Top_song_analysis.R

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```
# split data into train and test
set.seed(101)
sample_n(Data,10)
```

```
##      X                                          title           artist
## 1  434                                         Higher Carly Rae Jepsen
## 2   96      Castle Walls (feat. Christina Aguilera)             T.I.
## 3  211                                       All of Me      John Legend
## 4  447                                Treat You Better     Shawn Mendes
## 5  354                 Yesterday (feat. Bebe Rexha)     David Guetta
## 6  318                   Fireball (feat. John Ryan)          Pitbull
## 7  248 Can't Remember to Forget You (feat. Rihanna)          Shakira
## 8  132                      Lights - Single Version   Ellie Goulding
## 9  526                                   These Days       Rudimental
## 10 355                             Time of Our Lives          Pitbull
##            Genre year bpm Duration Energy Dancebility Loudness Valence
## 1   canadian pop 2016 114      234     87          65       77      44
## 2    atl hip hop 2011  80      329     86          45       77      58
## 3     neo mellow 2014 120      270     26          42       62      33
## 4   canadian pop 2017  83      188     82          44       85      75
## 5      dance pop 2015 128      243     78          57       85      28
## 6      dance pop 2015 123      235     94          69       77      79
## 7  colombian pop 2014 138      207     81          69       85      82
## 8      dance pop 2012 120      211     80          68       69      78
## 9      dance pop 2018  92      211     81          65       85      55
## 10     dance pop 2015 124      229     80          72       69      72
##    Acoustiveness Popularity        Rating
## 1              1         46 Below Average
## 2              7         49 Below Average
## 3             92         86 Above Average
## 4             11         84 Above Average
## 5              2         46 Below Average
## 6              9         67 Above Average
## 7             12         62 Below Average
## 8              3         65 Below Average
## 9             19         80 Above Average
## 10             9         45 Below Average
```

```
# Lets take a sample of 75/25 like before. Dplyr preserves class.
training_sample <- sample(c(TRUE, FALSE), nrow(Data), replace = T, prob =
c(0.75,0.25))
train <- Data[training_sample, ]
```

```r
test <- Data[!training_sample, ]

fit<-
lm(Popularity~Duration+Energy+Dancebility+Loudness+Valence+Acoustiveness,data
= train)
summary(fit)
```

```
##
## Call:
## lm(formula = Popularity ~ Duration + Energy + Dancebility + Loudness +
##     Valence + Acoustiveness, data = train)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -59.251  -6.735   2.563   8.765  28.476
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   77.30804    7.60943  10.159  < 2e-16 ***
## Duration      -0.04579    0.01992  -2.298  0.02201 *
## Energy        -0.24190    0.06325  -3.825  0.00015 ***
## Dancebility    0.06985    0.05660   1.234  0.21780
## Loudness       0.17117    0.06683   2.561  0.01076 *
## Valence        0.01038    0.03569   0.291  0.77137
## Acoustiveness -0.04579    0.03942  -1.162  0.24603
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.28 on 443 degrees of freedom
## Multiple R-squared:  0.05339,    Adjusted R-squared:  0.04057
## F-statistic: 4.164 on 6 and 443 DF,  p-value: 0.0004379
```

```r
coefficients(fit)
```

```
##   (Intercept)      Duration        Energy   Dancebility      Loudness
##   77.30803737   -0.04579099   -0.24189821    0.06984747    0.17117232
##       Valence Acoustiveness
##    0.01037873   -0.04579239
```

```r
confint(fit,level=0.95)
```

```
##                     2.5 %       97.5 %
## (Intercept)   62.35296256 92.263112189
## Duration      -0.08494685 -0.006635123
## Energy        -0.36619886 -0.117597558
## Dancebility   -0.04138104  0.181075977
## Loudness       0.03982101  0.302523625
## Valence       -0.05977312  0.080530568
## Acoustiveness -0.12327104  0.031686265
```

