modeling

```
#install.packages('GGally')
#install.packages('moments')
#install.packages("corrplot")

install.packages('GGally', repos='https://ftp.osuosl.org/pub/cran/')
```

```
## Installing package into '/opt/r'
## (as 'lib' is unspecified)
```

```
install.packages('moments', repos='https://ftp.osuosl.org/pub/cran/')
```

```
## Installing package into '/opt/r'
## (as 'lib' is unspecified)
```

```
install.packages("corrplot", repos = "http://cran.us.r-project.org")
```

```
## Installing package into '/opt/r'
## (as 'lib' is unspecified)
```

```
library(GGally)
library(ggplot2)
library(lmtest)
library(lubridate)
library(moments)
library(sandwich)
library(stargazer)
library(tidyverse)
library(data.table)

source('./functions/get_robust_se.R')
source('./functions/get_clean_dataset.R')
```

```
data_clean <- get_clean_dataset()
glimpse(data_clean)
```

```
## Rows: 5,408
## Columns: 24
## $ installs            <dbl> 500, 500, 500, 1000, 1000, 1000, 1000, 1000, 1000,~
## $ size                <dbl> 22.0, 10.0, 2.5, 5.4, 2.4, 13.0, 6.5, 53.0, 15.0, ~
## $ reviews             <dbl> 156, 120, 124, 726, 112, 112, 123, 787, 141, 171, ~
## $ rating              <dbl> 4.6, 4.5, 4.8, 4.8, 4.5, 4.4, 4.8, 4.8, 5.0, 4.8, ~
## $ price               <dbl> 3.49, 0.00, 0.00, 3.99, 7.99, 0.00, 0.00, 1.99, 0.~
## $ is_free             <lgl> FALSE, TRUE, TRUE, FALSE, FALSE, TRUE, TRUE, FALSE~
## $ last_updated        <dbl> 0.402739726, 0.010958904, 1.958904110, 0.632876712~
## $ android_version     <dbl> 4.4, 5.0, 4.2, 4.1, 4.0, 4.4, 3.0, 4.0, 4.1, 2.2, ~
## $ current_version     <dbl> 1.1, 1.5, 1.2, 2.3, 3.0, 4.5, 3.1, 1.4, 1.8, 1.7, ~
## $ category            <chr> "MEDICAL", "DATING", "FAMILY", "BUSINESS", "PRODUC~
## $ is_family_category  <lgl> FALSE, FALSE, TRUE, FALSE, FALSE, FALSE, FALSE, FA~
## $ is_game_category    <lgl> FALSE, FALSE, FALSE, FALSE, FALSE, FALSE, FALSE, F~
```

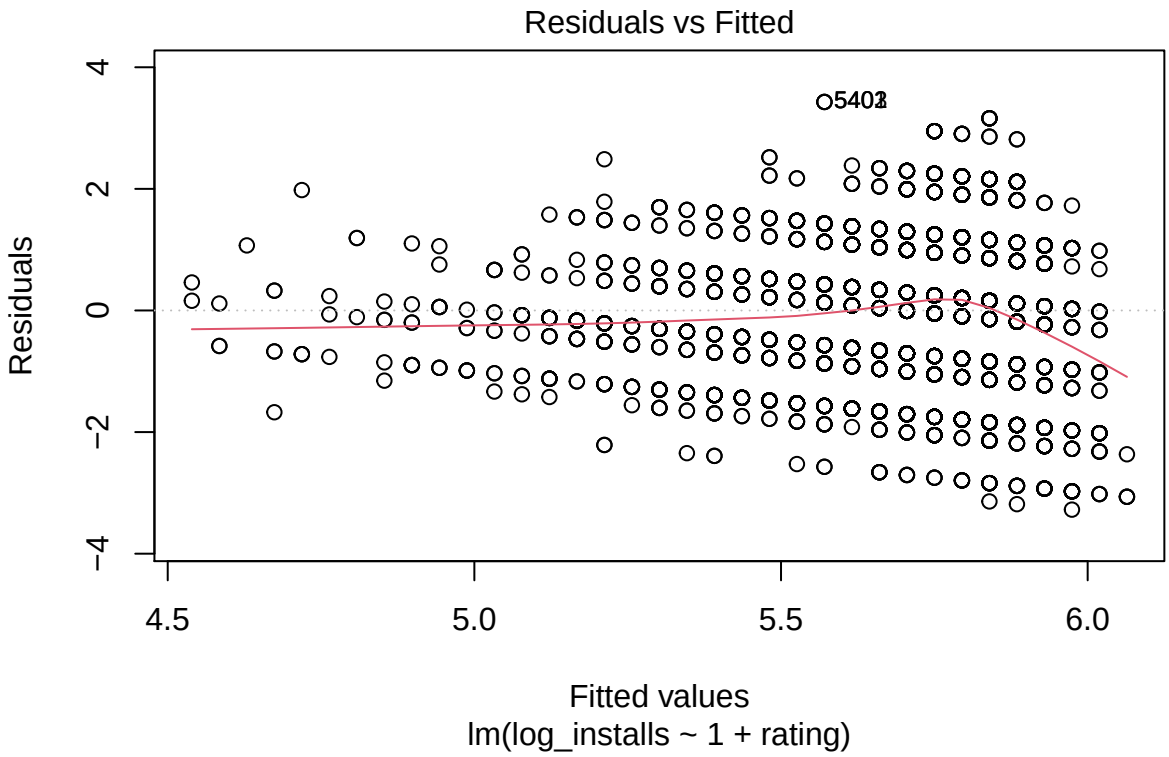
```
## $ is_tools_category   <lgl> FALSE, FALSE, FALSE, FALSE, FALSE, FALSE, FALSE, F~
## $ genre               <chr> "Medical", "Dating", "Entertainment", "Business", ~
## $ content_rating      <chr> "Everyone", "Mature 17+", "Everyone", "Everyone", ~
## $ is_content_everyone <lgl> TRUE, FALSE, TRUE, TRUE, TRUE, TRUE, TRUE, TRUE, T~
## $ type                <chr> "Paid", "Free", "Free", "Paid", "Paid", "Free", "F~
## $ install_group       <int> 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ log_installs        <dbl> 2.69897, 2.69897, 2.69897, 3.00000, 3.00000, 3.000~
## $ log_size            <dbl> 1.3424227, 1.0000000, 0.3979400, 0.7323938, 0.3802~
## $ log_price           <dbl> 0.6522463, 0.0000000, 0.0000000, 0.6981005, 0.9537~
## $ log_current_version <dbl> 0.3222193, 0.3979400, 0.3424227, 0.5185139, 0.6020~
## $ log_last_updated    <dbl> 0.146977097, 0.004733502, 0.471130891, 0.212953395~
## $ log_reviews         <dbl> 2.193125, 2.079181, 2.093422, 2.860937, 2.049218, ~
```

