Name: Hima Spandana
ID: 1990448
Date: 05-25-2020
Group Name: Manipogo

Individual Milestone 8

The video games space is a 70-year old industry that has rapidly reached across the entire globe with its influence. Video games have evolved over time to incorporate new and advancing technology. Now, incorporated with the internet, they connect people in their homes from all over the world. The video games industry has swelled to reach over 2.5 billion gamers around the world and took in $131 billion in 2018, with projections of $300 billion by 2025. Video games have engaged a massive, growing audience so I have decided as a team to try and gain insight into the trends in the sales of video game titles over time. Companies spend millions of dollars and thousands of hours of work on some games but it doesn't always generate enough revenue to even pay off these expenses. If the company is not big enough, they might even go bankrupt after an unsuccessful game release. One of the biggest indications of the revenue generated by the games is the number of sales.

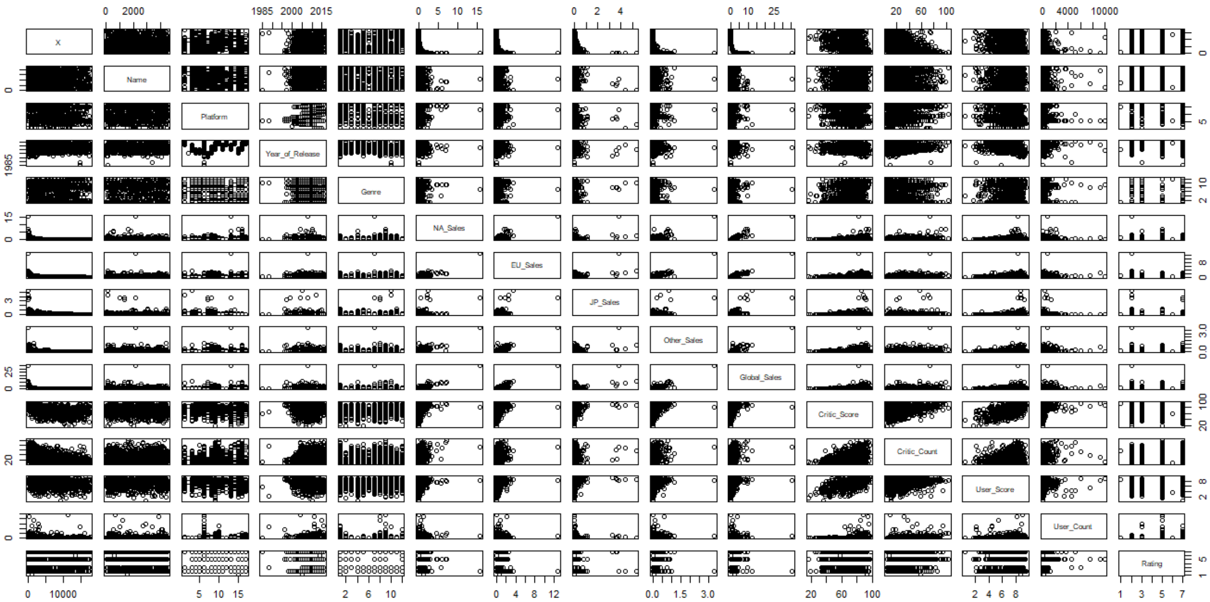
Using the Video Games Sales data I hope to identify trends and predict the sales in different regions as well as overall sales globally. I have decided to split the data into different rows to show individual predictions of the sales in the different regions such as NA, EU, JP, OTHER SALES, GLOBAL SALES.I believe that some games will sell more than others in different regions because some cultures might prefer some genres over others or some platforms are sold more in one region. I believe people also tend to buy more from local publishers/developers. Because of this reason each member of our group will take one region.I have taken EU_sales that is European region sales

To be able to explore the number of sales a game gets, we will use the data we found on https://www.kaggle.com/kendallgillies/video-game-sales-and-ratings. This dataset contains video games that were released between 1976 and 2017 which sold more than 100,000 copies. The author of this dataset created it mostly using VGChartz and Metacritic. It has 7112 observations and 15 variables. The original data had 17,417 observations,but since not all of the listed video games have information on Metacritic's website we removed the rows with missing values.I also dropped rows when there are missing values in any of the variables. For example, if one game is missing a Critic Score (or Platform information, or genre, etc.), I dropped that row.

The explanatory variables (column section) will consist of the platform, year of release, genre, critic score, critic count, user score, user count, publisher, and the rating. The Eu_sales will be the response variable. The game itself will be rows which are the observations.

I have pruned the dataset and removed 6 variables in order to test the regression model. The variables which I removed are x,platform,name, year of release, genre. Remaining 9 variables are in the model with 7112 observations. When performed on the regression test the adjusted R-Square happens to be 0.9999. That is 99.99% of variability EU_Sales is explained by the model. NA,JP,Global,Other sales have significant values and remaining variables are insignificant.

I plotted a scatter plot using all the variables in the dataset, this helps in identifying the second order term and the interaction terms that will be useful in the testing of the model.I used critic score and user score as the second order terms and other sales along with global sales as interaction term.When run the regression test, there is not much difference in the adjusted r square value. F test looks good. This tells that at least 1 beta is not equal to zero|| 99% of variability global sales is explained by the model. Null Hypothesis is rejected and the alternative is accepted. t-test looks good- The beta associated with global_sales is equal zero, we can reject that and accept the alternative,that the beta is not equal to zero and use that estimation. When using the interaction term for the model, there was no change in the adjusted R square, so removed the interaction term from the model.

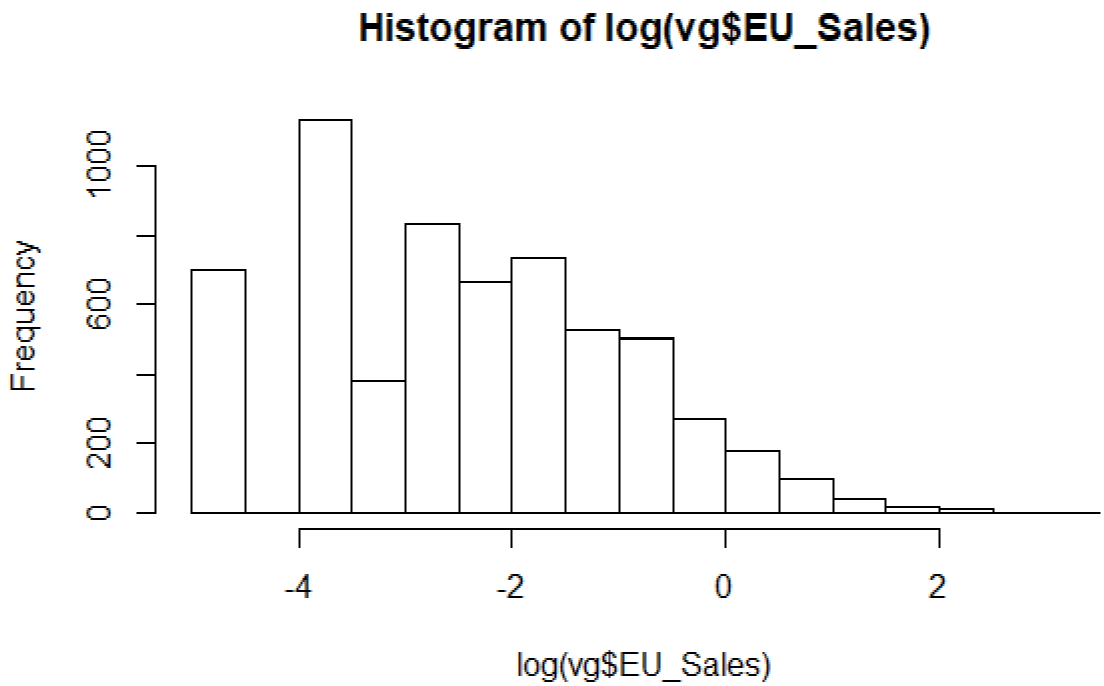


Performed correlation on the model, then obtained a symmetric matrix, the correlation between the same variables is always 1 and is placed diagonally on the matrix.Correlation test is used to evaluate the association between two or more variables.When performed the regression test and removed the non-significant variables from the dataset,I was left with 4 variables NA_Sales,JP_Sales,Other_Sales,Global_Sales that were significant and passed the p test. Ftest looks good. This tells that at least 1 beta is not equal to zero|| 99% of variability global sales is explained by the model. Null Hypothesis is rejected and the alternative is accepted. t-test looks good- The beta associated with global_sales is equal zero, we can reject that and accept the alternative,that the beta is not equal to zero and use that estimation. Performed multicollinearity by pruning some of the variables.

The Variance Inflation Factor (VIF) is 1/Tolerance, it is always greater than or equal to 1. There is no formal VIF value for determining presence of multicollinearity. Values of VIF that exceed 10 are often regarded as indicating multicollinearity, but in weaker models values above 2.5 may be a cause for concern. When performed VIF function on the model, shows the multicollinearity of the model. After pruning Other_Sales which had values above 10, the the VIF values came down.The values were multicollinear with Other_Sales .

```
NA_Sales    JP_Sales Other_Sales
2.312368    1.287669    2.142060
```

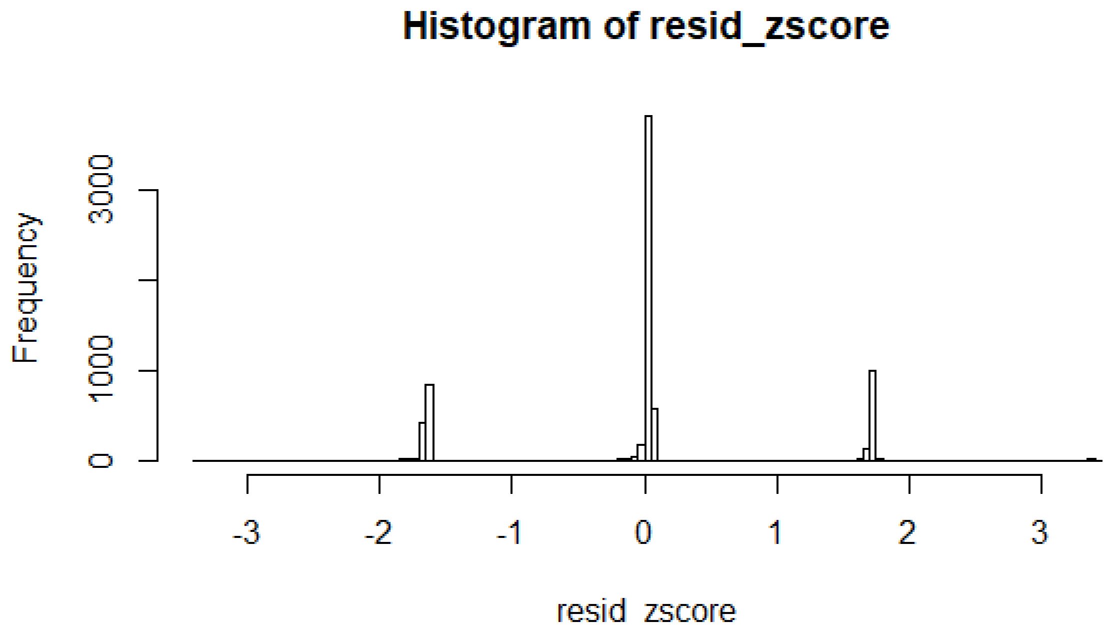
EU_sales on video games from 1985 to 2016 was more in the initial years and slowly reduced there after, making it less significant, this can be seen using the histogram and the graph is right skewed.



When transforming the variables by adding the log to the response variable, then the adjusted r square is 0.9999.Ftest looks good. This tells that at least 1 beta is not equal to zero|| 99% of variability global sales is explained by the model. Null Hypothesis is rejected and the alternative is accepted. t-test looks good- The beta associated with global_sales is equal zero, we can reject that and accept the alternative,that the beta is not equal to zero and use that estimation. This clearly shows how the variables are related to each other.

Transforming the independent variables was done by calculating the sum of the residual variables, the residuals are calculated using the difference between the actual and predicted values. The first residual is -1.907143e-03 dollars and sum of the residuals is 4.330846e-16(The sum of the assumptions is not equal to zero, as per the dataset considered).Calculated the mean of the residuals 5.278664e-20, standard deviation 0.005934796 and z-score normalization of all of the residuals.The below graph shows that

95% of variance is in between two standard deviations.The Durbin-Watson test has the null hypothesis that the autocorrelation of the disturbances is 0. It is possible to test against the alternative that it is greater than, not equal to, or less than 0, respectively. This can be specified by the alternative argument.

