# Predictive-Linear-Multiple-Regression.R

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```r
rm(list = ls())
library(ggplot2)
mydata <- read.csv("iMDB_no_outlier.csv")
head(mydata)
```

```
##                                           movie_title  director_name
## 1                                         Total Recall  Paul Verhoeven
## 2                                Gone in Sixty Seconds    Dominic Sena
## 3                                          End of Days     Peter Hyams
## 4 Legend of the Guardians: The Owls of Ga'Hoole        Zack Snyder
## 5                                    The Peanuts Movie   Steve Martino
## 6                                  The Spanish Prisoner    David Mamet
##        actor_1_name num_critic_for_reviews duration director_facebook_likes
## 1          Ronny Cox                    196      113                     719
## 2      Nicolas Cage                    175      127                      57
## 3        CCH Pounder                    174      121                     976
## 4      Abbie Cornish                   188      101                     976
## 5  Francesca Capaldi                   208       88                      20
## 6        Ben Gazzara                    97      110                     342
##   actor_facebook_likes movie_facebook_likes      gross num_user_for_reviews
## 1                 1130                17372 119412921                  391
## 2                26000                17372 101643008                  498
## 3                 2595                 2000  66862068                  524
## 4                 3230                16000  55673333                  160
## 5                  222                33000 130174897                  155
## 6                 1524                  578  10200000                  263
##        budget imdb_score
## 1 65,000,000        7.5
## 2 90,000,000        6.5
## 3 83,000,000        5.7
## 4 80,000,000        7.0
## 5 99,000,000        7.2
## 6 10,000,000        7.3
```

```r
mydata <- subset(mydata,select=-`movie_title`)
mydata <- subset(mydata,select=-`director_name`)
mydata <- subset(mydata,select=-`actor_1_name`)
mydata$budget <- as.numeric(gsub(",","",mydata$budget))

training_Data <- sample(nrow(mydata),
                        size = nrow(mydata)*.6, replace=F)
```

```
training <- mydata[training_Data,]
head(training)
```

```
##      num_critic_for_reviews duration director_facebook_likes
## 1058                    111      112                      52
## 1361                     49       91                       6
## 957                     287      115                     219
## 661                     119      103                      81
## 501                     118      120                     155
## 1778                     62      116                     976
##      actor_facebook_likes movie_facebook_likes     gross num_user_for_reviews
## 1058                16347                  365   6830957                  147
## 1361                 9221                  647   8080116                   66
## 957                  1997                17372  15045676                  376
## 661                  3319                17372  30669413                  291
## 501                 24233                11000  81593527                  263
## 1778                 2020                17372  50382128                  202
##        budget imdb_score
## 1058 2.1e+07        6.7
## 1361 1.5e+07        5.6
## 957  1.6e+07        5.6
## 661  3.5e+07        6.2
## 501  4.0e+07        7.3
## 1778 5.5e+06        5.6
```

```
testset <- mydata[-training_Data,]

model <- lm(imdb_score ~.,data=training)
summary(model)
```

```
##
## Call:
## lm(formula = imdb_score ~ ., data = training)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.88570 -0.43081  0.07519  0.51715  2.17225
##
## Coefficients:
##                           Estimate Std. Error t value Pr(>|t|)
## (Intercept)              4.411e+00  1.158e-01  38.089  < 2e-16 ***
## num_critic_for_reviews   7.615e-04  3.073e-04   2.478 0.013337 *
## duration                 1.401e-02  1.111e-03  12.609  < 2e-16 ***
## director_facebook_likes  2.625e-04  5.930e-05   4.427 1.03e-05 ***
## actor_facebook_likes     1.221e-05  2.893e-06   4.221 2.60e-05 ***
## movie_facebook_likes     1.697e-05  2.872e-06   5.907 4.45e-09 ***
## gross                    2.744e-09  7.572e-10   3.624 0.000302 ***
## num_user_for_reviews     5.539e-04  9.388e-05   5.900 4.63e-09 ***
## budget                  -1.246e-08  1.163e-09 -10.711  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error: 0.7648 on 1296 degrees of freedom
## Multiple R-squared:  0.3194, Adjusted R-squared:  0.3152
## F-statistic: 76.02 on 8 and 1296 DF,  p-value: < 2.2e-16
```

```r
res <- resid(model)

fit <- fitted(model)

plot(fit, res)
abline(0,0)
```
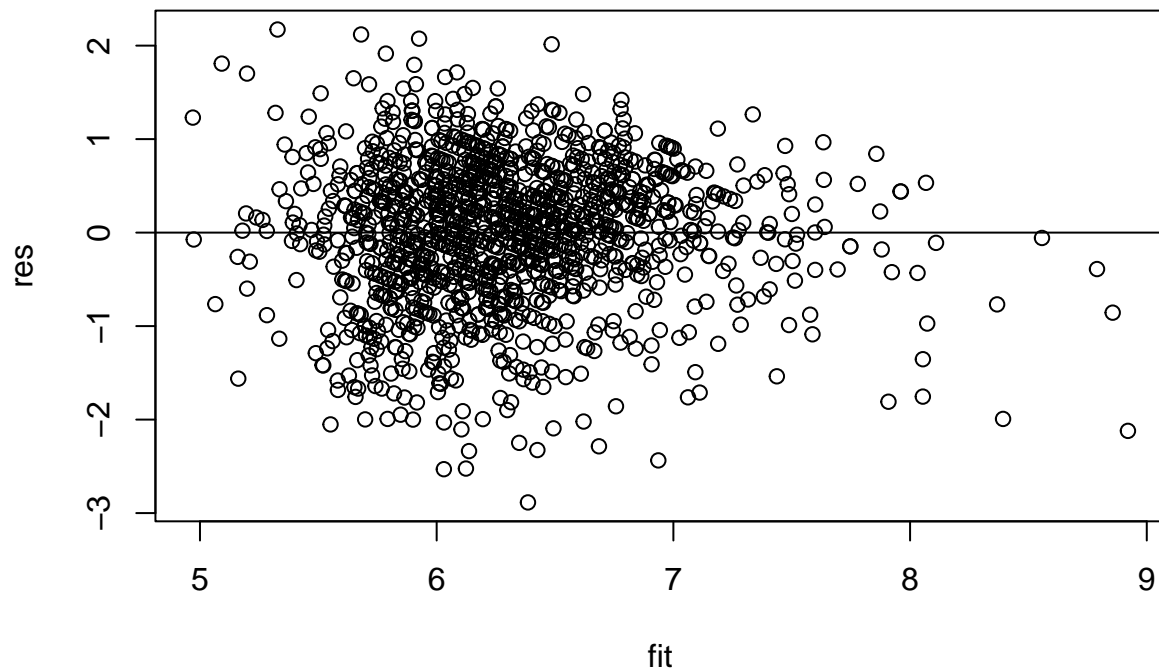


```r
qqnorm(res)
qqline(res)
```

## Normal Q−Q Plot



```
plot(density(res))
```
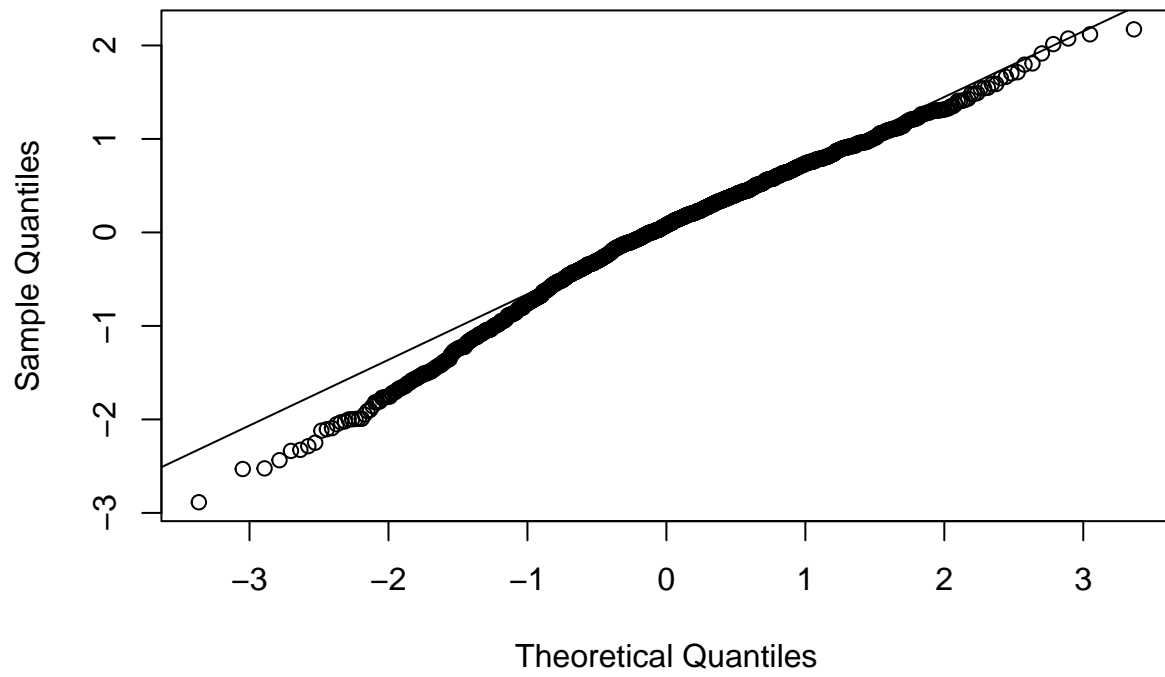
density.default(x = res)
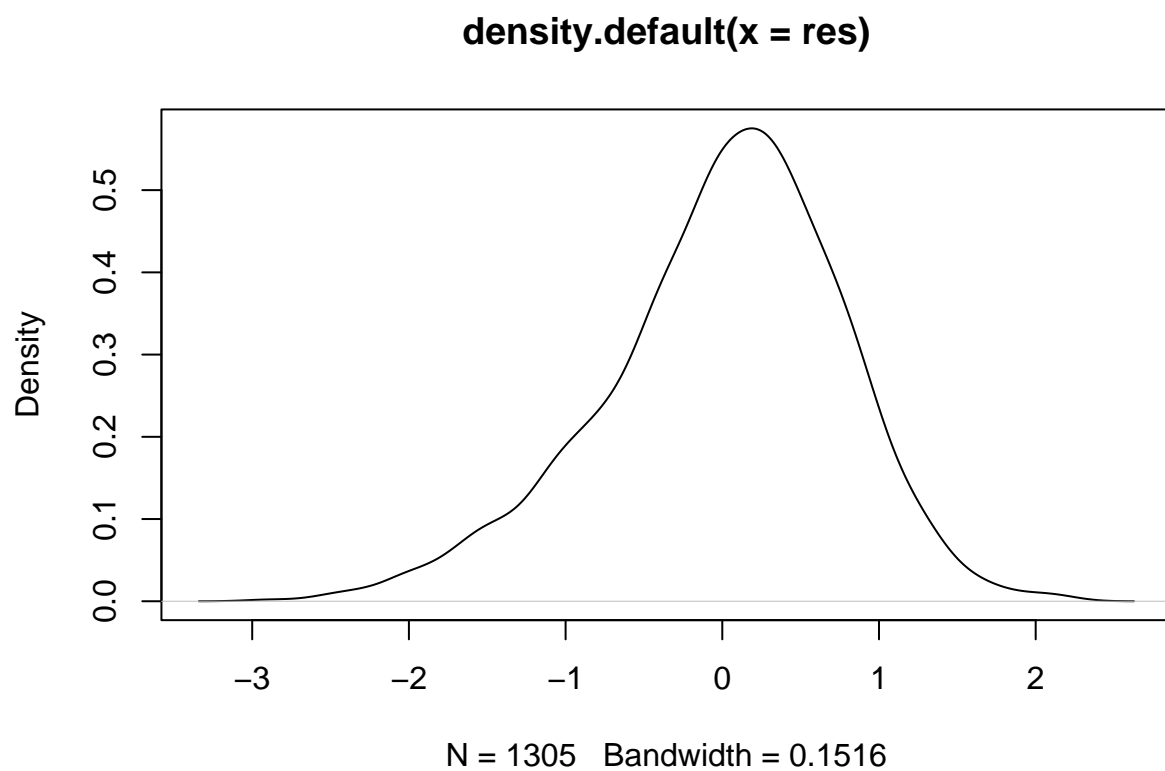
```
ggplot(model, aes(x = fit, y =res)) +
  geom_point() +
  stat_smooth(method = "lm")
```

```
## 'geom_smooth()' using formula = 'y ~ x'
```
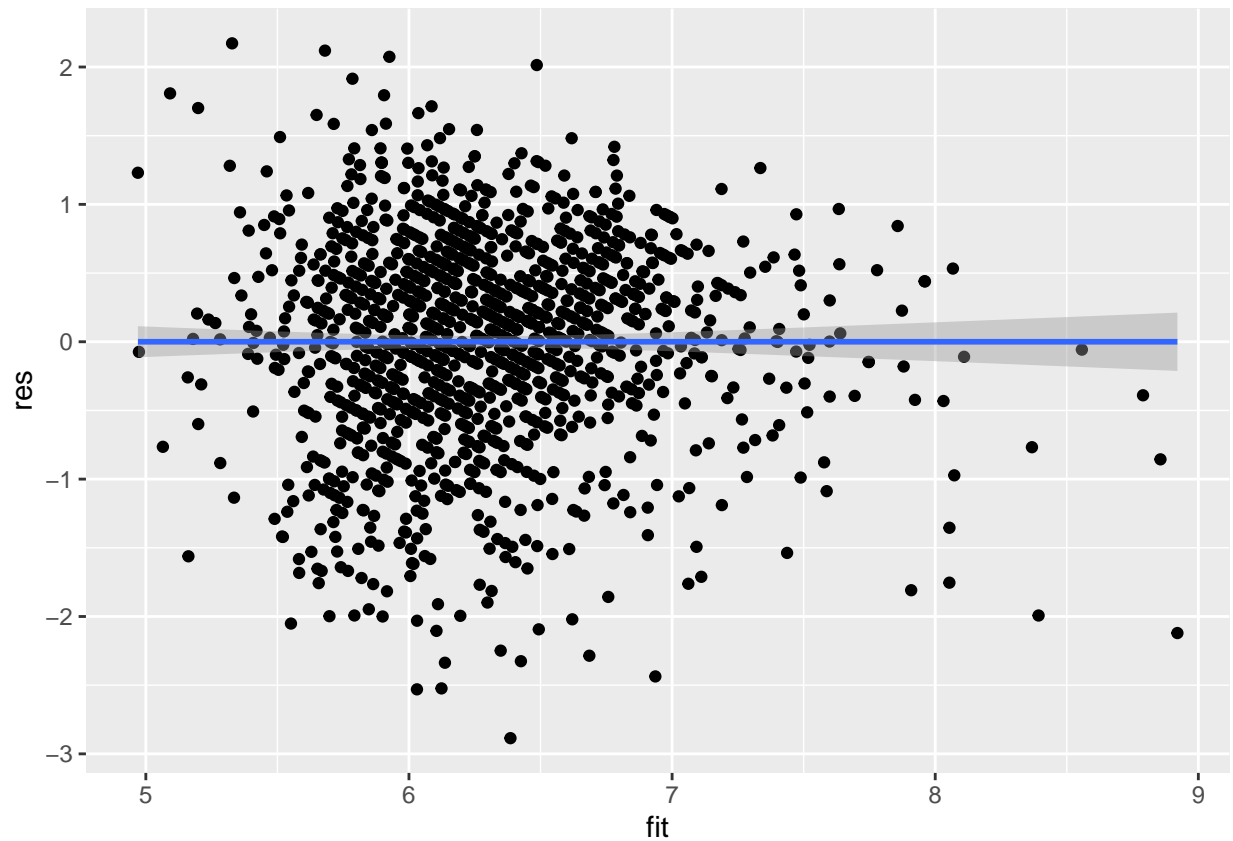
```
pred_model <- predict(model,
                      testset)
forecast::accuracy(pred_model,testset$imdb_score)
```

```
## Registered S3 method overwritten by 'quantmod':
##   method             from
##   as.zoo.data.frame zoo
```

```
##                    ME      RMSE       MAE       MPE      MAPE
## Test set 0.005734627 0.7898513 0.6122712 -1.734408 10.47275
```

```
#model1
model1 <- lm(imdb_score ~ num_critic_for_reviews
             +director_facebook_likes+actor_facebook_likes+movie_facebook_likes+num_user_for_reviews+bud
summary(model1)$adj.r.squared
```

```
## [1] 0.22557
```

```
ggplot(model1, aes(x = num_critic_for_reviews
                   +director_facebook_likes+actor_facebook_likes+movie_facebook_likes+num_user_for_revie
  geom_point() +
  stat_smooth(method = "lm")
```

