    125    240     80    109    140
## 0.0118 0.0118 0.0119 0.0119 0.0119 0.0120 0.0120 0.0120 0.0124 0.0124 0.0125
##      1     45    212    292    193    278    273    188    171    101     57
## 0.0126 0.0126 0.0126 0.0126 0.0128 0.0129 0.0132 0.0136 0.0137 0.0139 0.0143
##    144    170    337    282    311     12     54    129    267    157     82
## 0.0143 0.0143 0.0146 0.0147 0.0147 0.0148 0.0148 0.0155 0.0157 0.0158 0.0159
##    111    327     25     92    177    130     33    131    224     90    324
## 0.0166 0.0166 0.0167 0.0180 0.0183 0.0184 0.0185 0.0189 0.0190 0.0194 0.0194
##    136    259    122    221      6    321     13    284    121    120    192
## 0.0196 0.0198 0.0202 0.0202 0.0205 0.0210 0.0212 0.0223 0.0225 0.0230 0.0250
##     77     41    339    105     10    137     98
## 0.0255 0.0279 0.0292 0.0294 0.0331 0.0363 0.0424
```

```
leverage_outliers5 <- NHL %>% filter(leverage5 > h5)
leverage_outliers5
```

```
## # A tibble: 26 x 162
##      Salary Born   City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##       <dbl> <chr>  <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
```

```
##  1  6000000 90-09~ Miss~ ON      CAN   CAN      73   211  2009     1     1 L
##  2 10900000 87-08~ Cole~ NS      CAN   CAN      71   200  2005     1     1 L
##  3   667500 96-03~ Calg~ AB      CAN   CAN      70   166  2014     3    79 R
##  4   832500 95-04~ St-L~ QC      CAN   CAN      77   235  2013     1    21 L
##  5  8750000 85-07~ Anci~ QC      CAN   CAN      73   195  2003     2    45 R
##  6  2000000 84-12~ Hing~ MA      USA   USA      78   244  2003     1    26 L
##  7  5000000 91-04~ Boxf~ MA      USA   USA      75   228  2009     1    19 L
##  8  3800000 89-11~ Kitc~ ON      CAN   CAN      72   180  2009     5   130 L
##  9  5000000 88-05~ Hali~ NS      CAN   CAN      69   181  2006     3    71 L
## 10  1300000 89-04~ Otta~ ON      CAN   CAN      69   160  2007     6   179 L
## # i 16 more rows
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, ...
```

