

# Regression

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## How Linear Regression Works

Linear Regression uses predictor variables and target variables. In Linear Regression, we need to find the specific relationship between the predictors and the target variables. Typically with a linear relationship, we can determine this with a slope of a line that correlates with the data points. The `lm()` function in R will allow us to make a linear model and the formula will allow us to set the predictors and the target variables. These are separated by a tilde (~).

## Dataset

<https://www.kaggle.com/datasets/thedevastator/global-video-game-sales>

## Import Dataset

Here we are importing our Video Game Sales CSV file as `vgsales` to be used in our later code blocks.

```
vgsales <- read.csv("vgsales.csv")
```

## Split into 80/20 training data

We split the data using the `sample()` function and make sure to split the data 80/20 between training and testing. We find the index to split the data on and assign it to `i` and then separate the data between training and testing.

```
i <- sample(1:nrow(vgsales), 0.80*nrow(vgsales), replace=FALSE)
training <- vgsales[i, ]
testing <- vgsales[-i, ]
```

## Functions for data exploration

Here we are using different functions to explore the given data. `str()` will give us the structure of the data. `summary()` will give us a summary of the data. `hist()` will give us a histogram and we are plotting a histogram of the North America Sales. The `cor()` function will tell us the correlation of NA\_Sales to EU\_Sales. The `head()` function will show the first 6 rows of the training data.

```
str(training)
```

```

## 'data.frame': 13278 obs. of 11 variables:
## $ Rank      : int 7554 4618 8612 3353 10023 12196 8245 8880 5114 11081 ...
## $ Name       : chr "Langrisser III" "Mobile Suit Gundam: Gundam vs. Gundam" "Farming Simulator 20...
## $ Platform   : chr "SAT" "PSP" "PS3" "PS4" ...
## $ Year       : chr "1996" "2008" "2013" "2014" ...
## $ Genre      : chr "Strategy" "Fighting" "Simulation" "Action" ...
## $ Publisher  : chr "NCS" "Namco Bandai Games" "Focus Home Interactive" "Warner Bros. Interactive L...
## $ NA_Sales   : num 0 0 0 0.12 0 0.03 0.08 0.13 0.18 0.03 ...
## $ EU_Sales   : num 0 0 0.1 0.37 0 0.03 0.07 0 0.14 0.01 ...
## $ JP_Sales   : num 0.2 0.42 0.02 0 0.11 0 0 0 0 0.04 ...
## $ Other_Sales: num 0 0 0.04 0.1 0 0.01 0.02 0.01 0.05 0 ...
## $ Global_Sales: num 0.2 0.42 0.16 0.6 0.11 0.07 0.17 0.15 0.37 0.09 ...

summary(training)

##      Rank          Name        Platform        Year
## Min.   : 2 Length:13278    Length:13278    Length:13278
## 1st Qu.: 4112 Class :character Class :character Class :character
## Median : 8248 Mode  :character Mode  :character Mode  :character
## Mean   : 8278
## 3rd Qu.:12432
## Max.   :16600

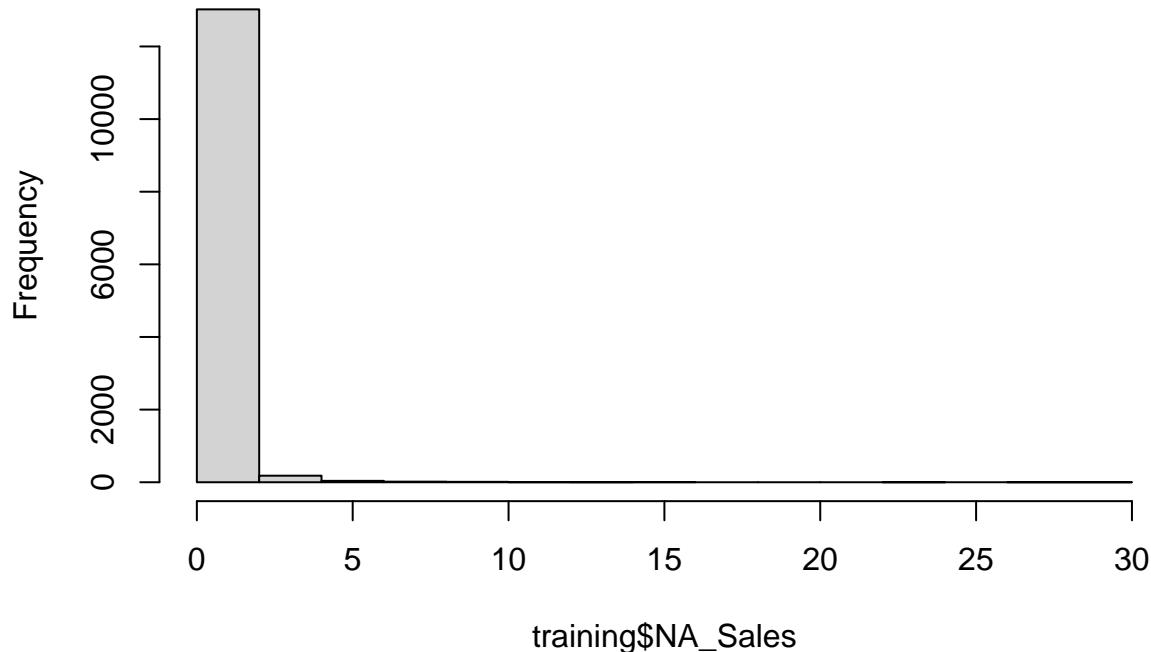
##      Genre        Publisher        NA_Sales        EU_Sales
## Length:13278    Length:13278    Min.   : 0.000  Min.   : 0.0000
## Class :character Class :character 1st Qu.: 0.000  1st Qu.: 0.0000
## Mode  :character Mode  :character Median : 0.080  Median : 0.0200
##                   Mode  :character Mean   : 0.265  Mean   : 0.1456
##                   Mode  :character 3rd Qu.: 0.240  3rd Qu.: 0.1100
##                   Mode  :character Max.   :29.080  Max.   :12.8800

##      JP_Sales        Other_Sales        Global_Sales
## Min.   : 0.00000  Min.   : 0.00000  Min.   : 0.010
## 1st Qu.: 0.00000  1st Qu.: 0.00000  1st Qu.: 0.060
## Median : 0.00000  Median : 0.01000  Median : 0.170
## Mean   : 0.07887  Mean   : 0.04833  Mean   : 0.538
## 3rd Qu.: 0.04000  3rd Qu.: 0.04000  3rd Qu.: 0.480
## Max.   :10.22000  Max.   :10.57000  Max.   :40.240

hist(training$NA_Sales)