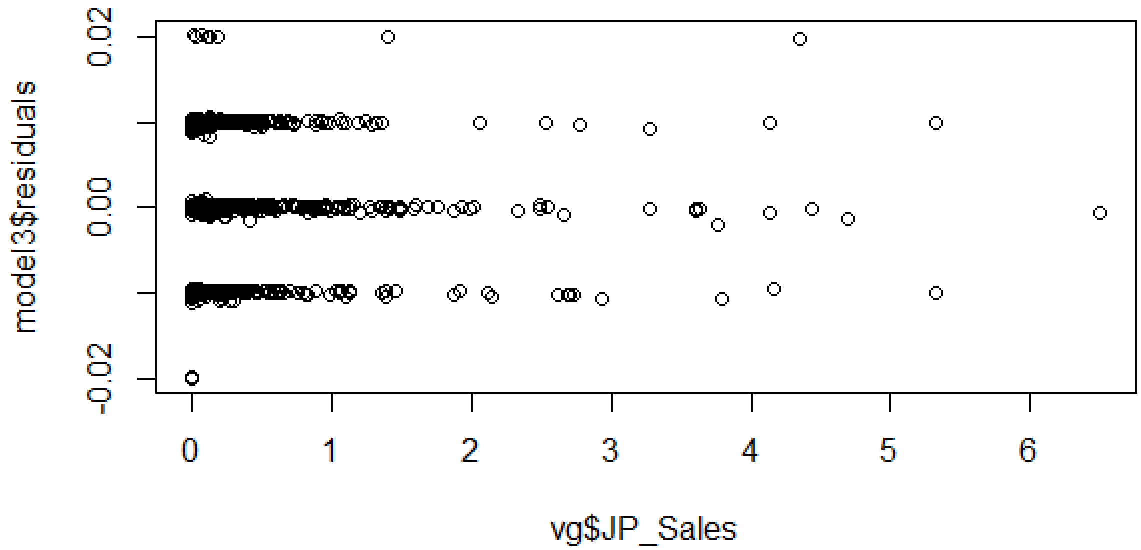


The Durbin-Watson test has the null hypothesis that the autocorrelation of the disturbances is 0. It is possible to test against the alternative that it is greater than, not equal to, or less than 0, respectively. This can be specified by the alternative argument.This test that the variables are not dependent on one another

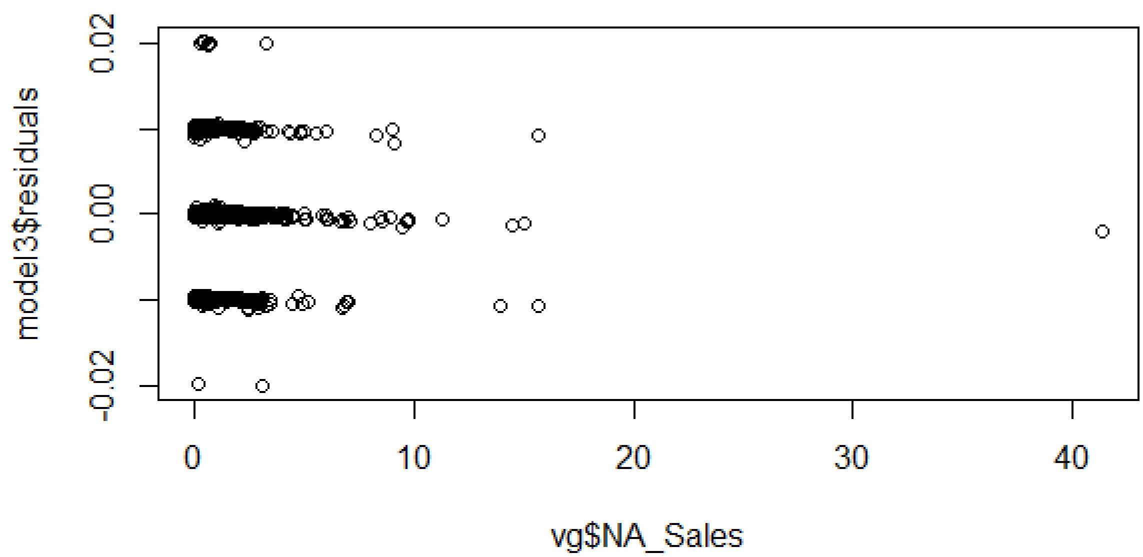
lag	Autocorrelation	D-W Statistic	p-value
1	0.1956712	1.608268	0

Alternative hypothesis: rho != 0

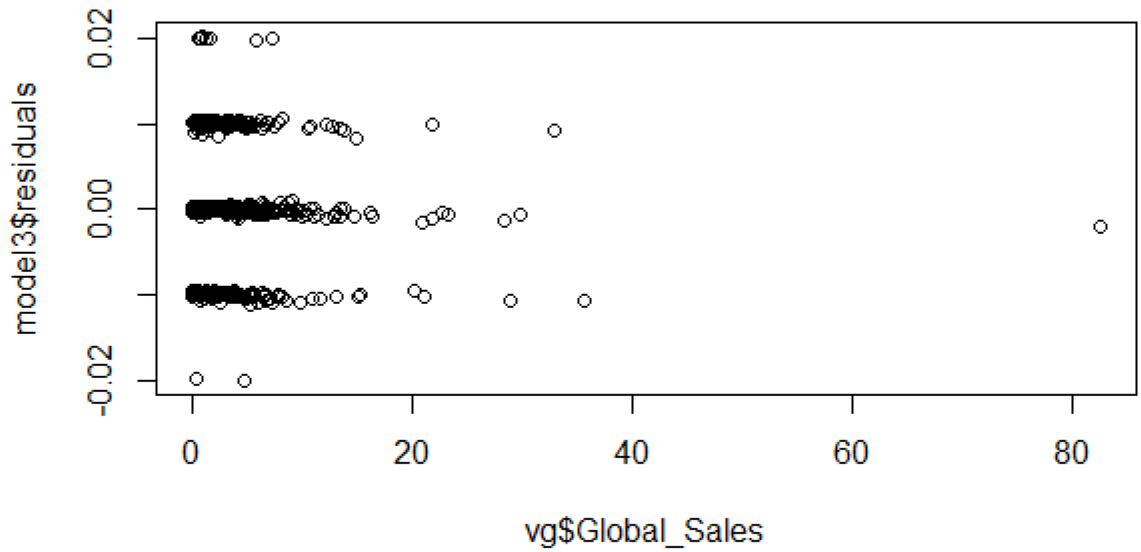
When plotted a graph between the residuals and JP_Sales of the dataset, I obtained the below graph.This shows that 95% of my points are in the two standard deviations.



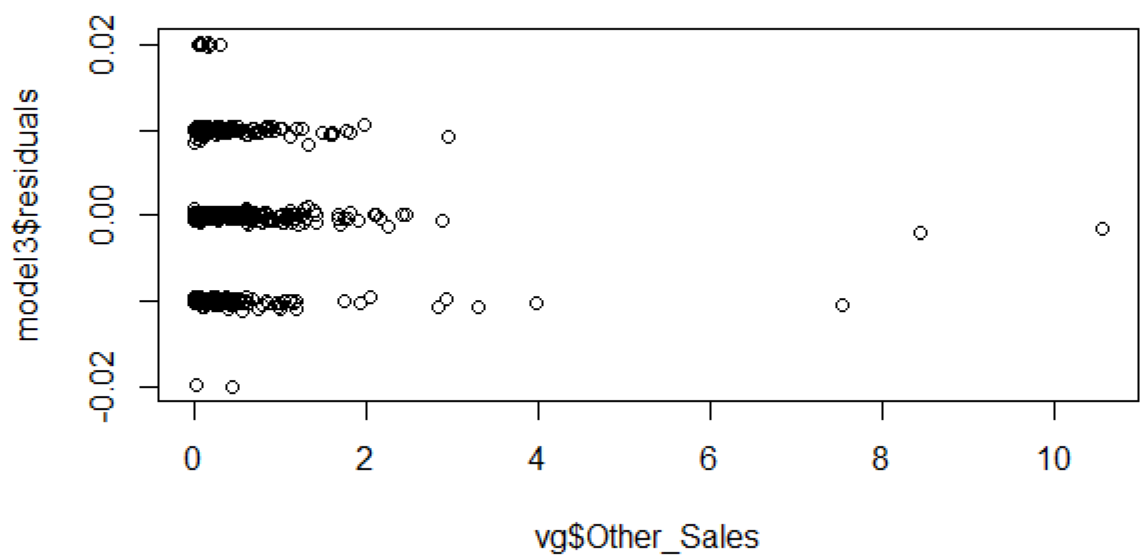
When plotted a graph between the residuals and NA_Sales of the dataset, I obtained the below graph.This shows that 95% of my points are in the two standard deviations.



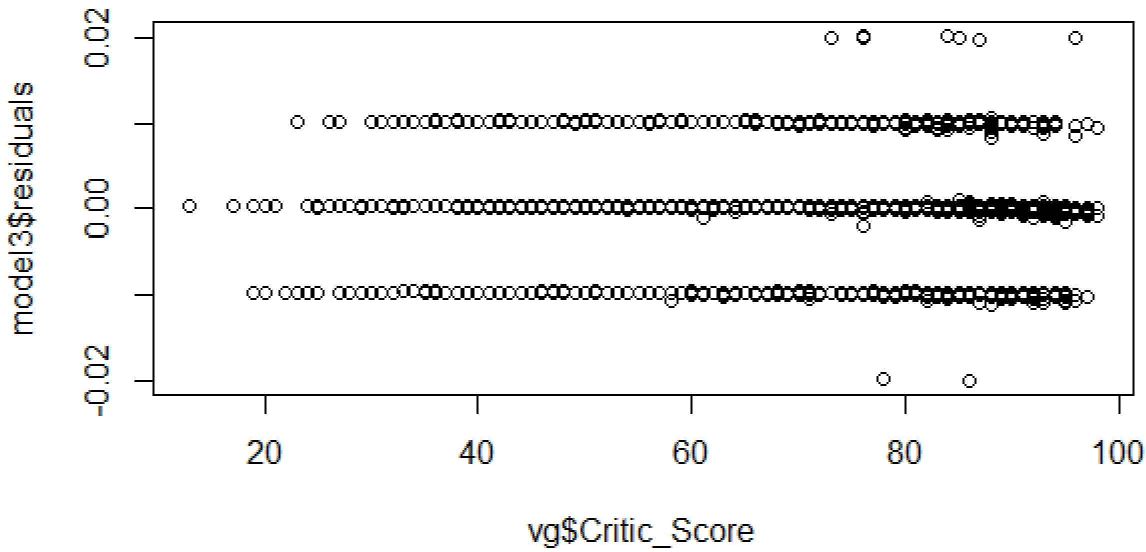
When plotted a graph between the residuals and Global_Sales of the dataset, I obtained the below graph.This shows that 95% of my points are in the two standard deviations.