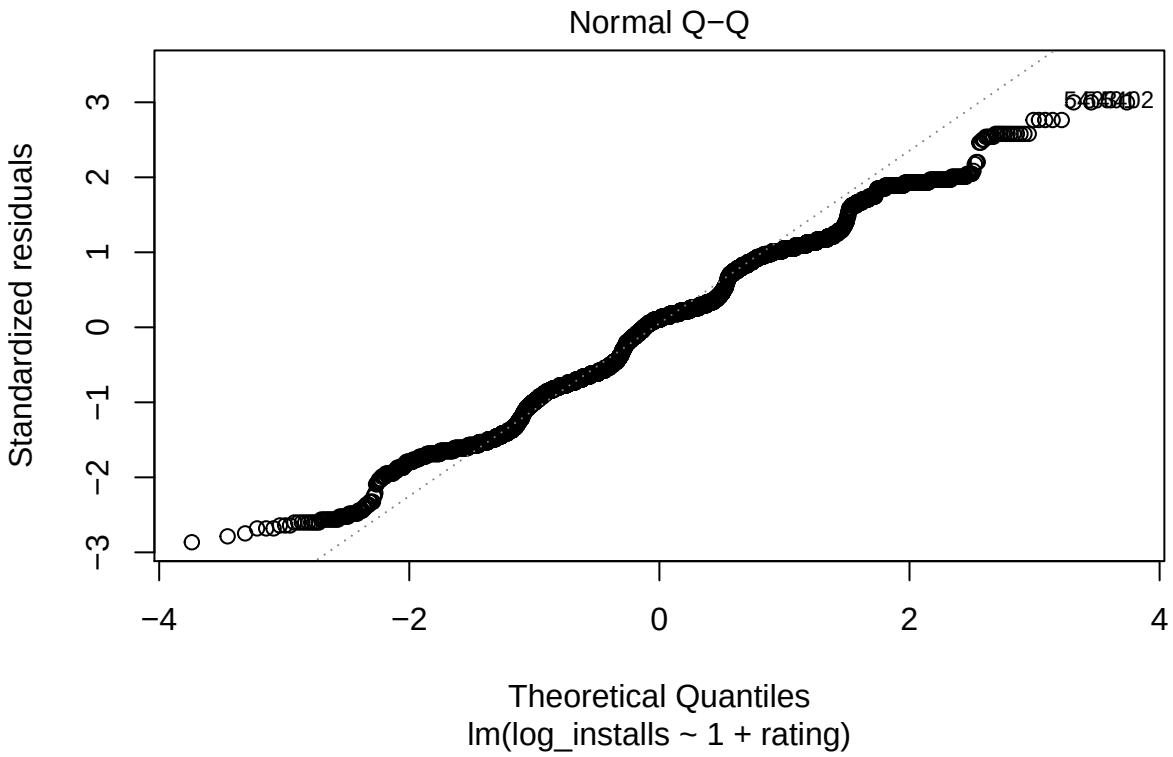
```r
model_small  <- lm(log_installs ~ 1 + rating, data = data_clean)
model_medium <- lm(log_installs ~ 1 + rating + log_size + log_current_version +
                     log_last_updated + is_free + is_family_category +
                     is_game_category + is_tools_category + is_content_everyone,
                   data = data_clean)
model_large  <- lm(log_installs ~ 1 + rating + log_size + log_current_version +
                     log_last_updated + is_free + is_content_everyone +
                     rating * is_family_category + rating * is_game_category +
                     rating * is_tools_category,
                   data = data_clean)

stargazer(
  model_small,
  model_medium,
  model_large,
  type = "text",
  se = list(get_robust_se(model_small), get_robust_se(model_medium),
            get_robust_se(model_large))
)
```

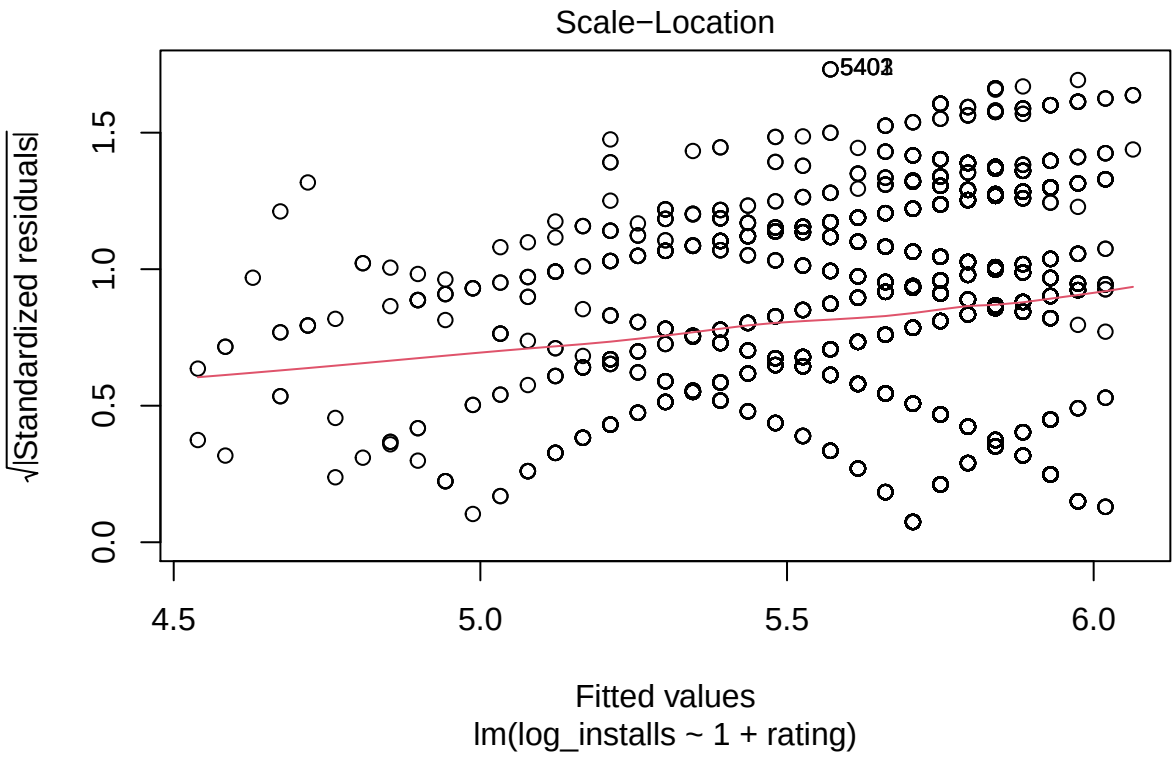
```
##
## ==========================================================================================
##                                                  Dependent variable:
##                              -------------------------------------------------------------
##                                                     log_installs
##                                      (1)                      (2)                      (3)
## ------------------------------------------------------------------------------------------
## rating                             0.448***                 0.338***                 0.288***
##                                   (0.032)                  (0.031)                  (0.039)
##
## log_size                                                    0.432***                 0.429***
##                                                            (0.033)                  (0.033)
##
## log_current_version                                         0.430***                 0.428***
##                                                            (0.057)                  (0.057)
##
## log_last_updated                                           -0.909***                -0.879***
##                                                            (0.071)                  (0.071)
##
## is_free                                                     1.418***                 1.423***
##                                                            (0.050)                  (0.051)
##
```