```
t5 <- qt(df =  359 - 3 - 2, 0.95)
t5
```

```
## [1] 1.649169
```

```
jackknife5 <- rstudent(model5)
sort(round(jackknife5, 4))
```

```
##     188     277      36     273      34     153     291      96     282     261
## -2.6970 -2.3788 -2.2706 -2.2522 -2.0952 -2.0544 -2.0487 -2.0253 -1.7908 -1.6970
##     193     205     343     166      98     354     355      64     230     317
## -1.6766 -1.6464 -1.5622 -1.5491 -1.5459 -1.5089 -1.4317 -1.4176 -1.4132 -1.4112
##      12      77     254     212      13     342     167     141     105       5
## -1.4070 -1.3847 -1.3613 -1.3515 -1.3409 -1.3284 -1.3267 -1.3177 -1.2535 -1.2323
##      72     312     112     151      53      51     255      69      79     198
## -1.1286 -1.1280 -1.1048 -1.0909 -1.0713 -1.0629 -1.0539 -1.0415 -1.0010 -0.9867
##     335     359     118     245     339      42     323     178     108     136
## -0.9707 -0.9578 -0.9523 -0.9426 -0.9420 -0.9413 -0.9282 -0.9215 -0.9137 -0.8998
##      83      80     226     172     117     232     256     351     303     258
## -0.8834 -0.8756 -0.8729 -0.8728 -0.8574 -0.8317 -0.8313 -0.8229 -0.8188 -0.8141
##     154     327     260     329     233     346     294      43     249      25
## -0.7907 -0.7781 -0.7775 -0.7591 -0.7520 -0.7395 -0.7236 -0.7134 -0.7113 -0.6948
##      68     270     321      75      94     242     330     353      61     290
## -0.6940 -0.6518 -0.6497 -0.6458 -0.6440 -0.6437 -0.6310 -0.6260 -0.6253 -0.6231
##      63     210      92     310     213     326      33       4     162     239
## -0.6146 -0.6109 -0.6103 -0.6039 -0.5982 -0.5922 -0.5822 -0.5809 -0.5794 -0.5764
##     349      38     128      90      73     307     344     211      81     221
## -0.5695 -0.5569 -0.5537 -0.5385 -0.5334 -0.5260 -0.5213 -0.5189 -0.4972 -0.4783
##     106     220     299     110      88     333      87      60     302      62
## -0.4668 -0.4631 -0.4610 -0.4537 -0.4395 -0.4384 -0.4367 -0.4338 -0.4162 -0.4080
##       6     246     197     275      78     143     164     223     234      58
## -0.4040 -0.4012 -0.3940 -0.3918 -0.3899 -0.3888 -0.3819 -0.3781 -0.3769 -0.3739
##     243     127     301      28       2     170     194     337     276      17
## -0.3716 -0.3704 -0.3675 -0.3669 -0.3579 -0.3500 -0.3500 -0.3499 -0.3241 -0.3215
##     352     148     280     216     278     247     135      16      95     150
```

```
## -0.3166 -0.3101 -0.2999 -0.2966 -0.2878 -0.2877 -0.2607 -0.2582 -0.2572 -0.2481
##     126     196     169      76     123     168     334     324     133     285
## -0.2449 -0.2401 -0.2393 -0.2359 -0.2315 -0.2297 -0.2293 -0.2290 -0.2280 -0.2208
##      85     345     131     158     130     202     201     304     179     314
## -0.2121 -0.2067 -0.2003 -0.1998 -0.1915 -0.1878 -0.1870 -0.1848 -0.1802 -0.1780
##      46     336     101       3      19     227     132     250     189     219
## -0.1761 -0.1716 -0.1695 -0.1593 -0.1562 -0.1531 -0.1501 -0.1412 -0.1366 -0.1364
##       8      91     251     298      50     311      82     289     295      29
## -0.1318 -0.1183 -0.1160 -0.1133 -0.1082 -0.1030 -0.0884 -0.0875 -0.0854 -0.0682
##      18     207     348      84     328      37     191     296     182     236
## -0.0660 -0.0651 -0.0606 -0.0590 -0.0583 -0.0536 -0.0483 -0.0469 -0.0452 -0.0423
##     340      49     116     274     206     111     257      86     122     134
## -0.0381 -0.0363 -0.0358 -0.0314 -0.0288 -0.0276 -0.0276 -0.0226 -0.0166 -0.0146
##     305     142     316     195     322     338      71     113     103      39
## -0.0131 -0.0052 -0.0018 -0.0003  0.0053  0.0079  0.0085  0.0173  0.0182  0.0185
##     175       7     208     263     308      93      56     174      40     287
##  0.0198  0.0201  0.0277  0.0277  0.0310  0.0329  0.0415  0.0415  0.0456  0.0463
##      23      67     121     225     149      54      27     183      89     292
##  0.0478  0.0521  0.0603  0.0617  0.0624  0.0633  0.0636  0.0704  0.0709  0.0769
##      32     347     173     331     144     159     119     114      21      15
##  0.0789  0.0849  0.1061  0.1097  0.1112  0.1216  0.1380  0.1453  0.1582  0.1625
##     203     138     146     115     199      74     181      48     265      57
##  0.1672  0.1721  0.1751  0.1804  0.1866  0.1894  0.2031  0.2130  0.2145  0.2176
##      66      11     155     104      30     222     204     184      97      70
##  0.2192  0.2234  0.2239  0.2297  0.2460  0.2481  0.2567  0.2631  0.2644  0.2672
##      26     288     224     129     145     177     313     100     267     209
##  0.2679  0.2740  0.2849  0.2966  0.3022  0.3195  0.3419  0.3444  0.3683  0.3731
##      35       1      65      45      52     252     306     357     192     120
##  0.3746  0.3790  0.3790  0.3876  0.3881  0.3976  0.3999  0.4235  0.4428  0.4765
##     156     235     152     214     341     297     283     272     190     262
##  0.4803  0.4846  0.5150  0.5240  0.5266  0.5267  0.5473  0.5550  0.5579  0.5649
##     107      20     248     253     124     217      44     356     269     318
##  0.5666  0.5918  0.6289  0.6351  0.6649  0.7164  0.7343  0.7514  0.7675  0.7827
##     268     160     200     102      41     332     320      59     315      55
##  0.7997  0.8222  0.8303  0.8589  0.9268  0.9420  0.9603  0.9744  0.9959  0.9987
##       9     165     147     293     286     157     185      31     266     171
##  1.0169  1.0299  1.0434  1.0504  1.0932  1.0976  1.1062  1.1156  1.1301  1.1598
##     241     163     279     350     244      14      99     161     180     125
##  1.1932  1.1980  1.2485  1.2638  1.2968  1.3223  1.3281  1.3690  1.3732  1.3907
##     284     215     109     237     140     187     238     240     229      22
##  1.4013  1.4838  1.4868  1.5133  1.6129  1.6202  1.6862  1.7345  1.7537  1.7597
##     309      10      24     218     231     176     139     264     319     325
##  1.7804  1.7870  1.8182  1.8203  1.9796  2.1257  2.1410  2.1746  2.3046  2.3268
##     228     271     281     300     358     186     259     137      47
##  2.5769  2.7764  2.8463  3.0856  3.4714  3.5166  3.7355  4.1471  4.9483
```