```r
# Predicted Values
fitted(fit)
```

```
##        1        2        3        5        6        9       10       11
## 65.03212 60.75252 69.16562 64.87399 65.36194 67.81960 69.23588 64.73262
##       12       13       14       15       16       17       19       21
## 63.19640 66.10702 65.41000 60.13229 63.53354 73.51360 60.80654 65.67944
##       23       24       26       27       28       29       32       33
## 70.06106 66.65067 63.45439 64.50433 64.94589 66.24588 67.10214 70.27231
##       34       35       36       37       39       40       41       42
## 67.32005 62.58122 72.39529 66.77912 60.59766 62.93427 64.98225 70.38174
##       45       48       49       50       53       55       58       59
## 65.70340 67.28001 58.04438 65.53398 63.13793 66.70695 64.96811 68.67403
##       60       61       63       67       69       70       71       72
## 67.75586 64.20582 59.57734 67.06304 62.98391 63.92387 63.75655 66.27112
##       73       75       76       77       79       80       81       82
## 66.37311 67.27358 60.21865 63.93898 70.70945 70.20433 63.25723 63.11920
##       83       84       85       87       88       89       90       93
## 64.44006 67.12414 68.97067 66.80702 67.48456 69.31305 65.97074 63.59041
##       94       95      100      101      102      103      104      105
## 68.53734 58.04438 59.88544 66.97356 64.47417 66.25058 65.71060 70.02836
##      106      107      109      110      111      112      113      114
## 63.99479 67.41618 71.51378 71.14027 73.39529 69.07568 68.96519 63.34190
##      115      116      117      118      119      121      122      124
## 66.57558 72.72257 68.54396 65.90522 67.58840 67.16670 62.32912 63.89161
##      126      128      129      130      131      132      133      134
## 62.91605 67.84408 64.99585 63.14437 65.52696 65.47455 67.32679 65.17172
##      135      137      138      139      141      144      146      147
## 67.40571 58.77959 64.64098 63.30665 67.79114 68.25660 60.45939 71.02708
##      149      151      152      153      155      156      162      165
## 70.69444 68.96519 69.63721 65.34434 66.08149 65.53852 61.27881 67.99856
##      166      167      168      169      170      171      172      173
## 67.18202 63.65691 70.15179 63.73902 65.47897 67.91944 67.54461 69.61840
##      174      175      176      178      179      181      182      183
## 67.99203 68.97210 64.28842 69.06685 68.28241 67.17132 66.00561 66.74653
##      184      185      186      188      190      192      193      195
## 66.74290 70.03682 60.89817 66.52200 64.06334 64.44808 62.63913 63.20804
##      196      197      198      199      200      202      203      204
## 64.05120 67.01580 66.83454 63.04535 68.59397 64.15926 67.94388 66.87029
##      205      206      207      208      210      213      214      215
## 66.07203 65.52374 66.97099 63.48534 71.45602 67.96138 66.34915 69.85942
##      216      217      218      219      220      222      223      225
## 64.12520 69.23432 72.46990 65.29850 67.18331 69.52988 61.67985 65.50235
##      226      227      228      229      230      231      232      233
```

```
## 66.02736 63.87692 63.50676 71.62120 70.00636 67.31782 68.50983 64.18375
##      234       235       237       238       241       242       243       244
## 69.35562 64.07675 64.95583 68.88792 69.92476 65.00829 69.38333 66.41935
##      245       246       247       249       250       253       254       256
## 64.91903 67.90622 66.69687 64.35974 66.71080 63.71533 70.38632 69.75881
##      258       260       261       262       263       264       265       266
## 66.98267 68.38841 67.33286 70.23092 67.78664 66.14992 65.70202 69.22865
##      267       268       269       270       271       272       273       275
## 69.15306 67.16891 64.85919 67.72767 64.99465 63.92701 68.86871 62.54164
##      277       278       279       281       282       283       284       285
## 67.38540 66.23538 69.23263 69.53922 64.70373 66.39748 66.04863 67.36237
##      286       287       288       290       291       292       293       295
## 62.93897 64.39058 69.41272 69.58496 63.01680 68.63433 66.82189 69.28824
##      296       299       300       301       302       303       304       305
## 65.72886 65.58391 70.21894 69.68819 70.24119 69.80723 62.13519 67.26833
##      306       307       309       310       311       312       315       316
## 65.06191 66.11904 72.14441 65.89408 68.23612 66.37531 62.21626 63.18731
##      317       318       319       320       321       322       323       325
## 61.85991 66.41487 67.99278 63.92701 62.43329 68.34119 65.45921 65.51665
##      326       330       331       332       334       335       336       337
## 64.63557 59.31671 69.08333 67.82801 65.66732 67.10816 66.33123 67.82406
##      338       340       341       342       344       345       346       347
## 67.91137 64.80121 66.85057 66.54911 66.25150 72.93186 67.94989 64.16263
##      348       349       350       351       353       354       355       356
## 69.32594 62.44551 60.38480 66.04274 67.25792 67.67927 64.55540 69.59674
```