```
## `geom_smooth()` using formula = 'y ~ x'
```
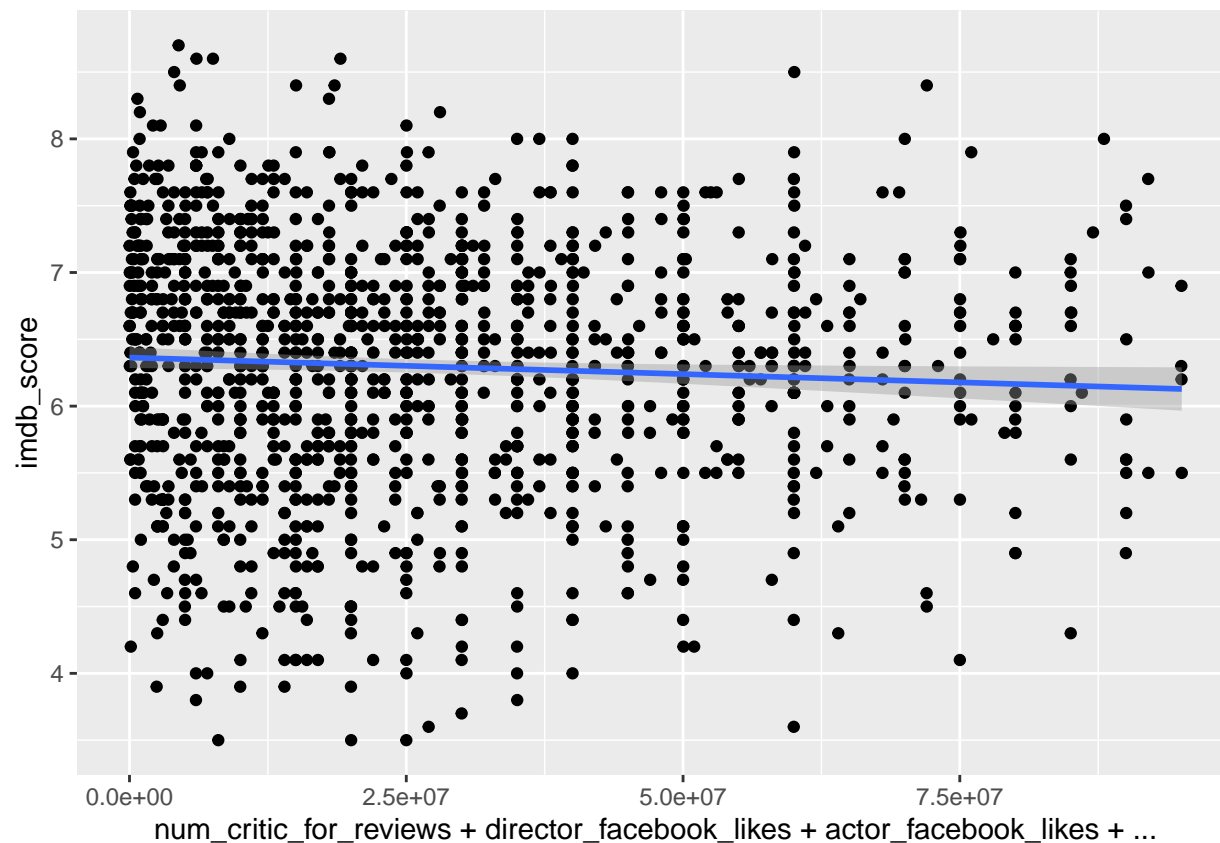
```
#model2
model2 <- lm(imdb_score ~ num_critic_for_reviews
             +director_facebook_likes+actor_facebook_likes+movie_facebook_likes+num_user_for_reviews+bud
summary(model2)$adj.r.squared
```

```
## [1] 0.2317614
```

```
#model3
model3 <- lm(imdb_score ~ num_critic_for_reviews
             +director_facebook_likes+actor_facebook_likes+movie_facebook_likes+num_user_for_reviews+bud
             ,data=training)
summary(model3)$adj.r.squared
```

```
## [1] 0.3151779
```

```
ggplot(model3, aes(x = num_critic_for_reviews
                   +director_facebook_likes+actor_facebook_likes+movie_facebook_likes+num_user_for_revi
  geom_point() +
  stat_smooth(method = "lm")
```

```
## `geom_smooth()` using formula = 'y ~ x'
```
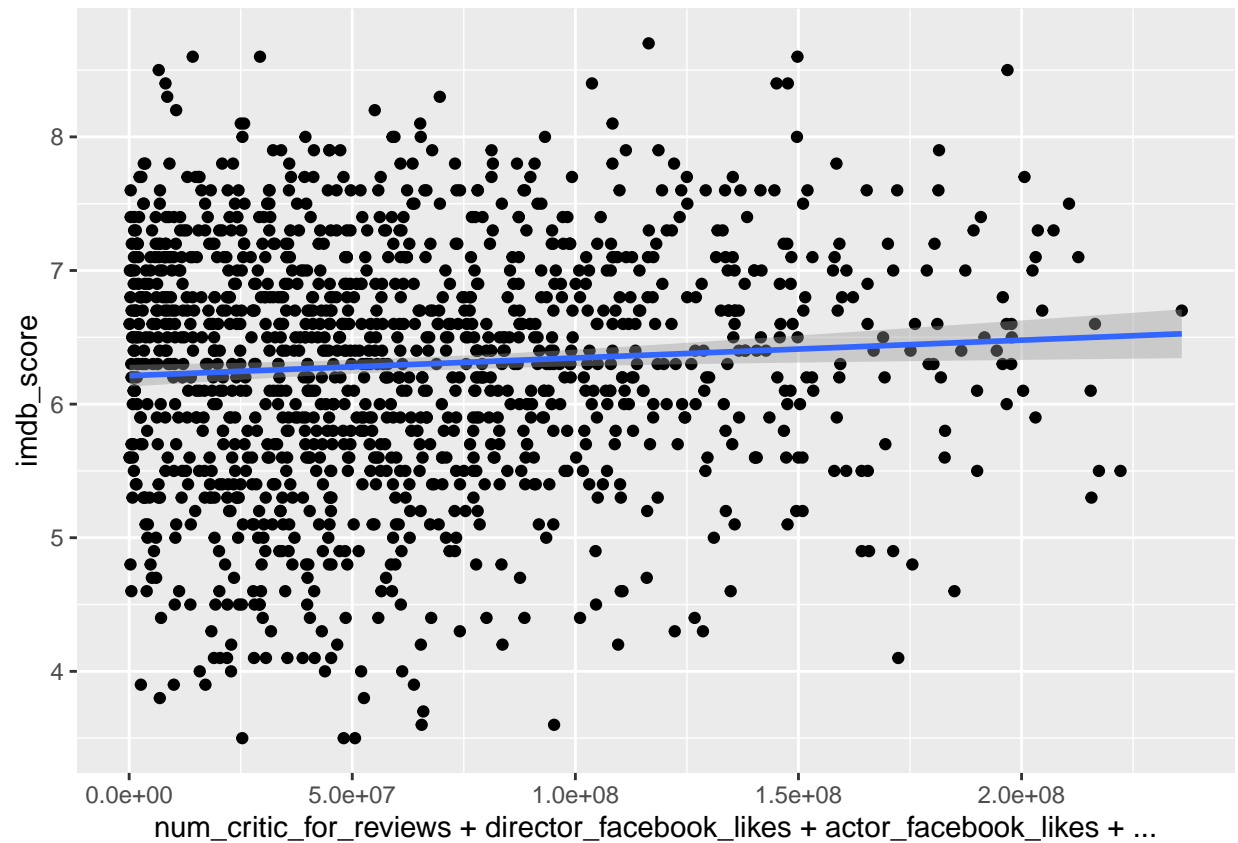
```
#Check prediction accuracy of top two models
#model1 and model3
pred_imdb1 <- predict(model1,
                      testset)
head(data.frame(actual=testset$imdb_score,
               predicted=pred_imdb1,
               residuals=testset$imdb_score-pred_imdb1))
```

```
##    actual predicted  residuals
## 1     7.5  6.316868  1.1831322
## 3     5.7  6.057596 -0.3575964
## 5     7.2  5.929016  1.2709841
## 11    6.7  6.587027  0.1129730
## 12    6.6  5.665016  0.9349845
## 16    7.6  6.098522  1.5014782
```

```
pred_imdb3 <- predict(model3,
                      testset)
head(data.frame(actual=testset$imdb_score,
               predicted=pred_imdb3,
               residuals=testset$imdb_score-pred_imdb3))
```

```
##    actual predicted  residuals
## 1     7.5  6.375473  1.12452687
## 3     5.7  6.000585 -0.30058458
```

```
## 5      7.2  5.580235  1.61976483
## 11     6.7  6.725546 -0.02554582
## 12     6.6  5.536122  1.06387811
## 16     7.6  6.213263  1.38673717
```

```
forecast::accuracy(pred_imdb1,testset$imdb_score)
```

```
##                   ME      RMSE       MAE       MPE     MAPE
## Test set 0.004950095 0.8359286 0.6540573 -1.971389 11.21451
```

```
forecast::accuracy(pred_imdb3,testset$imdb_score)
```

```
##                   ME      RMSE       MAE       MPE     MAPE
## Test set 0.005734627 0.7898513 0.6122712 -1.734408 10.47275
```

```
#We choose model3 because of the lower RMSE and MAPE, which means num_critic_for_reviews+director_faceb
```

```
mydataa <- read.csv("iMDB_outlier.csv")
head(mydataa)
```

```
##                                movie_title     director_name actor_1_name
## 1                                   Avatar     James Cameron  CCH Pounder
## 2 Pirates of the Caribbean: At World's End    Gore Verbinski  Johnny Depp
## 3                    The Dark Knight Rises Christopher Nolan    Tom Hardy
## 4                              John Carter    Andrew Stanton Daryl Sabara
## 5                              Spider-Man 3        Sam Raimi J.K. Simmons
## 6                                  Tangled      Nathan Greno Brad Garrett
##   num_critic_for_reviews duration director_facebook_likes actor_facebook_likes
## 1                    723      178                     976                 2791
## 2                    302      169                     563                46000
## 3                    813      164                   22000                73000
## 4                    462      132                     475                 1802
## 5                    392      156                     976                39000
## 6                    324      100                      15                 1636
##   movie_facebook_likes      gross num_user_for_reviews    budget imdb_score
## 1                33000 760505847                 3054 237000000        7.9
## 2                17372 309404152                 1238 300000000        7.1
## 3               164000 448130642                 2701 250000000        8.5
## 4                24000  73058679                  738 263700000        6.6
## 5                17372 336530303                 1902 258000000        6.2
## 6                29000 200807262                  387 260000000        7.8
```

```
mydataa <- subset(mydataa,select=-`movie_title`)
mydataa <- subset(mydataa,select=-`director_name`)
mydataa <- subset(mydataa,select=-`actor_1_name`)
mydataa$budget <- as.numeric(gsub(",","",mydataa$budget))

training_Dataa <- sample(nrow(mydataa),
                         size = nrow(mydataa)*.6, replace=F)

trainingset <- mydataa[training_Dataa,]
```

```
validset <- mydataa[-training_Dataa,]

modela <- lm(imdb_score ~.,data=trainingset)
summary(modela)
```

```
##
## Call:
## lm(formula = imdb_score ~ ., data = trainingset)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.0284 -0.4860  0.0987  0.5786  2.7405
##
## Coefficients:
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)             4.439e+00  1.113e-01  39.866  < 2e-16 ***
## num_critic_for_reviews  1.816e-03  2.683e-04   6.769 1.75e-11 ***
## duration                1.447e-02  1.046e-03  13.836  < 2e-16 ***
## director_facebook_likes 2.667e-05  6.725e-06   3.965 7.62e-05 ***
## actor_facebook_likes    5.865e-06  1.612e-06   3.639 0.000281 ***
## movie_facebook_likes    3.186e-06  1.504e-06   2.118 0.034315 *
## gross                   3.019e-09  4.277e-10   7.059 2.40e-12 ***
## num_user_for_reviews    2.422e-04  6.894e-05   3.513 0.000453 ***
## budget                 -8.528e-09  6.734e-10 -12.664  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8852 on 1767 degrees of freedom
## Multiple R-squared:  0.3103, Adjusted R-squared:  0.3071
## F-statistic: 99.36 on 8 and 1767 DF,  p-value: < 2.2e-16
```

```
res1 <- resid(modela)
res1
```

```
##           2880          1156          1599           119          2636
##   0.9325873076 -0.7716532846  0.4228965083  1.5834093229 -0.2075211081
##            864          1358           339          1901           446
##   0.4781688229 -0.8578084060  0.1662208402 -2.7687098817 -1.7899126176
##           1120          2128            51            19          1614
##   0.5284099794 -0.0450614522 -0.7156727718  0.4236213130  0.2448234704
##            431           846          2015          1888          2071
##   0.1096441251 -0.6338075222  0.0442539851  0.9105585215  0.0919403784
##            118             8          1350          2606          2226
##   0.8606817528 -1.7821886191 -0.6025178082  0.6025102402 -0.6843541583
##            962          2435          2801          2279          1773
##  -0.0661710633  0.9485032690  1.3366554367 -0.3839081051 -0.6077643405
##           1836           524          1543          2295          1369
##   0.7928102182  0.7392118655  0.3818277028 -0.0361479570 -0.8783199089
##           1635           519           830           391          2686
##   0.0656313520 -0.8369017591  0.3484123187 -0.5985596110  0.9414191641
##           2555          2011          1740          1666           964
##   1.1609015233  0.2878893265  0.7531956699 -1.4227797040  1.3963172034
```