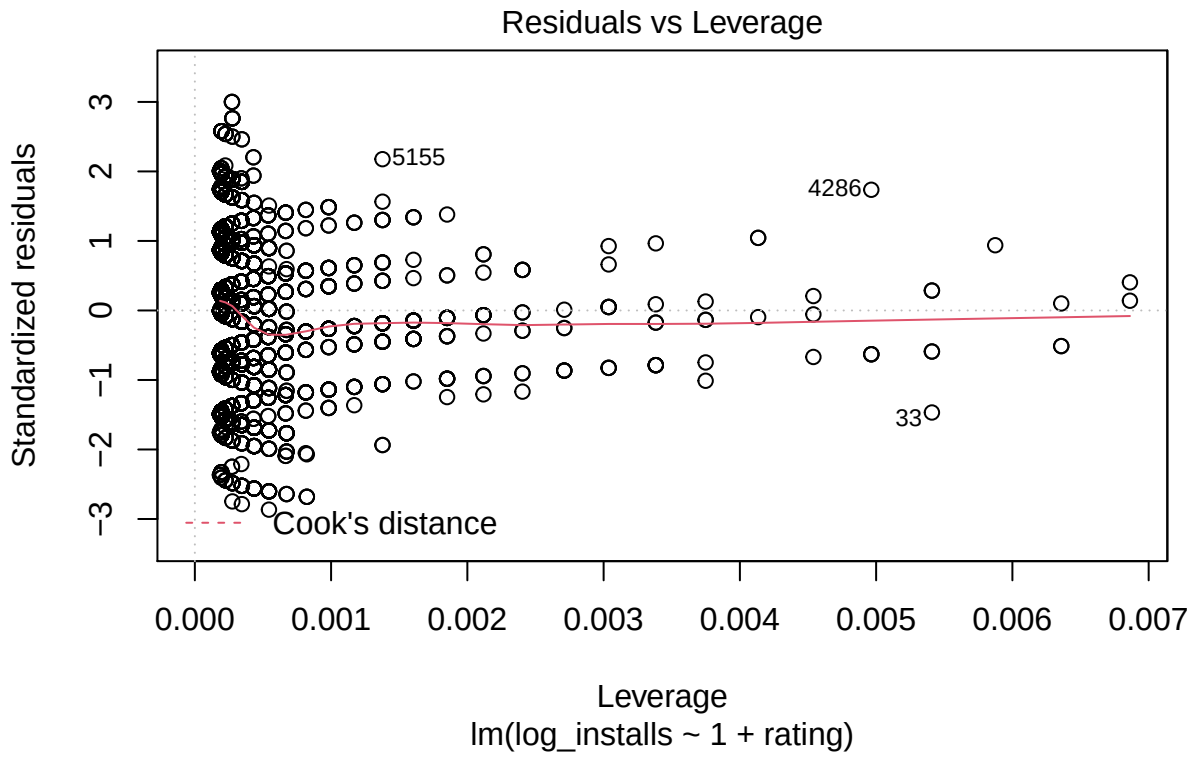
```
## is_family_category                                    0.032                  0.384
##                                                      (0.037)                (0.333)
##
## is_game_category                                     0.624***               -2.374***
##                                                      (0.046)                (0.450)
##
## is_tools_category                                    0.272***                -0.125
##                                                      (0.054)                (0.423)
##
## rating:is_family_category                                                    -0.085
##                                                                             (0.080)
##
## rating:is_game_category                                                     0.702***
##                                                                             (0.106)
##
## rating:is_tools_category                                                     0.095
##                                                                             (0.104)
##
## is_content_everyone                                  -0.067*                -0.066*
##                                                      (0.035)                (0.035)
##
## Constant                            3.822***         2.261***               2.469***
##                                      (0.133)         (0.154)                (0.181)
##
## ---------------------------------------------------------------------------------------------
## Observations                           5,408           5,408                  5,408
## R2                                     0.028           0.265                  0.271
## Adjusted R2                            0.028           0.264                  0.269
## Residual Std. Error           1.143 (df = 5406)  0.995 (df = 5398)      0.991 (df = 5395)
## F Statistic                155.421*** (df = 1; 5406) 216.073*** (df = 9; 5398) 166.929*** (df = 12; 53
## =============================================================================================
## Note:                                                          *p<0.1; **p<0.05; ***p<0
```

```
plot(model_small)
```

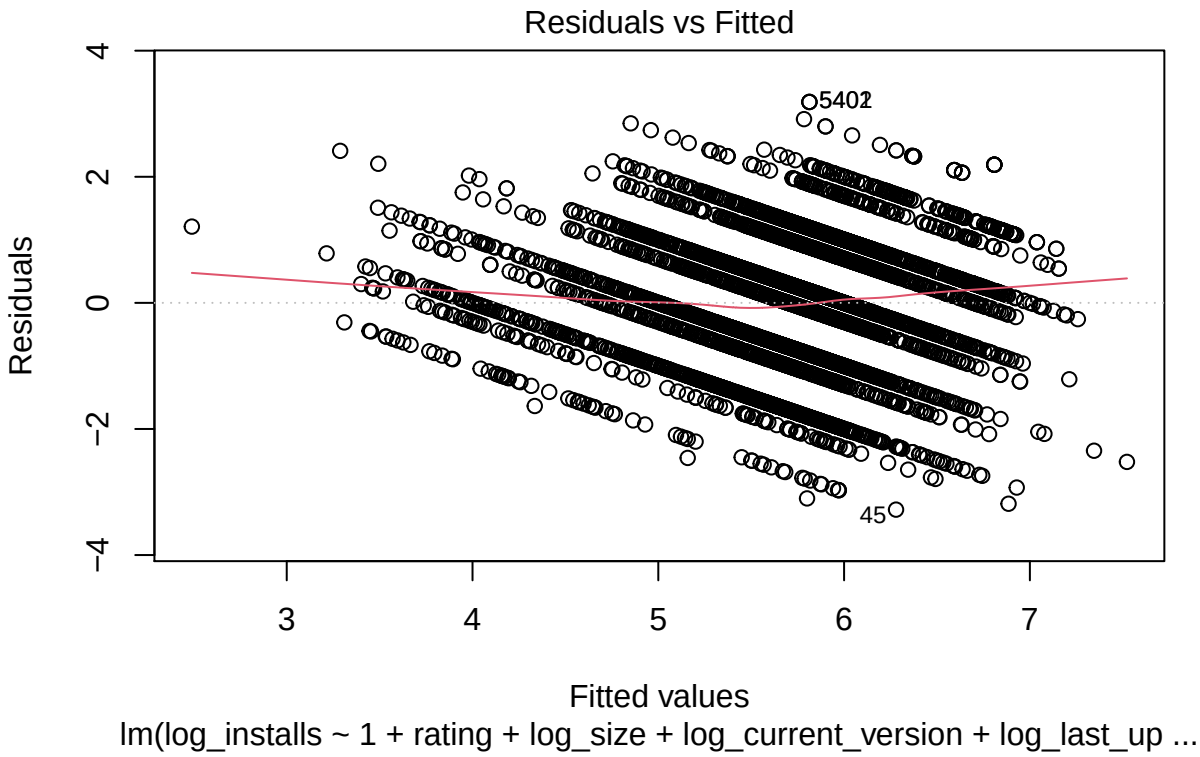

Residuals vs Fitted
Residuals
Fitted values
lm(log_installs ~ 1 + rating)
4.5
5.0
5.5
6.0
−4
−2
0
2
4