```
jackknife_outliers5 <- NHL %>% filter(jackknife5 > t5 | jackknife5 < -t5)
jackknife_outliers5
```

```
## # A tibble: 34 x 162
##      Salary Born   City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##       <dbl> <chr>  <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1 10900000 87-08~ Cole~ NS      CAN   CAN      71   200  2005     1     1 L
##  2  5000000 87-01~ St. ~ MB      CAN   CAN      72   196  2005     5   132 L
```

```
##  3  7000000 85-12~ Queb~ QC      CAN   USA      72   202  2005     2    44 L
##  4   925000 96-10~ Nort~ MA      USA   USA      74   196  2015     1     2 R
##  5   832500 95-04~ Lond~ ON      CAN   CAN      72   223  2013     1     9 L
##  6 13800000 88-04~ Winn~ MB      CAN   CAN      74   201  2006     1     3 L
##  7   875000 93-02~ Vict~ QC      CAN   CAN      73   193  2011     1    26 L
##  8 13800000 88-11~ Buff~ NY      USA   USA      71   177  2007     1     1 L
##  9  9000000 87-10~ Madi~ WI      USA   USA      72   202  2006     1     5 R
## 10   742500 94-05~ Denv~ CO      USA   USA      74   205  2012     4   120 L
## # i 24 more rows
## # i 150 more variables: `Last Name` <chr>, `First Name` <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, `E+/-` <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   `TOI/GP...29` <dbl>, `TOI/GP...30` <dbl>, `TOI%` <dbl>, `IPP%` <dbl>,
## #   `SH%` <dbl>, `SV%` <dbl>, PDO <dbl>, `F/60` <dbl>, `A/60` <dbl>,
## #   `Pct%` <dbl>, Diff <dbl>, `Diff/60` <dbl>, iCF...41 <dbl>, ...
```