```

## Histogram of training\$NA\_Sales



```
cor(training[,c("NA_Sales", "EU_Sales")])
```

```
##           NA_Sales EU_Sales
## NA_Sales 1.0000000 0.7096441
## EU_Sales 0.7096441 1.0000000
```

```
head(training)
```

```
##      Rank          Name Platform Year   Genre
## 7553 7554 Langrisser III SAT 1996 Strategy
## 4617 4618 Mobile Suit Gundam: Gundam vs. Gundam PSP 2008 Fighting
## 8611 8612 Farming Simulator 2013 PS3 2013 Simulation
## 3352 3353 LEGO The Hobbit PS4 2014 Action
## 10022 10023 Doukoku Shoshite... SAT 1998 Adventure
## 12195 12196 Armored Core: Nine Breaker PS2 2004 Simulation
##                               Publisher NA_Sales EU_Sales JP_Sales
## 7553                         NCS    0.00    0.00   0.20
## 4617                         Namco Bandai Games    0.00    0.00   0.42
## 8611                         Focus Home Interactive    0.00    0.10   0.02
## 3352 Warner Bros. Interactive Entertainment    0.12    0.37   0.00
## 10022 Data East    0.00    0.00   0.11
## 12195 505 Games    0.03    0.03   0.00
##      Other_Sales Global_Sales
## 7553        0.00        0.20
```

```

## 4617      0.00      0.42
## 8611      0.04      0.16
## 3352      0.10      0.60
## 10022     0.00      0.11
## 12195     0.01      0.07

```

## Graphs for Data Exploration

We use `ggplot2` to graph a scatter plot of the training data of the North American Sales vs the Global Sales. We then plot a bar graph of Number of Video Games by Genre

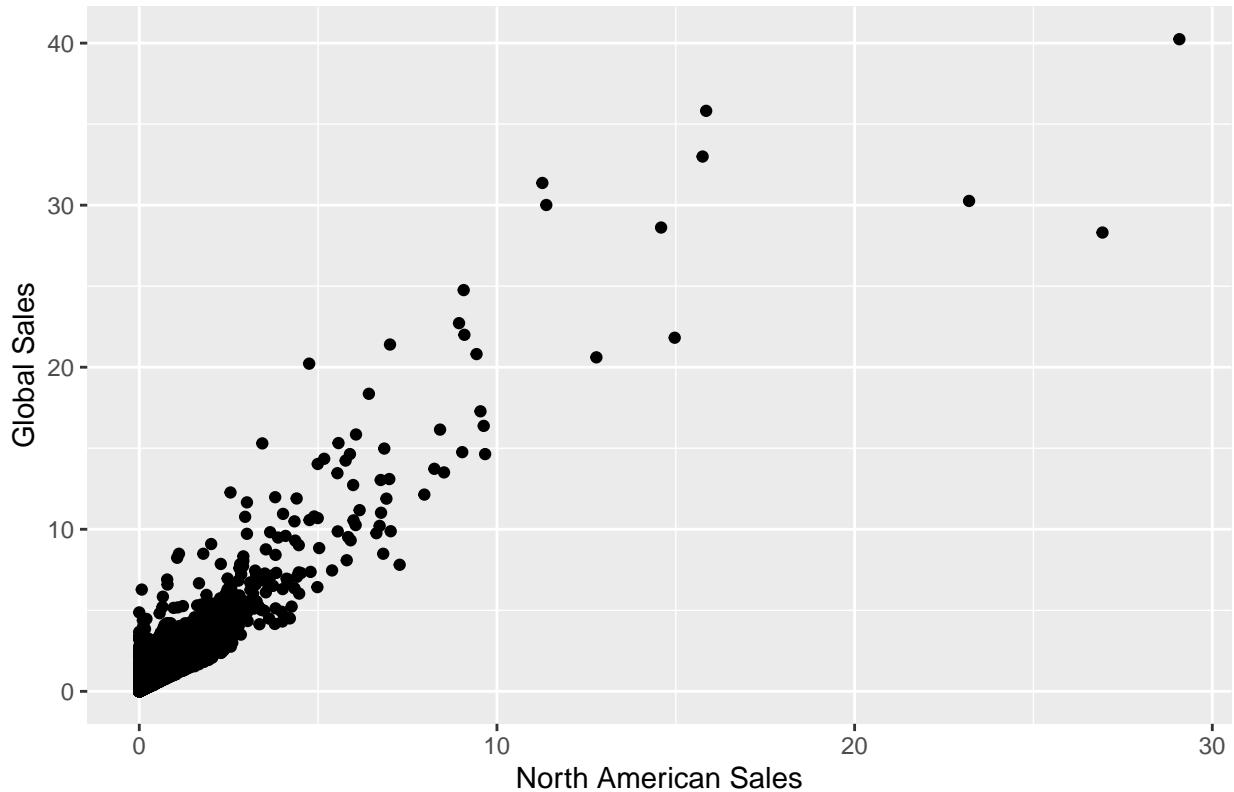
```

library(ggplot2)

ggplot(training, aes(x = NA_Sales, y = Global_Sales)) +
  geom_point() +
  labs(title = "North American Sales vs Global Sales",
      x = "North American Sales",
      y = "Global Sales")