```
##          2645           2330           1534           1797           2753
##    1.4564735547    0.5629771296   -0.4429238791   -0.3828296173   -2.0593548063
##          1430           1478           1922            826           1078
##   -0.2402068205    0.2266776817   -1.4370737713    0.0995688355    0.2219620935
##           374           2594           2938           2634            139
##   -0.3690145008    0.2684129510    0.9217391292   -0.6359324229    1.7918734287
##          1831           2224           1629            951           1356
##    0.6971065522   -0.4268226093   -0.0351569027   -0.3183964884   -1.4608128892
##          1311           1531            614           2354           1895
##    0.3309043150   -0.6372234863   -0.6902947047   -1.7386158955   -0.3637156781
##          2733           2749           1497           1998           2410
##    0.8142930653   -1.1484498875   -1.0224375944   -2.1011900046    0.4116909875
##          1624           1878            577           2460             46
##    0.2500987765    0.4499042694   -0.3180464660    1.2946672497   -1.2003088586
##          1194           2689           1276            188           1900
##    0.5697819930    0.8367296400    0.2687941961   -1.2328524034   -1.0528862619
##          1393           2467            829            112            865
##   -0.0134014814    0.1218358712    0.7025111485   -0.0530517647    0.4682176692
##          1199           2475           1319           2301           2203
##   -0.8574628326    0.3019789620   -0.0634422788   -0.7606243685    0.9234503779
##          1699            857           2189           1741           1185
##   -0.2655500367    0.8602938484    0.0676570249    0.9719783033   -0.2187053223
##          1536            869           2485           2769            429
##   -1.4313156760    0.0448582507    1.7979093264    0.5526895586   -2.4641148250
##          1772           2929           2028            255            151
##    0.2633353475    0.9450057282    1.0349718537   -0.3560656619   -0.2610128862
##           919           2260           1241           2040           1162
##   -0.9521308269    0.5392824819    0.9172852670   -1.3641279341    0.5433170361
##           397           1410            963            196           2885
##    0.2473505475   -1.1023471220    0.3028920183   -0.3765660578   -0.0481431809
##          2643            154           1600           2412           2145
##    0.9553904351    1.3466719455   -0.0382248150    0.6399325226    0.7129712868
##          1690           1802            516           1308           2277
##    0.1659503137   -0.1493358820   -0.3815898761    0.2624270805   -2.1096292735
##          2784           1208           1891            159           1835
##    0.3666358330   -0.0892243435   -0.5212942884    0.9783357009    1.1476344441
##          1636            843            202           1210            186
##    0.3189474277   -0.2510432328   -0.3978729243    0.2563439848   -0.1813223300
##           206            365            670           1815           1867
##   -0.0125247627   -0.1880790941   -0.2865552572    0.0461594117   -0.4231300116
##          2867           2504           1270           1546           2183
##    0.5485463801    0.2854647098    0.3683361613    0.7914375185    0.7565211254
##           376            720           2109           1388           2196
##    0.1008597411    0.2301373892   -3.4655811868    0.2566378224   -3.7978994657
##           262           2620           1273           1948           2795
##    0.0542129970   -0.2632144950   -0.1133172090   -1.5185338277    0.6257330592
##          2771           1736            144           2745           2817
##    0.7799984299    0.7811636683   -0.8906334480    0.2070720395   -0.1162182913
##          2688           2111           2337           2936           1463
##    0.6960495825   -0.0232513564    0.9200964600    0.5282226985    0.4487820025
##          1402           2233           1104           1073           2049
##    0.8319812733    0.3324701102    0.2628573216    0.3745290036   -0.8784770227
##          1938           1648           1428            680            474
##    0.6252033326   -0.5589352742   -0.2769279003   -0.4031050566   -0.1809728927
```

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```
##         2052           644          1687          2314          2355
## -1.2635313360 -1.3789203560  0.9564772301 -0.1608482496  0.2916120628
##          316          1873           935           953          1860
## -0.5529211731 -0.0991354477  0.6979241303 -0.5399862621  0.9128481943
##         1668          2188          2591          1540          1560
## -0.8709254094 -0.4461986585  0.9872457160 -2.1115787917 -1.6600151795
##         2365          1240          2633          2206          2716
##  0.5563893512  0.4395158443  1.0426958639 -1.5255577497  0.9275832479
##         2788          1493           382            32          2930
##  0.9008684178 -0.3976493672  0.3694752808 -0.1523991620  1.2737684112
##         1757          1601          2677          2091           294
##  1.3170819304  0.0229290045 -2.9710613865 -5.0284350837 -0.0069981623
##          229          1713          1782          1712           417
##  0.1513704360  0.5986727666  0.1530726514 -2.6935361018 -0.2107746726
##         2425          2841          2907          1989          2499
## -1.3057588655  0.3176116066  0.9105585215  1.5326163959 -0.4629873173
##          844          1918          1389          1615           238
## -0.1236695670  1.3729410994  0.0512812963  0.0959009330  0.3590888607
##          812          1626           162          1407           848
##  0.3335282042 -1.1475694817  1.0562919569  0.3314511408 -0.7758312136
##         2433            86          1904          2104          2173
##  0.8967282235 -0.7518140053 -0.7559057711  0.2273380955  0.8104882324
##         1858           469           836          2227           175
## -0.5325158199  0.0567866507 -0.7082936677 -0.6399361523  0.1962987815
##         1264          1154          2537          1174          1634
##  0.2765499268  0.1319252586 -1.9443844499  0.0238549536 -0.2088723013
##         2421          2612          2414          1021          2609
##  0.6318759061 -1.5878231408 -1.0124201171 -0.6516197488  0.4299709506
##         2857          1638          1022           337           884
##  1.5309486022 -1.7541324615  0.3720621460  0.8201740161  0.6525298598
##          129          2156          1898          1527          1533
## -0.2651912645  0.9730629125  0.4406776263 -0.7860518915 -1.0970082464
##         2876           378           493          1851          1385
## -0.2405807316 -0.7857103991  0.1665381273  1.2277088135  1.1028604798
##         1377           240          1412          1954           221
##  0.2055948855  1.4004431783 -0.4951813125  0.4837811202  0.3613524008
##         1105            93          1003           602          1584
## -0.0980616936  0.5739533443  0.3687662595  0.0809450728  0.4904826490
##           56          2754          1396          2564           581
##  0.4780516000  0.6215896976  0.5526895586  0.2108879873 -1.4528511945
##          638          2896          2664           476          2050
##  0.8176833640  1.8221963022  0.8628498330 -0.5593991193  0.1340658482
##         1976             9          1195          2770          1422
##  0.1571508939 -1.2184378429  0.3302624779  0.6252817322  0.1629930142
##         1290          2611          2098          2002          2024
##  0.3884077270  1.0594209201 -0.5583124349 -0.3092684200 -1.0553664111
##          330          2597          2809           708           591
##  0.6416726354  1.0801127326 -0.6400117293  0.4776904431  0.5356689934
##         2625          2409          1681          2592          1134
## -3.1909924496  0.0645325844 -0.1291186783 -1.0002815906  0.1152919490
##           23          1085           882          1791          2031
## -0.0142637799 -0.1221398896  0.5223078234  0.9284550576  0.3544761348
##         2076          1452           822           824          1747
## -0.3459855408 -1.1505670679 -0.2482577629 -0.8676616261 -2.5715624835
```

```
##          1460          432         1644         1159          482
## -0.1105222991 -1.3788464622  0.0596726622 -0.1654083017  0.9955064637
##          2647         2710         2610         1253          593
##  1.4590475648 -1.0115255062 -0.7334875057  0.2062586833 -0.8241914071
##          1654         2026         1111         1464          573
## -0.5733651622 -0.7676048396  0.4658762654 -0.5352059580  0.8367773940
##           423          466         2783         1807         2135
## -0.0959234124  0.8898540277  0.3671755549 -2.1346020070 -2.4620023918
##           711         1651          508           11         2284
##  0.0855955867  1.1830097416 -0.5790083528  0.0449267542 -0.0258469336
##            75          589         1604         1390         2831
##  0.4674606713 -0.3888052198  0.1502303819  0.1868724675  0.6492985304
##          1592          258         1899          993         1910
##  0.7668048783 -0.9679129560 -1.0040293871 -0.6142481790  0.6753785851
##           918          726         1313         1456         1132
##  0.0295197248 -0.4000469115 -0.1143664831  0.7570041760 -0.7269186853
##           414          685         2578          584         1952
##  0.4640809445 -1.9412103781 -1.6774697206 -0.4692655916  0.1477790953
##            26         1083          268         1007         1100
## -1.4751252639  0.8628114959  0.7088076117 -0.2702360455 -1.2120715265
##          1467         1991         1012          136         1171
## -0.3324594452 -0.0809597381  0.2933495985  1.1890556139 -0.1247800862
##          2866         2119         2334          201          102
##  1.2137652941  0.5632683489  0.1404824939  1.6755257627 -0.3118622277
##           603         2123         1386          759         2653
##  1.0725771536 -0.5766353482  1.1973401084  0.0787983435  2.1627548888
##          1869          395          271         1368         1450
##  0.6371032341 -0.8641992750  1.0642711471  0.1502303819  0.2224547648
##          2706           64         2315         2889         1220
##  0.8918881855  0.3635267858 -2.6370156519  0.9783357009 -1.1021642311
##          1158         2384         1129         2201         1512
## -0.8368432876  0.7494296483 -0.0540236393  0.4070783800 -0.5269621345
##            43         2273         1442          515         2684
##  1.0780064351 -0.4967182753  0.3994215038 -0.8800431143 -0.6026290957
##          1859          769         1093         1177         2895
## -0.6708056996 -0.4666943828  1.4035274727 -1.0543215979  0.0283454250
##          2886         2695         1438         1443         2849
## -0.4876887268 -1.7579615836 -0.6536630655 -0.0738288323  0.5362125910
##          2810         2382         1819         1212          264
##  0.3811286286  0.3176398795  0.0955720579 -0.6104047585 -0.2796643776
##          1103          876          116         2332          627
## -0.5639384498 -1.1191741499 -1.3692266777 -2.1830525439  0.1652432913
##           905          601          834         2370         2776
## -0.5436884250  0.4707122143  1.1124752302  0.7667036450  0.4900598620
##          2862         1820         2878         2940          910
## -1.0529099448 -0.5568465277  0.8050849572  0.4007146397  0.2895852178
##          1095         2544         1286         1929         2882
##  0.4592310146  0.7031235091 -2.0423369415 -1.2934197489  1.1241965985
##          1620         2899          613         1099         1879
##  0.5517058808  0.7631967217  0.7826617540  1.0486992594 -1.3982505802
##          2219         1426          288          902          677
##  1.0158570007  1.0077018953 -0.3593947735  0.3291386169 -0.0844986154
##          2181         2848          390         1683          858
## -0.0613771719 -0.2310143945  0.1047589780 -0.5156841107 -0.0502062606
```

```
##             2317           2083           1116           1299           1893
## -1.3815175961 -0.8911980259  0.3546950500 -0.6847252365  0.3495001387
##             2699           1277           1656             48           1655
##  0.4698938968 -0.2800972519 -1.4479314425  1.6692154453  0.2881973583
##             1178           2919           1697           1044           1349
## -0.7107408052  1.1867720770  0.1902898957  0.0123888252  0.2007402767
##             1698           1140           2589           1372           1416
##  0.6148831033 -0.2051951853  0.3929436625 -0.0328014694 -0.6916992700
##             1108           2487           2797           1675           1940
## -0.1043527555  0.9474451707 -0.8641992750 -1.3765265189 -0.7601144358
##              403           2654           2541            165           2614
##  0.1287941815 -0.5742852064 -1.4329545441  0.8872386965  1.0015395596
##              195           1424           2333           1514           2455
## -0.1041693461 -0.3849020728 -0.3091864328  0.9881048869  0.5986517767
##              933           1609           2172           2820           2640
##  0.5525803760  0.1693401265  1.7624399625  0.5258633389 -0.0790222049
##             2325            191           1458           2488           1535
## -0.5466959718  0.5134399228 -1.3602161030  0.2950410752 -1.2146889410
##             2234           2760           2531           1432           2275
##  0.0906507045  0.6075185794  0.4148258148  0.0019392487 -0.3315571553
##             2626            611            456            281           1166
##  1.1659763704 -0.2562328643  0.1506497409  0.3215582343 -0.3024944198
##             2000           2903            811            514           1357
##  0.5986007024 -0.1108084543 -0.3000849242  0.7769052083  0.2022849819
##             1417           1209           2696           1909           1164
##  0.1483709461 -0.3372200054  0.8159770445 -1.7600235278 -0.2264511249
##             2743            943           1947            283           2434
## -0.6750405055 -0.7183088196 -0.0001149737  1.1457626980  0.1577103512
##              556           1708           2941           1080            234
## -0.1019344226  0.7619872628 -1.8607689119 -1.0485608484 -0.1684927767
##              168            795            266           2630           1964
##  0.4216663543  0.2030362378 -0.4498134165  0.5612097574  0.9802934303
##              245            215           2656           2708           1361
## -0.5106380360 -0.0619269394 -0.3301939144 -0.4635143983 -0.1615520034
##             2650           1951           2682            396           1135
## -1.9611539131 -1.2464866276 -1.3504022898  0.4162511080 -0.0137658542
##              735           2814           1150           2066           1733
##  0.4541760010  0.2911033506  0.7732648521 -0.1598821585  0.1047536222
##             1547           2851            368           2387           1824
## -0.6482427688  1.0718370796  0.6829639912  0.0726185812 -0.2684591399
##             1943           1643           1573            689           1128
##  0.0607662598 -0.9317184146  0.4140985737  0.3745956520 -0.4324290702
##             1538            774           1006           2159            899
## -0.4469054010  1.0699402425  0.6954940346 -0.1652580325  0.1871323570
##             2094           2121            878           2450            754
##  0.5882829343  0.8036726711 -0.1625058934  0.3023469340 -1.1884356055
##              653            661           1176            842             77
##  0.1515040223 -0.7137620399  0.0265276931 -0.6365163284  0.4387782956
##              216            588           1685            520           1089
## -0.1501264794 -0.1027370181 -0.6249304896  0.1681905503 -0.0260992152
##              568            969           1745           2517           1695
## -0.0711035563  0.4875788113  0.9795313949  0.2941717356  0.5450830369
##             2164           2805            718            851           1211
##  0.2988720436  0.5956928779 -0.3301997793 -0.2569540166  0.7923900820
```

```