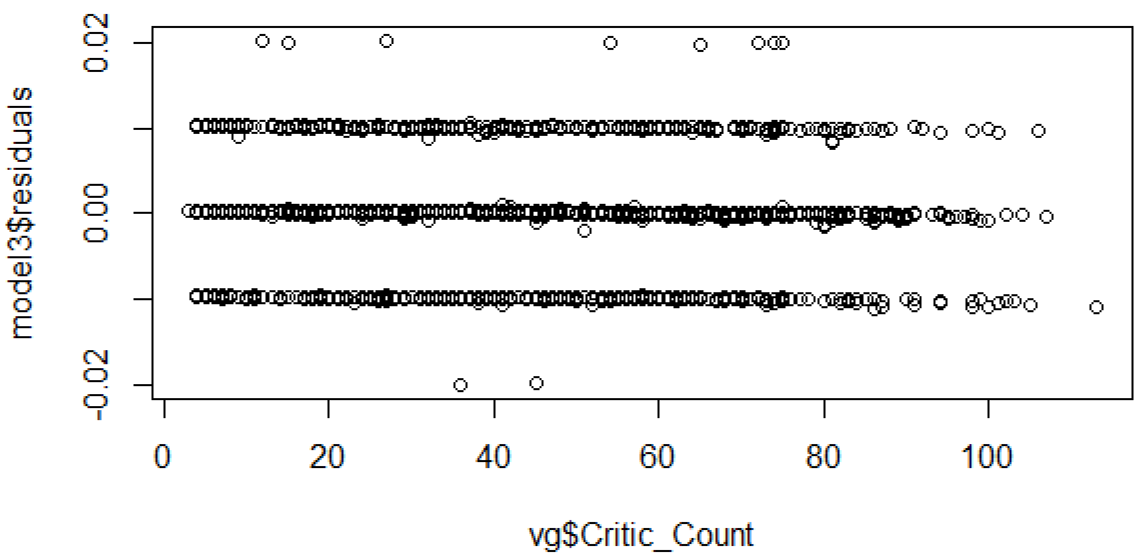


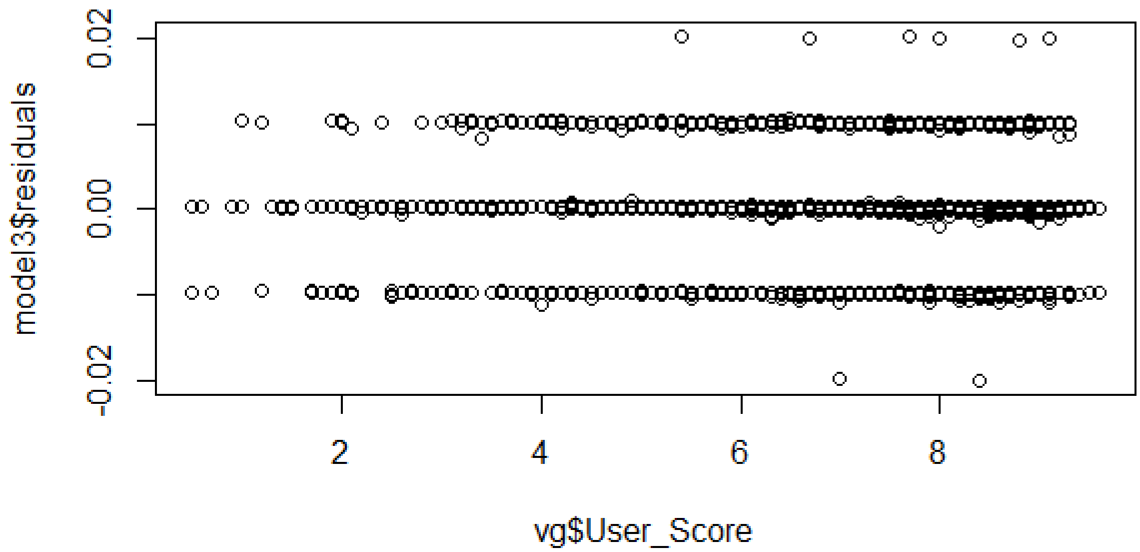
When plotted a graph between the residuals and Other_Sales of the dataset, I obtained the below graph.This shows that 95% of my points are in the two standard deviations.There are few outliers on the plot



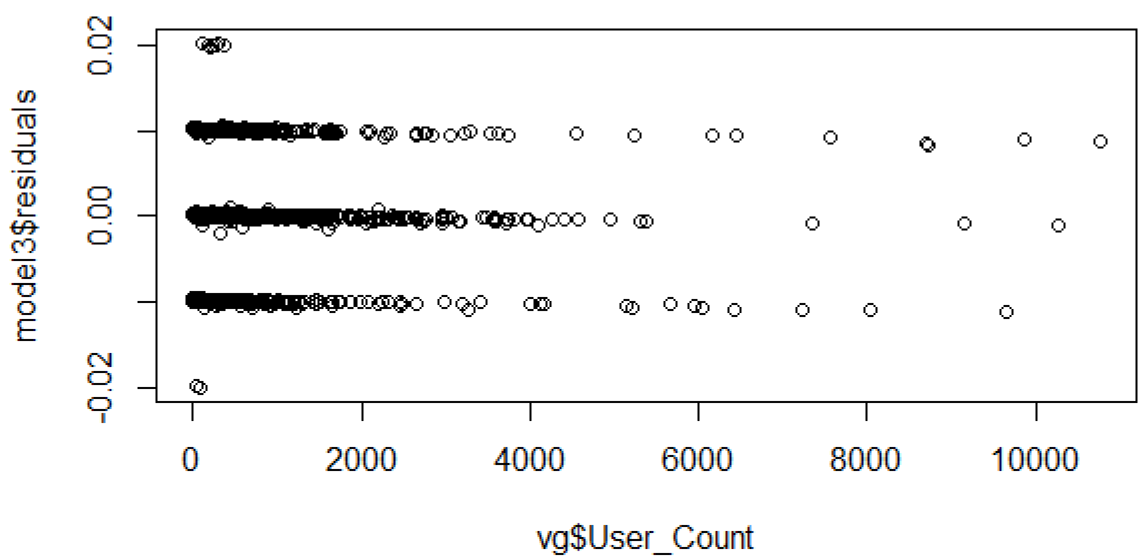
Plotted a graph between the residuals and the critic score, critic count, user count and user score.All the values looks pretty same on the horizontal line.


0.02
0.00
-0.02
model3$residuals
20
40
60
80
100
vg$Critic_Score

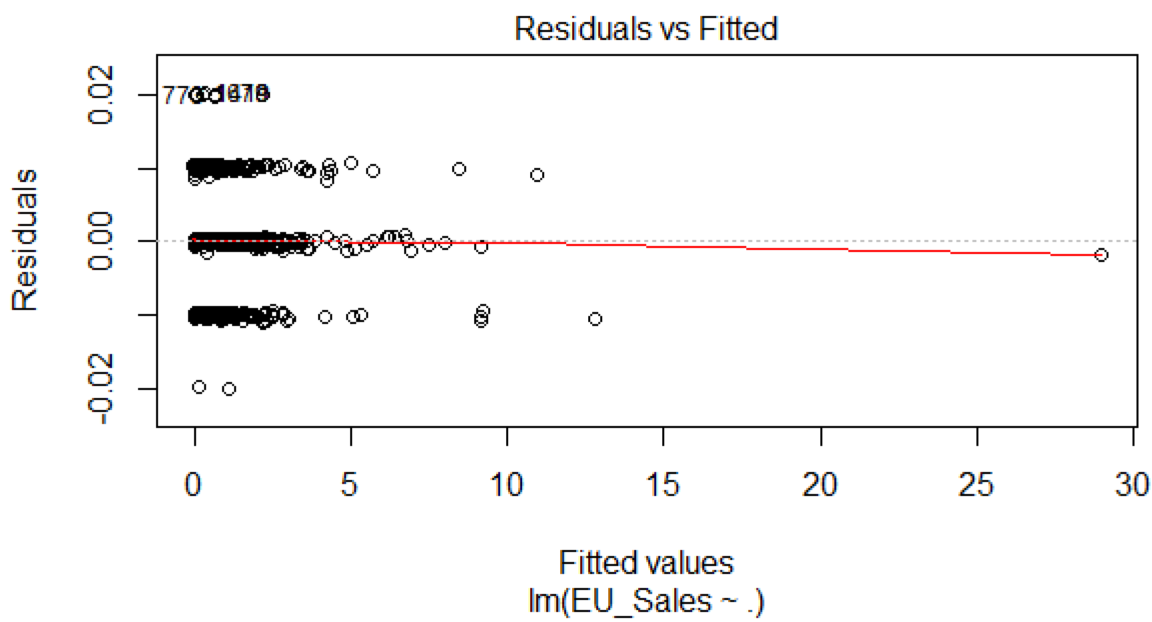

0.02
0.00
-0.02
model3$residuals
0
20
40
60
80
100
vg$Critic_Count



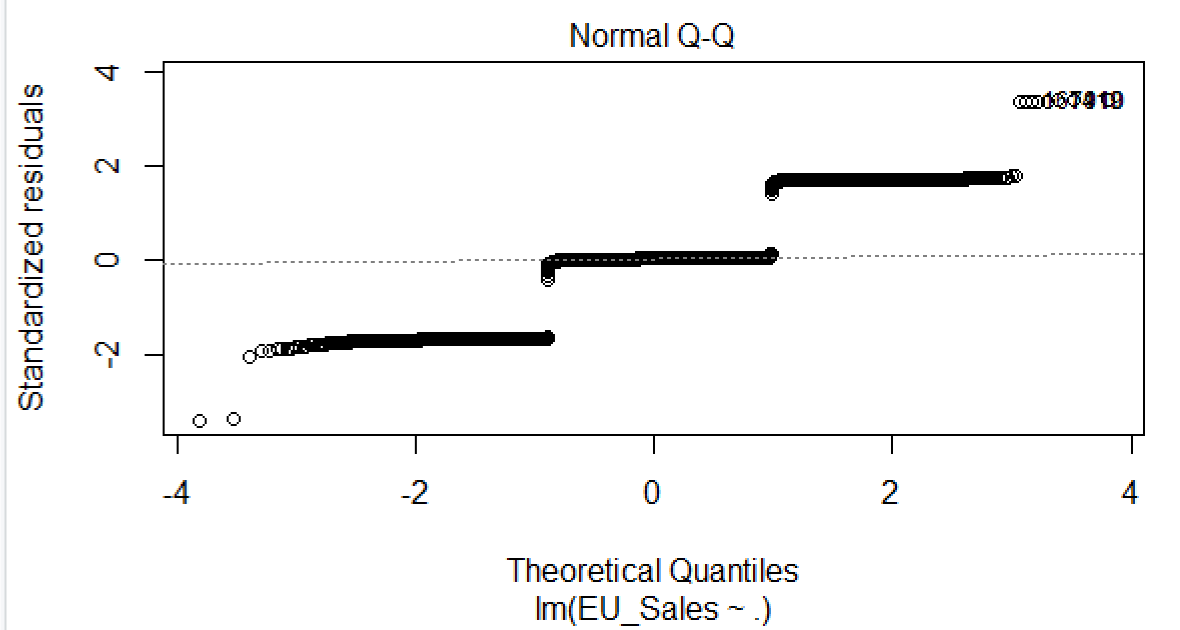
0.02
0.00
-0.02
model3$residuals
2
4
6
8
vg$User_Score



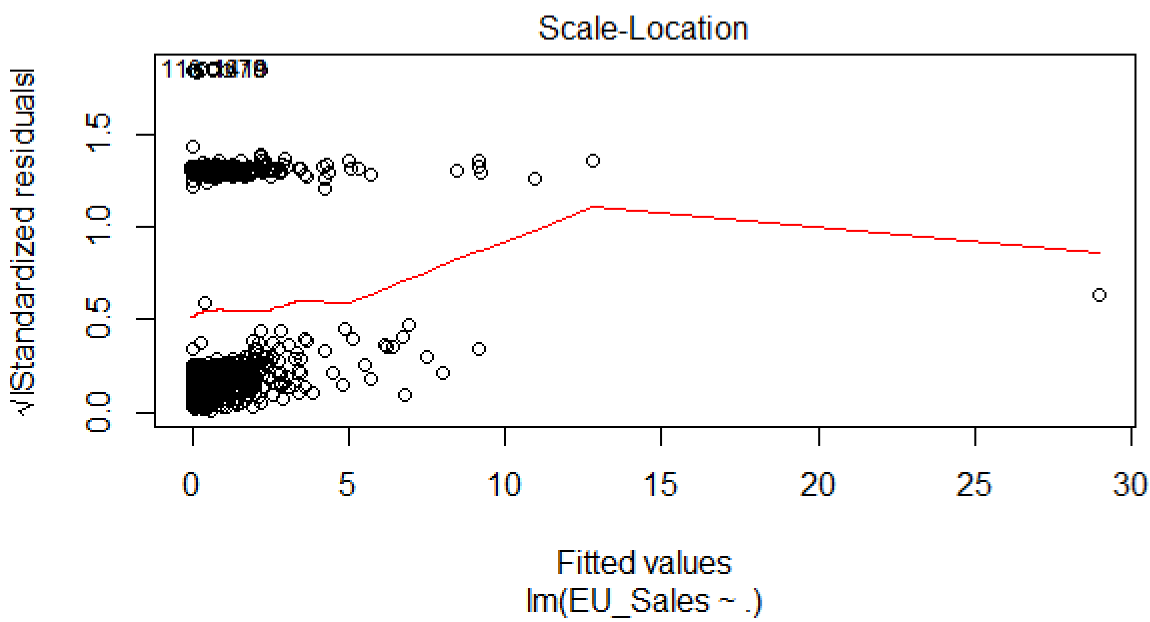
0.02
0.00
-0.02
model3$residuals
0
2000
4000
6000
8000
10000
vg$User_Count



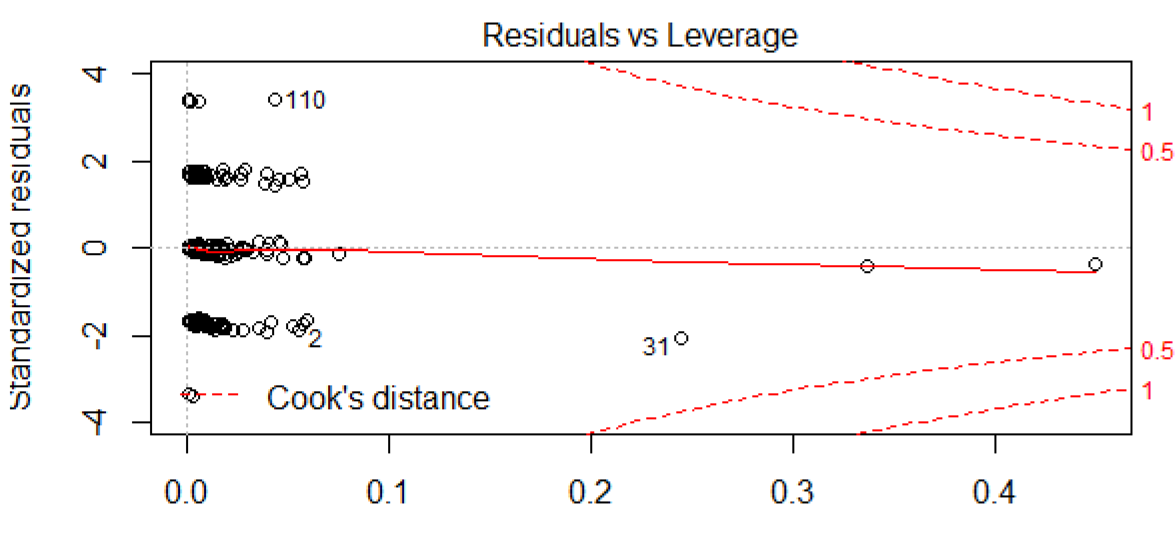
This graph is plotted between the residuals and fitted values of EU_Sales.The graph is unhealthy.Can't see any variance on the plot the variance.