```
residuals(fit)
```

```
##             1             2             3             5             6
##  17.967877695  21.247476289  10.834383439  13.126013784  11.638064852
##             9            10            11            12            13
##   8.180400662   3.764117708   8.267376146   9.803599785   6.892976034
##            14            15            16            17            19
##   7.589995471  11.867714749   8.466461478  -2.513603969   8.193463098
##            21            23            24            26            27
##   2.320560224  -4.061056001  -1.650667140   1.545609486  -0.504334957
##            28            29            32            33            34
##  -1.945888200  -3.245881509  -5.102143621  -8.272305751  -5.320052124
##            35            36            37            39            40
##  -0.581221665 -11.395288844  -5.779117843  -1.597660284  -4.934273928
##            41            42            45            48            49
##  -6.982250591 -13.381742736  -9.703403052 -15.280009046  -9.044380090
##            50            53            55            58            59
## -32.533983222  15.862072693   9.293045514  11.031890237   6.325973853
##            60            61            63            67            69
```

```
##   7.244139187   9.794176566  13.422655889   4.936962509   9.016085357
##            70            71            72            73            75
##   7.076125161   5.243449851   2.728881386   2.626889983  -0.273576088
##            76            77            79            80            81
##   6.781354767   2.061024319  -6.709454148  -6.204334556   0.742771637
##            82            83            84            85            87
##  -0.119200154  -1.440061932  -4.124135892  -7.970671323  -6.807018524
##            88            89            90            93            94
##  -8.484561795 -10.313047615  -7.970736263 -11.590408022 -18.537341518
##            95           100           101           102           103
##  -9.044380090 -31.885439333 -39.973564772 -39.474170817 -59.250576685
##           104           105           106           107           109
##  14.289403160   8.971638183  15.005210351  11.583820362   5.486215789
##           110           111           112           113           114
##   4.859729737   2.604713720   6.924317371   6.034809160  10.658097145
##           115           116           117           118           119
##   7.424420896   0.277429370   4.456035638   7.094776701   4.411595913
##           121           122           124           126           128
##   4.833304637   9.670884240   7.108393216   5.083948997  -0.844076419
##           129           130           131           132           133
##   1.004149650   1.855628580  -0.526963284  -2.474548501  -6.326789109
##           134           135           137           138           139
##  -6.171716900 -10.405710909 -20.779587327  23.359023534  21.693352913
##           141           144           146           147           149
##  13.208857625   9.743397962  16.540605166   5.972922552   5.305559829
##           151           152           153           155           156
##   6.034809160   5.362790046   9.655659199   7.918509332   8.461477936
##           162           165           166           167           168
##   9.721193218   2.001444848   2.817984366   6.343094806  -1.151786895
##           169           170           171           172           173
##   5.260975011   2.521029613   0.080562588   0.455393637  -2.618401681
##           174           175           176           178           179
##  -0.992031303  -2.972099207   0.711584496  -6.066853669  -6.282408775
#Anova Table
anova(fit)

## Analysis of Variance Table
##
## Response: Popularity
##                Df Sum Sq Mean Sq F value   Pr(>F)
## Duration        1   1082 1082.00  6.1371 0.013609 *
## Energy          1   1324 1323.69  7.5080 0.006391 **
## Dancebility     1    691  691.32  3.9212 0.048300 *
## Loudness        1   1064 1063.83  6.0341 0.014415 *
## Valence         1      6    6.33  0.0359 0.849762
## Acoustiveness   1    238  237.88  1.3493 0.246033
## Residuals     443  78103  176.30
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
vcov(fit)
```