```

North American Sales vs Global Sales

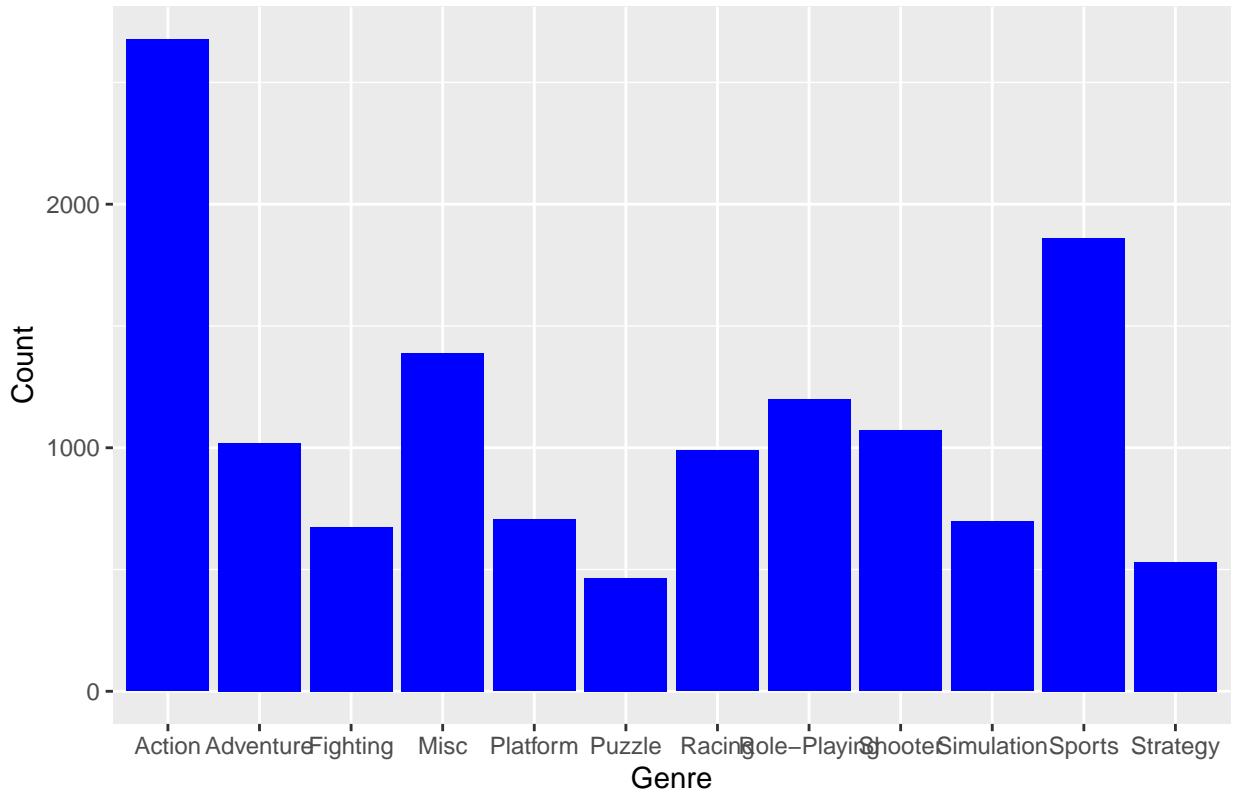


```

ggplot(training, aes(x = Genre)) +
  geom_bar(fill = "blue") +
  labs(title = "Number of Video Games by Genre",
      x = "Genre",
      y = "Count")