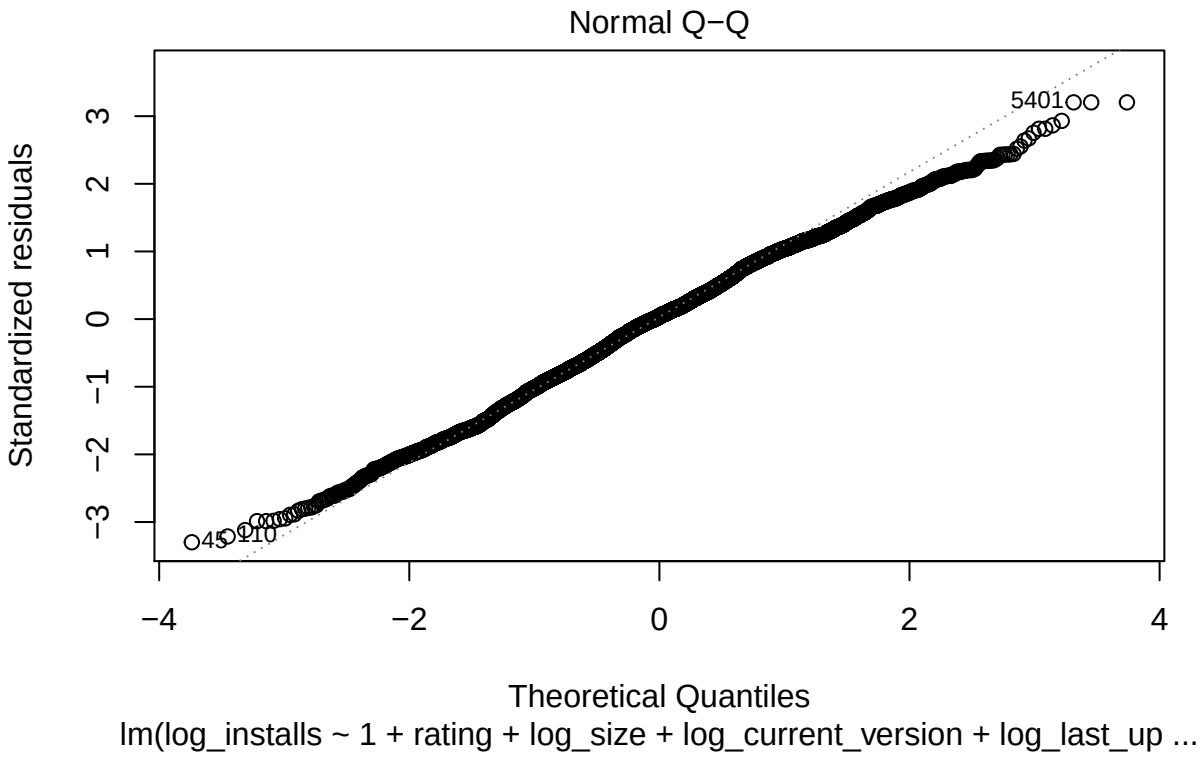

Normal Q−Q
Standardized residuals
−3
−2
−1
0
1
2
3
−4
−2
0
2
4
Theoretical Quantiles
lm(log_installs ~ 1 + rating)

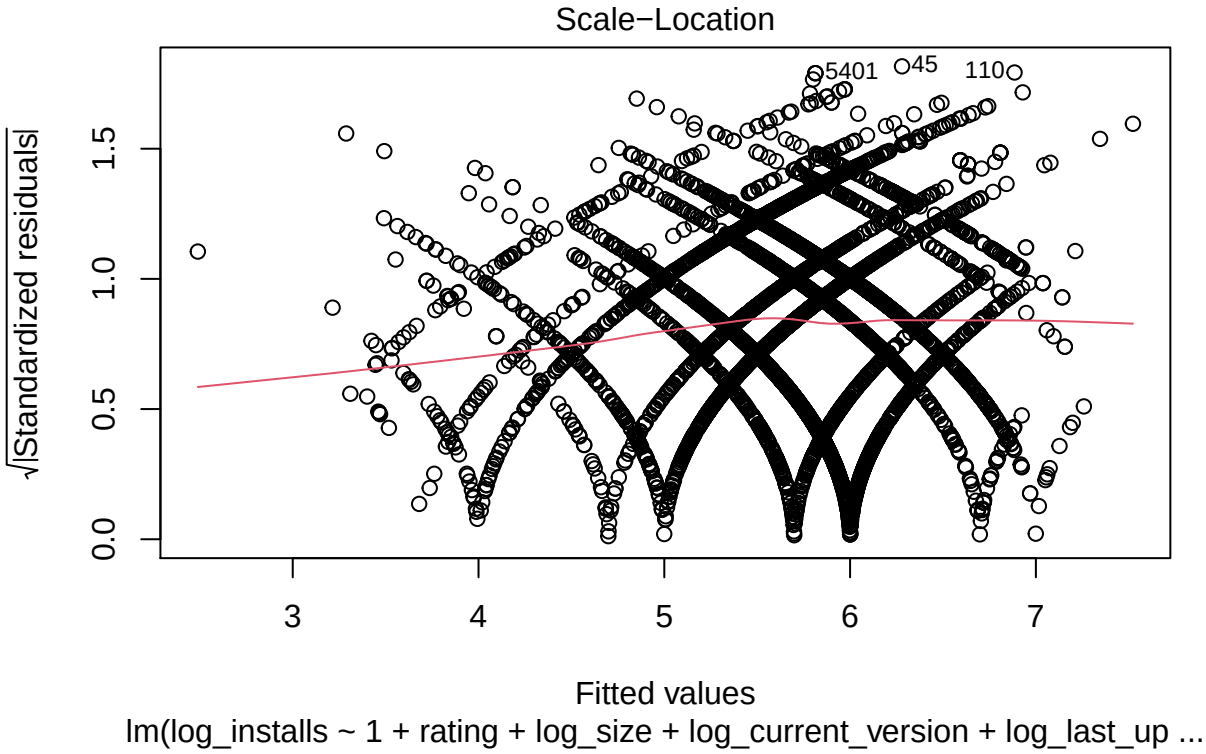

Scale−Location
√|Standardized residuals|
0.0
0.5
1.0
1.5
4.5
5.0
5.5
6.0
Fitted values
lm(log_installs ~ 1 + rating)