```
##                (Intercept)      Duration        Energy   Dancebility
## (Intercept)   57.90348536 -1.027372e-01 -1.359695e-01 -2.146779e-01
## Duration      -0.10273721  3.969366e-04  1.347027e-05  5.920213e-05
## Energy        -0.13596949  1.347027e-05  4.000132e-03  6.807489e-04
## Dancebility   -0.21467789  5.920213e-05  6.807489e-04  3.203021e-03
## Loudness      -0.14355265  3.413188e-05 -2.418697e-03 -1.652439e-04
## Valence        0.02097914  1.302745e-04 -6.396639e-04 -9.569402e-04
## Acoustiveness -0.10128607 -4.300423e-05  1.189534e-03  5.288583e-04
##                    Loudness       Valence Acoustiveness
## (Intercept)   -1.435526e-01  0.0209791364 -1.012861e-01
## Duration       3.413188e-05  0.0001302745 -4.300423e-05
## Energy        -2.418697e-03 -0.0006396639  1.189534e-03
## Dancebility   -1.652439e-04 -0.0009569402  5.288583e-04
## Loudness       4.466798e-03 -0.0001084142 -3.087668e-04
## Valence       -1.084142e-04  0.0012741064 -1.235214e-04
## Acoustiveness -3.087668e-04 -0.0001235214  1.554145e-03
```

```r
step <- stepAIC(fit, direction="both")
```

```
## Start:  AIC=2334.44
## Popularity ~ Duration + Energy + Dancebility + Loudness + Valence +
##     Acoustiveness
##
##                 Df Sum of Sq   RSS    AIC
## - Valence        1     14.91 78118 2332.5
## - Acoustiveness  1    237.88 78341 2333.8
## - Dancebility    1    268.54 78371 2334.0
## <none>                       78103 2334.4
## - Duration       1    931.32 79034 2337.8
## - Loudness       1   1156.47 79259 2339.1
## - Energy         1   2579.01 80682 2347.1
##
## Step:  AIC=2332.53
## Popularity ~ Duration + Energy + Dancebility + Loudness + Acoustiveness
##
##                 Df Sum of Sq   RSS    AIC
## - Acoustiveness  1    229.31 78347 2331.8
## <none>                       78118 2332.5
## - Dancebility    1    427.82 78545 2333.0
## + Valence        1     14.91 78103 2334.4
## - Duration       1   1008.85 79126 2336.3
## - Loudness       1   1170.85 79288 2337.2
## - Energy         1   2684.63 80802 2345.7
##
## Step:  AIC=2331.84
## Popularity ~ Duration + Energy + Dancebility + Loudness
##
##                 Df Sum of Sq   RSS    AIC
```

```
## <none>                       78347 2331.8
## + Acoustiveness  1    229.31 78118 2332.5
## - Dancebility    1    608.99 78956 2333.3
## + Valence        1      6.33 78341 2333.8
## - Duration       1   1048.83 79396 2335.8
## - Loudness       1   1063.83 79411 2335.9
## - Energy         1   2568.80 80916 2344.4
```

```
step$anova # display results
```

```
## Stepwise Model Path
## Analysis of Deviance Table
##
## Initial Model:
## Popularity ~ Duration + Energy + Dancebility + Loudness + Valence +
##     Acoustiveness
##
## Final Model:
## Popularity ~ Duration + Energy + Dancebility + Loudness
##
##
##              Step Df  Deviance Resid. Df Resid. Dev      AIC
## 1                                    443   78102.65 2334.439
## 2       - Valence  1  14.90543       444   78117.55 2332.525
## 3 - Acoustiveness  1 229.30739       445   78346.86 2331.844
```

```
fit6 <- lm(Popularity~Energy+Loudness+Duration+Dancebility,data = train)
summary(fit6)
```

```
##
## Call:
## lm(formula = Popularity ~ Energy + Loudness + Duration + Dancebility,
##     data = train)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -61.494  -6.552   2.380   9.000  27.419
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 74.25476    7.14840  10.388  < 2e-16 ***
## Energy      -0.20394    0.05339  -3.820 0.000153 ***
## Loudness     0.16278    0.06622   2.458 0.014346 *
## Duration    -0.04773    0.01956  -2.441 0.015046 *
## Dancebility  0.09031    0.04856   1.860 0.063568 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.27 on 445 degrees of freedom
## Multiple R-squared:  0.05043,    Adjusted R-squared:  0.04189
## F-statistic: 5.908 on 4 and 445 DF,  p-value: 0.0001221
```

```r
attach(Data)
```

```
## The following object is masked _by_ .GlobalEnv:
##
##     Rating
```

```r
fc= predict.lm(fit6,data.frame(Duration=189,Energy=32,Loudness =
62,Dancebility=64))
fc
```