```

Number of Video Games by Genre



## Linear Regression Model 1

This Linear Regression Model will take the `Global_Sales` as an X values, and `NA_Sales` as the Y values. We give the training data as well. We will later reference this linear regression model as `vgSalesModel`

```
vgSalesModel <- lm(Global_Sales ~ NA_Sales, data = training)

summary(vgSalesModel)

##
## Call:
## lm(formula = Global_Sales ~ NA_Sales, data = training)
##
## Residuals:
##      Min       1Q   Median       3Q      Max 
## -18.3946  -0.1162  -0.0601   0.0108  11.9169 
## 
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)    
## (Intercept) 0.079176  0.004952   15.99   <2e-16 ***
## NA_Sales    1.731356  0.006009  288.14   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```

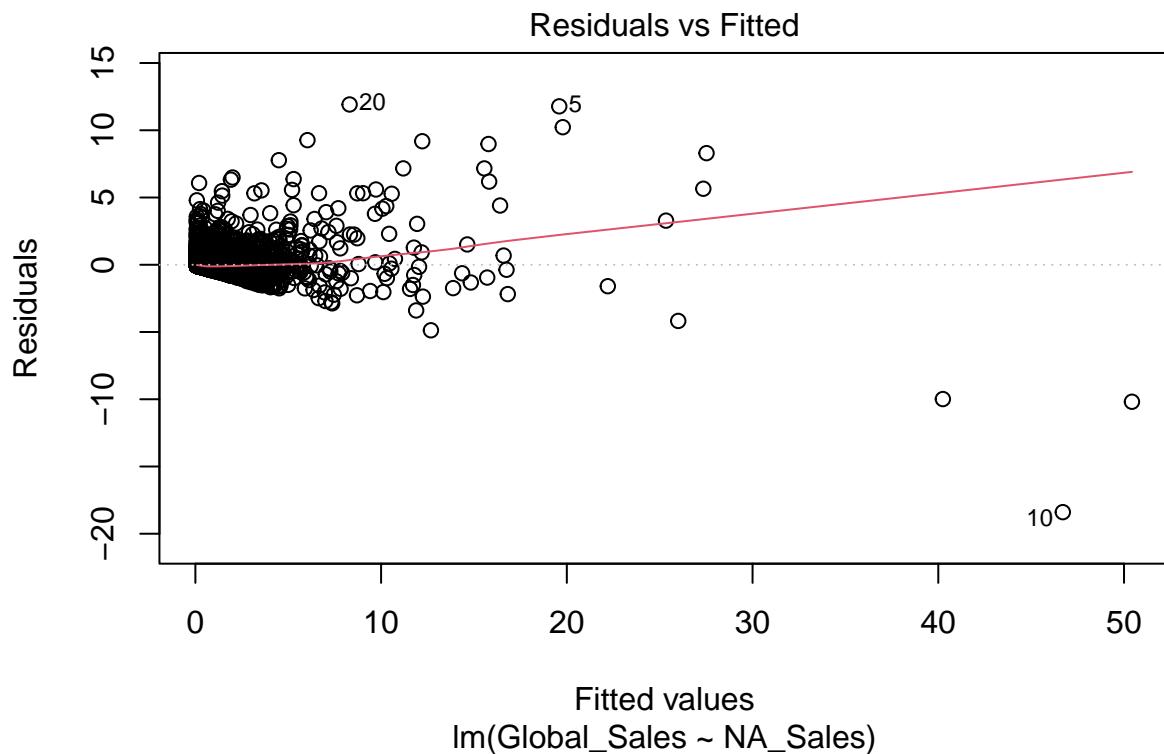
## Residual standard error: 0.5403 on 13276 degrees of freedom
## Multiple R-squared:  0.8621, Adjusted R-squared:  0.8621
## F-statistic: 8.303e+04 on 1 and 13276 DF, p-value: < 2.2e-16

```

## Plotting Residuals

We are plotting the residuals of the `vgSalesModel` using the `plot` function. We create a plot for the Residuals vs the Fitted Values. This comes from the `1` passed to the `which` parameter

```
plot(vgSalesModel, which = 1)
```



## Linear Regression Model 2 (Multiple Linear Regression Model)

Here we are building a multiple linear regression model. The formula specified in the `lm()` function call includes `Global_Sales` as a response variable and the rest of the values as predictor variables. We are predicting what the Global Sales will be using the variables `NA_Sales` `EU_Sales` `JP_Sales` and `Other_Sales`

```

vgSalesMultiModel <- lm(Global_Sales ~ Year + NA_Sales, data = training)

summary(vgSalesMultiModel)

```

```

##
## Call:

```

```

## lm(formula = Global_Sales ~ Year + NA_Sales, data = training)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -17.7994  -0.1225  -0.0552   0.0174  11.9228
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)    
## (Intercept) -0.928083  0.201911 -4.596 4.34e-06 ***
## Year1981     0.387906  0.221557  1.751  0.0800 .  
## Year1982     0.416749  0.225576  1.847  0.0647 .  
## Year1983     1.197222  0.244379  4.899 9.74e-07 ***
## Year1984     0.241945  0.250317  0.967  0.3338  
## Year1985     0.416720  0.263227  1.583  0.1134  
## Year1986     1.685307  0.236031  7.140 9.81e-13 ***
## Year1987     1.433194  0.258118  5.552 2.87e-08 ***
## Year1988     1.388403  0.253842  5.470 4.59e-08 ***
## Year1989     0.574977  0.250280  2.297  0.0216 *  
## Year1990     1.322877  0.250224  5.287 1.26e-07 *** 
## Year1991     1.177130  0.224138  5.252 1.53e-07 *** 
## Year1992     1.386333  0.221004  6.273 3.65e-10 *** 
## Year1993     1.213281  0.216644  5.600 2.18e-08 *** 
## Year1994     1.197764  0.209305  5.723 1.07e-08 *** 
## Year1995     1.146773  0.206162  5.562 2.71e-08 *** 
## Year1996     1.137600  0.205180  5.544 3.01e-08 *** 
## Year1997     1.074197  0.204858  5.244 1.60e-07 *** 
## Year1998     1.028683  0.204175  5.038 4.76e-07 *** 
## Year1999     1.005537  0.204485  4.917 8.88e-07 *** 
## Year2000     1.055604  0.204496  5.162 2.48e-07 *** 
## Year2001     0.985536  0.203695  4.838 1.32e-06 *** 
## Year2002     0.941342  0.202900  4.639 3.53e-06 *** 
## Year2003     0.956999  0.202979  4.715 2.44e-06 *** 
## Year2004     0.968591  0.202975  4.772 1.84e-06 *** 
## Year2005     0.971327  0.202785  4.790 1.69e-06 *** 
## Year2006     0.981175  0.202739  4.840 1.32e-06 *** 
## Year2007     0.987153  0.202583  4.873 1.11e-06 *** 
## Year2008     0.977902  0.202468  4.830 1.38e-06 *** 
## Year2009     0.983334  0.202459  4.857 1.21e-06 *** 
## Year2010     0.982015  0.202550  4.848 1.26e-06 *** 
## Year2011     1.009483  0.202641  4.982 6.38e-07 *** 
## Year2012     1.069160  0.203232  5.261 1.46e-07 *** 
## Year2013     1.127248  0.203451  5.541 3.07e-08 *** 
## Year2014     1.113091  0.203321  5.475 4.47e-08 *** 
## Year2015     1.073591  0.203296  5.281 1.31e-07 *** 
## Year2016     1.004430  0.204462  4.913 9.10e-07 *** 
## Year2017     0.944750  0.368409  2.564  0.0103 *  
## Year2020     0.748911  0.570626  1.312  0.1894  
## YearN/A      0.915107  0.204943  4.465 8.07e-06 *** 
## NA_Sales     1.737674  0.006062 286.649 < 2e-16 *** 
## ---        
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.5337 on 13237 degrees of freedom
## Multiple R-squared:  0.8659, Adjusted R-squared:  0.8655

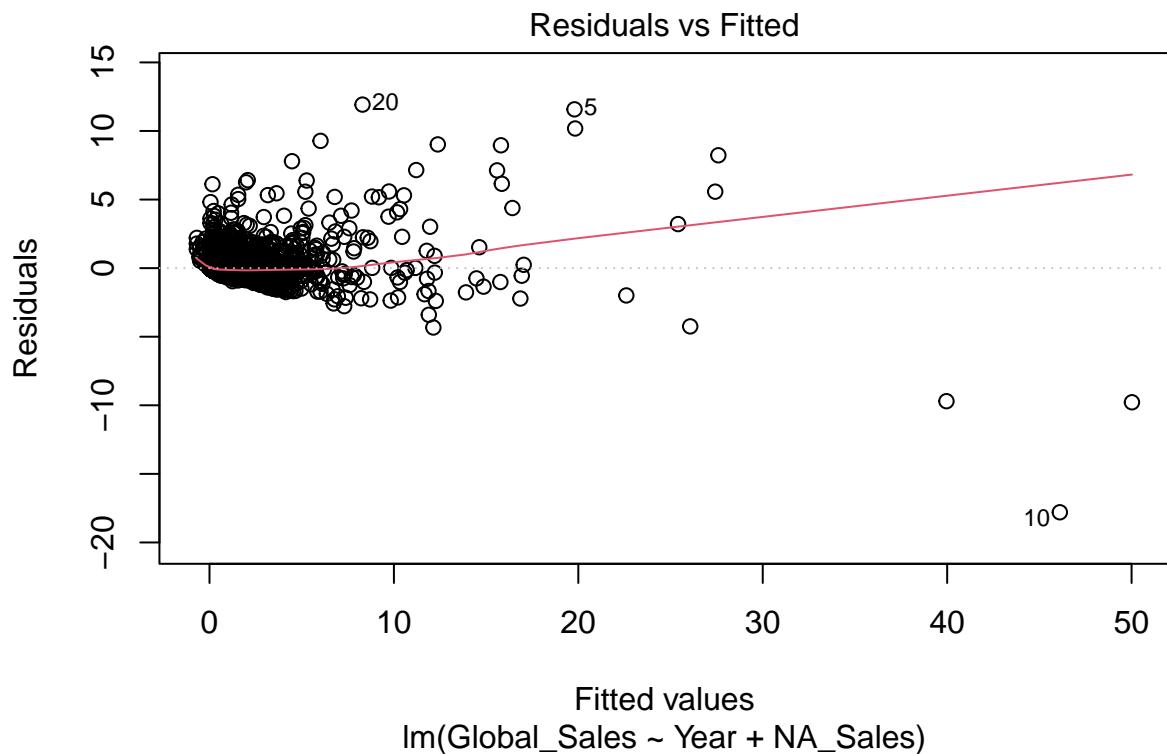
```