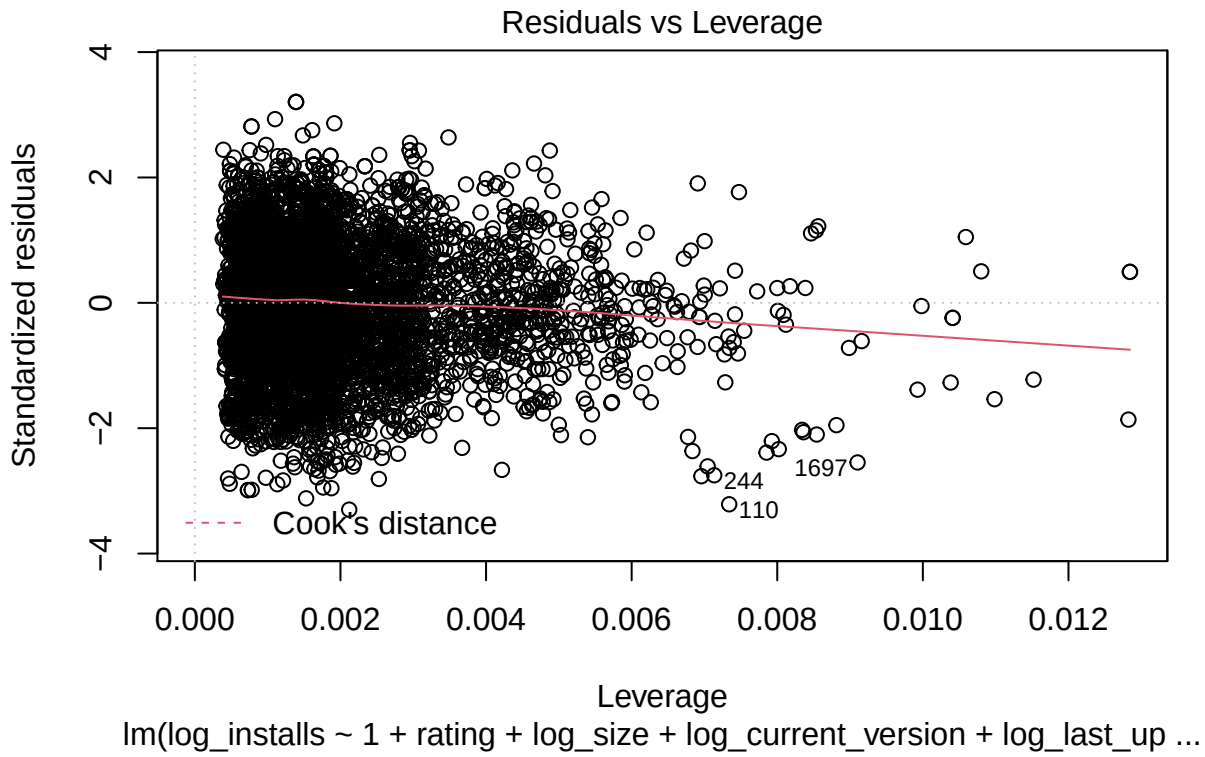



```
plot(model_medium)
```

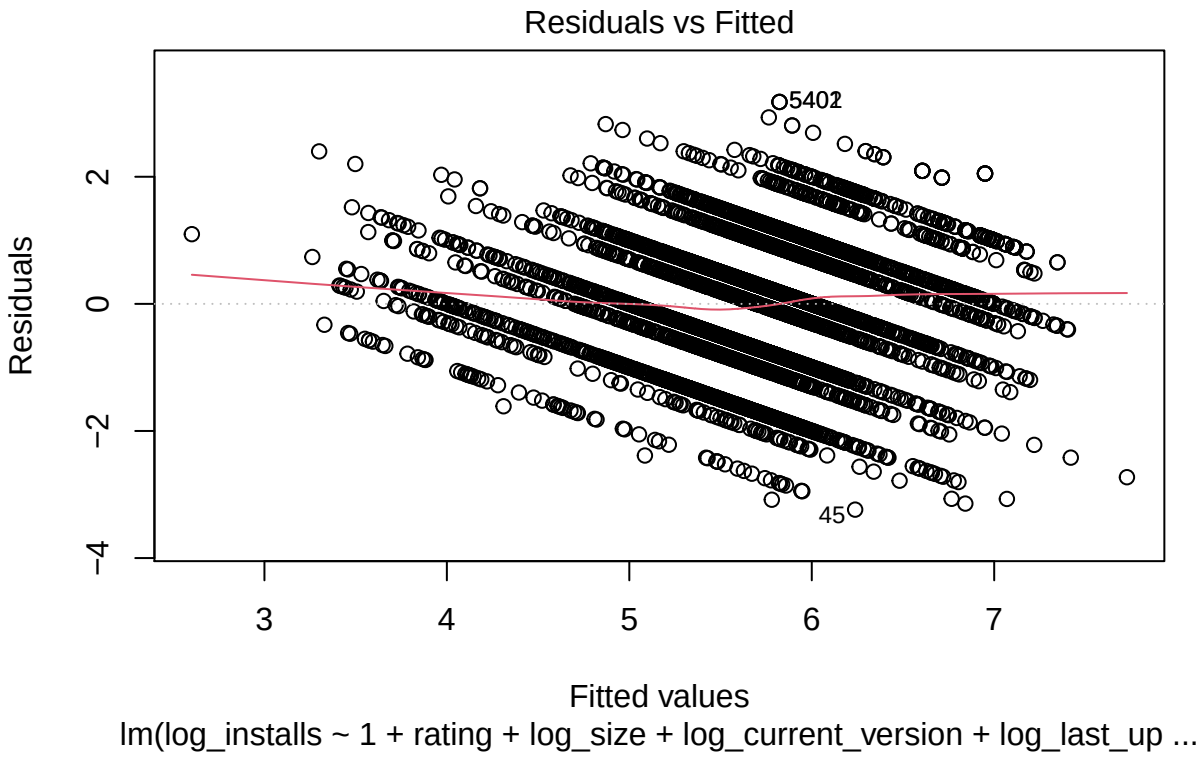

Residuals vs Fitted
Residuals
Fitted values
lm(log_installs ~ 1 + rating + log_size + log_current_version + log_last_up ...
5402
45
4
2
0
−2
−4
3
4
5
6
7