##          1247          1632           445           696          2588
## -0.5515456030  0.3750720898 -1.2421520241  0.3353019193  1.5169556553
##          1056           574          2029           622           542
##  0.1990189284  0.0495941718  0.4912386958 -1.5533537796  0.0211755605
##          2420           470           103          2932           194
##  0.1731898768  0.4518391880  1.8148755880  1.6892125797 -0.5773665311
##           787           823           537           766           576
## -0.7033046789  0.0523411265  1.0037840400  0.7831006301 -1.1467458496
##          1087          1593           701          1717          2377
## -0.3078019391 -0.3591900631  0.5180408981  0.1214500721 -0.2874091506
##           954          1625          1503          1067          2170
## -0.0688082466 -0.0817885574  0.3958966158  0.2211309373 -1.6451821123
##          2452            58          2471          1306          2747
##  0.5780244120  2.0438927022  0.7155356020  0.7352288387  0.5544367498
##           275          1259          2008          1864          2842
## -0.5624083456  0.2423124351  0.2589026477 -1.5277762573  0.2966650697
##          2679          1202           794           505           732
## -2.6873344385  0.5560827345 -1.2409562583 -0.9150971479  0.0779144114
##             4          1008           523          1001          2824
##  1.1617893010 -0.0862553019  0.2439983715 -0.7444289754 -0.3009230475
##          1296          2231          2785           379          2570
##  0.6610199129  1.0377437120 -1.3357714688 -0.0838637604  0.1384348095
##          1829          2165           124          1188          1433
##  0.0603333549 -2.8999812418  0.2071999418 -0.7775802061  0.7355472105
##          1029            47          2670          1739          2671
##  0.0438754971  1.1384619593 -0.7595554639 -0.2368639485 -0.9067447427
##          1309           481          1278          2508           917
##  0.2375090945  1.1830224882 -0.0147057766 -0.1503260020 -0.3440636018
##            72          1327          2877           135          2718
##  0.7125379323 -0.5994313815  1.4104306555  0.5537237126  0.8625119741
##           652           580          2092           421           479
## -0.2029184902  0.3389592898 -0.2796533406 -0.6986363025  0.0456891099
##          2307           814           503           742          1057
##  0.6877402289 -2.2992883998 -0.5234248661 -0.2130141284 -0.9143759488
##           261           986          2526           802          2582
## -2.2801893070  1.4460346540 -0.5523563012  0.0789278396  0.5447161398
##           347          1146           109          2703          2406
## -0.7648938612  0.6075185794 -0.0654557975  1.5689919163  0.5025996590
##           237           554           630           138           128
##  0.7236518087  0.0699728377 -0.0707282986 -0.2097358031 -1.0928116057
##          1981           958           259           306            39
## -0.7079270487  0.4446723088  0.9384139059  0.3465973653 -0.2297380355
##           789          2268          2432          1326          2036
##  0.1606375126  0.3544450261 -2.0583299913 -2.1473847013 -0.1026310124
##          1912          1359          1790          2298          1709
##  0.7832845656 -0.2051108090 -2.7135855492 -0.6591804044  0.8306763473
##           913          2285           462          2372           352
## -0.1542326696  0.1984540401 -0.3289679707 -0.2163922568  0.1348170587
##          2416           674           598             3          1559
## -2.7738098023  0.8430034198 -0.2664288788 -1.2011883382 -0.7963502988
##          2230          1821           426          2265          2685
##  1.3433136753  0.3818922511 -0.2079053170 -0.1310913968 -0.5743827934
##          2017          1575           631           997          2077
## -0.0825562484  1.0227396852 -0.0367316664 -0.3325313661 -0.4122927971
```

```
##            278         2496         1251         2239         1288
## -2.2317428873  0.4873469051 -0.0017081226 -0.7976395770  0.8230417374
##           2454          868         2287          553         2346
## -3.4833617838  0.0160154574 -2.1168815282  0.6690093786  0.3475593838
##            319         2218          512          385         1679
## -0.0432983908  0.8345710737  0.2387847028  1.1014328655 -0.4432687702
##           2051         2572          784         1963          487
##  1.1986925087  0.7650621337 -0.5907733698 -0.0572149410 -0.3802701088
##           1173         2871         2379         2955          928
##  0.1131321062 -0.4061150783  1.8575077518  1.3900441121  0.6917556235
##            536          641         1927         1862         1064
## -0.4886082073 -1.1211360343 -0.3237044614 -0.7889478266  0.2227854883
##           2551         2951         1732         1376         2756
##  0.1497308291  0.6096221330 -0.1137288657 -1.0333538139 -0.4399427257
##           2339         1704         2375          308          817
## -0.0365536647 -0.3568736053 -0.6953565146  1.2756537925  0.2183095107
##            904         1451         2055           63         1091
##  0.1960609494  0.0393789282  0.1428333851 -0.6474956449  0.5110408276
##           1088         1856         1631          157         2208
## -0.2337290155  0.2933725285 -0.1016814048  0.5327506805  0.2872345021
##            831         1074         2259         2774          220
##  0.9365855172  1.1296136209  0.6723823520  1.1150886658 -0.3752790366
##            747         1014         2532         1885         1147
## -0.8452026698 -0.2635320477  0.7759753831  0.1240202030 -0.2777274782
##           1658         1453         1124          637          783
## -0.2478447270 -0.6502842516 -0.3598525035  0.0188255093 -0.6428489386
##           1139         2528         1041          155         2280
##  0.1065343017 -0.3739710323  0.3780050385  1.2973609774  0.0454430481
##           2240         1252         2744           33         2607
## -0.5082905502 -1.0293488871 -1.5101642617  0.2296416711  1.4120488022
##           1920         2865          673         2873         1866
##  0.2872598655  1.2134513183  0.1580137358 -0.0215042121 -0.2400551064
##           1145         2850         1650         2149          540
## -0.3617683015  0.4922288470  1.6119755134  0.2070143817  0.0438370831
##           1420         2364         2006         2081          891
##  1.1109734698  0.4972754580  0.8033698519 -1.8074460629  0.3994541321
##            370         2884         1043         1348         1322
## -0.5737159034  0.7687973385  0.4421101297  0.0486134975  1.0925463025
##            413         1580         2844          819         2651
## -0.0556073601 -0.2777712310 -0.4081902254 -1.7302114990  0.1391651922
##           2927         1565         2310         2730          454
##  1.7577176292 -1.9374155892  0.5643124931 -0.7049881128 -0.1717578777
##           1659         1555         2709         1916          799
##  0.4634527761  0.1823536027 -1.0121198646  0.8776385089  0.5419313846
##           2577         1758         2827          719         1619
##  0.3743774155  0.0426801850  0.1580137358  0.1624785106 -1.0124984018
##            384          585         2472         1499         1649
##  0.1569916069 -1.4333121780  0.7046794525  1.2352967922 -1.1492142295
##           2584           14         1470          861          440
##  0.2933471679 -1.3467985323 -0.3872032973  0.9791789865 -0.0429092242
##            453         1537         1019         1408         2391
## -0.2651928218  0.5254956617 -1.6937212711 -0.3557196944  0.0390308005
##            989         1607         2042          728         2041
##  0.3743194512  0.5349115694  0.3649930375 -0.7575461915  1.0849481669
```

```
##             1729           2070            550           1660            860
##      0.7479195023  -1.1232764921  -0.5452021590   0.0167535847   0.4785615751
##             1845            346            408           2822           1363
##      1.3237412670   0.7775793584   0.4706907895   0.9454877662  -1.8151642087
##             2811           1123           2292           2571           1477
##     -1.3726428971   1.5485281092   0.9179364389   0.2155189358  -0.7690009240
##              263           1476            441           2559           2779
##      1.8814993187  -0.7055101186   0.6302700119  -1.6056076073   0.2175771262
##               13             73            364            786           2529
##      0.7182481848   0.7795255689  -0.2680767373  -0.8732476435  -0.1785739219
##             1957            770           1487            945            276
##     -0.3927992426  -0.6038198806   1.1476600081   0.3670604614   0.8102403536
##              688             67            252            693           2445
##     -1.0576263064   0.0385279084   0.2405270704  -0.0117326107   0.3347466279
##             2229           1882            934             45           2837
##      0.4675240080   0.8163919371  -0.1278416997  -0.9493414495   2.2790080585
##             1465            681            459           2108            695
##      0.0436299268   0.7992066630   0.2792719716  -0.2169936149   0.5022968018
##             1204           1521            757           1843            133
##      0.6613752070  -0.3651493544   0.5052015272   0.8101175424   0.4819330721
##             1863           1024           1994           2162            172
##     -0.1317915877  -0.6363354200   0.2339227158  -0.1728260012  -0.9352921396
##             2283           1711           1774            355            147
##     -0.0468540879   0.1932749627  -2.7018922715  -0.7225142448  -0.0141420745
##             1504           1061           2220            906            849
##     -0.4914858868   0.1142779418   0.5802027812   0.4848925959   0.0234064817
##             2393           1096           2556           2018            877
##      0.2892219646  -0.5953183645   0.7196955337   0.3995828869  -0.5075407738
##              716           2187           2347            342            599
##     -0.0237141945   0.6949704696   0.3915442529   0.4273105958   0.2671344364
##             1130            293           2013           1491           2497
##      0.1397462588   1.0975272109  -0.5430776052   0.9990961817  -0.2076455051
##              925           2215            315           2278           1595
##     -0.3339965919   1.0760868935  -0.3029824180   0.6777568045   0.2955959533
##             1842           1552            596           2898            483
##      0.2346969897   0.3481495789   1.6117048571   0.1716264190   0.3722265872
##              448           2319            528            896           1670
##     -0.3245145283  -0.0956048637  -1.5138517089  -0.0095792010   0.7790619567
##             2479            952            965           2197           2547
##      1.1720524920   1.2229066585  -3.7023189378  -1.0158914394   0.7728858844
##              511           1337            662            461           1297
##     -0.3432505651   0.2414289809   0.0059525419   0.4927106587  -0.1629997361
##              818           1962            532            304           2441
##     -0.0899326646  -0.1160788272   1.0429732931   0.3093208640   1.0486302545
##             2444           2303            521            125           1237
##     -3.8118535353   1.9744520678  -2.6850093614   1.5795102788  -0.2593969689
##             2270           1969            971           1971           2246
##     -1.0658655553  -1.1740227856   0.6773416968   0.7631951651  -0.5900214531
##             2773           1932           1579            373            539
##      0.5662101865  -1.4528492676   0.2175592641   1.2838396039  -0.7427427294
##             2674           2692            565           1771           2329
##     -1.7780007722  -0.7872818850   0.2054329858  -1.2228874205   1.1368894545
##              740           1425           2396            762            850
##      1.2653424823   0.2289072471   0.5229343049   0.3167863660   0.4955961843
```

```
##           2548          1481           936          1720           833
## -0.7751014933  1.1839159575 -0.1224610230  1.1996996817  0.2357625856
##            297          2495          1541          1663          1017
##  0.3904178134  0.3516461960  0.6470101367  0.7108504101 -0.1309236008
##           1373          2494          1883           705          2395
##  1.3237412670 -0.9653184417  0.6520819173  0.4639490658  0.8297627694
##            796          2397          2342          2599           750
##  0.2573160637 -0.7360850211  0.9217391292  1.4639204392 -0.5907292721
##           2707          2905           792          2503          2095
##  1.2895600479  1.8089110646  0.0023710260 -0.7716487498 -0.4483580795
##            303          1562           675          2558           265
## -0.5271981046  1.1858911642 -1.8781429736 -0.4115202003 -0.7336125850
##           2361           309          2887          2911          1232
## -0.4184496644  0.3184084815  0.3598354042  0.9836581744  0.8557556206
##             65          2641          2266          2143          1696
## -0.2683970638 -0.5926201442 -0.9091073865  0.7661528945 -3.8709378473
##              6           534          1761          1818          2476
##  2.7405368847 -0.4167775291  0.4360432422  0.9236801270  0.0353868800
##            656          2402          1561          1988          2728
## -1.1906532537  0.9395083998 -3.0730037719 -0.5259669341  0.5271803694
##           2790          1071          1693           684           377
##  0.4964425250  0.7617005487 -0.3823289891  0.5612276725 -1.3109822186
##           1242           890          1727           778          1839
##  0.1067989446  0.6977489774 -0.7708977429 -0.1534827557  0.3075526202
##            212          2195          2249          1515          2539
##  0.4492913174 -0.2883759940 -1.2868844908  0.1130751764 -1.3896929364
##           1669          1517          1935          2782          1542
##  1.1584859065  0.8621872594 -1.5805794645  0.6722650082  0.5024174099
##           2276          2701           889           277          2258
##  1.3324019489  1.6007530172  0.4126642730  0.4618189838  0.1237792863
##            360          2901          2302          2097          2520
##  0.0169814356  1.2149733776  0.2047862877  0.4903567820 -0.8772286251
##           2255          2157          1652          1996           251
##  0.8602905417  0.6037809621 -1.1507075120  1.1166422976 -0.1652138764
##           2045            81           678           714            22
##  0.2696829215 -0.4696956243 -1.1662670523  0.1441814246  0.8208540438
##            369          1236          1960           480          2786
## -2.1980729701  0.5426583824  0.7144466725 -1.0243114208 -0.0694272398
##           1811          2368          1317          1889          1291
##  0.6681143552  0.0623390198 -0.4521839614 -0.6848451518 -0.0220428299
##           2462          1841           329          2952           324
##  0.4668823241 -0.1851434908  1.4290230607  0.1363577348  0.8918065707
##            791          1378          2446          1233          1254
##  0.3678944871  0.2847173367  0.5892509555 -0.6604556904  0.4180206457
##           2019           457           388           404           773
##  0.4258989342 -0.4528442558  0.2750281498  0.6457228458  0.0235184503
##           1131           616           743          2835          2858
##  0.1571014252 -0.0694272398 -0.2423308028  0.4491295134  1.0859550557
##           2767           184          1653          2603            27
##  0.2751684124 -0.6175471093  0.0332836681  1.4443504096 -0.6712824968
##           2511          1480           145          1827          1825
## -0.0922485537  0.0518233320 -0.6876088750 -0.3469726926 -0.1434978731
##            745          2658          1398           205          2242
##  0.7659156084 -0.5850161573  1.1631678223 -0.3320539728  0.7581303580
```

```