This plot is called the normal Q-Q plot.This tells if the dataset is normal..This clearly shows that the dataset is not normal.Lot of variation in the data.



This Graph shows the fitted values against standardized residuals.and below graph shows the leverage against standardized residuals.The points 110 and 2 tell that they have lot of leverage on the regression line against the residuals.



Based on my observation residuals vs the fitted values had a multiplicative trend, this was clearly shown using the log to find the EU_Sales.

R Code

```
> Videogames <-
read.csv("C:/Users/spand/Downloads/video_without_na2.csv")
>
> vg <- Videogames[,-c(1,2,3,4,5,15)]  # Reduced dataframe(got down from
15 varibles to 9 variables)
>
>
> model<- lm(EU_Sales~., data=vg)
> summary(model)

Call:
lm(formula = EU_Sales ~ ., data = vg)

Residuals:
       Min         1Q     Median         3Q        Max
-0.0200425  0.0000900  0.0002366  0.0002957  0.0203024

Coefficients:
               Estimate Std. Error   t value Pr(>|t|)
(Intercept)  -3.746e-04  4.086e-04    -0.917    0.359
NA_Sales     -9.997e-01  3.178e-04 -3146.037   <2e-16 ***
JP_Sales     -9.998e-01  4.029e-04 -2481.313   <2e-16 ***
Other_Sales  -9.998e-01  5.008e-04 -1996.395   <2e-16 ***
Global_Sales  9.999e-01  2.076e-04  4817.100   <2e-16 ***
Critic_Score -7.551e-07  6.866e-06    -0.110    0.912
Critic_Count  2.556e-06  4.228e-06     0.605    0.545
User_Score    1.411e-05  6.132e-05     0.230    0.818
```

```
User_Count    1.308e-07  1.349e-07     0.970    0.332
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.005938 on 7103 degrees of freedom
Multiple R-squared:  0.9999, Adjusted R-squared:  0.9999
F-statistic: 1.166e+07 on 8 and 7103 DF,  p-value: < 2.2e-16


>
>
> # Second order terms
>
> vg$User_ScoreSQ<- (vg$User_Score)^2
> vg$Critic_CountSQ<- (vg$Critic_Count)^2
> vg$oth_glo <- (vg$Other_Sales*vg$Global_Sales)
>
> model1<- lm(EU_Sales~., data=vg)
> summary(model1)

Call:
lm(formula = EU_Sales ~ ., data = vg)

Residuals:
       Min         1Q     Median         3Q        Max
-0.0203347  0.0000397  0.0002127  0.0003657  0.0202522

Coefficients:
```

```
                 Estimate Std. Error   t value Pr(>|t|)
(Intercept)    -1.719e-03  9.534e-04    -1.803   0.0715 .
NA_Sales       -9.997e-01  3.193e-04 -3130.720   <2e-16 ***
JP_Sales       -9.998e-01  4.109e-04 -2433.446   <2e-16 ***
Other_Sales    -9.996e-01  5.139e-04 -1945.377   <2e-16 ***
Global_Sales    9.999e-01  2.122e-04  4712.679   <2e-16 ***
Critic_Score   -2.651e-06  6.962e-06    -0.381   0.7034
Critic_Count    1.239e-05  1.244e-05     0.996   0.3195
User_Score      4.582e-04  2.995e-04     1.530   0.1261
User_Count      1.529e-07  1.413e-07     1.082   0.2793
User_ScoreSQ   -3.497e-05  2.336e-05    -1.497   0.1344
Critic_CountSQ -1.455e-07  1.552e-07    -0.937   0.3487
oth_glo        -1.937e-05  1.220e-05    -1.587   0.1125
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.005937 on 7100 degrees of freedom
Multiple R-squared:  0.9999, Adjusted R-squared:  0.9999
F-statistic: 8.48e+06 on 11 and 7100 DF,  p-value: < 2.2e-16



> cor(vg)
               NA_Sales   EU_Sales   JP_Sales Other_Sales
NA_Sales     1.00000000 0.83822288 0.46593039  0.72757489
EU_Sales     0.83822288 1.00000000 0.51853618  0.71824465
JP_Sales     0.46593039 0.51853618 1.00000000  0.39350299
Other_Sales  0.72757489 0.71824465 0.39350299  1.00000000
```

```
Global_Sales 0.95493628 0.93846112 0.61194730  0.80542648
Critic_Score 0.23414177 0.21185550 0.14579914  0.19145237
Critic_Count 0.28629767 0.26772828 0.17110924  0.24197435
User_Score   0.08572921 0.05500952 0.12709240  0.05673655
User_Count   0.24581553 0.28443056 0.07367786  0.24204360
             Global_Sales Critic_Score Critic_Count User_Score
NA_Sales        0.9549363    0.2341418    0.2862977 0.08572921
EU_Sales        0.9384611    0.2118555    0.2677283 0.05500952
JP_Sales        0.6119473    0.1457991    0.1711092 0.12709240
Other_Sales     0.8054265    0.1914524    0.2419743 0.05673655
Global_Sales    1.0000000    0.2373172    0.2932474 0.08791800
Critic_Score    0.2373172    1.0000000    0.3919509 0.58372381
Critic_Count    0.2932474    0.3919509    1.0000000 0.19365819
User_Score      0.0879180    0.5837238    0.1936582 1.00000000
User_Count      0.2649160    0.2643284    0.3611373 0.01887583
             User_Count
NA_Sales     0.24581553
EU_Sales     0.28443056
JP_Sales     0.07367786
Other_Sales  0.24204360
Global_Sales 0.26491599
Critic_Score 0.26432837
Critic_Count 0.36113728
User_Score   0.01887583
User_Count   1.00000000
>
>
```

```
> model2<-lm(EU_Sales~
NA_Sales+JP_Sales+Other_Sales+Global_Sales, data=vg)
> summary(model2)

Call:
lm(formula = EU_Sales ~ NA_Sales + JP_Sales + Other_Sales +
Global_Sales,
    data = vg)

Residuals:
       Min         1Q     Median         3Q        Max
-0.0200976  0.0001473  0.0002283  0.0002441  0.0202215

Coefficients:
               Estimate Std. Error   t value Pr(>|t|)
(Intercept)  -2.433e-04  7.607e-05    -3.198  0.00139 **
NA_Sales     -9.998e-01  3.153e-04 -3171.241  < 2e-16 ***
JP_Sales     -9.998e-01  3.959e-04 -2525.611  < 2e-16 ***
Other_Sales  -9.998e-01  5.005e-04 -1997.790  < 2e-16 ***
Global_Sales  9.999e-01  2.049e-04  4879.089  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.005937 on 7107 degrees of freedom
Multiple R-squared:  0.9999, Adjusted R-squared:  0.9999
F-statistic: 2.332e+07 on 4 and 7107 DF,  p-value: < 2.2e-16
```

```
install.packages("car")
library(car)

> vif(model2)
Error in vif(model2) : could not find function "vif"
>
>
> model3<-lm(EU_Sales~ NA_Sales+JP_Sales+Other_Sales, data=vg)
> summary(model3)

Call:
lm(formula = EU_Sales ~ NA_Sales + JP_Sales + Other_Sales, data = vg)

Residuals:
    Min      1Q  Median      3Q     Max
-9.6293 -0.0524 -0.0033  0.0380  6.1848

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.004188   0.004403  -0.951    0.341
NA_Sales     0.437643   0.006496  67.372   <2e-16 ***
JP_Sales     0.356568   0.016313  21.858   <2e-16 ***
Other_Sales  0.544965   0.022434  24.292   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Residual standard error: 0.3437 on 7108 degrees of freedom
Multiple R-squared:  0.7447, Adjusted R-squared:  0.7446
F-statistic:  6912 on 3 and 7108 DF,  p-value: < 2.2e-16

>
> vif(model3)
Error in vif(model3) : could not find function "vif"
>
>
> # Transforming the variables
>
> hist(log(vg$EU_Sales))
>
>
> vg <- Videogames[,-c(1,2,3,4,5,15)]
> model4<- lm(log(EU_Sales+1)~., data=Vg)
Error in is.data.frame(data) : object 'Vg' not found
> summary(model4)

Call:
lm(formula = EU_Sales ~ ., data = vg)

Residuals:
      Min         1Q     Median         3Q        Max
-0.0200425  0.0000900  0.0002366  0.0002957  0.0203024
```

```
Coefficients:
               Estimate Std. Error   t value Pr(>|t|)
(Intercept)  -3.746e-04  4.086e-04    -0.917    0.359
NA_Sales     -9.997e-01  3.178e-04 -3146.037   <2e-16 ***
JP_Sales     -9.998e-01  4.029e-04 -2481.313   <2e-16 ***
Other_Sales  -9.998e-01  5.008e-04 -1996.395   <2e-16 ***
Global_Sales  9.999e-01  2.076e-04  4817.100   <2e-16 ***
Critic_Score -7.551e-07  6.866e-06    -0.110    0.912
Critic_Count  2.556e-06  4.228e-06     0.605    0.545
User_Score    1.411e-05  6.132e-05     0.230    0.818
User_Count    1.308e-07  1.349e-07     0.970    0.332
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.005938 on 7103 degrees of freedom
Multiple R-squared:  0.9999, Adjusted R-squared:  0.9999
F-statistic: 1.166e+07 on 8 and 7103 DF,  p-value: < 2.2e-16


>
>
>
> model3$residuals
            1             2             3             4             5
 4.914048e+00  2.797614e+00  1.345387e+00  3.303795e-01  4.822433e-01
            6             7             8             9            10
```

-2.284928e+00 7.266120e-01 1.675090e+00 -2.665780e+00
2.684317e+00
11 12 13 14 15
3.558985e+00 -9.629260e+00 4.534707e+00 1.567601e-01 6.759840e-
01
16 17 18 19 20
1.313070e+00 7.973900e-01 -4.720166e-01 -1.209113e+00
1.999764e+00
21 22 23 24 25
1.831115e-02 -8.506126e-01 3.698509e+00 2.279331e+00 6.396372e-
01
26 27 28 29 30
4.434419e-01 -1.840649e+00 5.962392e-01 -9.098926e-03 -
1.379590e+00
31 32 33 34 35
-5.798929e+00 -1.190857e-01 -4.998898e-01 9.257971e-01 -2.740160e-
01
36 37 38 39 40
2.090068e+00 4.529087e-01 5.823464e-01 -8.800843e-01 -6.745178e-
02
41 42 43 44 45
4.412310e-01 -1.574621e+00 -1.036805e+00 -5.358284e-01 8.510496e-
01
46 47 48 49 50
-1.127808e-01 1.017699e+00 -7.666113e-01 -2.736934e-01
5.603415e+00
51 52 53 54 55