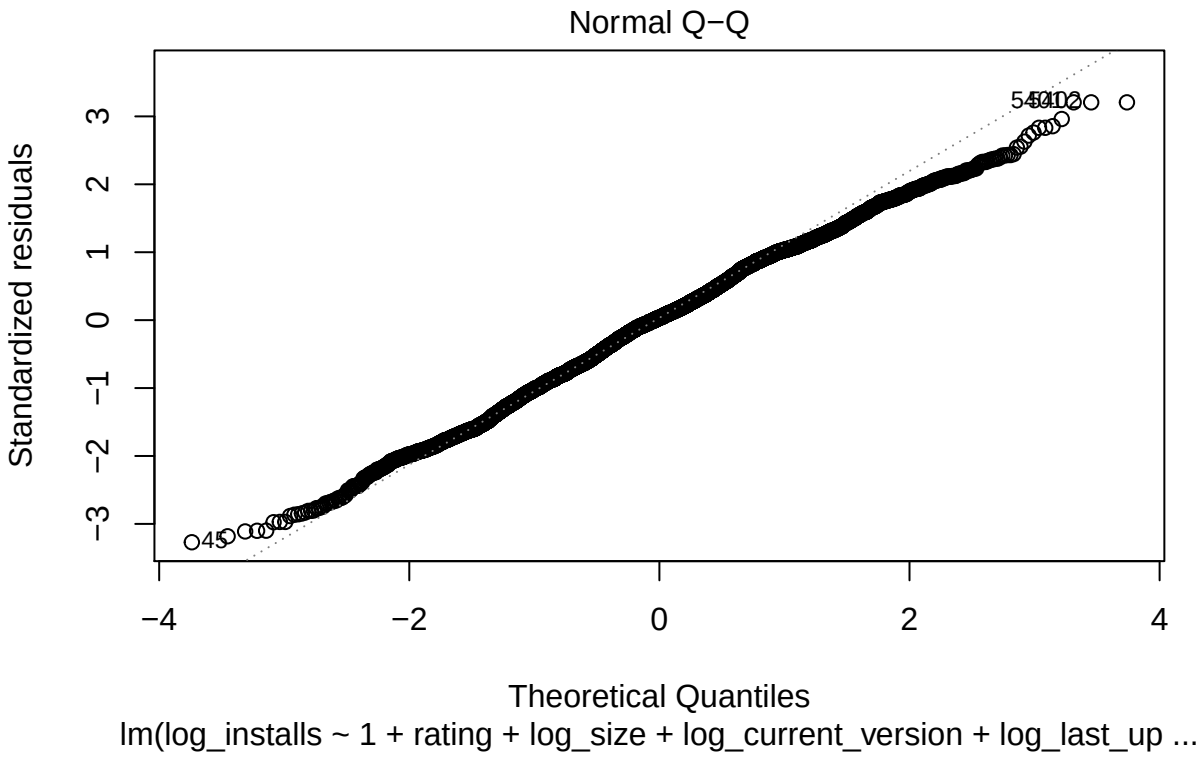

Normal Q−Q
Standardized residuals
Theoretical Quantiles
lm(log_installs ~ 1 + rating + log_size + log_current_version + log_last_up ...
5401
45
110
−3
−2
−1
0
1
2
3
−4
−2
0
2
4

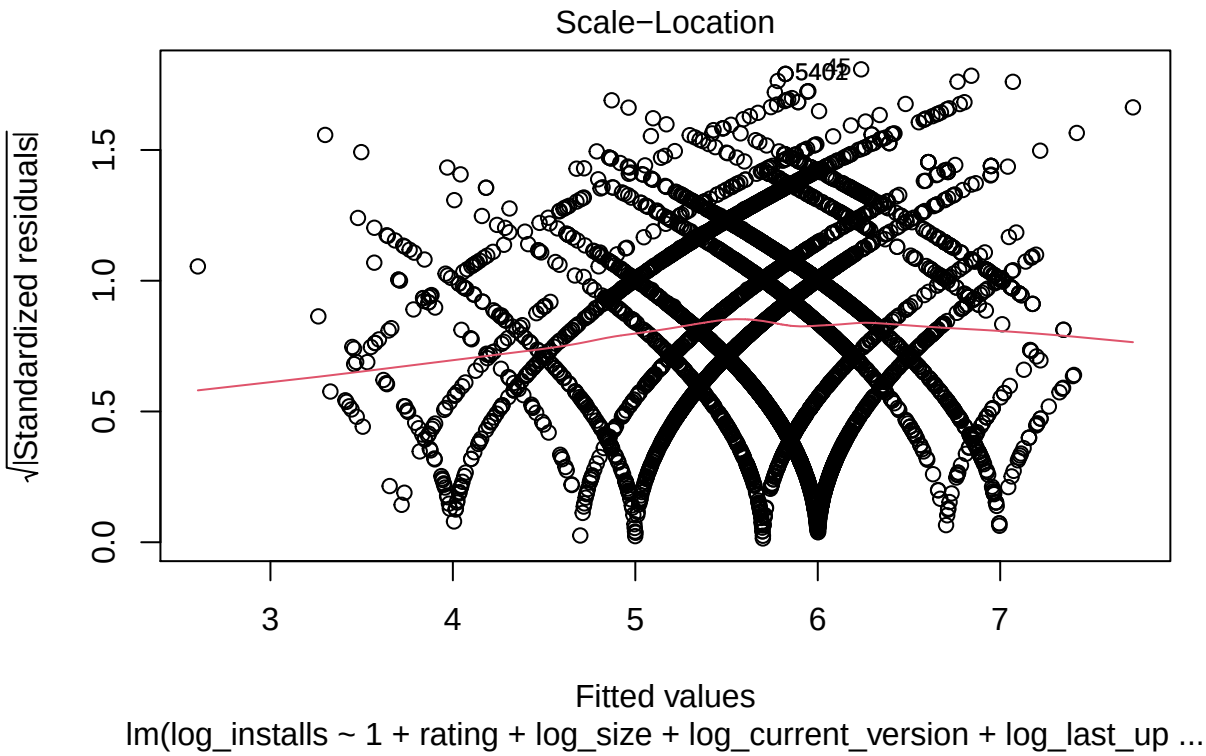

Scale−Location
5401
45
110
√|Standardized residuals|
0.0
0.5
1.0
1.5
3
4
5
6
7
Fitted values
lm(log_installs ~ 1 + rating + log_size + log_current_version + log_last_up ...