##           1137           1549           1126           2521            749
## -1.2276375296 -1.1261264507 -0.3690471137 -0.8954346785  0.2572350824
##           1072           2388           1949            181             29
## -0.2583596506 -0.2465671165 -0.7159509386 -2.4672003581 -1.2237664060
##           1172           2381           2200           2344           1418
## -0.9778672445  1.2093242379  1.0466629734  0.6443347943 -0.1283754114
##            105           2727           2141            912           1557
##  1.3073150697  0.4156882141 -0.3261082436 -0.2658890506 -1.5916940972
##           2261            156           2134           2470            940
##  0.3083972796  1.6239086856 -1.4556531369 -2.3552649626  0.3516993708
##           1054            978            507            838           1678
##  1.4944139959  0.1179768039  0.1261331208  0.3440427521  0.5636709362
##            707           2512            615           2598            806
##  0.3646106165  0.7287651973  0.2592197782  1.0892944417  0.1547246035
##            797            182           2540           1770            648
## -0.3544115947 -0.3237660905  0.6297487878  0.9931349163  0.1627382321
##           2440           1830           1186           2723           1136
##  0.1619395374 -0.4350484580 -1.0903916567  0.2402564556 -0.5418514119
##           1966           1766           1597           2169           1803
##  0.9592191566  0.3076041838  0.2604138139 -0.8994340767  0.3697097487
##            609            150            564            764           1016
##  0.2794560922  0.3913153216 -1.0988880616  0.4026159721 -0.5554153032
##            420           2236            970           2205           2139
## -0.5429346759  0.7242480936  0.6463417048  0.5523313917  1.0544790405
##           1702           1550           1870           1392           2138
##  0.1953523925  0.4651351141  0.6703712449  0.9464772641  0.6228399260
##           2321           2426           1686           2068           2177
## -0.3245543205  0.8771679039 -1.9922053396 -1.2179700427  0.1885036207
##            753           1905            270            284           2900
## -1.0982483922 -0.1256593451  1.4167971468 -0.1356692987 -0.7537922629
##           2500           1973           1168           2451           2502
##  1.1146229473 -0.1432400280  0.7025940356  0.6028987885  0.9784917454
##            152           2678           2251            111           1724
##  1.1059094174  0.8590947085  0.3274357938  0.1757127443  0.0955564199
##           1941           1170           2514           1038           1588
##  0.9912930724 -1.0999240007 -1.0748249783 -0.8893272447 -1.0534231163
##            386           2116           1894            780           2680
##  0.0682337463  0.2476651902 -0.4713066976  0.6459594461  0.4775324534
##            244           2617            200           1568           1455
##  0.0426922242 -1.2483989121 -1.4342296379 -0.4932034865 -0.6821663307
##            546           1284            741           1473           2632
## -1.0097617799  0.9448356064  0.5844511610  0.4654880088 -0.9155941381
##           2576            241           1026            722            881
##  0.2893747923 -0.1515722137 -0.9418147117 -0.1382050561 -0.2147204726
##           1721           2398           2082           2740           2575
## -0.3415362102 -0.6152569048  0.8977119583  0.3089409876  0.7249903876
##           2167           1440           2845           1783           2713
##  0.0990594146 -0.2283811251  1.0938507887  0.7502916060 -1.7614045212
##           1231            471           2263           1205           1642
## -0.0755806866 -0.6590563486  0.3518700965  1.0236095885 -0.2278495095
##            393           2209            624            422           1002
##  0.7434901139  0.4223893613 -1.5096136456  0.1587631010  0.6176299474
##           1816           2725           1955            199            137
## -1.0575826032  1.3839730027 -0.9266094286 -0.7894748393  0.2436739762
```

```
##             992        2311        2550        2322         768
## -1.3906646779  0.4967513451  0.5061437157  0.3729362160 -0.6566818035
##             549        2819        2133        1577        2158
##  0.6179999835  0.6920525380  0.7266634882 -1.8094852015  0.8530338341
##            1880        1564         291        2127        2552
## -0.0822497913 -0.3289314430 -1.1887213211 -0.5568120642 -0.4611756624
##            2309        2600        2830        1324        1786
## -1.6136716580  0.5393327810  0.2180666129  0.7620890332  0.5207661631
##             856        1303         873        1558        1726
##  0.7836873509 -0.3011092529 -1.0456857185 -0.9093659536 -0.6110991575
##            2473        1587          84        1353        2565
##  0.7456786418 -0.8092313358  0.3996170004 -0.3946168169  0.9970796655
##             709         371        1192        1714        2720
##  0.4210759444  0.0884926690 -0.2019184493  0.0522682308  0.7557000173
##            1169         608          70         169        2351
##  0.7384620089 -1.1736940317  0.1103326358  1.3826752259  0.9916161959
##            2631        2316        2366        1307        2443
##  2.2777357603 -0.0078712747 -1.0113371435  0.4591863079  0.3894202714
##            2715        1692        2039        2888        2257
##  0.8170880517 -1.9556095412  0.7686616193  0.4615195385  0.0398910075
##            1742        2505        2847        1591        1855
##  0.4732777937  1.7100493261  1.7316900699  0.2636247084  0.6790103961
##            1911         655        1395          42          30
##  0.0258922792  0.9456644516  0.7797785776  0.9082853040 -1.2059358983
##            2144         724         914        1374        2312
##  0.4068186255 -0.3103772818  0.4041477447  0.0719249025 -0.6113403342
##            2340        1075         489        1812        1853
## -1.4753477336 -0.5917651502  0.6646409319  0.0503164832  0.7225487666
##            1890         888        1688        1045        2943
##  0.2555779570 -0.7079270877 -1.4784864736  0.5872113451  1.0122129374
##             915        1263        1193         739         839
## -0.2362006023  0.6986607873  0.3469844798 -3.6957695573  0.2774266752
##             990         192        2553         372        2818
##  0.6031857739 -0.0837876017 -0.1672430624  0.8339714855 -1.0871427839
##            2151        2676         183         955        2300
##  0.4319829808  0.1295002239 -0.2313980422  0.5449222066 -0.3560656619
##            1342          96         282        2415         171
## -0.4673337447 -0.1605490820 -0.0609591557  0.9744558529  0.5431942495
##            2345        1228        1519         968        2585
##  0.3975444886  0.7326408538  1.1272768476 -0.4281906725  0.6628231127
##            2100        1098        2586        1086         854
##  0.6019942863 -0.4032232894  1.1211452907 -1.5625094213  0.2980769481
##              35        1875        1215        1834         903
## -0.3714246257  1.2109186775 -1.0121198646  0.4819629605  0.2743196225
##            2734        2179        2089         219        1622
## -0.8109879474  0.4746638288 -0.9877033940 -0.1693791777  0.9161330285
##            1931        2056         837        2746          99
## -0.6438628599 -0.0992711836  0.2957347926 -2.9091845255 -0.3188981678
##             394         852        2057        1351         552
## -0.3156170376  0.9506617158  0.2927559643 -0.8439238638 -0.0467221851
##             665        1701         178        1399         375
## -0.6729782164 -0.8027160252  1.0880613179 -0.0486458065  0.4457546580
##             235        2126        1457        1258        1798
##  0.4944230478  0.6245945050  0.5731095963  0.7472408305 -0.7214393639
```

```
##           320          2616          1572          1778          2004
## -0.6272414378 -1.3155930007 -0.3967179255  0.4670781853 -0.9715066164
##          1551          2834           870          2491           813
## -0.4826173637  1.4114128447 -0.4891349487 -2.9528612291 -1.3479319800
##          2604           686          2661          1471          2925
##  0.2071354286  0.4572024548  0.7884756363  0.4430647326  0.2971985557
##          2755           117          1524           485          2762
##  1.6562538161 -0.1616361209  0.2412267514 -0.4096921556  0.1037861541
##          1461          2667          1764           121          2174
## -0.8385951117 -0.7612548548 -0.3039286148  0.1472639973 -0.0496535388
##          1444          2483          1814          2874          2293
## -0.2846423265  0.1640622170  0.2828637988  0.2763276137 -0.0751603134
##          1070          2407          2048           269          1608
##  1.3744464255 -0.7292627138 -0.2261748720 -1.3613620397 -0.6449953954
##          2212          1321          2012           517          1522
##  0.1495021014 -3.2126316037 -0.1794820926 -0.1821581305  0.2359137760
##           356          1015          1127          1315           250
##  0.8068661315  0.5425661283  0.3209811604  1.3692294103  1.9247032603
##          1200           435           687          2665          2060
## -0.0848943197 -0.7427010847  0.8660175605  0.2537102316 -1.1487861460
##            90          2628           803          2269           594
## -0.6516107044 -0.0889472075 -0.4854606850  0.8100676864  1.0876566763
##          1238          2103           410          2457          2131
## -0.6454968698 -0.0467713163  0.7208014067 -0.2495892153  0.8802265351
##           273          1437          1037          1122           455
## -0.9184242285  0.4031661186  0.3500862190 -0.5808777606 -0.6815816284
##           960           140          1925           108           569
##  0.4615972564 -0.2594787778 -0.6160978731  0.5997050343  0.6998246715
##          1076          2569          1035          2580          1511
## -0.0842614452  0.3563982032 -1.2075427790  0.7262001550 -0.7471909289
##          2545           555          2386          1914          1510
## -0.2610763151  0.1892233806 -0.0921031906  0.1943339531 -0.4115034864
##          1509           715           142           434          1785
##  0.5094351813 -1.0689197373 -0.2785634633  0.3110701365 -1.1924123072
##           874           845           668          1924          1025
##  0.3532557694 -1.4722986421  0.2383016817 -0.3794488819  0.6615104352
##          1138          1384          2155          1446          1574
##  0.1416965143  0.8210451316  0.9439978631  0.5132742990  0.1376493805
##           350          1526          1485          2486          1484
##  0.0461119547  0.1444700734 -0.2373066279 -0.8484419281 -1.4555182386
##           148           566          2846           115          2796
##  1.2739537788  0.0300237742 -0.4536274936  0.1675536936  0.8291526682
##          1161          1746          1794          2663          1896
##  0.7561710289  0.0840803911  0.3056587252  0.6837474560 -0.3560990991
##           994           335           667          2704          1838
## -0.0127625050 -0.1731063159 -1.2901104037  1.3973562687  0.5413934959
##          1371          1310          1267          1492           104
## -0.3545447919  0.6929095451  1.9041445877 -1.2737669469  0.2337226056
##          2404          2360           311           193          1090
##  0.7748688659  0.4201432957 -0.6744444257  0.3573292396  0.3728335077
##          1352          2238          2915          1978           300
##  0.0981047142 -0.5270521528 -1.0667889636  0.6084700471  1.2850161114
##          2772           544          2948           570          1110
##  1.3540155547 -0.2831804243  0.8066919183 -0.0545100804 -2.5715624835
```

```
##          166          2463           651           407          2908
## -1.0872992559 -1.3874779187 -0.1660855167 -0.0726255564  0.6402016603
##         2738          1018           127          1680           443
##  1.8390044499  0.1538117543  1.2110829244 -0.7631071414  0.7198712674
##         1217           120            31          2175          1796
## -0.4441864867 -1.7862336911 -0.5007026115  0.0803437809 -1.0509197232
##         1272          1102           326          2390           249
##  0.7722137930  0.0379629405 -0.1493600371 -0.6679158334  1.4190395052
##          180          1728          1809          1040          2902
## -0.0532558800 -1.2883850162 -0.7221012707 -1.5046105027  1.3198313324
##         2282          2281          2648          1684          2768
##  0.9694046904  0.3244848509  0.0940827794  0.1600781948 -0.7207819035
##          327          2853          2781          1346          1548
##  0.3655443976 -0.1432400280  2.5623404020  0.6139384228  0.0848371863
##          439          2152          2765          2080          1950
##  0.5488510755 -0.0567709566  0.4993899968  0.5161611704  0.0219033108
##         2693           260          2020           988           692
## -0.6891787615  1.1377491874  0.6850907145  0.4783246872 -0.2939514542
##         2003          1787          1756          2117          2252
##  0.3324147251  0.7193712385 -0.0460592629 -0.2663215202 -0.8411761354
##         1982           983          2422           243           203
##  0.2664901851  0.7602903050 -0.1533432193  0.9016498234 -2.0839345390
##          557          1563           141          1532          2106
## -0.6057897211 -0.0191752420 -0.5695246198 -0.2966940733  0.9278482199
##         1413           628           730          2705           217
## -0.1744191171  0.4607266961 -0.0836611156 -0.7771103095 -0.3676816418
##         2825          2917          1027           449          2563
##  1.6740483210  0.6358790150 -0.2923040659  0.3531573839 -0.2369412919
##         1403          1305          1472          2120          1590
##  0.0522591957 -0.7785150886 -0.5472356528  0.0430734822 -0.2058705169
##         2840           947            52          1759            12
##  0.7369995257  0.3063553706  1.4375355508  0.3298201995 -0.7254472649
##         2792          1799            25          1936          1800
##  0.4035279539 -0.5750010229  0.3153945584 -0.3891011392 -0.9435541134
##         1023           246          2115          2166          1754
## -0.1391289094  0.3411899234  1.0525817626  0.2674237080 -0.4299894007
##          976           713          2110          1589          2662
##  0.9685247949  0.5108724504  0.2155732334 -0.9105807715  1.4320821876
##         1735          1907          2639          1335          2816
## -0.3536363749  0.9247297184  0.1624021445 -2.4145785358 -2.1137183946
##         2763           547           325          2237           746
##  1.1364935100 -1.0997790850  0.4913717797  0.5433170361  0.0212162819
##         2061           727          2037          2808          1980
## -0.7238334823 -2.0373047824 -0.6989035698  0.4827763661 -0.7931437986
##           36          2935          2163          2059           859
##  1.6261065299 -0.4790008702  0.2826290798 -1.0980442839 -0.1505509047
##          777          2958          2027          1163          2608
##  0.3022154099 -0.1644023584 -0.0884422559 -0.3286639965 -0.1320032005
##         2007          1494          2035           357          1876
## -1.2272545358 -0.5261307865 -0.5662129732 -1.0221547274  0.4883522191
##          416           313           425          2338           875
## -0.0425601242 -0.6922343194  1.5386632227  0.0813726347  0.6913621655
##         2766          2067           625          2481          2657
## -0.1650895515 -1.3879152136 -0.0265764451  0.5226847991  0.3537376978
```

```
##        2180         2596         2879         1201         1362
## -0.8234643135  0.4827414536  1.4475266297 -1.3406971167 -0.4841381612
##         343         2190          198          582          161
##  0.5770000051  0.0361019857 -0.0384597357  0.7659558100  0.2799596622
##         950          666         1738          790         2752
## -0.9860040677 -0.0902978308  0.6325739648 -0.2673722154 -0.1533653375
##        2961         2199         1744         2960         1674
##  0.7576690774  0.7679035192  0.9414865553  1.0676643536 -0.4155360840
##        1672          110         1776         2065          381
## -1.0398626072  0.3086630799 -1.4093300322 -0.1809152860  0.0421934394
##         525         2184          946         2668          571
## -1.1291636386 -0.5032793520  0.0906434540 -1.0471956136  0.0264813205
##        2247          733         1345         1877          298
##  0.5110466924  1.0599850954 -0.4008822544  0.0983723180  0.5481064554
##         871         1077          567          149          163
##  0.0202756714 -0.3044573767 -0.5474744611 -1.6371816119  0.2084903342
##        2590         1219          226          879         1149
##  0.2036142842 -0.5505435160  0.1705875532 -0.4821290731  0.7062266273
##         592           71         1529         1566         2032
##  0.6911646081 -0.6878307690  0.8235277436  1.1542849563 -0.3859409133
##        1266          317         2401         1459          173
## -0.2308928515  0.6719686726  0.3033753006 -0.6830543971 -1.1596987523
##         359         1983         2014         1314         1627
## -1.0004078525 -1.8009242741 -1.5147856511  0.5946770779  0.1819904625
##        2427         1157         1118          475         1944
## -0.5977052299  0.5815632138 -0.0793846324  0.2877437765  0.9081318045
##        1840          418         1730         1483          437
##  0.1344919190 -4.1454562554 -0.1429528438 -0.2240603841  0.7864024856
##        1897           10          114         2719         2063
##  0.8073286336  0.0047777992 -0.0432562121  0.8566256579 -0.7631304326
##        1598         1295          400         2046          254
## -0.0762426903  0.4281245627  1.4811676997 -0.1005392916  0.7774772853
##        2102          274         1380          231          562
##  0.7559230181  1.3033378572  0.3460397855  0.8532289951  0.1773514381
##         907         2942         2400          123         1826
##  0.1377745940  1.3081140725  0.9181319661  0.5683699977 -0.1848945182
##        1206         2921         1338         1000         2562
## -1.0176782526  0.6220201506  0.6899021707 -0.0347765892  0.9125039544
##        1092           16         2464         1323         2112
##  0.3878954540  1.1037949129  1.3936178410  0.4687466903  0.0312907299
##         731         1332          213          973          190
##  0.0950355571  1.0902329606  0.0051810695 -0.2300230675 -0.9451237383
##        1183         2105         2759          301          944
##  1.2372313486  0.6608241748 -0.8199863002  0.9363348930 -0.4121596996
##        2595
## -0.8023473058
```

```
fit1 <- fitted(modela)
fit1
```

```
##     2880     1156     1599      119     2636      864     1358      339
## 5.867413 6.171653 6.677103 5.716591 6.107521 5.621831 5.957808 6.633779
##     1901      446     1120     2128       51       19     1614      431
## 5.868710 5.889913 6.171590 6.345061 6.515673 7.476379 6.855177 5.790356
```

```