-1.148023e+00 7.663397e-02 4.920702e+00 -1.511964e+00
1.465331e+00

56 57 58 59 60

-3.329005e-01 3.425975e+00 -3.526235e-01 5.663942e+00 -6.933233e-01

61 62 63 64 65

-7.371570e-01 5.166571e-01 1.519982e+00 1.101102e-01 -5.911040e-01

66 67 68 69 70

1.571883e+00 -2.394969e-01 9.954634e-01 1.235043e-01 8.187052e-01

71 72 73 74 75

1.073365e+00 9.291675e-01 1.358594e-01 -7.711460e-02 -5.152561e-01

76 77 78 79 80

-1.501341e+00 1.215638e+00 8.717617e-01 9.200245e-02 -2.822028e-01

81 82 83 84 85

9.128546e-01 2.419648e-01 1.641499e-01 1.119313e+00 7.032056e-01

86 87 88 89 90

3.121439e+00 -2.054665e-01 6.970220e-01 -9.419480e-01 8.597145e-01

91 92 93 94 95

-3.895283e-01 -9.582675e-01 2.361045e-03 -9.090061e-01 -8.936196e-01

96 97 98 99 100

6.184800e+00 1.256148e+00 -4.757091e-01 -2.700024e-01 -1.700754e-02

101 102 103 104 105

3.470327e+00 2.393731e-01 3.356788e-02 -1.796364e-01 -2.597624e+00

106 107 108 109 110

4.965479e-01 2.240511e-01 -3.140833e-01 1.069387e+00 -1.234344e+00

111 112 113 114 115

2.948397e-01 7.748607e-01 4.162118e-01 -2.761302e-01 2.306573e-01

116 117 118 119 120

2.790252e-01 -1.214217e-01 2.874957e-01 -5.634817e-01 1.875310e-01

121 122 123 124 125

-1.309419e+00 1.921838e-02 8.558191e-01 1.871013e-01 9.836346e-01

126 127 128 129 130

-4.964023e-01 -1.002349e+00 1.656173e+00 -2.331875e-01 7.388330e-02

131 132 133 134 135

-6.010900e-01 -1.289247e-01 -1.231659e-01 -1.990663e+00 -9.264846e-01

136 137 138 139 140

1.253993e+00 2.670380e+00 8.076812e-01 8.853288e-01 -1.403809e+00

141 142 143 144 145

-7.118660e-01 -1.774639e-01 3.942251e-01 2.385471e+00 -5.265957e-01

146 147 148 149 150

5.446355e-01 -2.286760e-01 -2.323300e+00 -5.147123e-01 -7.711241e-01

151 152 153 154 155

2.464447e-01 -1.840874e+00 2.435394e-01 6.893272e-01 -2.301710e-01

156 157 158 159 160

3.993947e-01 1.781124e-01 4.236659e-04 9.279776e-01 -2.775130e-01

161 162 163 164 165

-3.674797e-02 6.951594e-01 7.948398e-01 -3.435565e-01 4.028117e-02

166 167 168 169 170

-1.970537e-01 -5.318754e-01 -4.505821e-01 7.918123e-01 -1.079472e-01

171 172 173 174 175

-1.612323e+00 -7.143446e-01 -1.680451e+00 1.921361e-01 -1.654570e-01

176 177 178 179 180

-1.332912e-01 -3.325326e-01 -1.241923e-01 1.507357e+00 -4.686820e-01

181 182 183 184 185

1.914060e-02 6.211135e-01 -3.729191e-02 5.040457e-01 -9.633352e-01

186 187 188 189 190

-1.169544e-01 -2.352101e-02 -2.547174e-01 -1.982505e+00
2.265628e+00

191 192 193 194 195

9.799790e-01 -4.667614e-01 1.740793e+00 1.395428e+00 2.408933e-
01

196 197 198 199 200

7.773791e-01 -3.344189e-01 -1.565039e+00 1.336021e+00 -
1.791605e+00

201 202 203 204 205

9.280380e-01 3.994451e-01 6.394361e-01 -1.895498e+00
1.301914e+00

206 207 208 209 210

-3.240439e-01 2.996709e-01 1.159396e-02 4.063600e-01 8.578038e-01

211 212 213 214 215

1.197163e+00 -5.192343e-01 -1.576103e-01 -5.324450e-02 8.406294e-
01

216 217 218 219 220

1.329543e+00 -8.163172e-01 2.001338e-01 -8.245848e-01 -6.046573e-
02

221 222 223 224 225

1.045168e+00 5.480735e-01 1.054233e+00 -1.161312e-01 3.267248e-
01

226 227 228 229 230

6.226805e-01 1.079585e+00 -2.323429e-01 5.831284e-01
1.234805e+00

231 232 233 234 235

7.551388e-01 -3.685305e-01 6.359934e-01 1.894563e+00 5.770473e-02

236 237 238 239 240

6.507508e-01 6.155457e-02 -4.452348e-01 -4.943338e-02 -1.842645e+00

241 242 243 244 245

-3.763724e-01 1.890392e+00 -2.364322e-01 6.106186e-01 1.290552e-01

246 247 248 249 250

6.126362e-02 -5.859206e-01 -1.422081e-01 5.457659e-01 -1.803475e-01

251 252 253 254 255

-2.909825e-01 4.240225e-01 9.510258e-01 4.357362e-02 1.858344e+00

256 257 258 259 260

-8.512607e-01 -2.173153e-01 -1.004584e+00 4.821197e-01 1.813784e+00

261 262 263 264 265

-9.281522e-02 -1.890738e-01 -9.351408e-02 -1.068647e+00 -9.916598e-02

266 267 268 269 270

1.090396e+00 -5.048924e-01 1.332777e+00 3.201338e-01 -1.403228e-01

271 272 273 274 275

4.464790e-01 1.459759e+00 1.968463e-01 -1.877687e-02 -3.299275e-02

276 277 278 279 280

1.732615e+00 6.310727e-01 -1.813074e-01 1.644629e-01 9.182788e-
01
281 282 283 284 285
3.661334e-01 5.058207e-01 -1.040638e-01 4.555749e-02 -3.653191e-
02
286 287 288 289 290
1.210606e-01 3.592111e-01 -5.309301e-02 9.724706e-01 5.097201e-02
291 292 293 294 295
8.676993e-01 1.599518e+00 -1.051252e+00 1.849596e-01
1.869193e+00
296 297 298 299 300
1.343871e+00 -1.746337e-02 4.187342e-01 2.095488e-01 -5.162197e-
01
301 302 303 304 305
-3.220013e-01 -5.654968e-01 2.598776e-01 -1.078136e+00 -
1.634023e+00
306 307 308 309 310
2.494022e-01 4.158690e-01 1.277479e-01 8.552060e-01 7.825336e-02
311 312 313 314 315
1.460234e-01 -4.955379e-01 -1.696833e-01 2.729604e-02 -2.145594e-
01
316 317 318 319 320
-9.052074e-01 -1.162371e+00 3.851468e-01 3.839057e-02 9.027273e-
02
321 322 323 324 325
-9.346146e-02 -1.497502e-01 -1.463283e-01 -2.189376e-01 3.721008e-
01

326 327 328 329 330
1.637028e-01 1.300277e+00 -1.045170e+00 1.668287e-01 5.605190e-01
331 332 333 334 335
-4.212845e-01 -1.364105e+00 3.824786e-01 5.528175e-01 -3.005576e-02
336 337 338 339 340
7.138302e-01 1.112488e-01 -1.668550e-01 6.306123e-01 3.212951e-01
341 342 343 344 345
2.538127e-01 -5.605186e-01 -2.918750e-01 -1.768099e-01 -3.304891e-01
346 347 348 349 350
-1.957216e-01 -1.140220e+00 -1.645365e-01 3.503253e-01 5.610203e-01
351 352 353 354 355
-5.427762e-02 -7.101359e-01 3.257934e-01 2.658293e-01 3.289897e-01
356 357 358 359 360
-2.313050e-01 -1.266413e-01 -1.045693e+00 -3.511293e-01 5.956306e-01
361 362 363 364 365
-5.176335e-01 -1.128565e+00 -3.834172e-02 -2.682962e-01 -4.614670e-01
366 367 368 369 370
2.301598e-01 1.439848e-01 -9.413371e-01 -1.872398e-01 -1.394874e-02
371 372 373 374 375

5.078322e-01 3.798804e-01 7.940018e-01 3.763197e-01 -1.290019e-01
376 377 378 379 380
4.086849e-01 -1.034364e+00 1.595144e-01 4.923373e-01 1.166711e-01
381 382 383 384 385
-4.138515e-01 -4.140332e-01 1.178279e-01 -1.032103e+00 -2.725608e-01
386 387 388 389 390
7.136239e-01 -1.015496e+00 3.905990e-01 8.493432e-01 -4.220629e-01
391 392 393 394 395
1.312197e-01 3.876869e-01 1.800611e-01 -3.357687e-01 -2.810580e-01
396 397 398 399 400
3.929125e-01 8.045699e-01 3.745725e-01 -4.986128e-02 -4.845247e-01
401 402 403 404 405
-2.466276e-02 -9.619041e-01 -1.012932e+00 1.407071e+00 -7.240599e-03
406 407 408 409 410
5.762620e-01 -5.391854e-01 2.380248e-02 -8.649653e-01 1.171145e+00
411 412 413 414 415
3.782948e-01 1.124501e-01 1.190998e-01 6.628942e-02 -1.043106e+00
416 417 418 419 420

3.258845e-01 -6.098281e-01 -8.289574e-01 -2.628322e-01 -3.466532e-01
421 422 423 424 425
5.754043e-01 -2.431055e-01 -9.519963e-01 6.765716e-02 -8.502045e-01
426 427 428 429 430
1.270143e+00 4.883650e-01 1.287582e-01 -1.081558e+00 -3.496908e-01
431 432 433 434 435
6.107535e-05 -4.965391e-01 1.039993e-01 -6.249059e-01 -4.879035e-01
436 437 438 439 440
3.965460e-01 9.815498e-02 -3.370479e-01 -3.353028e-01 -7.933195e-01
441 442 443 444 445
2.541126e-01 6.278163e-01 -9.721770e-01 -2.110085e-01 2.773589e-01
446 447 448 449 450
-7.037180e-01 6.312891e-01 -6.853305e-01 -1.227589e+00 -6.017306e-02
451 452 453 454 455
-8.519734e-01 -5.543780e-01 -1.655206e-01 -1.937091e-01 8.218761e-01
456 457 458 459 460
-6.251676e-02 -1.002164e+00 4.862985e-01 -4.054047e-01 -1.037968e+00
461 462 463 464 465

1.718776e-01 -8.485866e-01 -8.686702e-01 -4.034372e-01 -4.227100e-01

466 467 468 469 470

5.170841e-01 -1.170410e+00 -1.610957e-01 -4.142357e-03 -6.783103e-03

471 472 473 474 475

-3.604710e-01 -7.022580e-01 4.857115e-01 -9.633494e-02 1.017435e-02

476 477 478 479 480

1.101841e-01 2.716047e-01 1.457441e-01 4.060177e-01 8.371829e-01

481 482 483 484 485

7.215818e-01 1.493883e-01 -1.087518e+00 -1.863625e-01 -1.555693e-01

486 487 488 489 490

3.910913e-02 -7.760123e-01 9.871555e-02 -9.190180e-01 -1.548371e-01

491 492 493 494 495

1.301991e-01 -2.759585e-01 -7.831073e-01 -5.902431e-01 1.635908e-01

496 497 498 499 500

-1.091134e-01 -2.491332e-01 4.410229e-02 3.096085e-01 2.068037e-01

501 502 503 504 505

-8.514182e-02 -2.124262e-01 2.096823e-01 3.826825e-02 4.801230e-01

506 507 508 509 510

-3.146228e-01 2.214308e-01 -9.481187e-01 -6.329104e-01 3.989730e-01

511 512 513 514 515

-1.275053e-01 -6.421448e-01 -2.010692e-01 -3.346496e-01 4.394385e-01

516 517 518 519 520

1.351220e-01 1.070031e+00 -6.687847e-01 1.129667e+00 -4.003449e-03

521 522 523 524 525

-5.319010e-01 2.413905e-01 1.183732e-03 -8.516858e-01 5.312343e-01

526 527 528 529 530

1.301904e-02 4.750844e-01 -2.859939e-01 2.118987e-01 -3.292733e-01

531 532 533 534 535

-5.225828e-02 -5.607159e-01 -5.046696e-01 4.091532e-01 -4.772306e-01

536 537 538 539 540

-5.352947e-01 -4.907411e-01 -7.333918e-01 -7.464915e-01 -7.598629e-01

541 542 543 544 545

-8.339994e-02 -6.026752e-03 -9.963973e-04 -4.504403e-01 8.126368e-02

546 547 548 549 550

-7.758892e-01 -3.833185e-01 -1.268703e-01 -2.190985e-01 -2.309717e-01

551 552 553 554 555

-7.502157e-01 4.116641e-01 -1.701735e-01 8.490336e-01 -3.570671e-01
556 557 558 559 560
-2.602249e-01 -7.422174e-01 -2.706442e-01 -1.878974e-02 -2.230874e-02
561 562 563 564 565
2.210309e-01 -2.096736e-01 5.035579e-01 -8.518354e-01 1.925882e-01
566 567 568 569 570
-8.899012e-01 5.445224e-01 6.652091e-01 3.842585e-01 -1.825360e-01
571 572 573 574 575
-3.111545e-01 -7.516203e-02 -3.279874e-03 -2.030830e-01 -6.500522e-01
576 577 578 579 580
6.437431e-01 -7.550532e-01 -1.264834e-01 -3.363417e-01 3.617944e-01
581 582 583 584 585
5.834707e-01 -4.932421e-01 4.662298e-02 9.333279e-01 3.740613e-01
586 587 588 589 590
6.130824e-02 4.776464e-02 -4.595403e-01 4.305221e-01 4.777420e-01
591 592 593 594 595
-1.032387e-03 -1.191099e-01 1.873613e-03 4.629643e-01 6.103273e-02
596 597 598 599 600
5.813392e-01 1.371089e-02 -5.681267e-01 1.921859e-01 -7.351675e-01

```
          601           602           603           604           605 
 1.699734e-02 -5.269768e-01  4.040878e-01  2.660589e-01  9.480836e-01 
          606           607           608           609           610 
-5.764109e-01  4.640860e-01 -2.594806e-02 -2.826610e-01 -8.406229e-
02 
          611           612           613           614           615 
 1.721023e-01  4.486764e-01  5.225864e-01  3.043688e-01  1.865623e-01 
          616           617           618           619           620 
-4.865378e-01 -7.435988e-02  2.239943e-01  5.212507e-01  2.436718e-
01 
          621           622           623           624           625 
 6.288013e-01 -8.123244e-01  3.488220e-01 -6.366289e-01 -3.174555e-
02 
          626           627           628           629           630 
-2.186392e-01  1.907648e-01  1.109456e-01 -4.196664e-02 -7.968325e-
01 
          631           632           633           634           635 
-5.037873e-01  2.901477e-01 -7.752846e-01  1.824314e-01 -1.607546e-
01 
          636           637           638           639           640 
-1.968947e-02  1.851413e-01 -1.585786e-01 -1.042262e-01 -5.247391e-
01 
          641           642           643           644           645 
 4.510951e-01 -2.896220e-01 -7.516472e-01 -2.535100e-01  2.345360e-
01 
          646           647           648           649           650 
```