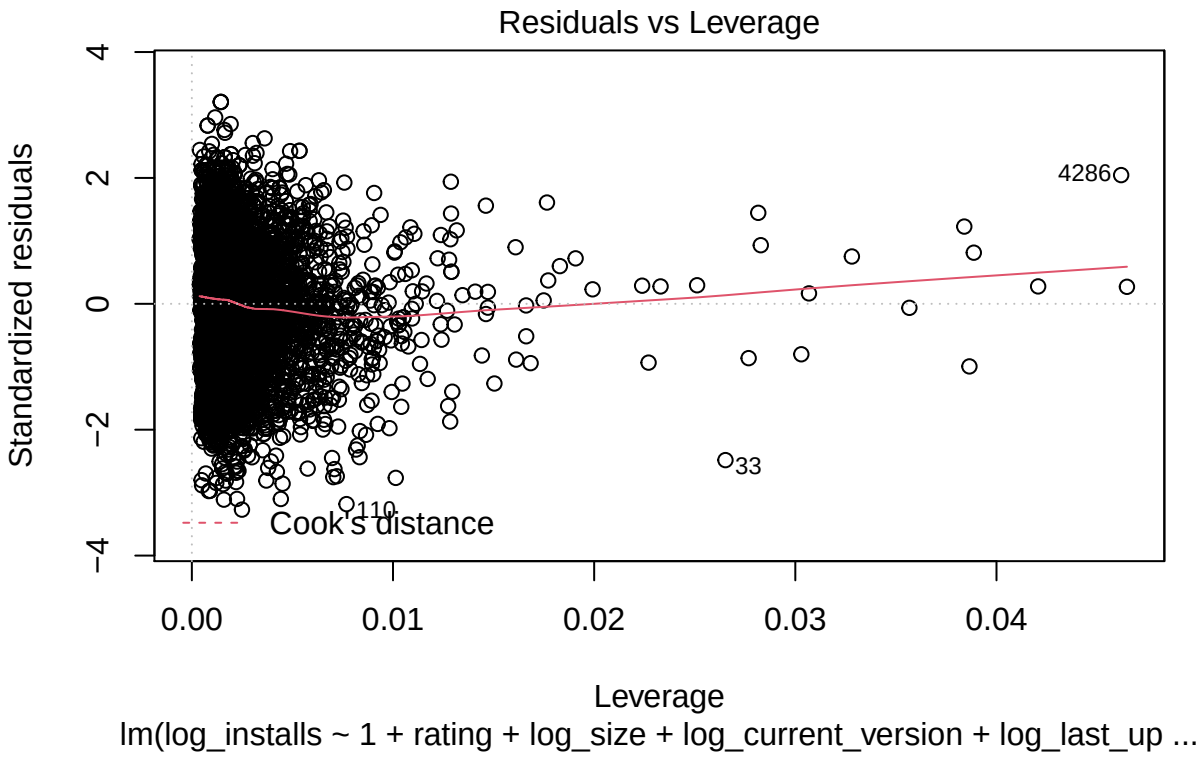



```
plot(model_large)
```

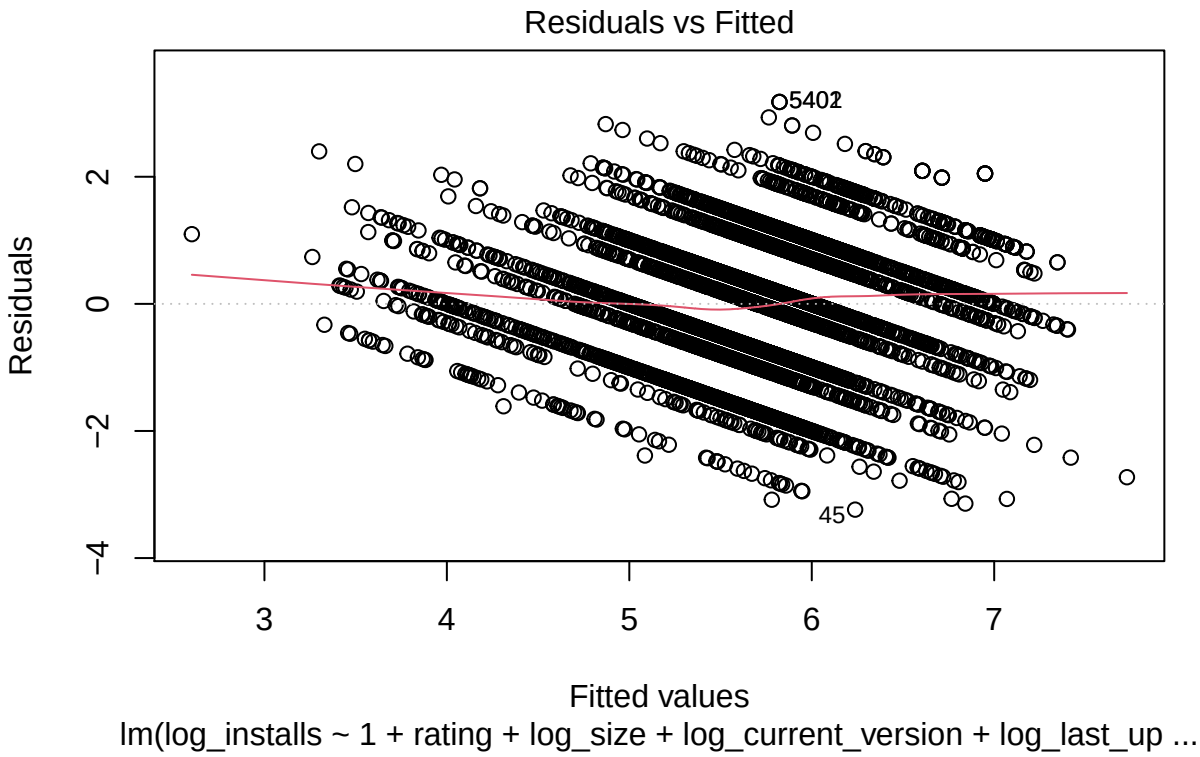

Residuals vs Fitted
Residuals
Fitted values
lm(log_installs ~ 1 + rating + log_size + log_current_version + log_last_up ...
5402
45
−4
−2
0
2
3
4
5
6
7

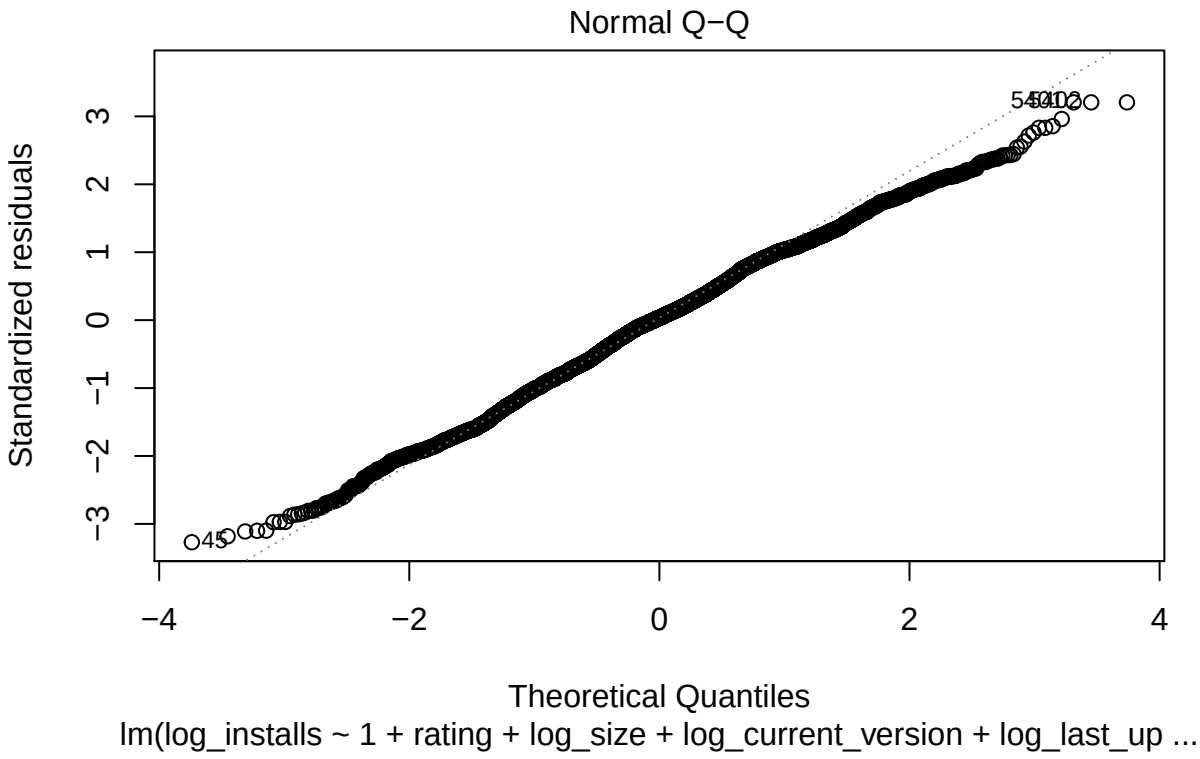

Normal Q−Q
Standardized residuals
Theoretical Quantiles
lm(log_installs ~ 1 + rating + log_size + log_current_version + log_last_up ...