```
cookCV5 <- 4/359
cookCV5
```

```
## [1] 0.01114206
```

```
cook5 <- cooks.distance(model5)
sort(round(cook5, 4))
```

```
##      3      7      8     18     23     27     29     32     37     39     40
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##     49     50     54     56     67     71     82     84     86     89     91
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##     93    103    111    113    116    119    121    122    134    142    146
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    149    159    173    174    175    182    183    189    191    195    206
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    207    208    219    225    227    236    250    251    257    263    274
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    287    289    292    295    296    298    305    308    316    322    328
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
##    331    338    340    347    348     15     16     19     21     46     48
## 0.0000 0.0000 0.0000 0.0000 0.0000 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##     66     74     85     95     97    101    104    114    115    123    132
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##    133    135    138    144    148    150    155    158    168    169    179
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##    181    184    194    196    199    201    202    203    222    247    265
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001
##    285    304    311    314    336    345      2     11     17     26     28
## 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0002 0.0002 0.0002 0.0002 0.0002
##     30     57     58     70     76     78    126    127    130    145    164
## 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002
##    197    204    209    216    243    252    276    280    288    301    334
## 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002 0.0002
##    352     62     73     87    131    213    214    223    234    324    333
## 0.0002 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003
##    344     20     38     88     94    107    156    211    272    275    278
```

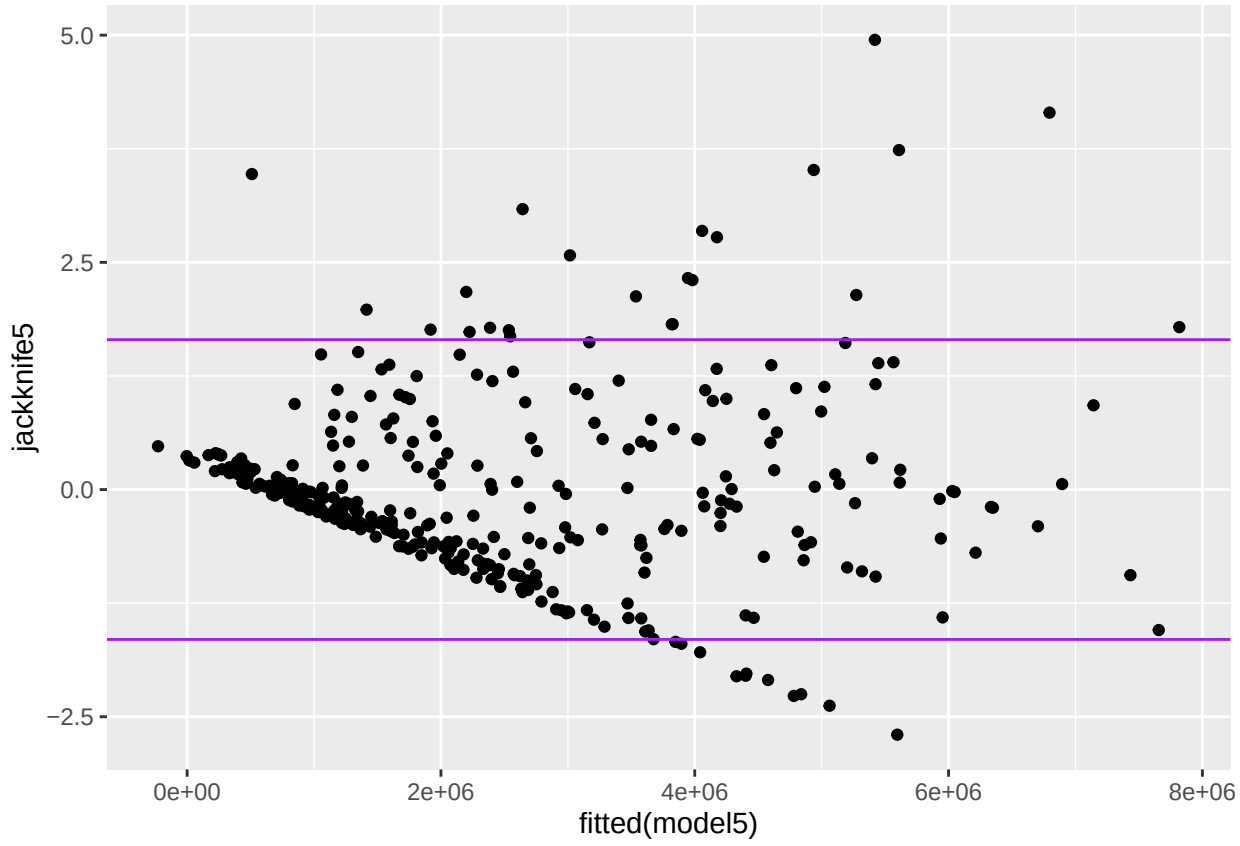
```