```
##      1
## 74.579
```

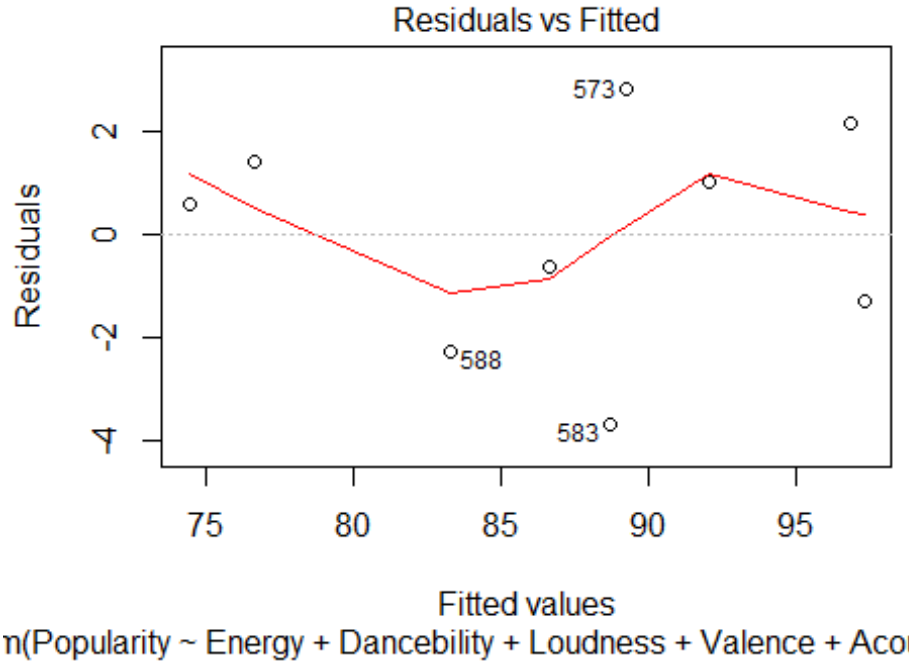
```r
d_g = Data[Data$Genre == 'pop' & Data$year == c(2019),c(4,7:13)]
ft_g = lm(Popularity~Energy+Dancebility+Loudness+Valence+Acoustiveness, data=
d_g)
summary(ft_g)
```

```
##
## Call:
## lm(formula = Popularity ~ Energy + Dancebility + Loudness + Valence +
##     Acoustiveness, data = d_g)
##
## Residuals:
##     568     570     572     573     580     583     588     591     595
##  2.1587 -1.2913  0.9937  2.8030 -0.6407 -3.6889 -2.2917  1.3775  0.5796
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)   141.77347   18.35008   7.726  0.00451 **
## Energy         -0.87601    0.17643  -4.965  0.01569 *
## Dancebility    -0.15562    0.11479  -1.356  0.26823
## Loudness        0.27513    0.19323   1.424  0.24969
## Valence         0.00154    0.09881   0.016  0.98854
## Acoustiveness  -0.26450    0.09281  -2.850  0.06511 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.496 on 3 degrees of freedom
## Multiple R-squared:  0.9335, Adjusted R-squared:  0.8227
## F-statistic: 8.423 on 5 and 3 DF,  p-value: 0.05478
```

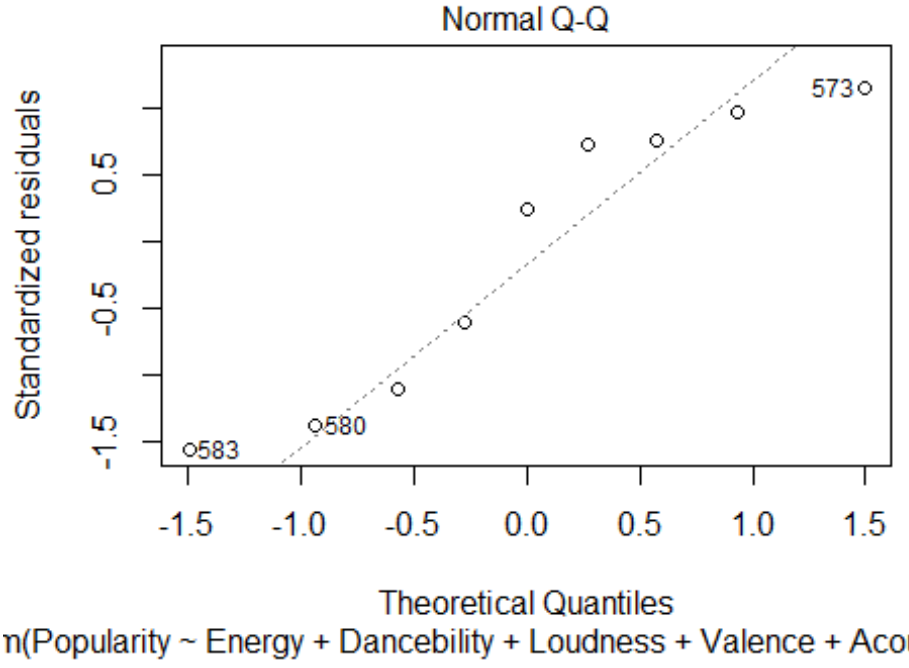
```r
fc_g= predict.lm(ft_g,data.frame(Acoustiveness=32,Loudness =
62,Dancebility=64,Valence=59,Energy=70))
fc_g
```