##        846       2015       1888       2071        118          8       1350       2606
## 5.533808 5.655746 6.989441 5.908060 5.339318 8.682189 5.902518 7.197490
##       2226        962       2435       2801       2279       1773       1836        524
## 5.784354 6.766171 6.351497 7.063345 5.883908 7.307764 7.507190 5.460788
##       1543       2295       1369       1635        519        830        391       2686
## 6.618172 7.036148 5.678320 6.434369 6.736902 6.351588 5.798560 6.158581
##       2555       2011       1740       1666        964       2645       2330       1534
## 6.139098 7.312111 6.546804 6.122780 6.403683 6.343526 5.737023 6.342924
##       1797       2753       1430       1478       1922        826       1078        374
## 5.882830 6.559355 6.240207 5.773322 6.237074 6.400431 6.278038 6.469015
##       2594       2938       2634        139       1831       2224       1629        951
## 6.431587 6.578261 6.035932 6.108127 6.402893 5.926823 5.935157 6.418396
##       1356       1311       1531        614       2354       1895       2733       2749
## 6.060813 7.269096 5.737223 6.190295 6.238616 6.763716 7.285707 5.748450
##       1497       1998       2410       1624       1878        577       2460         46
## 6.022438 6.101190 5.988309 6.349901 6.050096 6.518046 6.405333 7.400309
##       1194       2689       1276        188       1900       1393       2467        829
## 6.230218 5.763270 6.031206 6.432852 5.852886 7.813401 6.078164 6.597489
##        112        865       1199       2475       1319       2301       2203       1699
## 7.053052 6.331782 5.957463 6.898021 6.663442 5.960624 6.276550 6.365550
##        857       2189       1741       1185       1536        869       2485       2769
## 6.539706 6.532343 5.428022 6.418705 6.231316 6.255142 6.802091 6.847310
##        429       1772       2929       2028        255        151        919       2260
## 5.864115 6.036665 5.754994 7.165028 6.356066 8.361013 6.952131 6.160718
##       1241       2040       1162        397       1410        963        196       2885
## 6.182715 5.964128 6.856683 7.352649 5.902347 6.097108 5.676566 6.048143
##       2643        154       1600       2412       2145       1690       1802        516
## 6.044610 5.353328 6.138225 6.260067 5.887029 5.634050 6.049336 5.981590
##       1308       2277       2784       1208       1891        159       1835       1636
## 6.237573 6.509629 6.333364 6.889224 6.121294 5.721664 6.652366 6.381053
##        843        202       1210        186        206        365        670       1815
## 6.051043 7.097873 6.943656 5.781322 6.112525 6.088079 8.386555 5.653841
##       1867       2867       2504       1270       1546       2183        376        720
## 5.923130 6.651454 6.414535 6.131664 7.408562 5.943479 6.299140 6.269863
##       2109       1388       2196        262       2620       1273       1948       2795
## 5.965581 7.343362 5.897899 5.945787 6.163214 7.313317 5.918534 7.074267
##       2771       1736        144       2745       2817       2688       2111       2337
## 6.020002 6.118836 6.590633 6.292928 6.316218 6.203950 5.923251 5.779904
##       2936       1463       1402       2233       1104       1073       2049       1938
## 5.771777 6.351218 5.868019 7.067530 6.737143 6.625471 5.978477 6.574797
##       1648       1428        680        474       2052        644       1687       2314
## 6.858935 5.876928 6.303105 6.180973 6.963531 6.278920 6.943523 5.760848
##       2355        316       1873        935        953       1860       1668       2188
## 6.408388 5.452921 6.499135 6.602076 5.839986 6.587152 6.370925 5.846199
##       2591       1540       1560       2365       1240       2633       2206       2716
## 7.012754 6.111579 5.760015 6.343611 7.060484 5.957304 6.125558 6.672417
##       2788       1493        382         32       2930       1757       1601       2677
## 6.299132 7.197649 5.930525 6.852399 6.126232 6.182918 7.977071 5.971061
##       2091        294        229       1713       1782       1712        417       2425
## 6.628435 5.606998 6.648630 7.001327 6.846927 6.193536 5.410775 6.205759
##       2841       2907       1989       2499        844       1918       1389       1615
## 5.782388 6.989441 6.567384 5.962987 6.323670 6.227059 5.848719 6.304099
##        238        812       1626        162       1407        848       2433         86
## 7.340911 6.166472 5.747569 5.643708 6.568549 6.275831 5.903272 9.551814
```

```
##      1904      2104      2173      1858       469       836      2227       175
## 7.255906 5.872662 6.589512 6.232516 6.043213 6.308294 5.939936 7.103701
##      1264      1154      2537      1174      1634      2421      2612      2414
## 6.923450 7.568075 6.544384 6.176145 6.008872 8.568124 6.187823 6.412420
##      1021      2609      2857      1638      1022       337       884       129
## 6.151620 6.670029 5.969051 5.854132 6.627938 6.279826 6.247470 6.865191
##      2156      1898      1527      1533      2876       378       493      1851
## 5.926937 6.759322 6.386052 6.697008 6.140581 6.185710 6.433462 7.072291
##      1385      1377       240      1412      1954       221      1105        93
## 5.997140 7.294405 7.099557 5.895181 7.016219 5.038648 6.098062 5.826047
##      1003       602      1584        56      2754      1396      2564       581
## 8.131234 6.019055 5.709517 6.821948 5.978410 6.847310 5.989112 5.752851
##       638      2896      2664       476      2050      1976         9      1195
## 6.382317 5.877804 6.737150 6.159399 5.765934 6.742849 7.318438 5.669738
##      2770      1422      1290      2611      2098      2002      2024       330
## 6.474718 6.637007 6.811592 6.540579 6.058312 5.809268 6.455366 6.658327
##      2597      2809       708       591      2625      2409      1681      2592
## 6.619887 6.340012 5.822310 7.964331 5.890992 5.935467 7.429119 6.900282
##      1134        23      1085       882      1791      2031      2076      1452
## 7.584708 5.914264 6.322140 6.177692 6.571545 6.345524 5.745986 6.350567
##       822       824      1747      1460       432      1644      1159       482
## 6.348258 6.767662 7.771562 6.510522 5.478846 6.740327 5.765408 6.404494
##      2647      2710      2610      1253       593      1654      2026      1111
## 6.040952 6.111526 6.333488 6.093741 8.924191 8.373365 5.867605 6.534124
##      1464       573       423       466      2783      1807      2135       711
## 5.735206 6.263223 5.795923 5.710146 5.932824 6.234602 6.762002 6.314404
##      1651       508        11      2284        75       589      1604      1390
## 6.216990 7.779008 6.455073 6.025847 7.332539 6.688805 5.949770 6.113128
##      2831      1592       258      1899       993      1910       918       726
## 6.250701 6.933195 6.367913 5.904029 6.714248 6.124621 5.970480 5.900047
##      1313      1456      1132       414       685      2578       584      1952
## 6.714366 6.442996 6.126919 5.835919 6.241210 6.277470 6.369266 5.752221
##        26      1083       268      1007      1100      1467      1991      1012
## 8.675125 6.737189 6.291192 6.670236 6.412072 7.232459 7.880960 6.306650
##       136      1171      2866      2119      2334       201       102       603
## 6.510944 6.324780 5.986235 7.336732 5.759518 6.424474 7.011862 5.527423
##      2123      1386       759      2653      1869       395       271      1368
## 6.376635 6.802660 6.421202 5.637245 6.062897 6.364199 6.235729 5.949770
##      1450      2706        64      2315      2889      1220      1158      2384
## 6.277545 6.208112 6.536473 5.937016 5.721664 6.202164 6.136843 6.950570
##      1129      2201      1512        43      2273      1442       515      2684
## 7.654024 5.892922 6.126962 5.521994 6.396718 6.800578 6.180043 5.902629
##      1859       769      1093      1177      2895      2886      2695      1438
## 5.870806 6.266694 6.796473 6.154322 6.171655 5.787689 5.857962 6.353663
##      1443      2849      2810      2382      1819      1212       264      1103
## 6.573829 6.563787 6.218871 6.182360 6.304428 5.810405 5.679664 6.263938
##       876       116      2332       627       905       601       834      2370
## 5.919174 7.569227 5.683053 6.634757 7.043688 6.529288 6.587525 6.333296
##      2776      2862      1820      2878      2940       910      1095      2544
## 6.209940 6.552910 6.956847 6.294915 6.299285 7.010415 5.940769 7.796876
##      1286      1929      2882      1620      2899       613      1099      1879
## 6.242337 6.093420 6.175803 6.748294 6.336803 6.817338 6.251301 5.798251
##      2219      1426       288       902       677      2181      2848       390
## 6.384143 6.892298 6.259395 6.070861 6.084499 6.461377 5.931014 6.795241
```

```
##     1683      858     2317     2083     1116     1299     1893     2699
## 6.315684 6.450206 6.181518 7.391198 6.045305 6.084725 5.850500 6.030106
##     1277     1656       48     1655     1178     2919     1697     1044
## 6.480097 6.047931 5.830785 6.311803 7.310741 6.013228 6.709710 6.087611
##     1349     1698     1140     2589     1372     1416     1108     2487
## 5.899260 7.485117 6.105195 5.807056 6.132801 6.491699 6.204353 6.952555
##     2797     1675     1940      403     2654     2541      165     2614
## 6.364199 5.976527 5.960114 6.471206 5.774285 6.432955 6.512761 6.298460
##      195     1424     2333     1514     2455      933     1609     2172
## 6.204169 6.384902 5.809186 6.611895 6.501348 6.247420 5.830660 5.937560
##     2820     2640     2325      191     1458     2488     1535     2234
## 6.174137 5.879022 5.846696 4.886560 5.860216 6.604959 5.914689 6.109349
##     2760     2531     1432     2275     2626      611      456      281
## 6.892481 6.185174 5.898061 6.231557 6.134024 7.056233 6.449350 6.678442
##     1166     2000     2903      811      514     1357     1417     1209
## 6.202494 6.101399 6.210808 6.200085 6.223095 6.497715 6.851629 5.737220
##     2696     1909     1164     2743      943     1947      283     2434
## 5.884023 5.860024 6.926451 5.975041 6.118309 6.600115 7.054237 6.742290
##      556     1708     2941     1080      234      168      795      266
## 7.301934 6.738013 6.060769 6.148561 8.268493 5.778334 6.096964 5.749813
##     2630     1964      245      215     2656     2708     1361     2650
## 6.038790 6.419707 6.010638 6.361927 6.030194 6.363514 6.561552 5.861154
##     1951     2682      396     1135      735     2814     1150     2066
## 5.746487 5.750402 6.283749 6.813766 7.145824 7.108897 6.126735 5.859882
##     1733     1547     2851      368     2387     1824     1943     1643
## 6.195246 8.348243 6.428163 6.417036 6.327381 6.468459 6.539234 6.331718
##     1573      689     1128     1538      774     1006     2159      899
## 6.285901 6.625404 7.032429 5.846905 6.530060 7.104506 6.665258 6.612868
##     2094     2121      878     2450      754      653      661     1176
## 8.411717 5.896327 6.362506 6.097653 6.288436 5.948496 5.513762 6.173472
##      842       77      216      588     1685      520     1089      568
## 5.736516 6.061222 7.650126 7.802737 6.324930 6.131809 6.126099 6.471104
##      969     1745     2517     1695     2164     2805      718      851
## 7.112421 6.720469 6.605828 6.254917 6.801128 6.204307 6.030200 7.856954
##     1211     1247     1632      445      696     2588     1056      574
## 6.507610 5.851546 6.524928 6.342152 7.564698 5.783044 5.700981 5.650406
##     2029      622      542     2420      470      103     2932      194
## 6.508761 6.553354 8.578824 7.326810 6.748161 6.185124 6.010787 6.777367
##      787      823      537      766      576     1087     1593      701
## 5.903305 5.847659 6.896216 6.916899 6.246746 5.907802 6.459190 6.781959
##     1717     2377      954     1625     1503     1067     2170     2452
## 6.378550 6.487409 6.668808 6.581789 7.704103 6.678869 5.945182 6.621976
##       58     2471     1306     2747      275     1259     2008     1864
## 6.256107 5.884464 5.664771 6.345563 5.762408 6.057688 6.141097 5.927776
##     2842     2679     1202      794      505      732        4     1008
## 5.703335 5.887334 6.843917 5.940956 6.715097 6.622086 5.438211 5.986255
##      523     1001     2824     1296     2231     2785      379     2570
## 5.556002 5.944429 5.900923 6.238980 6.762256 6.435771 6.583864 5.961565
##     1829     2165      124     1188     1433     1029       47     2670
## 6.239667 6.199981 5.592800 5.877580 6.064453 6.156125 6.061538 6.159555
##     1739     2671     1309      481     1278     2508      917       72
## 6.136864 6.006745 6.362491 7.216978 6.214706 5.950326 7.444064 6.287462
##     1327     2877      135     2718      652      580     2092      421
## 6.699431 6.289569 5.546276 6.137488 6.202918 6.561041 8.279653 6.698636
```

```
##       479      2307       814       503       742      1057       261       986
## 6.554311 6.012260 5.799288 7.023425 5.713014 5.714376 5.580189 6.353965
##      2526       802      2582       347      1146       109      2703      2406
## 5.852356 6.621072 6.455284 7.464894 6.892481 7.265456 6.531008 5.897400
##       237       554       630       138       128      1981       958       259
## 7.776348 6.630027 6.370728 7.509736 6.592812 5.807927 6.155328 6.261586
##       306        39       789      2268      2432      1326      2036      1912
## 6.653403 7.229738 6.439362 6.145555 6.058330 5.847385 6.302631 6.616715
##      1359      1790      2298      1709       913      2285       462      2372
## 5.805111 5.513586 6.159180 6.369324 5.554233 7.201546 6.228968 6.916392
##       352      2416       674       598         3      1559      2230      1821
## 5.865183 5.873810 5.856997 5.766429 9.701188 5.996350 6.256686 6.518108
##       426      2265      2685      2017      1575       631       997      2077
## 6.007905 5.931091 5.874383 6.282556 6.177260 6.336732 7.932531 5.812293
##       278      2496      1251      2239      1288      2454       868      2287
## 6.531743 6.512653 6.101708 6.197640 6.676958 5.783362 5.783985 6.216882
##       553      2346       319      2218       512       385      1679      2051
## 6.230991 6.352441 5.943298 6.265429 6.061215 6.598567 6.243269 6.901307
##      2572       784      1963       487      1173      2871      2379      2955
## 6.134938 6.190773 6.257215 7.080270 6.086868 6.006115 6.242492 6.409956
##       928       536       641      1927      1862      1064      2551      2951
## 6.808244 6.388608 6.121136 5.723704 5.788948 5.677215 6.250269 5.990378
##      1732      1376      2756      2339      1704      2375       308       817
## 6.013729 5.833354 6.139943 6.136554 6.656874 6.295357 6.324346 6.181690
##       904      1451      2055        63      1091      1088      1856      1631
## 5.703939 6.160621 6.757167 5.847496 6.788959 5.733729 6.406627 6.701681
##       157      2208       831      1074      2259      2774       220       747
## 6.867249 6.312765 6.563414 6.870386 6.227618 6.384911 5.875279 6.745203
##      1014      2532      1885      1147      1658      1453      1124       637
## 7.163532 6.124025 6.375980 6.577727 6.347845 7.150284 5.659853 6.281174
##       783      1139      2528      1041       155      2280      2240      1252
## 6.842849 6.693466 6.973971 6.321995 6.802639 6.454557 8.408291 9.529349
##      2744        33      2607      1920      2865       673      2873      1866
## 6.210164 6.570358 6.687951 6.212740 7.086549 6.241986 6.521504 5.940055
##      1145      2850      1650      2149       540      1420      2364      2006
## 6.161768 5.907771 6.188024 7.792986 6.156163 6.289027 6.802725 5.896630
##      2081       891       370      2884      1043      1348      1322       413
## 5.707446 6.800546 7.073716 5.731203 6.957890 6.251387 6.507454 6.355607
##      1580      2844       819      2651      2927      1565      2310      2730
## 6.477771 5.908190 6.030211 5.960835 5.742282 7.237416 6.735688 6.404988
##       454      1659      1555      2709      1916       799      2577      1758
## 6.671758 6.236547 5.717646 6.312120 7.122361 6.858069 6.425623 6.257320
##      2827       719      1619       384       585      2472      1499      1649
## 6.241986 5.837521 5.812498 5.943008 9.333312 6.095321 7.064703 7.049214
##      2584        14      1470       861       440       453      1537      1019
## 6.006653 9.446799 6.787203 6.820821 6.742909 6.265193 6.274504 6.393721
##      1408      2391       989      1607      2042       728      2041      1729
## 6.555720 6.960969 6.225681 6.165088 5.835007 5.457546 6.515052 6.052080
##      2070       550      1660       860      1845       346       408      2822
## 6.023276 6.045202 5.783246 6.021438 6.576259 5.422421 6.029309 6.254512
##      1363      2811      1123      2292      2571      1477       263      1476
## 5.915164 6.372643 6.251472 6.082064 5.684481 6.569001 5.218501 5.605510
##       441      2559      2779        13        73       364       786      2529
## 6.769730 6.905608 6.282423 5.881752 6.820474 7.968077 5.873248 6.778574
```

```