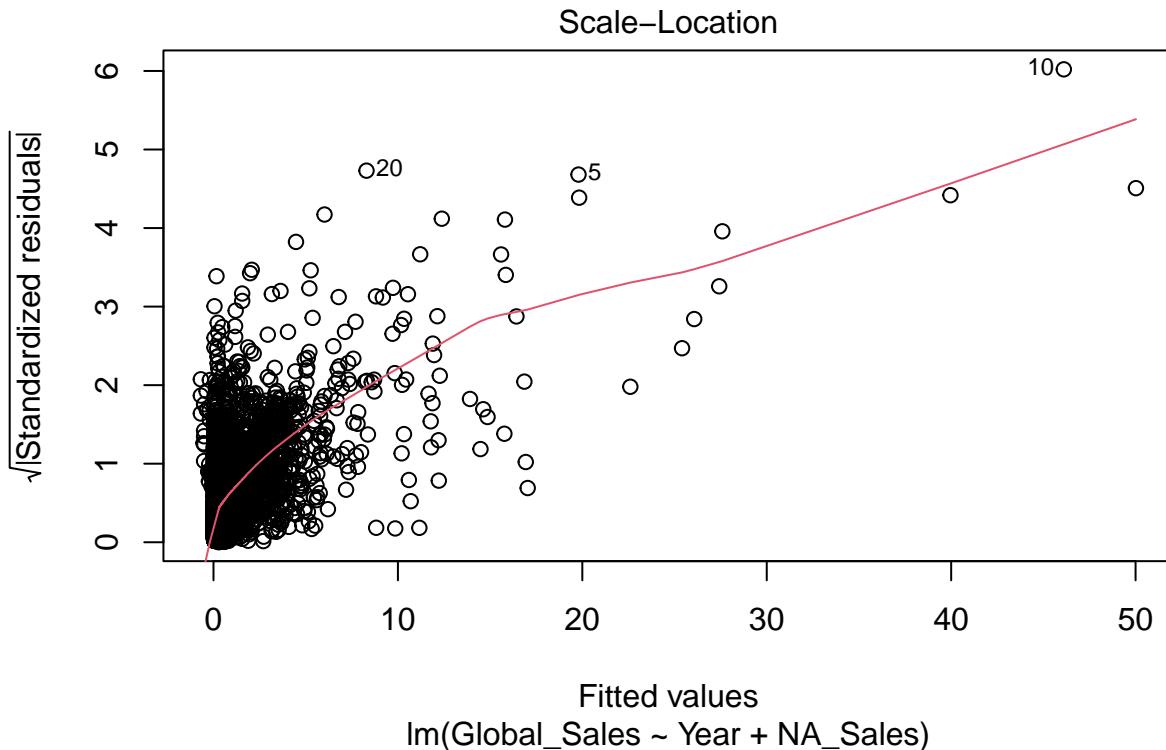
```
## F-statistic: 2136 on 40 and 13237 DF, p-value: < 2.2e-16
```

### Plot Residuals

We are plotting the residuals of the `vgSalesMultiModel` using the `plot` function. We create a plot for the Residuals vs the Fitted Values and the Normal Q-Q plot. These come from the `c(1,3)` values passed to the `which` parameter

```
plot(vgSalesMultiModel, which = c(1,3))
```





### Linear Regression Model 3

Here we are building a multiple linear regression model. The formula specified in the `lm()` function call includes `Global_Sales` as a response variable and the rest of the values as predictor variables. We are predicting what the Global Sales will be using the variables `NA_Sales`, `Year` and `Genre`. We are then stating that the `Year` should vary based on the `Genre` by doing `Year*Genre`

```
vgSalesModel3 <- lm(Global_Sales ~ NA_Sales + Year*Genre, data = training)
summary(vgSalesModel3)
```

```
##
## Call:
## lm(formula = Global_Sales ~ NA_Sales + Year * Genre, data = training)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -13.3974  -0.1228  -0.0368   0.0425  11.6368
##
## Coefficients: (95 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) -2.186167  0.388118 -5.633 1.81e-08 ***
## NA_Sales     1.774002  0.006185 286.822 < 2e-16 ***
## Year1981    1.756122  0.406631   4.319 1.58e-05 ***
##
```

## Year1982	1.941142	0.411881	4.713	2.47e-06	***
## Year1983	1.918083	0.434432	4.415	1.02e-05	***
## Year1984	2.616965	0.646339	4.049	5.18e-05	***
## Year1985	3.891838	0.647976	6.006	1.95e-09	***
## Year1986	2.548418	0.441544	5.772	8.03e-09	***
## Year1987	1.823686	0.533070	3.421	0.000626	***
## Year1988	2.041115	0.533059	3.829	0.000129	***
## Year1989	1.857866	0.646393	2.874	0.004057	**
## Year1990	2.022054	0.532945	3.794	0.000149	***
## Year1991	2.257991	0.466258	4.843	1.30e-06	***
## Year1992	2.095622	0.646196	3.243	0.001186	**
## Year1993	2.307094	0.451733	5.107	3.32e-07	***
## Year1994	2.342440	0.489578	4.785	1.73e-06	***
## Year1995	2.248789	0.428947	5.243	1.61e-07	***
## Year1996	2.280221	0.406638	5.608	2.09e-08	***
## Year1997	2.264652	0.400997	5.648	1.66e-08	***
## Year1998	2.241430	0.397734	5.636	1.78e-08	***
## Year1999	2.221977	0.397203	5.594	2.26e-08	***
## Year2000	2.265768	0.398294	5.689	1.31e-08	***
## Year2001	2.255351	0.395089	5.708	1.17e-08	***
## Year2002	2.191047	0.391272	5.600	2.19e-08	***
## Year2003	2.174386	0.391064	5.560	2.75e-08	***
## Year2004	2.247058	0.391253	5.743	9.50e-09	***
## Year2005	2.190553	0.390213	5.614	2.02e-08	***
## Year2006	2.175374	0.390404	5.572	2.57e-08	***
## Year2007	2.211528	0.390085	5.669	1.46e-08	***
## Year2008	2.219452	0.389946	5.692	1.29e-08	***
## Year2009	2.238695	0.389583	5.746	9.32e-09	***
## Year2010	2.224628	0.389973	5.705	1.19e-08	***
## Year2011	2.293102	0.389832	5.882	4.15e-09	***
## Year2012	2.300278	0.389676	5.903	3.66e-09	***
## Year2013	2.417011	0.390766	6.185	6.39e-10	***
## Year2014	2.369075	0.390248	6.071	1.31e-09	***
## Year2015	2.307980	0.389774	5.921	3.27e-09	***
## Year2016	2.267843	0.391866	5.787	7.32e-09	***
## Year2017	2.196167	0.646473	3.397	0.000683	***
## Year2020	2.065108	0.657979	3.139	0.001702	**
## YearN/A	2.202816	0.380950	5.782	7.53e-09	***
## GenreAdventure	-0.306645	0.197150	-1.555	0.119877	
## GenreFighting	1.678885	0.646351	2.597	0.009402	**
## GenreMisc	1.741610	0.466173	3.736	0.000188	***
## GenrePlatform	-0.032254	0.187496	-0.172	0.863420	
## GenrePuzzle	-0.028914	0.179400	-0.161	0.871964	
## GenreRacing	0.027057	0.139727	0.194	0.846460	
## GenreRole-Playing	0.111243	0.148869	0.747	0.454924	
## GenreShooter	-0.097560	0.128811	-0.757	0.448830	
## GenreSimulation	-0.067922	0.161297	-0.421	0.673690	
## GenreSports	-0.064992	0.113490	-0.573	0.566879	
## GenreStrategy	-0.021975	0.208902	-0.105	0.916224	
## Year1981:GenreAdventure	NA	NA	NA	NA	
## Year1982:GenreAdventure	NA	NA	NA	NA	
## Year1983:GenreAdventure	NA	NA	NA	NA	
## Year1984:GenreAdventure	NA	NA	NA	NA	
## Year1985:GenreAdventure	NA	NA	NA	NA	