```
##        1
## 79.17777
```

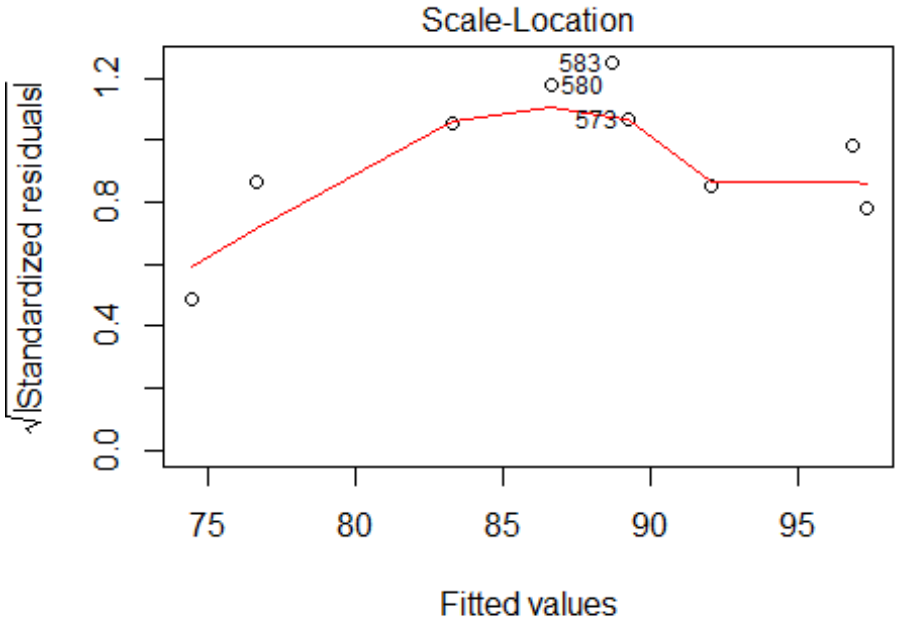
```r
#diagnostic plots
plot(ft_g)
```



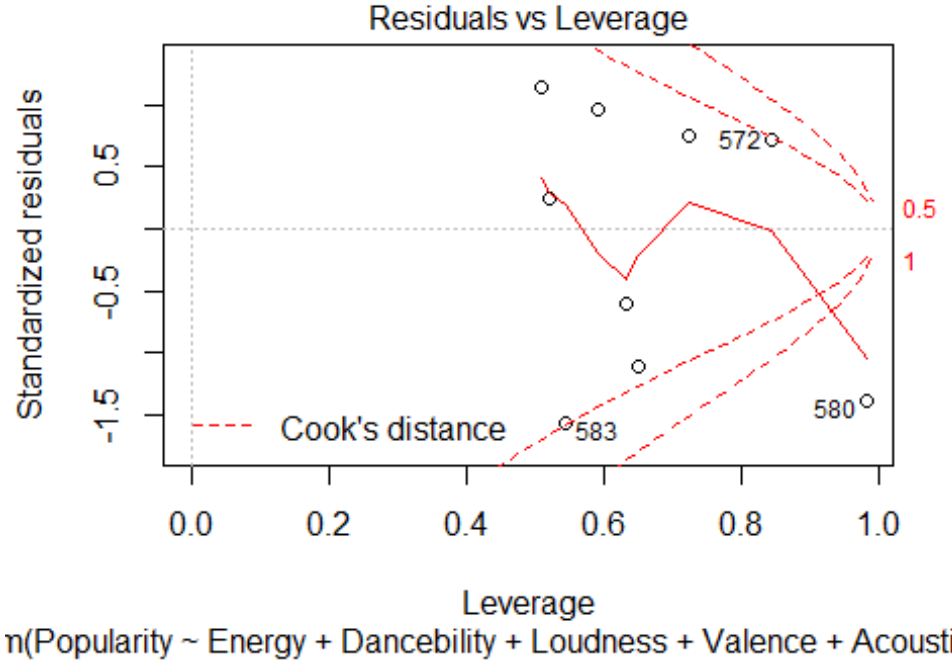