##     1957      770     1487      945      276      688       67      252
## 7.292799 7.703820 6.652340 6.132940 6.889760 6.257626 6.061472 6.659473
##      693     2445     2229     1882      934       45     2837     1465
## 6.611733 6.165253 6.632476 7.583608 6.127842 7.249341 5.420992 6.456370
##      681      459     2108      695     1204     1521      757     1843
## 6.700793 6.220728 6.316994 5.797703 6.238625 6.365149 7.694798 6.789882
##      133     1863     1024     1994     2162      172     2283     1711
## 6.918067 6.231792 6.836335 6.166077 7.672826 7.635292 6.146854 6.406725
##     1774      355      147     1504     1061     2220      906      849
## 5.501892 6.322514 6.914142 5.691486 5.685722 6.319797 6.015107 5.876594
##     2393     1096     2556     2018      877      716     2187     2347
## 6.210778 5.795318 6.780304 6.600417 6.007541 6.323714 5.905030 6.108456
##      342      599     1130      293     2013     1491     2497      925
## 6.472689 6.432866 6.560254 6.902473 6.743078 6.800904 6.107646 8.033997
##     2215      315     2278     1595     1842     1552      596     2898
## 6.423913 7.402982 6.022243 6.504404 7.065303 5.851850 6.488295 6.728374
##      483      448     2319      528      896     1670     2479      952
## 6.527773 6.324515 6.395605 5.713852 6.809579 6.220938 6.627948 6.377093
##      965     2197     2547      511     1337      662      461     1297
## 7.802319 6.015891 6.627114 6.643251 6.658571 6.194047 6.107289 6.163000
##      818     1962      532      304     2441     2444     2303      521
## 6.589933 6.216079 6.657027 8.190679 6.551370 5.811854 6.625548 5.685009
##      125     1237     2270     1969      971     1971     2246     2773
## 5.320490 6.459397 6.265866 6.174023 7.122658 6.336805 6.390021 6.133790
##     1932     1579      373      539     2674     2692      565     1771
## 6.352849 6.382441 5.916160 6.642743 6.078001 6.087282 6.394567 5.722887
##     2329      740     1425     2396      762      850     2548     1481
## 6.163111 5.834658 6.371093 6.577066 6.783214 5.804404 5.875101 6.716084
##      936     1720      833      297     2495     1541     1663     1017
## 6.122461 7.100300 6.364237 6.409582 6.448354 6.652990 7.789150 7.330924
##     1373     2494     1883      705     2395      796     2397     2342
## 6.576259 6.165318 7.247918 7.636051 6.270237 6.442684 6.136085 6.578261
##     2599      750     2707     2905      792     2503     2095      303
## 6.936080 7.990729 6.510440 5.991089 6.197629 5.871649 6.548358 6.027198
##     1562      675     2558      265     2361      309     2887     2911
## 6.014109 5.478143 7.011520 6.833613 5.818450 7.281592 6.240165 5.716342
##     1232       65     2641     2266     2143     1696        6      534
## 6.144244 5.668397 8.792620 5.909107 6.633847 6.170938 5.059463 6.816778
##     1761     1818     2476      656     2402     1561     1988     2728
## 6.263957 6.776320 7.464613 5.490653 6.260492 5.973004 6.325967 6.272820
##     2790     1071     1693      684      377     1242      890     1727
## 6.003557 6.338299 6.282329 5.738772 5.710982 6.293201 6.402251 6.070898
##      778     1839      212     2195     2249     1515     2539     1669
## 6.253483 6.392447 6.650709 6.488376 6.286884 6.286925 6.289693 7.441514
##     1517     1935     2782     1542     2276     2701      889      277
## 6.637813 6.680579 5.827735 6.297583 6.367598 6.699247 6.687336 5.738181
##     2258      360     2901     2302     2097     2520     2255     2157
## 5.676221 6.383019 5.885027 6.495214 6.309643 6.477229 5.639709 6.496219
##     1652     1996      251     2045       81      678      714       22
## 5.950708 6.283358 6.865214 6.030317 5.969696 5.866267 5.755819 7.379146
##      369     1236     1960      480     2786     1811     2368     1317
## 9.498073 6.657342 6.085553 5.624311 7.069427 6.931886 6.437661 6.052184
##     1889     1291     2462     1841      329     2952      324      791
## 5.784845 6.922043 5.933118 7.985143 6.570977 6.163642 6.108193 7.832106
```

```
##      1378      2446      1233      1254      2019       457       388       404
## 6.515283 6.210749 7.460456 6.881979 6.474101 5.852844 6.324972 6.054277
##       773      1131       616       743      2835      2858      2767       184
## 7.076482 7.542899 7.069427 7.242331 5.650870 6.114045 6.024832 6.717547
##      1653      2603        27      2511      1480       145      1827      1825
## 6.266716 7.255650 7.171282 5.792249 5.948177 6.487609 6.046973 6.743498
##       745      2658      1398       205      2242      1137      1549      1126
## 6.634084 5.885016 6.136832 6.332054 7.541870 6.927638 6.026126 5.769047
##      2521       749      1072      2388      1949       181        29      1172
## 7.495435 7.742765 6.958360 5.946567 5.815951 6.167200 7.223766 6.177867
##      2381      2200      2344      1418       105      2727      2141       912
## 6.390676 6.053337 7.355665 6.728375 5.392685 6.384312 6.426108 6.265889
##      1557      2261       156      2134      2470       940      1054       978
## 5.691694 7.091603 5.976091 5.955653 5.955265 6.248301 6.305586 7.382023
##       507       838      1678       707      2512       615      2598       806
## 6.073867 5.855957 6.536329 7.635389 5.971235 6.240780 6.310706 6.545275
##       797       182      2540      1770       648      2440      1830      1186
## 6.454412 6.323766 6.670251 6.206865 5.937262 6.038060 6.135048 6.090392
##      2723      1136      1966      1766      1597      2169      1803       609
## 6.459744 6.941851 6.540781 6.292396 6.439586 6.299434 6.830290 6.420544
##       150       564       764      1016       420      2236       970      2205
## 6.408685 6.298888 6.897384 6.355415 6.142935 6.075752 6.553658 5.847669
##      2139      1702      1550      1870      1392      2138      2321      2426
## 6.945521 6.004648 5.934865 7.229629 7.253523 6.277160 6.024554 6.122832
##      1686      2068      2177       753      1905       270       284      2900
## 6.392205 5.817970 6.311496 6.798248 6.025659 5.783203 9.035669 7.053792
##      2500      1973      1168      2451      2502       152      2678      2251
## 6.285377 6.643240 6.097406 5.897101 6.221508 5.394091 7.040905 6.072564
##       111      1724      1941      1170      2514      1038      1588       386
## 6.524287 6.304444 6.708707 7.699924 5.774825 5.989327 5.953423 6.331766
##      2116      1894       780      2680       244      2617       200      1568
## 5.852335 6.071307 6.954041 6.022468 6.357308 5.848399 8.134230 7.693203
##      1455       546      1284       741      1473      2632      2576       241
## 5.882166 6.509762 6.955164 7.015549 8.434512 5.715594 6.110625 7.151572
##      1026       722       881      1721      2398      2082      2740      2575
## 6.041815 5.938205 6.714720 6.141536 5.715257 6.102288 6.891059 5.875010
##      2167      1440      2845      1783      2713      1231       471      2263
## 6.700941 6.328381 5.806149 6.249708 6.361405 6.475581 7.059056 6.148130
##      1205      1642       393      2209       624       422      1002      1816
## 5.876390 6.027850 5.556510 6.777611 5.909614 5.841237 6.682370 7.057583
##      2725      1955       199       137       992      2311      2550      2322
## 5.716027 6.826609 8.389475 7.756326 5.990665 6.003249 6.693856 6.527064
##       768       549      2819      2133      1577      2158      1880      1564
## 6.956682 6.982000 6.507947 6.373337 6.409485 6.546966 6.082250 6.028931
##       291      2127      2552      2309      2600      2830      1324      1786
## 6.488721 6.256812 6.061176 5.713672 7.560667 5.981933 6.137911 6.379234
##       856      1303       873      1558      1726      2473      1587        84
## 6.316313 6.401109 5.745686 5.809366 5.911099 6.454321 6.209231 7.700383
##      1353      2565       709       371      1192      1714      2720      1169
## 6.294617 6.202920 5.978924 6.911507 5.901918 6.247732 6.344300 6.561538
##       608        70       169      2351      2631      2316      2366      1307
## 6.873694 6.889667 5.917325 6.108384 6.222264 6.507871 6.011337 6.640814
##      2443      2715      1692      2039      2888      2257      1742      2505
## 6.010580 6.282912 6.055610 6.431338 5.738480 6.260109 6.126722 6.089951
```

```
##     2847     1591     1855     1911      655     1395       42       30
## 6.468310 6.236375 6.920990 6.474108 6.954336 6.720221 5.391715 6.905936
##     2144      724      914     1374     2312     2340     1075      489
## 6.293181 5.910377 6.395852 6.428075 6.111340 5.975348 5.891765 6.535359
##     1812     1853     1890      888     1688     1045     2943      915
## 6.449684 6.077451 6.444422 5.907927 6.278486 5.612789 5.987787 6.636201
##     1263     1193      739      839      990      192     2553      372
## 6.201339 6.353016 6.095770 5.622573 6.496814 6.683788 6.267243 5.966029
##     2818     2151     2676      183      955     2300     1342       96
## 6.487143 6.568017 5.770500 6.631398 6.455078 6.356066 6.367334 6.760549
##      282     2415      171     2345     1228     1519      968     2585
## 6.760959 6.225544 7.556806 6.402456 7.667359 8.172723 6.228191 6.437177
##     2100     1098     2586     1086      854       35     1875     1215
## 6.698006 7.503223 5.978855 5.962509 6.401923 5.971425 5.989081 6.312120
##     1834      903     2734     2179     2089      219     1622     1931
## 6.118037 6.025680 5.910988 6.425336 6.087703 6.369379 6.683867 6.143863
##     2056      837     2746       99      394      852     2057     1351
## 6.999271 5.704265 6.209185 7.418898 5.915617 7.349338 6.907244 6.243924
##      552      665     1701      178     1399      375      235     2126
## 6.546722 6.272978 6.302716 6.411939 6.648646 6.254245 6.405577 6.175405
##     1457     1258     1798      320     2616     1572     1778     2004
## 6.526890 6.152759 6.121439 6.127241 7.015593 6.096718 6.632922 6.071507
##     1551     2834      870     2491      813     2604      686     2661
## 6.382617 5.988587 6.189135 5.852861 5.747932 5.592865 5.742798 7.711524
##     1471     2925     2755      117     1524      485     2762     1461
## 6.256935 6.402801 6.043746 5.961636 6.658773 6.909692 7.196214 6.038595
##     2667     1764      121     2174     1444     2483     1814     2874
## 6.161255 6.603929 6.752736 5.949654 6.284642 6.135938 6.017136 5.823672
##     2293     1070     2407     2048      269     1608     2212     1321
## 5.875160 6.225554 6.329263 6.326175 5.161362 5.744995 7.850498 5.912632
##     2012      517     1522      356     1015     1127     1315      250
## 6.179482 5.582158 7.064086 6.693134 6.557434 7.479019 6.230771 5.375297
##     1200      435      687     2665     2060       90     2628      803
## 6.084894 7.642701 7.933982 6.346290 6.348786 7.251611 5.888947 6.285461
##     2269      594     1238     2103      410     2457     2131      273
## 6.389932 6.812343 6.245497 5.946771 6.279199 6.149589 7.119773 8.418424
##     1437     1037     1122      455      960      140     1925      108
## 5.996834 6.649914 6.580878 6.381582 6.738403 5.759479 6.016098 7.000295
##      569     1076     2569     1035     2580     1511     2545      555
## 6.000175 6.484261 6.443602 6.207543 6.273800 6.347191 6.761076 6.410777
##     2386     1914     1510     1509      715      142      434     1785
## 6.192103 6.105666 6.211503 6.490565 7.468920 7.978563 7.188930 6.092412
##      874      845      668     1924     1025     1138     1384     2155
## 6.246744 6.272299 6.261698 6.279449 6.538490 7.158303 6.078955 6.756002
##     1446     1574      350     1526     1485     2486     1484      148
## 6.486726 6.362351 6.153888 6.255530 6.337307 5.948442 6.055518 6.126046
##      566     2846      115     2796     1161     1746     1794     2663
## 6.269976 5.853627 5.632446 6.270847 7.043829 5.715920 5.894341 6.516253
##     1896      994      335      667     2704     1838     1371     1310
## 5.956099 6.412763 6.573106 6.090110 6.602644 6.458607 5.954545 6.707090
##     1267     1492      104     2404     2360      311      193     1090
## 6.395855 5.973767 8.066277 6.625131 5.979857 5.674444 6.342671 5.827166
##     1352     2238     2915     1978      300     2772      544     2948
## 6.601895 6.327052 5.866789 7.091530 5.714984 6.045984 6.683180 6.493308
```

```
##       570      1110       166      2463       651       407      2908      2738
## 6.254510 7.771562 5.987299 6.787478 6.066086 5.672626 6.059798 6.160996
##      1018       127      1680       443      1217       120        31      2175
## 5.846188 5.688917 6.163107 6.080129 6.144186 5.986234 6.900703 7.719656
##      1796      1272      1102       326      2390       249       180      1728
## 6.150920 6.827786 7.562037 5.549360 6.267916 5.480960 6.753256 6.188385
##      1809      1040      2902      2282      2281      2648      1684      2768
## 6.122101 5.904611 5.880169 6.130595 5.875515 5.905917 7.939922 6.120782
##       327      2853      2781      1346      1548       439      2152      2765
## 5.734456 6.643240 6.037660 6.786062 6.415163 6.851149 5.956771 7.000610
##      2080      1950      2693       260      2020       988       692      2003
## 6.083839 6.578097 5.989179 5.862251 6.014909 7.621675 5.893951 5.867585
##      1787      1756      2117      2252      1982       983      2422       243
## 6.780629 6.246059 6.066322 6.741176 6.533510 6.539710 6.253343 6.298350
##       203       557      1563       141      1532      2106      1413       628
## 8.583935 7.005790 6.719175 5.569525 5.896694 6.772152 5.574419 6.039273
##       730      2705       217      2825      2917      1027       449      2563
## 6.483661 6.477110 5.267682 6.025952 6.664121 6.192304 6.946843 6.136941
##      1403      1305      1472      2120      1590      2840       947        52
## 6.247741 5.878515 6.647236 6.256927 6.905871 6.063000 6.193645 5.362464
##      1759        12      2792      1799        25      1936      1800      1023
## 6.270180 7.925447 5.796472 8.575001 6.984605 5.989101 6.643554 5.939129
##       246      2115      2166      1754       976       713      2110      1589
## 6.358810 6.747418 6.432576 6.429989 6.431475 6.089128 5.884427 6.410581
##      2662      1735      1907      2639      1335      2816      2763       547
## 5.967918 5.753636 6.675270 6.337598 5.814579 6.313718 6.163506 8.499779
##       325      2237       746      2061       727      2037      2808      1980
## 6.308628 6.856683 7.578784 6.223833 8.337305 5.998904 6.317224 6.393144
##        36      2935      2163      2059       859       777      2958      2027
## 6.673893 5.979001 6.317371 6.598044 6.150551 6.397785 6.264402 5.988442
##      1163      2608      2007      1494      2035       357      1876       416
## 6.528664 6.832003 5.927255 6.426131 5.866213 6.422155 7.111648 5.842560
##       313       425      2338       875      2766      2067       625      2481
## 6.192234 6.961337 6.618627 6.108638 6.465090 5.887915 6.126576 7.077315
##      2657      2180      2596      2879      1201      1362       343      2190
## 6.046262 6.123464 6.217259 6.152473 5.540697 7.184138 6.723000 6.363898
##       198       582       161       950       666      1738       790      2752
## 7.038460 6.034044 6.320040 6.386004 6.190298 7.567426 5.967372 5.953365
##      2961      2199      1744      2960      1674      1672       110      1776
## 5.842331 6.232096 6.658513 5.832336 7.915536 6.739863 6.791337 5.709330
##      2065       381       525      2184       946      2668       571      2247
## 6.080915 8.057807 6.529164 5.803279 6.209357 6.747196 6.073519 6.788953
##       733      1345      1877       298       871      1077       567       149
## 6.640015 5.900882 6.101628 6.051894 7.179724 6.404457 6.447474 7.137182
##       163      2590      1219       226       879      1149       592        71
## 6.191510 5.996386 6.050544 6.529412 6.282129 6.493773 5.108835 6.787831
##      1529      1566      2032      1266       317      2401      1459       173
## 6.476472 6.545715 5.885941 6.630893 6.728031 5.696625 6.383054 7.759699
##       359      1983      2014      1314      1627      2427      1157      1118
## 5.900408 6.700924 6.014786 6.605323 6.218010 6.297705 6.018437 6.179385
##       475      1944      1840       418      1730      1483       437      1897
## 6.012256 5.891868 6.165508 6.545456 6.242953 6.424060 6.113598 6.592671
##        10       114      2719      2063      1598      1295       400      2046
## 7.295222 5.143256 6.243374 5.763130 7.176243 6.771875 5.518832 6.600539
```

```
##      254      2102      274      1380      231      562      907      2942
## 5.922523 6.444077 5.496662 7.553960 6.246771 6.222649 5.762225 5.691886
##     2400       123     1826      1206     2921     1338     1000     2562
## 6.381868 4.831630 6.884895 9.017678 5.977980 6.310098 6.134777 6.687496
##     1092        16     2464      1323     2112      731     1332      213
## 6.212105 5.696205 6.406382 6.131253 5.668709 6.304964 6.009767 6.394819
##      973       190     1183      2105     2759      301      944     2595
## 6.630023 7.945124 6.162769 6.139176 6.719986 6.063665 7.012160 6.302347
```

```
plot(fit1, res1)
abline(0,0)
```
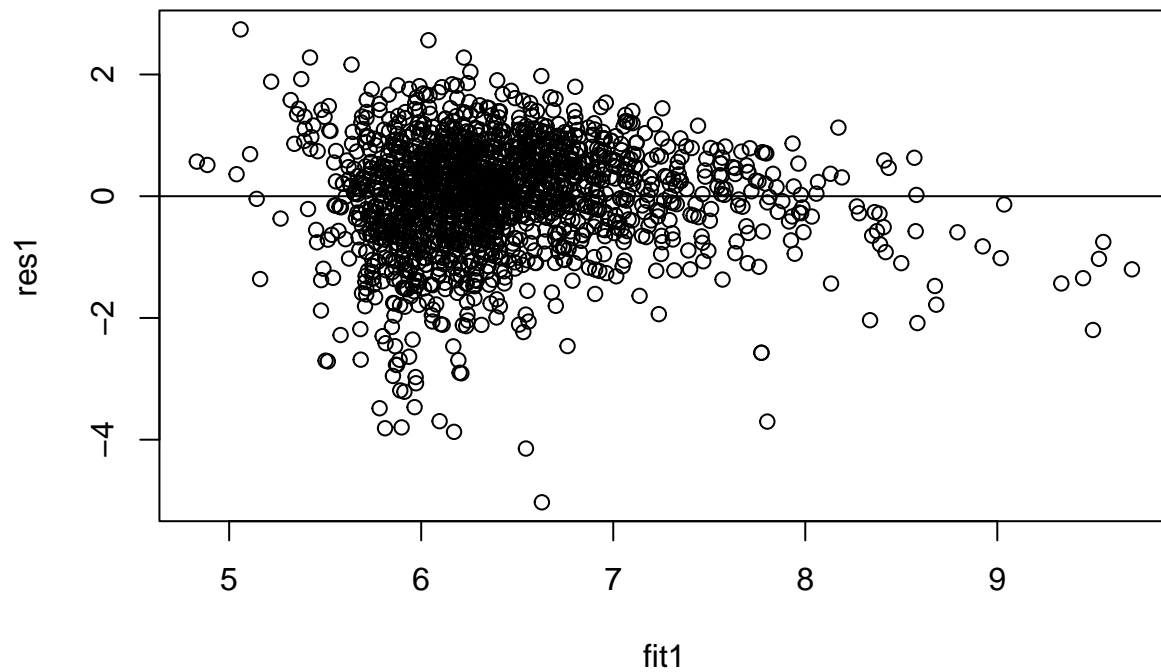


```
qqnorm(res1)
qqline(res1)
```