## Year1986:GenreAdventure	NA	NA	NA	NA
## Year1987:GenreAdventure	1.164062	0.663239	1.755	0.079263 .
## Year1988:GenreAdventure	NA	NA	NA	NA
## Year1989:GenreAdventure	NA	NA	NA	NA
## Year1990:GenreAdventure	NA	NA	NA	NA
## Year1991:GenreAdventure	0.714821	0.610728	1.170	0.241846
## Year1992:GenreAdventure	0.788659	0.628697	1.254	0.209707
## Year1993:GenreAdventure	0.255717	0.599684	0.426	0.669809
## Year1994:GenreAdventure	1.532152	0.511483	2.996	0.002745 **
## Year1995:GenreAdventure	0.294306	0.325109	0.905	0.365349
## Year1996:GenreAdventure	0.379314	0.265409	1.429	0.152980
## Year1997:GenreAdventure	0.280626	0.287344	0.977	0.328775
## Year1998:GenreAdventure	0.406187	0.246128	1.650	0.098904 .
## Year1999:GenreAdventure	0.384218	0.255319	1.505	0.132385
## Year2000:GenreAdventure	0.319520	0.266978	1.197	0.231405
## Year2001:GenreAdventure	0.343041	0.249529	1.375	0.169231
## Year2002:GenreAdventure	0.336388	0.220555	1.525	0.127237
## Year2003:GenreAdventure	0.316025	0.273178	1.157	0.247356
## Year2004:GenreAdventure	0.234135	0.223644	1.047	0.295161
## Year2005:GenreAdventure	0.289616	0.218601	1.325	0.185241
## Year2006:GenreAdventure	0.349527	0.212468	1.645	0.099978 .
## Year2007:GenreAdventure	0.281095	0.210559	1.335	0.181902
## Year2008:GenreAdventure	0.287304	0.205667	1.397	0.162456
## Year2009:GenreAdventure	0.272987	0.206117	1.324	0.185385
## Year2010:GenreAdventure	0.306350	0.206270	1.485	0.137518
## Year2011:GenreAdventure	0.241662	0.208349	1.160	0.246114
## Year2012:GenreAdventure	0.227823	0.216352	1.053	0.292352
## Year2013:GenreAdventure	0.145885	0.218068	0.669	0.503515
## Year2014:GenreAdventure	0.159624	0.212228	0.752	0.451985
## Year2015:GenreAdventure	0.256604	0.216870	1.183	0.236745
## Year2016:GenreAdventure	0.261845	0.223962	1.169	0.242364
## Year2017:GenreAdventure	NA	NA	NA	NA
## Year2020:GenreAdventure	NA	NA	NA	NA
## YearN/A:GenreAdventure	NA	NA	NA	NA
## Year1981:GenreFighting	NA	NA	NA	NA
## Year1982:GenreFighting	NA	NA	NA	NA
## Year1983:GenreFighting	NA	NA	NA	NA
## Year1984:GenreFighting	NA	NA	NA	NA
## Year1985:GenreFighting	-2.334557	0.976885	-2.390	0.016872 *
## Year1986:GenreFighting	NA	NA	NA	NA
## Year1987:GenreFighting	NA	NA	NA	NA
## Year1988:GenreFighting	NA	NA	NA	NA
## Year1989:GenreFighting	NA	NA	NA	NA
## Year1990:GenreFighting	NA	NA	NA	NA
## Year1991:GenreFighting	NA	NA	NA	NA
## Year1992:GenreFighting	-1.080703	0.854078	-1.265	0.205770
## Year1993:GenreFighting	-1.520733	0.718192	-2.117	0.034241 *
## Year1994:GenreFighting	-1.665612	0.722295	-2.306	0.021126 *
## Year1995:GenreFighting	-1.498778	0.679605	-2.205	0.027446 *
## Year1996:GenreFighting	-1.614288	0.666473	-2.422	0.015443 *
## Year1997:GenreFighting	-1.719264	0.662672	-2.594	0.009485 **
## Year1998:GenreFighting	-1.744339	0.658246	-2.650	0.008059 **
## Year1999:GenreFighting	-1.695151	0.664600	-2.551	0.010764 *
## Year2000:GenreFighting	-1.606633	0.661808	-2.428	0.015211 *