## 0.0003 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004 0.0004
##    313    357     35     43     52     60     63    100    129    143    224
## 0.0004 0.0004 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005
##    249    270    290    299    353      1     45     65     81    106    128
## 0.0005 0.0005 0.0005 0.0005 0.0005 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006
##    170    177    235    246    253    294    297    306    310    337      4
## 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0006 0.0007
##     83    110    152    190    220    232    260    267    283    302    303
## 0.0007 0.0007 0.0007 0.0007 0.0007 0.0007 0.0007 0.0007 0.0007 0.0007 0.0007
##    326    351     44     68     75    226    318    217    239    256    262
## 0.0007 0.0007 0.0008 0.0008 0.0008 0.0008 0.0008 0.0009 0.0009 0.0009 0.0009
##    330    335    162    341      6     51    118    124    151    248    307
## 0.0009 0.0009 0.0010 0.0010 0.0011 0.0011 0.0011 0.0011 0.0011 0.0011 0.0011
##    329    349     79    108    245    185    198    233    255    293     61
## 0.0011 0.0011 0.0012 0.0012 0.0012 0.0013 0.0013 0.0013 0.0013 0.0013 0.0014
##    242    312    320    210    268    221    241    258    154    192    279
## 0.0014 0.0014 0.0014 0.0015 0.0015 0.0016 0.0016 0.0016 0.0017 0.0017 0.0017
##      5     69    120    332     90    254    356    160    178    269     33
## 0.0018 0.0018 0.0018 0.0018 0.0019 0.0019 0.0019 0.0020 0.0020 0.0020 0.0021
##    346    215     92    200    286     59     55    102    112    117    172
## 0.0021 0.0022 0.0023 0.0023 0.0023 0.0024 0.0025 0.0025 0.0025 0.0025 0.0025
##    230    165     25    238    315    342    350     14     42     53    167
## 0.0025 0.0026 0.0027 0.0027 0.0027 0.0027 0.0028 0.0029 0.0029 0.0029 0.0030
##    180    237    321    147     80    163      9    327     22    323    359
## 0.0030 0.0030 0.0030 0.0031 0.0032 0.0032 0.0033 0.0034 0.0035 0.0035 0.0035
##     99     72    141    266    205     31    264    343    161    244    166
## 0.0036 0.0040 0.0040 0.0040 0.0041 0.0044 0.0045 0.0045 0.0046 0.0046 0.0047
##    355    261     24    136    231    176    171    354     64    157    309
## 0.0050 0.0051 0.0052 0.0054 0.0055 0.0061 0.0062 0.0062 0.0064 0.0064 0.0066
##    229    212    317    125     41    187    153    339    300    109     12
## 0.0076 0.0077 0.0077 0.0078 0.0082 0.0082 0.0087 0.0089 0.0090 0.0092 0.0099
##    319    140     96    193    240    218     34    325     13    228    271
## 0.0100 0.0109 0.0119 0.0121 0.0121 0.0123 0.0126 0.0129 0.0130 0.0140 0.0144
##    284    291    105    282     77    139    281    277     36    273    358
## 0.0149 0.0151 0.0158 0.0158 0.0167 0.0168 0.0171 0.0184 0.0199 0.0223 0.0319
##    188     98    186     10    259     47    137
## 0.0330 0.0351 0.0360 0.0362 0.0908 0.0933 0.2065
```