## Normal Q–Q Plot
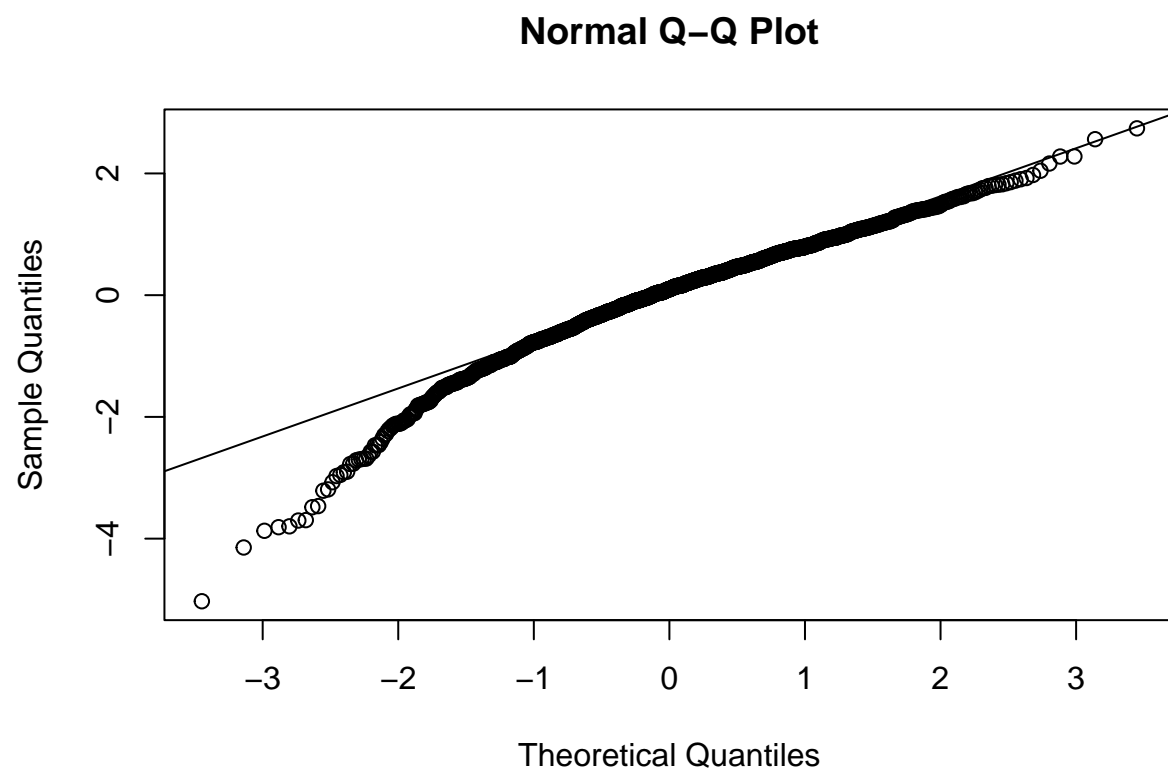


```
plot(density(res1))
```

## density.default(x = res1)
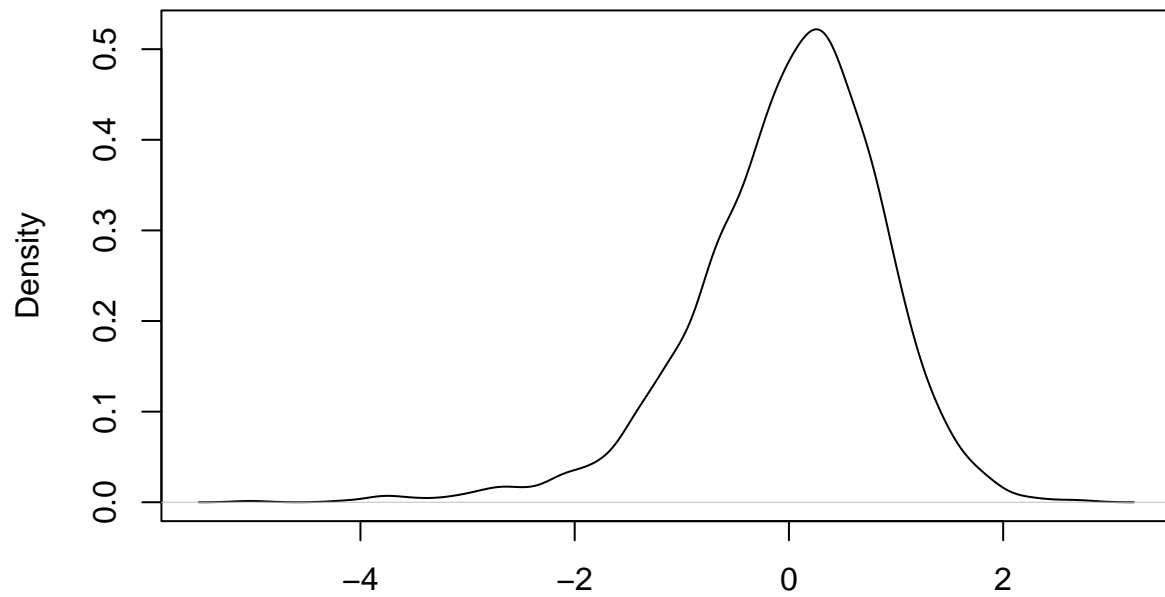


N = 1776   Bandwidth = 0.1601

```
ggplot(modela, aes(x = fit1, y =res1)) +
  geom_point() +
  stat_smooth(method = "lm")
```

```
## 'geom_smooth()' using formula = 'y ~ x'
```
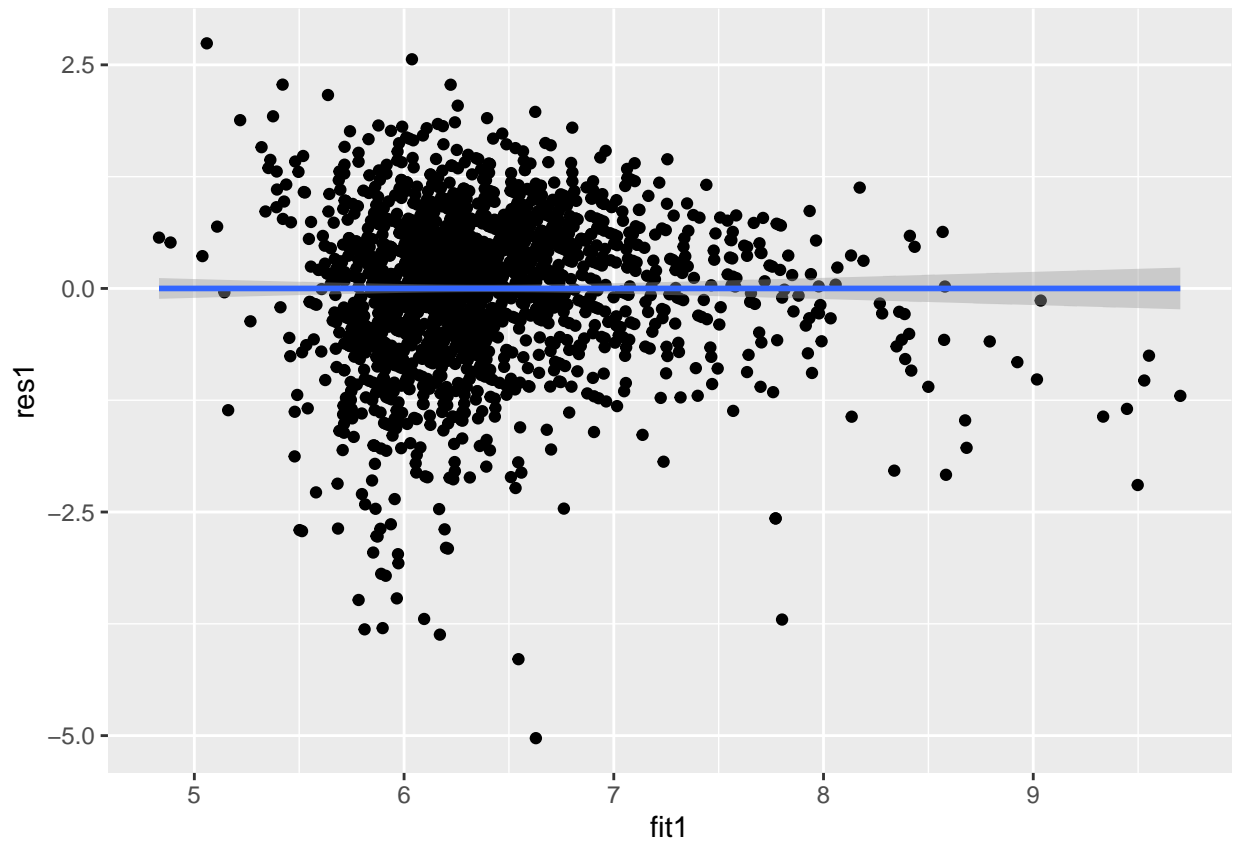
```
pred_modela <- predict(modela,
                       validset)

forecast::accuracy(pred_modela,validset$imdb_score)
```

```
##                  ME      RMSE      MAE       MPE     MAPE
## Test set 0.002914939 0.8702228 0.6566114 -2.458541 11.68463
```

```
#model1
model1a <- lm(imdb_score ~ num_critic_for_reviews
            +director_facebook_likes+actor_facebook_likes+movie_facebook_likes+num_user_for_reviews+bu
summary(model1a)$adj.r.squared
```

```
## [1] 0.2150225
```

```
#model2
model2a <- lm(imdb_score ~ num_critic_for_reviews
            +director_facebook_likes+actor_facebook_likes+movie_facebook_likes+num_user_for_reviews+bu
summary(model2a)$adj.r.squared
```

```
## [1] 0.2325212
```

```
ggplot(model2a, aes(x = num_critic_for_reviews
                    +director_facebook_likes+actor_facebook_likes+movie_facebook_likes+num_user_for_revi
  geom_point() +
  stat_smooth(method = "lm")
```

## 'geom_smooth()' using formula = 'y ~ x'
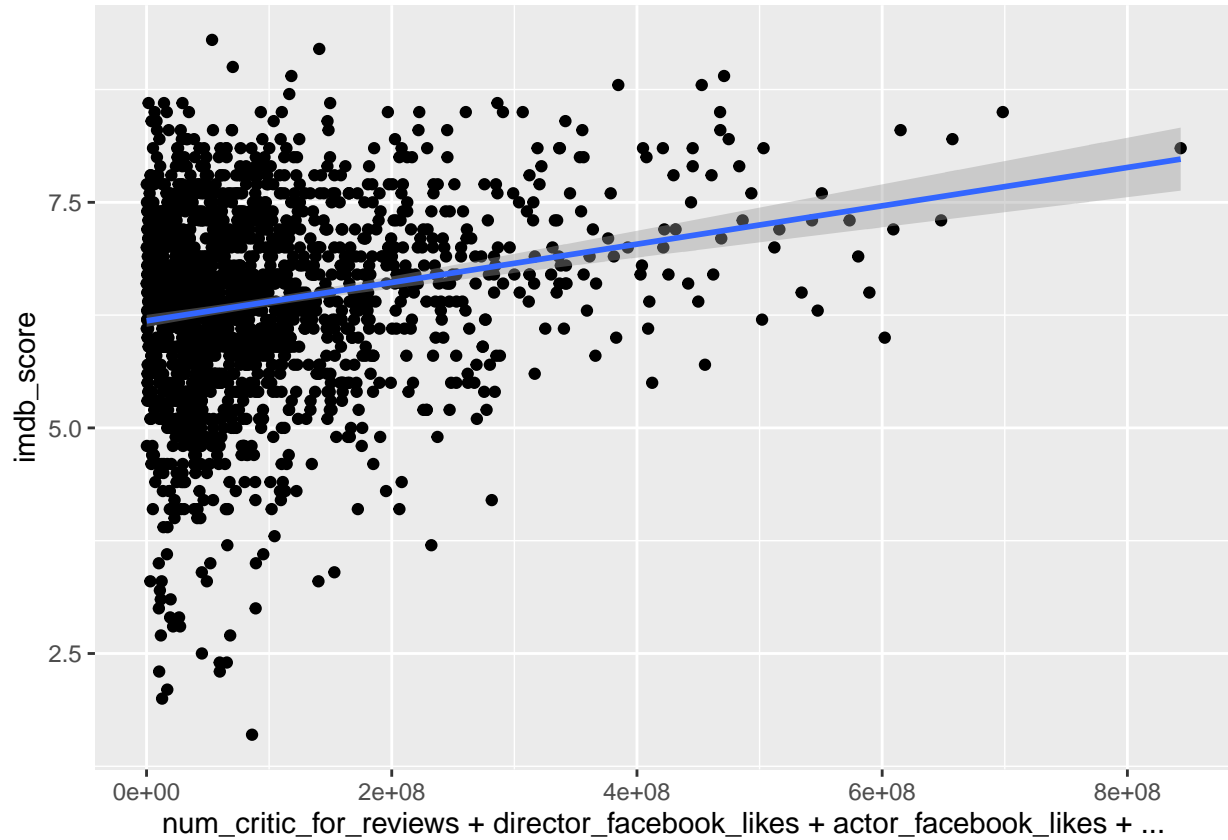


```
#model3
model3a <- lm(imdb_score ~ num_critic_for_reviews
              +director_facebook_likes+actor_facebook_likes+movie_facebook_likes+num_user_for_reviews+bu
              ,data=trainingset)
summary(model3a)$adj.r.squared
```

## [1] 0.3071483

```
ggplot(model3a, aes(x = num_critic_for_reviews
                    +director_facebook_likes+actor_facebook_likes+movie_facebook_likes+num_user_for_revi
  geom_point() +
  stat_smooth(method = "lm")
```

## 'geom_smooth()' using formula = 'y ~ x'
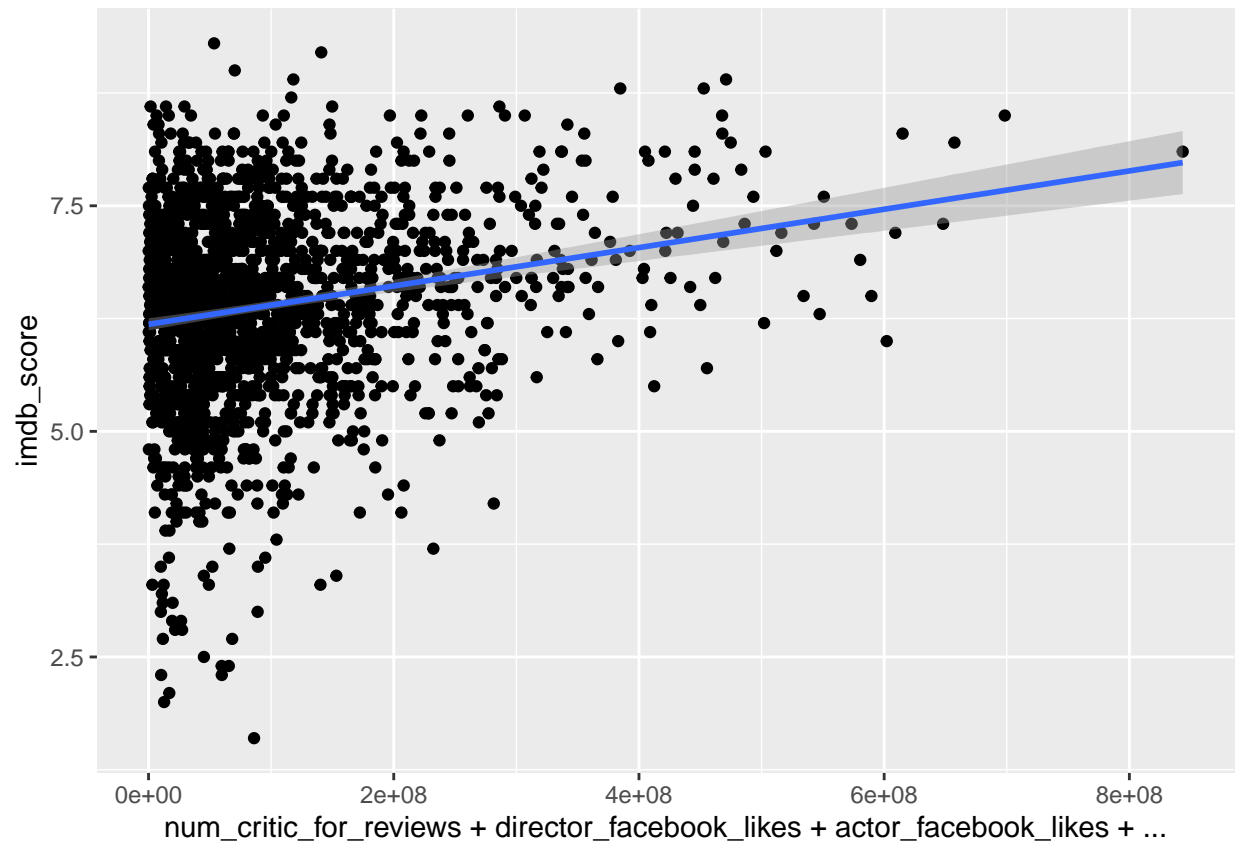
```
#Check prediction accuracy of top two models
#model2a and model3a
pred_imdb2a <- predict(model2a,
                       validset)
head(data.frame(actual=validset$imdb_score,
                predicted=pred_imdb2a,
                residuals=validset$imdb_score-pred_imdb2a))
```

```
##    actual predicted   residuals
## 1     7.9  9.124830 -1.22483033
## 2     7.1  6.098096  1.00190395
## 5     6.2  6.882332 -0.68233218
## 7     7.5  8.024386 -0.52438592
## 15    6.7  6.380783  0.31921731
## 17    7.0  6.972435  0.02756456
```

```
pred_imdb3a <- predict(model3a,
                       validset)
head(data.frame(actual=validset$imdb_score,
                predicted=pred_imdb3a,
                residuals=validset$imdb_score-pred_imdb3a))
```

```
##    actual predicted  residuals
## 1     7.9  9.489991 -1.5899914
## 2     7.1  6.448604  0.6513955
```

```
## 5      6.2  6.994804 -0.7948035
## 7      7.5  7.945914 -0.4459139
## 15     6.7  6.430020  0.2699798
## 17     7.0  7.210181 -0.2101810
```

```
forecast::accuracy(pred_imdb2a,validset$imdb_score)
```

```
##                      ME      RMSE       MAE       MPE     MAPE
## Test set -0.0001252456 0.9115175 0.6958987 -2.752876 12.42475
```

```
forecast::accuracy(pred_imdb3a,validset$imdb_score)
```

```
##                  ME      RMSE       MAE       MPE     MAPE
## Test set 0.002914939 0.8702228 0.6566114 -2.458541 11.68463
```

#We choose model3a because of the lower RMSE and MAPE, which means num_critic_for_reviews+director_face