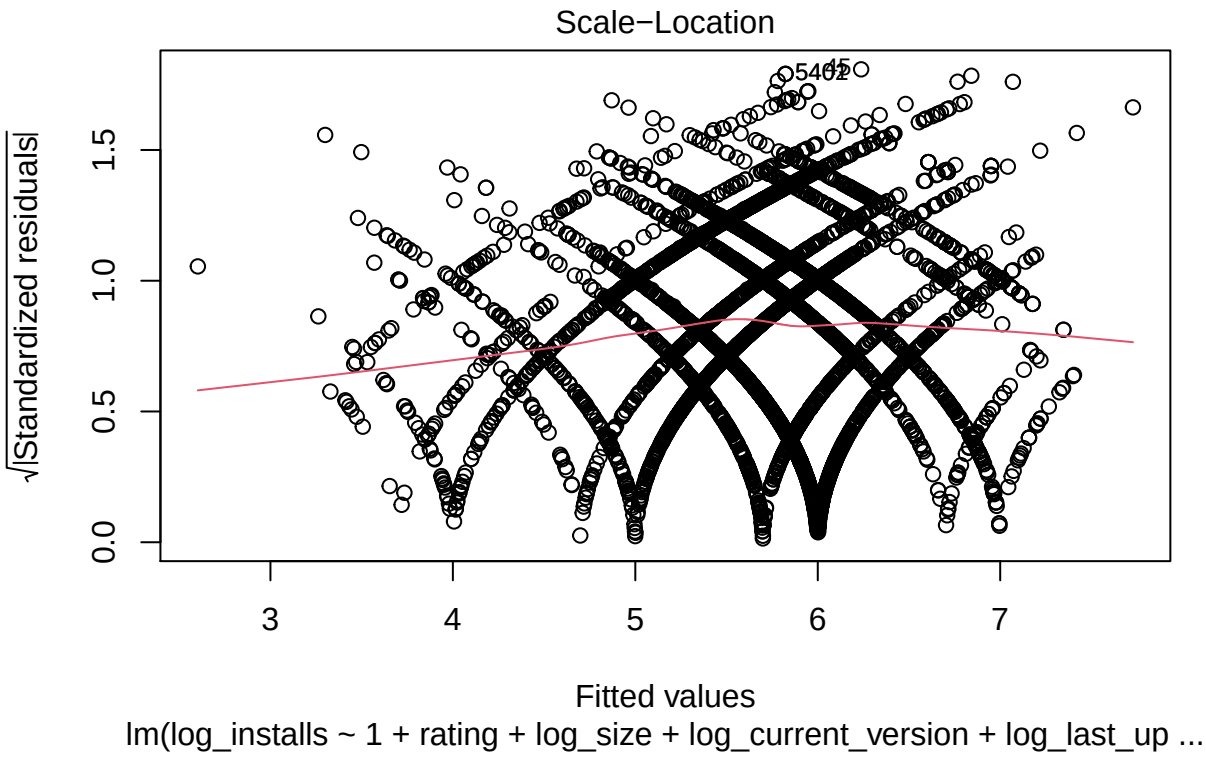

Scale−Location
√|Standardized residuals|
0.0
0.5
1.0
1.5
3
4
5
6
7
Fitted values
lm(log_installs ~ 1 + rating + log_size + log_current_version + log_last_up ...

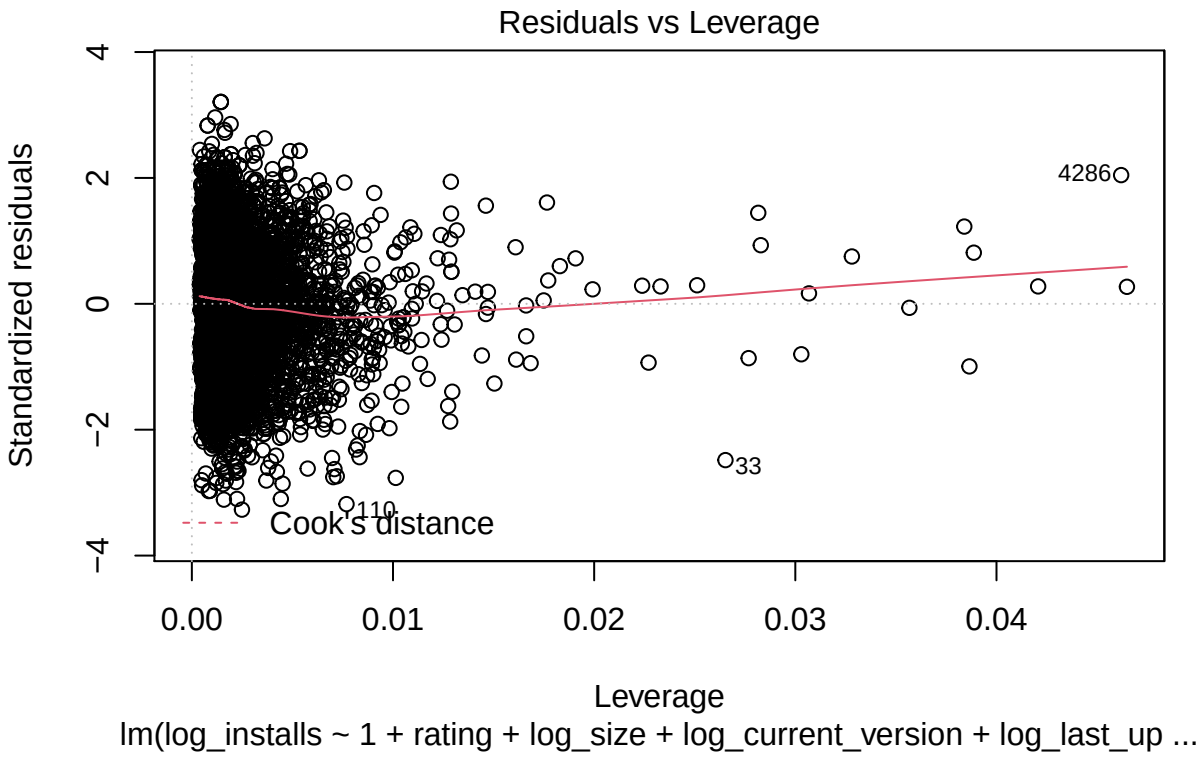



```
plot(model_large)
```


Residuals vs Fitted
Residuals
Fitted values
lm(log_installs ~ 1 + rating + log_size + log_current_version + log_last_up ...
5402
45
2
0
−2
−4
3
4
5
6
7


Normal Q−Q
Standardized residuals
Theoretical Quantiles
lm(log_installs ~ 1 + rating + log_size + log_current_version + log_last_up ...
−4
−2
0
2
4
−3
−2
−1
0
1
2
3
45


Scale−Location
√|Standardized residuals|
0.0
0.5
1.0
1.5
3
4
5
6
7
Fitted values
lm(log_installs ~ 1 + rating + log_size + log_current_version + log_last_up ...


Residuals vs Leverage
Standardized residuals
4
2
0
−2
−4
4286
33
110
Cook's distance
0.00
0.01
0.02
0.03
0.04
Leverage
lm(log_installs ~ 1 + rating + log_size + log_current_version + log_last_up ...