3.563278e-01 -1.337549e-01 2.766756e-01 -6.938339e-01 -7.879460e-01

651 652 653 654 655

-3.077687e-01 -4.261832e-02 3.656912e-02 -1.186504e-01 1.837202e-01

656 657 658 659 660

4.327449e-01 -5.107802e-01 7.415310e-02 -7.967107e-01 2.806791e-01

661 662 663 664 665

-3.836574e-01 6.401886e-01 -7.664550e-01 3.049971e-01 -3.448815e-01

666 667 668 669 670

9.042380e-02 1.261296e-01 -6.186559e-01 -1.584473e-01 -6.908011e-03

671 672 673 674 675

-1.981452e-01 1.779227e-01 -1.122605e-01 1.779227e-01 5.685739e-01

676 677 678 679 680

4.584036e-01 -1.266369e-01 5.314659e-01 7.644226e-01 7.349426e-01

681 682 683 684 685

-1.224577e-02 1.687335e-01 3.220564e-01 3.407491e-01 -7.981045e-02

686 687 688 689 690

-3.462683e-02 -2.232933e-02 -8.461877e-02 -4.310567e-01 2.328735e-01

691 692 693 694 695

1.722992e-01 -5.178531e-01 2.448299e-01 4.903811e-01 -7.140146e-01

696 697 698 699 700

-4.137837e-01 6.303657e-01 -3.957440e-02 -1.995991e-01 -2.531334e-01

701 702 703 704 705

3.900954e-02 -1.808463e-01 5.446001e-01 1.030214e-01 1.722322e-01

706 707 708 709 710

-6.882307e-01 4.906368e-01 -2.584958e-01 1.118696e-01 2.113159e-01

711 712 713 714 715

-5.682777e-01 2.524142e-01 -1.158451e-01 -7.172285e-03 1.568955e-02

716 717 718 719 720

1.984742e-01 -7.266760e-01 -3.355453e-01 -1.519900e-01 -1.040795e-01

721 722 723 724 725

-2.712291e-03 -6.590867e-01 -1.724344e-01 -2.812183e-02 -1.389174e-01

726 727 728 729 730

-2.902409e-01 7.498358e-02 8.444061e-02 -6.219721e-01 1.485646e-01

731 732 733 734 735

-9.476158e-02 7.182558e-01 1.424394e-01 6.998561e-02 1.652545e-01

736 737 738 739 740

-1.224259e-02 -5.234552e-01 2.554600e-01 -5.102948e-01 -3.594814e-01

```
         741          742          743          744          745
-5.208800e-01 -3.016552e-01  2.563543e-01  2.952976e-01  4.340252e-
02
         746          747          748          749          750
-1.971687e-01  1.696310e-01  5.279686e-01 -6.879299e-01  4.135287e-
01
         751          752          753          754          755
-3.086504e-01 -2.267273e-01  4.350132e-01 -5.865061e-04  1.734039e-
01
         756          757          758          759          760
-6.033931e-01  6.411244e-01  3.607221e-01 -5.305333e-02 -5.100858e-
01
         761          762          763          764          765
-1.389709e-01 -5.762955e-01  1.640074e-01  5.084383e-01 -1.378144e-
01
         766          767          768          769          770
 1.528790e-01 -6.084675e-01  4.762033e-01  1.199451e-02 -5.852988e-
02
         771          772          773          774          775
-5.416849e-01  1.579812e+00  2.738600e-01 -1.751628e-01 -1.449895e-
01
         776          777          778          779          780
 9.017351e-01 -2.966676e-01 -1.250686e-02 -7.514810e-02  2.927800e-
01
         781          782          783          784          785
 2.385943e-01  1.466383e-01 -2.987110e-02  6.401420e-02 -1.950240e-
01
```

```
          786           787           788           789           790 
-5.663188e-01  1.582099e-01  1.193735e-01  2.546359e-02  7.259994e-02 
          791           792           793           794           795 
-4.873929e-01 -5.460434e-01 -7.867959e-03  1.582099e-01  4.275390e-
01 
          796           797           798           799           800 
-1.185865e-01  8.607028e-02 -3.755431e-02  2.729639e-01  1.525864e-
01 
          801           802           803           804           805 
 4.526308e-01  1.377853e-01  5.685533e-01  1.004467e-01 -1.883119e-04 
          806           807           808           809           810 
-3.483220e-02 -5.112449e-02  5.713083e-01 -5.121660e-02 -6.501402e-
01 
          811           812           813           814           815 
-1.846490e-02 -9.115094e-03 -5.916849e-01  2.659911e-01  2.764154e-
01 
          816           817           818           819           820 
 3.151035e-01  2.499023e-01  5.858110e-02 -4.337836e-01 -3.873268e-
02 
          821           822           823           824           825 
 5.994961e-01 -1.074366e-01 -2.147885e-01 -6.116849e-01  2.470779e-
01 
          826           827           828           829           830 
-3.804188e-02 -7.347973e-01  4.364639e-01  9.755969e-01  1.138097e-
02 
          831           832           833           834           835 
```

2.092143e-01 -1.918983e-01 8.921437e-02 4.444011e-01 -5.734286e-01

836 837 838 839 840

2.963098e-02 -3.775430e-01 -8.107812e-02 -3.615292e-02 -6.768771e-01

841 842 843 844 845

9.846883e-02 3.194130e-01 2.899881e-01 -8.231545e-02 1.563758e-01

846 847 848 849 850

-1.499240e-01 7.545998e-02 1.455417e-01 7.572244e-02 -3.774595e-01

851 852 853 854 855

1.971732e-01 -7.972359e-02 -6.059395e-01 -1.643005e-01 -3.045707e-01

856 857 858 859 860

-2.296598e-01 -9.902830e-02 -6.982748e-02 -2.737607e-01 1.368971e-02

861 862 863 864 865

4.841716e-02 8.156575e-02 -1.821540e-01 1.399182e-01 -2.085983e-01

866 867 868 869 870

-1.006571e-01 -1.413910e-03 4.420305e-01 8.922937e-01 6.341665e-01

871 872 873 874 875

-1.756312e-01 -5.270213e-01 -1.015190e-01 1.450268e-01 1.972913e-01

876 877 878 879 880

-8.928901e-02 -7.383936e-02 4.394193e-01 -3.303851e-01 -5.077907e-01

881 882 883 884 885

1.787829e-01 9.761484e-01 -1.567947e-01 -4.243190e-02 -7.121215e-02

886 887 888 889 890

1.572244e-02 2.339710e-02 -1.303042e-02 1.397442e-01 4.714754e-01

891 892 893 894 895

-2.982558e-01 -5.226448e-01 5.026600e-02 2.510345e-01 4.777852e-02

896 897 898 899 900

-5.368140e-01 -4.182437e-01 -5.115144e-02 -6.508650e-02 4.974783e-01

901 902 903 904 905

-3.738555e-01 1.441207e-01 -1.524183e-01 8.596634e-02 -2.113383e-01

906 907 908 909 910

-6.615972e-02 -7.508650e-02 2.539423e-02 1.391088e-01 8.704380e-01

911 912 913 914 915

1.437796e-01 -2.780213e-01 9.887631e-05 -1.802719e-01 3.607450e-01

916 917 918 919 920

-7.319755e-02 1.526161e-01 5.922610e-02 -5.817388e-01 1.428735e-01

921 922 923 924 925

-6.625711e-01 2.272253e-02 3.867782e-02 2.305145e-01 -1.263268e-01

926 927 928 929 930

1.599046e-01 -1.189147e-01 2.180737e-01 1.293128e-01 4.004120e-01

931 932 933 934 935

4.511713e-02 2.167282e-01 3.503254e-01 6.446344e-01 1.383232e-01

936 937 938 939 940

1.157472e-01 2.447489e-01 8.260932e-02 -1.886589e-01 4.322911e-01

941 942 943 944 945

4.038921e-03 1.469925e-01 2.186122e-01 3.226290e-01 -4.309551e-01

946 947 948 949 950

4.641232e-01 4.247618e-01 6.786580e-01 1.109343e-01 -3.032322e-01

951 952 953 954 955

-1.009209e-01 2.663829e-02 -3.210899e-01 -1.858204e-01 2.949356e-02

956 957 958 959 960

4.745610e-01 -4.599102e-01 -2.508071e-01 -5.030146e-01 -5.229962e-01

961 962 963 964 965

1.370761e-01 -9.434276e-02 -5.153130e-01 -1.569861e-02 1.266698e-01

966 967 968 969 970

-1.019572e-01 -7.331979e-02 1.370761e-01 -1.597254e-01 1.046019e-01

971 972 973 974 975

2.297740e-01 1.102907e-01 2.162316e-01 -1.396368e-01 -5.132469e-01

```
         976           977           978           979           980 
-4.778073e-01  2.090418e-01  8.503904e-03 -6.570859e-02 -3.569861e-
02 
         981           982           983           984           985 
 1.053615e-02  2.481088e-01  7.467893e-02  1.314525e-01 -7.882791e-02 
         986           987           988           989           990 
 5.163320e-02  4.476929e-02 -2.502719e-01 -5.238655e-01 -6.498397e-
01 
         991           992           993           994           995 
 2.270356e-01  2.023729e-02 -4.935144e-01 -5.507896e-01 -2.445827e-
02 
         996           997           998           999          1000 
-2.886913e-01  2.424852e-01  1.032529e-01 -7.371930e-02 -5.700305e-
01 
 [ reached getOption("max.print") -- omitted 6112 entries ]
> sum(model3$residuals)
[1] -4.025297e-12
> hist(model3$residuals, breaks= 100)

> # calculating
> mean = mean(model3$residuals)
> mean
[1] -5.660517e-16
> sd = sd(model3$residuals)
> sd
[1] 0.3435785
>
```

```
> resid_zscore = (model3$residuals- mean)/sd
> resid_zscore
            1             2             3             4             5
 1.430255e+01  8.142577e+00  3.915807e+00  9.615839e-01
1.403590e+00
            6             7             8             9            10
-6.650382e+00  2.114836e+00  4.875422e+00 -7.758868e+00
7.812821e+00
           11            12            13            14            15
 1.035858e+01 -2.802638e+01  1.319846e+01  4.562570e-01
1.967481e+00
           16            17            18            19            20
 3.821747e+00  2.320838e+00 -1.373825e+00 -3.519176e+00
5.820400e+00
           21            22            23            24            25
 5.329540e-02 -2.475745e+00  1.076467e+01  6.634093e+00
1.861692e+00
           26            27            28            29            30
 1.290657e+00 -5.357289e+00  1.735380e+00 -2.648282e-02 -
4.015356e+00
           31            32            33            34            35
-1.687803e+01 -3.466042e-01 -1.454951e+00  2.694573e+00 -7.975355e-
01
           36            37            38            39            40
 6.083233e+00  1.318210e+00  1.694944e+00 -2.561524e+00 -1.963213e-
01
           41            42            43            44            45
```