n(Popularity ~ Energy + Dancebility + Loudness + Valence + Acoustiv



n(Popularity ~ Energy + Dancebility + Loudness + Valence + Acoustiv



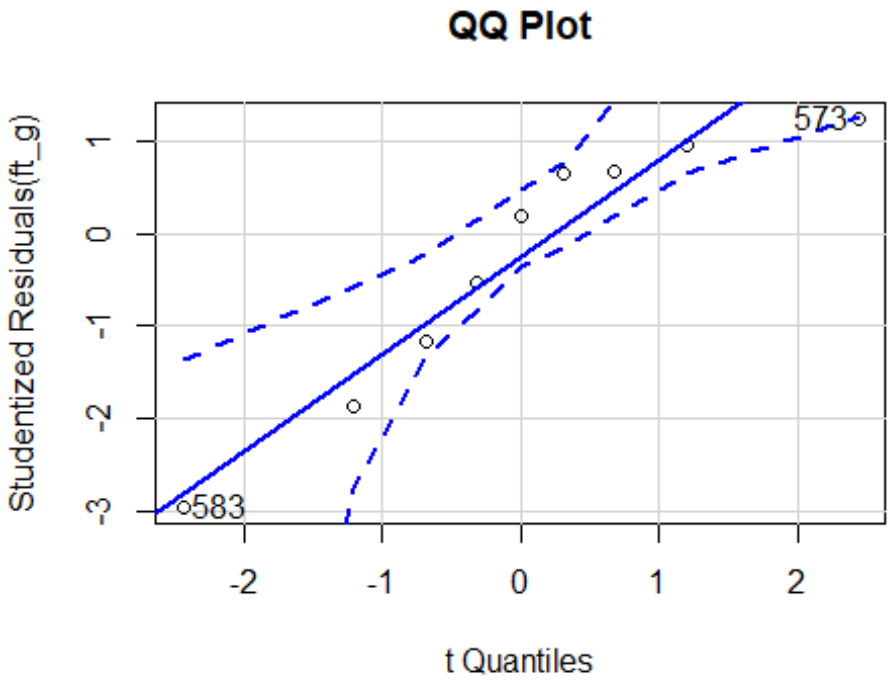