```
cook_outliers5 <- NHL %>% filter(cook5 > cookCV5)
cook_outliers5
```

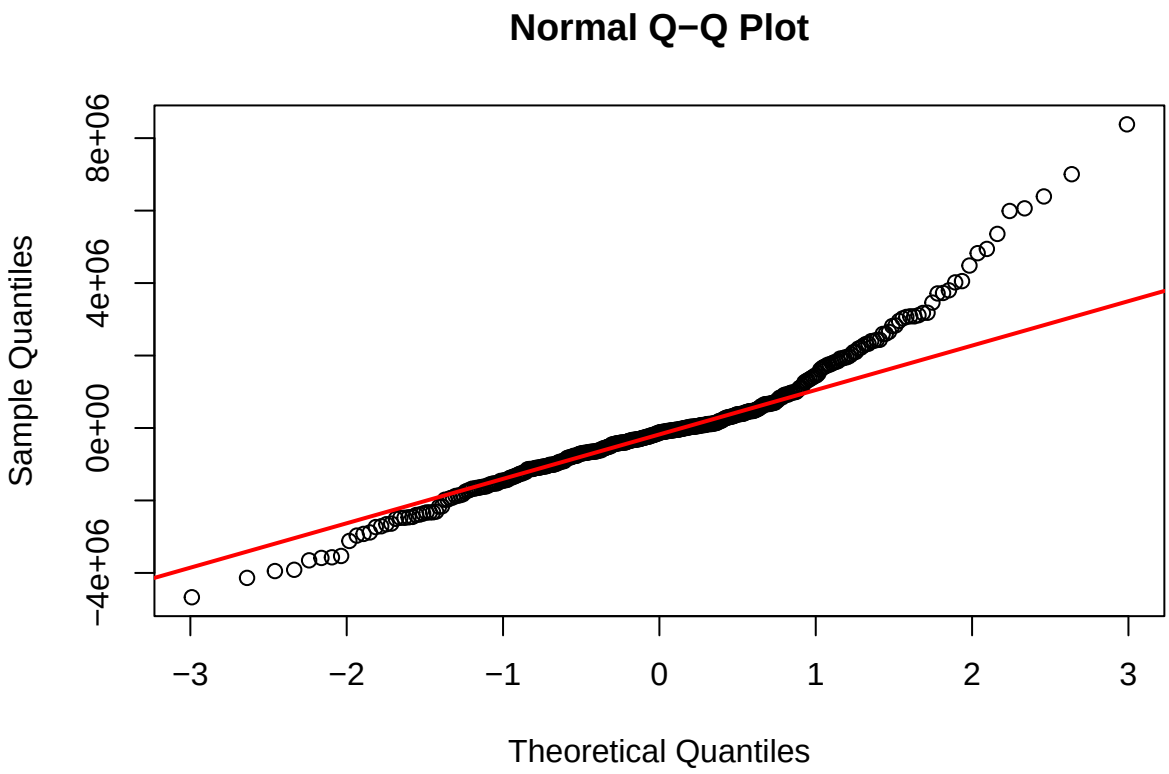
```
## # A tibble: 27 x 162
##      Salary Born   City  `Pr/St` Cntry Nat      Ht    Wt DftYr DftRd  Ovrl Hand
##       <dbl> <chr>  <chr> <chr>   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1 10900000 87-08~ Cole~ NS      CAN   CAN      71   200  2005     1     1 L
##  2   667500 96-03~ Calg~ AB      CAN   CAN      70   166  2014     3    79 R
##  3   925000 96-10~ Nort~ MA      USA   USA      74   196  2015     1     2 R
##  4   832500 95-04~ Lond~ ON      CAN   CAN      72   223  2013     1     9 L
##  5 13800000 88-04~ Winn~ MB      CAN   CAN      74   201  2006     1     3 L
##  6  2000000 84-12~ Hing~ MA      USA   USA      78   244  2003     1    26 L
##  7   875000 93-02~ Vict~ QC      CAN   CAN      73   193  2011     1    26 L
##  8  5000000 88-05~ Hali~ NS      CAN   CAN      69   181  2006     3    71 L
##  9  1300000 89-04~ Otta~ ON      CAN   CAN      69   160  2007     6   179 L
## 10 13800000 88-11~ Buff~ NY      USA   USA      71   177  2007     1     1 L
```