1.284222e+00 -4.583002e+00 -3.017667e+00 -1.559552e+00
2.477017e+00

46 47 48 49 50

-3.282534e-01 2.962058e+00 -2.231255e+00 -7.965965e-01
1.630898e+01

51 52 53 54 55

-3.341372e+00 2.230465e-01 1.432192e+01 -4.400637e+00
4.264909e+00

56 57 58 59 60

-9.689214e-01 9.971449e+00 -1.026326e+00 1.648515e+01 -
2.017948e+00

61 62 63 64 65

-2.145527e+00 1.503753e+00 4.423973e+00 3.204806e-01 -
1.720434e+00

66 67 68 69 70

4.575034e+00 -6.970661e-01 2.897339e+00 3.594645e-01
2.382877e+00

71 72 73 74 75

3.124076e+00 2.704382e+00 3.954246e-01 -2.244454e-01 -
1.499675e+00

76 77 78 79 80

-4.369717e+00 3.538167e+00 2.537300e+00 2.677771e-01 -8.213635e-
01

81 82 83 84 85

2.656903e+00 7.042489e-01 4.777653e-01 3.257809e+00
2.046710e+00

86 87 88 89 90

9.085082e+00 -5.980191e-01 2.028713e+00 -2.741581e+00
2.502236e+00

91 92 93 94 95

-1.133739e+00 -2.789079e+00 6.871923e-03 -2.645702e+00 -
2.600919e+00

96 97 98 99 100

1.800113e+01 3.656073e+00 -1.384572e+00 -7.858536e-01 -4.950119e-
02

101 102 103 104 105

1.010054e+01 6.967058e-01 9.770077e-02 -5.228396e-01 -
7.560498e+00

106 107 108 109 110

1.445224e+00 6.521103e-01 -9.141531e-01 3.112497e+00 -
3.592612e+00

111 112 113 114 115

8.581436e-01 2.255266e+00 1.211403e+00 -8.036889e-01 6.713380e-
01

116 117 118 119 120

8.121150e-01 -3.534031e-01 8.367686e-01 -1.640038e+00 5.458170e-
01

121 122 123 124 125

-3.811122e+00 5.593593e-02 2.490899e+00 5.445665e-01
2.862911e+00

126 127 128 129 130

-1.444801e+00 -2.917380e+00 4.820364e+00 -6.787022e-01 2.150406e-
01

131 132 133 134 135

-1.749499e+00 -3.752409e-01 -3.584796e-01 -5.793910e+00 -
2.696574e+00
136 137 138 139 140
3.649800e+00 7.772258e+00 2.350791e+00 2.576788e+00 -
4.085846e+00
141 142 143 144 145
-2.071917e+00 -5.165163e-01 1.147409e+00 6.943017e+00 -
1.532680e+00
146 147 148 149 150
1.585185e+00 -6.655713e-01 -6.762067e+00 -1.498092e+00 -
2.244390e+00
151 152 153 154 155
7.172880e-01 -5.357945e+00 7.088319e-01 2.006317e+00 -6.699228e-
01
156 157 158 159 160
1.162456e+00 5.184039e-01 1.233098e-03 2.700919e+00 -8.077137e-
01
161 162 163 164 165
-1.069566e-01 2.023292e+00 2.313416e+00 -9.999360e-01 1.172401e-
01
166 167 168 169 170
-5.735334e-01 -1.548046e+00 -1.311439e+00 2.304604e+00 -3.141851e-
01
171 172 173 174 175
-4.692737e+00 -2.079131e+00 -4.891025e+00 5.592204e-01 -4.815697e-
01
176 177 178 179 180

-3.879499e-01 -9.678505e-01 -3.614671e-01 4.387229e+00 -
1.364119e+00
        181   182   183   184   185
 5.570955e-02 1.807778e+00 -1.085397e-01 1.467047e+00 -
2.803829e+00
        186   187   188   189   190
-3.404009e-01 -6.845893e-02 -7.413661e-01 -5.770167e+00
6.594209e+00
        191   192   193   194   195
 2.852271e+00 -1.358529e+00 5.066654e+00 4.061452e+00 7.011304e-
01
        196   197   198   199   200
 2.262596e+00 -9.733408e-01 -4.555114e+00 3.888547e+00 -
5.214544e+00
        201   202   203   204   205
 2.701095e+00 1.162602e+00 1.861106e+00 -5.516930e+00
3.789276e+00
        206   207   208   209   210
-9.431439e-01 8.722051e-01 3.374471e-02 1.182728e+00
2.496675e+00
        211   212   213   214   215
 3.484395e+00 -1.511254e+00 -4.587315e-01 -1.549704e-01
2.446688e+00
        216   217   218   219   220
 3.869693e+00 -2.375927e+00 5.824981e-01 -2.399990e+00 -1.759881e-
01
        221   222   223   224   225