```
## Warning in sqrt(crit * p * (1 - hh)/hh): NaNs produced

## Warning in sqrt(crit * p * (1 - hh)/hh): NaNs produced
```



```r
# Assessing Outliers
outlierTest(ft_g)
```

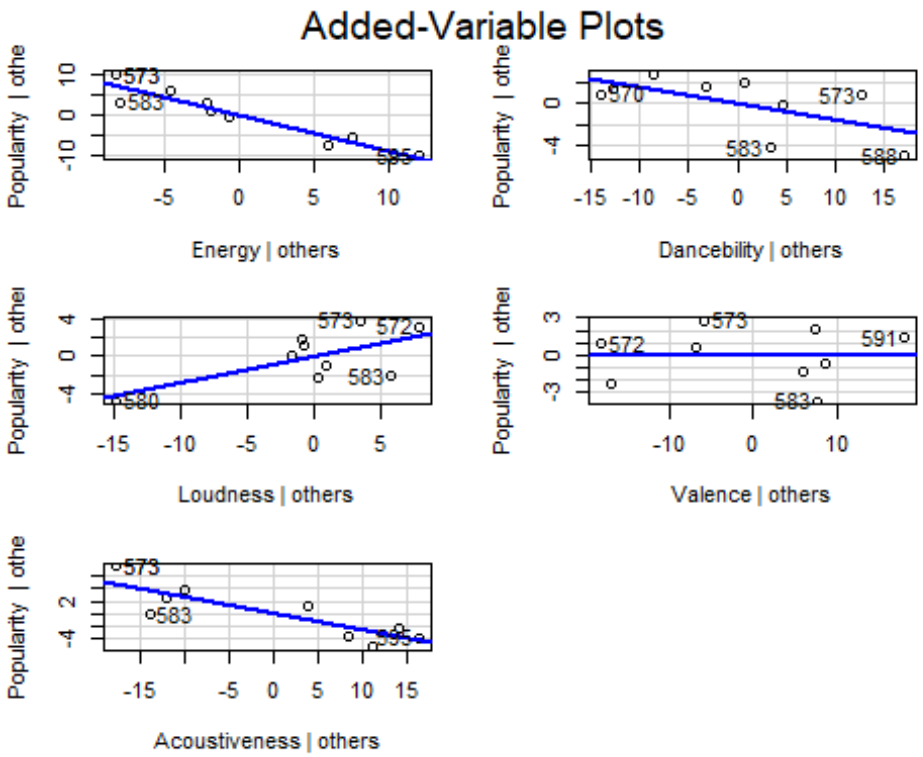
```
## No Studentized residuals with Bonferroni p < 0.05
## Largest |rstudent|:
##      rstudent unadjusted p-value Bonferroni p
## 583 -2.961341           0.097619      0.87857
```

```r
qqPlot(ft_g, main="QQ Plot")
```

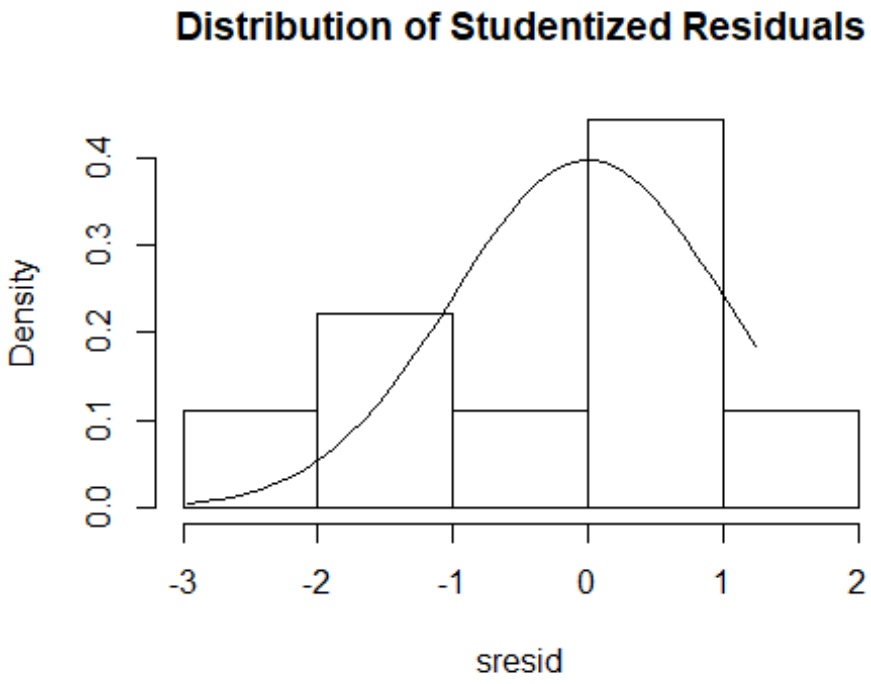



```
## 573 583
##   4   6
```

```r
# added variable plots
avPlots(ft_g)
```




```
# distribution of studentized residuals
sresid <- studres(ft_g)
hist(sresid, freq=FALSE,
     main="Distribution of Studentized Residuals")
xfit<-seq(min(sresid),max(sresid),length=40)
yfit<-dnorm(xfit)
lines(xfit, yfit)
```


Distribution of Studentized Residuals
Density
0.0
0.1
0.2
0.3
0.4
-3
-2
-1
0
1
2
sresid