```
## # i 17 more rows
## # i 150 more variables: 'Last Name' <chr>, 'First Name' <chr>, Position <chr>,
## #   Team <chr>, GP <dbl>, G <dbl>, A <dbl>, A1 <dbl>, A2 <dbl>, PTS <dbl>,
## #   PM <dbl>, 'E+/-' <dbl>, PIM <dbl>, Shifts <dbl>, TOI <dbl>, TOIX <dbl>,
## #   'TOI/GP...29' <dbl>, 'TOI/GP...30' <dbl>, 'TOI%' <dbl>, 'IPP%' <dbl>,
## #   'SH%' <dbl>, 'SV%' <dbl>, PDO <dbl>, 'F/60' <dbl>, 'A/60' <dbl>,
## #   'Pct%' <dbl>, Diff <dbl>, 'Diff/60' <dbl>, iCF...41 <dbl>, ...
```

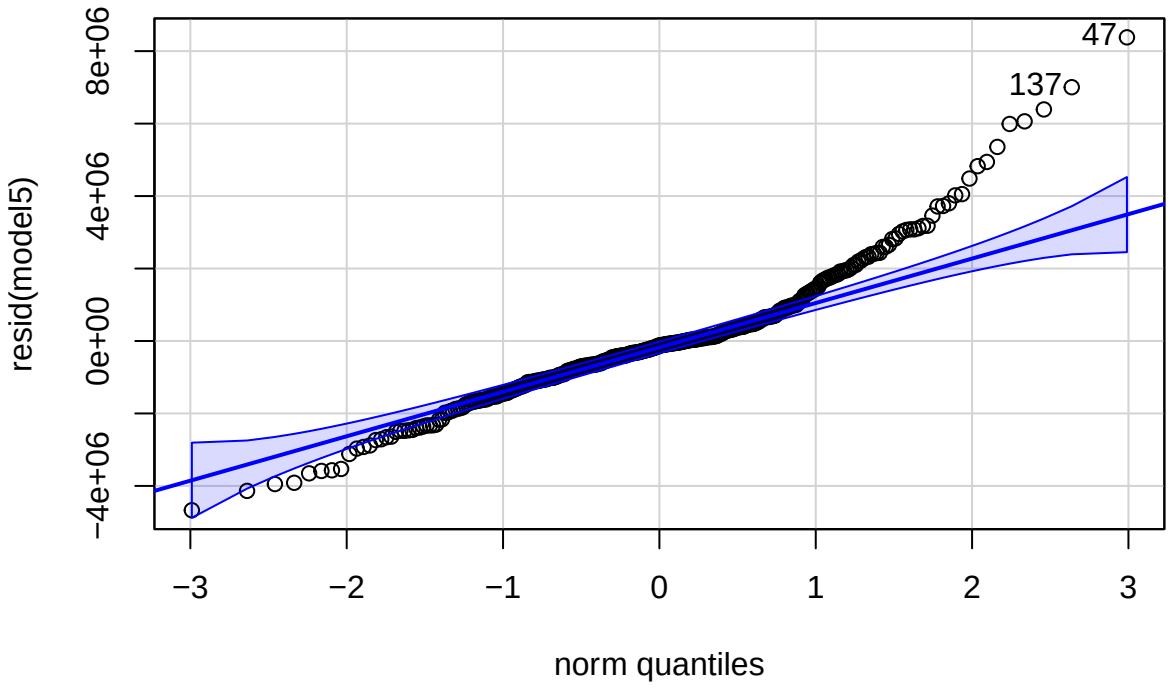
```
ggplot(NHL, aes(x = fitted(model5), y = jackknife5)) + geom_point()+ geom_hline(yintercept = t5, col =
```