3.042008e+00 1.595192e+00 3.068390e+00 -3.380048e-01 9.509468e-01

226 227 228 229 230

1.812339e+00 3.142178e+00 -6.762441e-01 1.697221e+00 3.593954e+00

231 232 233 234 235

2.197864e+00 -1.072624e+00 1.851086e+00 5.514208e+00 1.679521e-01

236 237 238 239 240

1.894038e+00 1.791573e-01 -1.295875e+00 -1.438780e-01 -5.363098e+00

241 242 243 244 245

-1.095448e+00 5.502068e+00 -6.881460e-01 1.777232e+00 3.756206e-01

246 247 248 249 250

1.783104e-01 -1.705347e+00 -4.139028e-01 1.588475e+00 -5.249091e-01

251 252 253 254 255

-8.469172e-01 1.234136e+00 2.768002e+00 1.268229e-01 5.408791e+00

256 257 258 259 260

-2.477631e+00 -6.325055e-01 -2.923884e+00 1.403230e+00 5.279096e+00

261 262 263 264 265

-2.701427e-01 -5.503075e-01 -2.721768e-01 -3.110344e+00 -2.886269e-01

266 267 268 269 270

3.173644e+00 -1.469511e+00 3.879104e+00 9.317634e-01 -4.084155e-01

271 272 273 274 275

1.299496e+00 4.248692e+00 5.729296e-01 -5.465090e-02 -9.602683e-02

276 277 278 279 280

5.042852e+00 1.836765e+00 -5.277031e-01 4.786764e-01 2.672690e+00

281 282 283 284 285

1.065647e+00 1.472213e+00 -3.028821e-01 1.325970e-01 -1.063277e-01

286 287 288 289 290

3.523520e-01 1.045499e+00 -1.545295e-01 2.830418e+00 1.483563e-01

291 292 293 294 295

2.525476e+00 4.655466e+00 -3.059715e+00 5.383330e-01 5.440367e+00

296 297 298 299 300

3.911395e+00 -5.082790e-02 1.218744e+00 6.099008e-01 -1.502480e+00

301 302 303 304 305

-9.371987e-01 -1.645903e+00 7.563851e-01 -3.137962e+00 -4.755895e+00

306 307 308 309 310

7.258958e-01 1.210405e+00 3.718158e-01 2.489114e+00 2.277598e-01

311 312 313 314 315

4.250075e-01 -1.442285e+00 -4.938707e-01 7.944632e-02 -6.244844e-01

316 317 318 319 320

-2.634645e+00 -3.383131e+00 1.120986e+00 1.117374e-01 2.627427e-01

321 322 323 324 325

-2.720236e-01 -4.358544e-01 -4.258948e-01 -6.372275e-01 1.083016e+00

326 327 328 329 330

4.764641e-01 3.784511e+00 -3.042011e+00 4.855621e-01 1.631415e+00

331 332 333 334 335

-1.226167e+00 -3.970287e+00 1.113220e+00 1.608999e+00 -8.747859e-02

336 337 338 339 340

2.077634e+00 3.237944e-01 -4.856388e-01 1.835424e+00 9.351432e-01

341 342 343 344 345

7.387328e-01 -1.631414e+00 -8.495149e-01 -5.146130e-01 -9.619028e-01

346 347 348 349 350

-5.696562e-01 -3.318659e+00 -4.788906e-01 1.019637e+00 1.632874e+00

351 352 353 354 355

-1.579774e-01 -2.066881e+00 9.482357e-01 7.737076e-01 9.575387e-01

356 357 358 359 360

-6.732234e-01 -3.685949e-01 -3.043535e+00 -1.021977e+00
1.733609e+00

361 362 363 364 365

-1.506595e+00 -3.284737e+00 -1.115952e-01 -7.808877e-01 -
1.343120e+00

366 367 368 369 370

6.698901e-01 4.190739e-01 -2.739803e+00 -5.449695e-01 -4.059840e-
02

371 372 373 374 375

1.478068e+00 1.105658e+00 2.310977e+00 1.095295e+00 -3.754656e-
01

376 377 378 379 380

1.189495e+00 -3.010562e+00 4.642737e-01 1.432969e+00 3.395763e-
01

381 382 383 384 385

-1.204533e+00 -1.205061e+00 3.429432e-01 -3.003980e+00 -7.933000e-
01

386 387 388 389 390

2.077033e+00 -2.955646e+00 1.136855e+00 2.472050e+00 -
1.228432e+00

391 392 393 394 395

3.819205e-01 1.128379e+00 5.240756e-01 -9.772692e-01 -8.180314e-
01

396 397 398 399 400

1.143589e+00 2.341735e+00 1.090209e+00 -1.451234e-01 -
1.410230e+00

401 402 403 404 405

-7.178204e-02 -2.799664e+00 -2.948183e+00 4.095341e+00 -2.107408e-02

406 407 408 409 410

1.677235e+00 -1.569322e+00 6.927816e-02 -2.517519e+00 3.408669e+00

411 412 413 414 415

1.101043e+00 3.272909e-01 3.466450e-01 1.929382e-01 -3.036005e+00

416 417 418 419 420

9.485009e-01 -1.774931e+00 -2.412716e+00 -7.649844e-01 -1.008949e+00

421 422 423 424 425

1.674739e+00 -7.075690e-01 -2.770826e+00 1.969191e-01 -2.474557e+00

426 427 428 429 430

3.696807e+00 1.421407e+00 3.747562e-01 -3.147922e+00 -1.017790e+00

431 432 433 434 435

1.777624e-04 -1.445198e+00 3.026945e-01 -1.818816e+00 -1.420064e+00

436 437 438 439 440

1.154164e+00 2.856843e-01 -9.809927e-01 -9.759133e-01 -2.308991e+00

441 442 443 444 445

7.396057e-01 1.827286e+00 -2.829563e+00 -6.141495e-01 8.072652e-01

446 447 448 449 450

-2.048202e+00 1.837394e+00 -1.994684e+00 -3.572952e+00 -
1.751363e-01

451 452 453 454 455

-2.479705e+00 -1.613541e+00 -4.817548e-01 -5.637987e-01
2.392106e+00

456 457 458 459 460

-1.819577e-01 -2.916841e+00 1.415393e+00 -1.179948e+00 -
3.021050e+00

461 462 463 464 465

5.002572e-01 -2.469848e+00 -2.528302e+00 -1.174221e+00 -
1.230316e+00

466 467 468 469 470

1.504996e+00 -3.406529e+00 -4.688760e-01 -1.205651e-02 -1.974252e-
02

471 472 473 474 475

-1.049167e+00 -2.043952e+00 1.413684e+00 -2.803870e-01 2.961287e-
02

476 477 478 479 480

3.206956e-01 7.905173e-01 4.241944e-01 1.181732e+00
2.436657e+00

481 482 483 484 485

2.100195e+00 4.348012e-01 -3.165269e+00 -5.424161e-01 -4.527911e-
01

486 487 488 489 490

1.138288e-01 -2.258617e+00 2.873159e-01 -2.674842e+00 -4.506601e-
01

491 492 493 494 495

3.789500e-01 -8.031891e-01 -2.279268e+00 -1.717928e+00 4.761382e-01

496 497 498 499 500

-3.175794e-01 -7.251129e-01 1.283616e-01 9.011289e-01 6.019111e-01

501 502 503 504 505

-2.478090e-01 -6.182756e-01 6.102894e-01 1.113814e-01 1.397419e+00

506 507 508 509 510

-9.157233e-01 6.444840e-01 -2.759541e+00 -1.842113e+00 1.161228e+00

511 512 513 514 515

-3.711097e-01 -1.868990e+00 -5.852206e-01 -9.740122e-01 1.279005e+00

516 517 518 519 520

3.932784e-01 3.114373e+00 -1.946527e+00 3.287944e+00 -1.165221e-02

521 522 523 524 525

-1.548121e+00 7.025776e-01 3.445303e-03 -2.478868e+00 1.546181e+00

526 527 528 529 530

3.789248e-02 1.382754e+00 -8.323976e-01 6.167404e-01 -9.583642e-01

531 532 533 534 535

-1.521000e-01 -1.631988e+00 -1.468863e+00 1.190858e+00 -1.389000e+00

536 537 538 539 540

-1.557998e+00 -1.428323e+00 -2.134569e+00 -2.172696e+00 -
2.211614e+00

541 542 543 544 545

-2.427391e-01 -1.754112e-02 -2.900058e-03 -1.311026e+00 2.365215e-
01

546 547 548 549 550

-2.258259e+00 -1.115665e+00 -3.692614e-01 -6.376956e-01 -6.722531e-
01

551 552 553 554 555

-2.183535e+00 1.198166e+00 -4.952973e-01 2.471149e+00 -
1.039259e+00

556 557 558 559 560

-7.573958e-01 -2.160256e+00 -7.877216e-01 -5.468836e-02 -6.493056e-
02

561 562 563 564 565

6.433201e-01 -6.102642e-01 1.465627e+00 -2.479304e+00 5.605362e-
01

566 567 568 569 570

-2.590096e+00 1.584856e+00 1.936120e+00 1.118401e+00 -5.312790e-
01

571 572 573 574 575

-9.056288e-01 -2.187624e-01 -9.546215e-03 -5.910820e-01 -
1.892005e+00

576 577 578 579 580

1.873642e+00 -2.197615e+00 -3.681355e-01 -9.789372e-01
1.053018e+00

581 582 583 584 585

1.698217e+00 -1.435603e+00 1.356982e-01 2.716491e+00
1.088722e+00

586 587 588 589 590

1.784403e-01 1.390210e-01 -1.337512e+00 1.253053e+00
1.390489e+00

591 592 593 594 595

-3.004806e-03 -3.466745e-01 5.453231e-03 1.347478e+00 1.776384e-
01

596 597 598 599 600

1.692013e+00 3.990615e-02 -1.653557e+00 5.593654e-01 -
2.139737e+00

601 602 603 604 605

4.947149e-02 -1.533789e+00 1.176115e+00 7.743760e-01
2.759439e+00

606 607 608 609 610

-1.677669e+00 1.350742e+00 -7.552296e-02 -8.226970e-01 -2.446669e-
01

611 612 613 614 615

5.009113e-01 1.305892e+00 1.521010e+00 8.858787e-01 5.429977e-
01

616 617 618 619 620

-1.416089e+00 -2.164277e-01 6.519451e-01 1.517123e+00 7.092173e-
01

621 622 623 624 625

1.830153e+00 -2.364305e+00 1.015262e+00 -1.852936e+00 -9.239680e-
02

626 627 628 629 630

-6.363588e-01 5.552293e-01 3.229118e-01 -1.221457e-01 -
2.319216e+00

631 632 633 634 635

-1.466295e+00 8.444876e-01 -2.256500e+00 5.309746e-01 -4.678832e-
01

636 637 638 639 640

-5.730706e-02 5.388617e-01 -4.615497e-01 -3.033550e-01 -
1.527276e+00

641 642 643 644 645

1.312932e+00 -8.429575e-01 -2.187702e+00 -7.378518e-01 6.826271e-
01

646 647 648 649 650

1.037107e+00 -3.892996e-01 8.052763e-01 -2.019434e+00 -
2.293351e+00

651 652 653 654 655

-8.957741e-01 -1.240425e-01 1.064360e-01 -3.453371e-01 5.347257e-
01

656 657 658 659 660

1.259523e+00 -1.486648e+00 2.158258e-01 -2.318861e+00 8.169287e-
01

661 662 663 664 665

-1.116652e+00 1.863297e+00 -2.230800e+00 8.877072e-01 -
1.003793e+00

666 667 668 669 670

2.631824e-01 3.671056e-01 -1.800625e+00 -4.611678e-01 -2.010607e-
02

671 672 673 674 675

-5.767103e-01 5.178518e-01 -3.267391e-01 5.178518e-01
1.654859e+00

676 677 678 679 680

1.334203e+00 -3.685823e-01 1.546854e+00 2.224885e+00
2.139082e+00

681 682 683 684 685

-3.564184e-02 4.911061e-01 9.373592e-01 9.917649e-01 -2.322918e-01

686 687 688 689 690

-1.007829e-01 -6.499048e-02 -2.462866e-01 -1.254609e+00 6.777884e-01

691 692 693 694 695

5.014842e-01 -1.507234e+00 7.125881e-01 1.427275e+00 -2.078170e+00

696 697 698 699 700

-1.204335e+00 1.834707e+00 -1.151830e-01 -5.809419e-01 -7.367557e-01

701 702 703 704 705

1.135390e-01 -5.263608e-01 1.585082e+00 2.998481e-01 5.012891e-01

706 707 708 709 710

-2.003125e+00 1.428020e+00 -7.523631e-01 3.256012e-01 6.150442e-01

711 712 713 714 715

-1.653997e+00 7.346626e-01 -3.371722e-01 -2.087525e-02 4.566513e-02

716 717 718 719 720

5.776677e-01 -2.115022e+00 -9.766192e-01 -4.423736e-01 -3.029279e-01

721 722 723 724 725

-7.894240e-03 -1.918300e+00 -5.018779e-01 -8.184980e-02 -4.043251e-01

726 727 728 729 730

-8.447588e-01 2.182430e-01 2.457681e-01 -1.810277e+00 4.324036e-01

731 732 733 734 735

-2.758077e-01 2.090514e+00 4.145760e-01 2.036961e-01 4.809805e-01

736 737 738 739 740

-3.563258e-02 -1.523539e+00 7.435273e-01 -1.485235e+00 -1.046286e+00

741 742 743 744 745

-1.516044e+00 -8.779805e-01 7.461303e-01 8.594765e-01 1.263249e-01

746 747 748 749 750

-5.738680e-01 4.937183e-01 1.536675e+00 -2.002250e+00 1.203593e+00

751 752 753 754 755

-8.983403e-01 -6.598996e-01 1.266125e+00 -1.707051e-03 5.046996e-01

756 757 758 759 760

-1.756202e+00 1.866020e+00 1.049897e+00 -1.544140e-01 -1.484627e+00

761 762 763 764 765

-4.044808e-01 -1.677333e+00 4.773507e-01 1.479832e+00 -4.011149e-01

766 767 768 769 770

4.449608e-01 -1.770971e+00 1.386010e+00 3.491054e-02 -1.703538e-01

771 772 773 774 775

-1.576597e+00 4.598111e+00 7.970814e-01 -5.098190e-01 -4.219981e-01

776 777 778 779 780

2.624539e+00 -8.634638e-01 -3.640176e-02 -2.187218e-01 8.521489e-01

781 782 783 784 785

6.944389e-01 4.267973e-01 -8.694113e-02 1.863161e-01 -5.676259e-01

786 787 788 789 790

-1.648295e+00 4.604768e-01 3.474417e-01 7.411287e-02 2.113053e-01

791 792 793 794 795

-1.418578e+00 -1.589283e+00 -2.290003e-02 4.604768e-01 1.244371e+00

796 797 798 799 800

-3.451513e-01 2.505113e-01 -1.093034e-01 7.944733e-01 4.441092e-01

801 802 803 804 805

1.317402e+00 4.010301e-01 1.654799e+00 2.923545e-01 -5.480899e-04

806 807 808 809 810

-1.013806e-01 -1.488000e-01 1.662817e+00 -1.490681e-01 -
1.892261e+00
811 812 813 814 815
-5.374288e-02 -2.652988e-02 -1.722125e+00 7.741787e-01 8.045190e-
01
816 817 818 819 820
9.171225e-01 7.273516e-01 1.705028e-01 -1.262546e+00 -1.127331e-
01
821 822 823 824 825
1.744859e+00 -3.126988e-01 -6.251512e-01 -1.780335e+00 7.191308e-
01
826 827 828 829 830
-1.107225e-01 -2.138659e+00 1.270347e+00 2.839517e+00 3.312481e-
02
831 832 833 834 835
6.089273e-01 -5.585283e-01 2.596623e-01 1.293449e+00 -
1.668989e+00
836 837 838 839 840
8.624224e-02 -1.098855e+00 -2.359814e-01 -1.052246e-01 -
1.970080e+00
841 842 843 844 845
2.865978e-01 9.296653e-01 8.440230e-01 -2.395827e-01 4.551386e-01
846 847 848 849 850
-4.363604e-01 2.196295e-01 4.236055e-01 2.203935e-01 -
1.098612e+00
851 852 853 854 855

5.738812e-01 -2.320390e-01 -1.763613e+00 -4.782036e-01 -8.864661e-01

856 857 858 859 860

-6.684347e-01 -2.882261e-01 -2.032359e-01 -7.967923e-01 3.984449e-02

861 862 863 864 865

1.409202e-01 2.374007e-01 -5.301672e-01 4.072379e-01 -6.071345e-01

866 867 868 869 870

-2.929668e-01 -4.115247e-03 1.286549e+00 2.597059e+00 1.845769e+00

871 872 873 874 875

-5.111821e-01 -1.533918e+00 -2.954755e-01 4.221067e-01 5.742250e-01

876 877 878 879 880

-2.598795e-01 -2.149127e-01 1.278949e+00 -9.616003e-01 -1.477947e+00

881 882 883 884 885

5.203554e-01 2.841122e+00 -4.563579e-01 -1.234999e-01 -2.072661e-01

886 887 888 889 890

4.576086e-02 6.809828e-02 -3.792560e-02 4.067317e-01 1.372250e+00

891 892 893 894 895

-8.680864e-01 -1.521180e+00 1.463014e-01 7.306467e-01 1.390615e-01

896 897 898 899 900

-1.562421e+00 -1.217317e+00 -1.488785e-01 -1.894371e-01
1.447932e+00
901 902 903 904 905
-1.088123e+00 4.194695e-01 -4.436201e-01 2.502088e-01 -6.151093e-01
906 907 908 909 910
-1.925607e-01 -2.185425e-01 7.391099e-02 4.048823e-01
2.533448e+00
911 912 913 914 915
4.184769e-01 -8.091929e-01 2.877838e-04 -5.246891e-01
1.049964e+00
916 917 918 919 920
-2.130446e-01 4.441957e-01 1.723801e-01 -1.693176e+00 4.158396e-01
921 922 923 924 925
-1.928442e+00 6.613491e-02 1.125735e-01 6.709225e-01 -3.676797e-01
926 927 928 929 930
4.654092e-01 -3.461062e-01 6.347130e-01 3.763706e-01
1.165416e+00
931 932 933 934 935
1.313154e-01 6.307969e-01 1.019637e+00 1.876236e+00 4.025956e-01
936 937 938 939 940
3.368871e-01 7.123523e-01 2.404380e-01 -5.491000e-01
1.258202e+00
941 942 943 944 945

 1.175546e-02 4.278280e-01 6.362802e-01 9.390257e-01 -
1.254313e+00
946 947 948 949 950
 1.350851e+00 1.236288e+00 1.975264e+00 3.228792e-01 -8.825706e-
01
951 952 953 954 955
-2.937345e-01 7.753191e-02 -9.345459e-01 -5.408384e-01 8.584228e-
02
956 957 958 959 960
 1.381230e+00 -1.338588e+00 -7.299850e-01 -1.464046e+00 -
1.522203e+00
961 962 963 964 965
 3.989658e-01 -2.745887e-01 -1.499841e+00 -4.569148e-02 3.686780e-
01
966 967 968 969 970
-2.967509e-01 -2.134004e-01 3.989658e-01 -4.648877e-01 3.044485e-
01
971 972 973 974 975
 6.687670e-01 3.210059e-01 6.293515e-01 -4.064191e-01 -
1.493827e+00
976 977 978 979 980
-1.390679e+00 6.084252e-01 2.475098e-02 -1.912477e-01 -1.039024e-
01
981 982 983 984 985
 3.066592e-02 7.221314e-01 2.173563e-01 3.825982e-01 -2.294320e-01
986 987 988 989 990

```
 1.502807e-01  1.303030e-01 -7.284271e-01 -1.524733e+00 -
1.891387e+00
          991           992           993           994           995
 6.607969e-01  5.890152e-02 -1.436395e+00 -1.603097e+00 -7.118685e-
02
          996           997           998           999          1000
-8.402485e-01  7.057637e-01  3.005220e-01 -2.145632e-01 -
1.659099e+00
 [ reached getOption("max.print") -- omitted 6112 entries ]
>
> hist(resid_zscore, breaks = 100)
```

```
install.packages("car")
library(car)
```

```
> durbinWatsonTest(model3)
 lag Autocorrelation D-W Statistic p-value
   1     -0.08118536      2.133604   0.002
 Alternative hypothesis: rho != 0
```

```
plot(vg$JP_Sales, model3$residuals)

plot(vg$Global_Sales, model3$residuals)

plot(vg$NA_Sales, model3$residuals)
```

```
plot(vg$Other_Sales, model3$residuals)

plot(vg$Critic_Score, model3$residuals)

plot(vg$Critic_Count, model3$residuals)

plot(vg$User_Score, model3$residuals)

plot(vg$User_Count, model3$residuals)

plot(model3)
```