```
qqnorm(resid(model5))
qqline(resid(model5), col = "red", lwd = 2)
```




```
qqPlot(resid(model5))
```




```
## [1]  47 137
```

```
skewness(jackknife5)
```

```
## [1] 1.07496
```

```
kurtosis(jackknife5)
```

```
## [1] 6.179353
```

```
ols_vif_tol(model5)
```

```
##   Variables Tolerance      VIF
## 1        GS 0.9999249 1.000075
## 2        Wt 0.9999249 1.000075
```

```
eigprop(model5)
```

```
##
## Call:
## eigprop(mod = model5)
##
```

```
##   Eigenvalues      CI (Intercept)     GS     Wt
## 1      2.6324  1.0000      0.0007 0.0511 0.0007
## 2      0.3649  2.6860      0.0020 0.9467 0.0021
## 3      0.0027 31.1192      0.9972 0.0022 0.9971
##
## ================================
## Row 2==> GS, proportion 0.946701 >= 0.50
## Row 3==> Wt, proportion 0.997137 >= 0.50
```

```
ols_step_forward_p(model5)
```

```
##
##                                 Selection Summary
## ------------------------------------------------------------------------------------
##         Variable                    Adj.
## Step    Entered     R-Square    R-Square     C(p)          AIC             RMSE
## ------------------------------------------------------------------------------------
##    1    GS             0.4540      0.4525    19.5684    11365.1352    1801945.3109
##    2    Wt             0.4811      0.4781     3.0000    11348.8823    1759179.4048
## ------------------------------------------------------------------------------------
```

```
ols_step_backward_p(model5)
```

```
## [1] "No variables have been removed from the model."
```

```
ols_step_both_p(model5)
```

```
##
##                                  Stepwise Selection Summary
## ------------------------------------------------------------------------------------------------
##                      Added/                    Adj.
## Step    Variable    Removed     R-Square    R-Square     C(p)          AIC             RMSE
## ------------------------------------------------------------------------------------------------
##    1       GS       addition       0.454       0.452    19.5680    11365.1352    1801945.3109
##    2       Wt       addition       0.481       0.478     3.0000    11348.8823    1759179.4048
## ------------------------------------------------------------------------------------------------
```

```
ols_step_best_subset(model5)
```

```
## Best Subsets Regression
## --------------------
## Model Index    Predictors
## --------------------
##      1         GS
##      2         GS Wt
## --------------------
##
##                                                          Subsets Regression Summary
## ------------------------------------------------------------------------------------------------------------
##                        Adj.        Pred
## Model    R-Square    R-Square    R-Square     C(p)          AIC           SBIC          SBC
```

```
## ------------------------------------------------------------------------------------------------
##   1        0.4540      0.4525       0.446    19.5684    11365.1352    10346.1676    11376.7852    1.
##   2        0.4811      0.4781      0.4699     3.0000    11348.8823    10330.1349    11364.4156    1.
## ------------------------------------------------------------------------------------------------
## AIC: Akaike Information Criteria
##  SBIC: Sawa's Bayesian Information Criteria
##  SBC: Schwarz Bayesian Criteria
##  MSEP: Estimated error of prediction, assuming multivariate normality
##  FPE: Final Prediction Error
##  HSP: Hocking's Sp
##  APC: Amemiya Prediction Criteria
```