## Year2001:GenreFighting	-1.647129	0.661962	-2.488	0.012850	*
## Year2002:GenreFighting	-1.684899	0.652762	-2.581	0.009857	**
## Year2003:GenreFighting	-1.646279	0.653726	-2.518	0.011804	*
## Year2004:GenreFighting	-1.754250	0.654907	-2.679	0.007402	**
## Year2005:GenreFighting	-1.633885	0.653527	-2.500	0.012428	*
## Year2006:GenreFighting	-1.664031	0.652332	-2.551	0.010756	*
## Year2007:GenreFighting	-1.624595	0.652971	-2.488	0.012859	*
## Year2008:GenreFighting	-1.625576	0.652531	-2.491	0.012744	*
## Year2009:GenreFighting	-1.719573	0.652073	-2.637	0.008372	**
## Year2010:GenreFighting	-1.694026	0.653727	-2.591	0.009571	**
## Year2011:GenreFighting	-1.751989	0.652436	-2.685	0.007256	**
## Year2012:GenreFighting	-1.747176	0.657560	-2.657	0.007892	**
## Year2013:GenreFighting	-1.821503	0.660002	-2.760	0.005791	**
## Year2014:GenreFighting	-1.678969	0.659724	-2.545	0.010941	*
## Year2015:GenreFighting	-1.731152	0.659413	-2.625	0.008668	**
## Year2016:GenreFighting	-1.679986	0.667094	-2.518	0.011802	*
## Year2017:GenreFighting	NA	NA	NA	NA	
## Year2020:GenreFighting	NA	NA	NA	NA	
## YearN/A:GenreFighting	-1.710748	0.664847	-2.573	0.010089	*
## Year1981:GenreMisc	NA	NA	NA	NA	
## Year1982:GenreMisc	-2.063527	0.709789	-2.907	0.003653	**
## Year1983:GenreMisc	0.648733	0.722998	0.897	0.369585	
## Year1984:GenreMisc	NA	NA	NA	NA	
## Year1985:GenreMisc	NA	NA	NA	NA	
## Year1986:GenreMisc	NA	NA	NA	NA	
## Year1987:GenreMisc	NA	NA	NA	NA	
## Year1988:GenreMisc	NA	NA	NA	NA	
## Year1989:GenreMisc	NA	NA	NA	NA	
## Year1990:GenreMisc	NA	NA	NA	NA	
## Year1991:GenreMisc	NA	NA	NA	NA	
## Year1992:GenreMisc	-1.221168	0.786186	-1.553	0.120380	
## Year1993:GenreMisc	-1.762538	0.599874	-2.938	0.003307	**
## Year1994:GenreMisc	-1.861760	0.592432	-3.143	0.001678	**
## Year1995:GenreMisc	-1.675495	0.517127	-3.240	0.001198	**
## Year1996:GenreMisc	-1.674351	0.496151	-3.375	0.000741	***
## Year1997:GenreMisc	-1.834591	0.504265	-3.638	0.000276	***
## Year1998:GenreMisc	-1.662775	0.497222	-3.344	0.000828	***
## Year1999:GenreMisc	-1.799687	0.487132	-3.694	0.000221	***
## Year2000:GenreMisc	-1.653784	0.491044	-3.368	0.000760	***
## Year2001:GenreMisc	-1.754363	0.486009	-3.610	0.000308	***
## Year2002:GenreMisc	-1.736231	0.477673	-3.635	0.000279	***
## Year2003:GenreMisc	-1.618544	0.475118	-3.407	0.000660	***
## Year2004:GenreMisc	-1.779900	0.472786	-3.765	0.000167	***
## Year2005:GenreMisc	-1.589270	0.471333	-3.372	0.000749	***
## Year2006:GenreMisc	-1.585481	0.471459	-3.363	0.000773	***
## Year2007:GenreMisc	-1.708411	0.470220	-3.633	0.000281	***
## Year2008:GenreMisc	-1.769333	0.469409	-3.769	0.000164	***
## Year2009:GenreMisc	-1.770473	0.469168	-3.774	0.000162	***
## Year2010:GenreMisc	-1.794552	0.469547	-3.822	0.000133	***
## Year2011:GenreMisc	-1.871078	0.469752	-3.983	6.84e-05	***
## Year2012:GenreMisc	-1.799918	0.476678	-3.776	0.000160	***
## Year2013:GenreMisc	-1.874936	0.476296	-3.936	8.31e-05	***
## Year2014:GenreMisc	-1.741698	0.475464	-3.663	0.000250	***
## Year2015:GenreMisc	-1.797550	0.476435	-3.773	0.000162	***

## Year2016:GenreMisc	-1.775450	0.489223	-3.629	0.000285	***
## Year2017:GenreMisc	NA	NA	NA	NA	
## Year2020:GenreMisc	NA	NA	NA	NA	
## YearN/A:GenreMisc	-1.810452	0.470925	-3.844	0.000121	***
## Year1981:GenrePlatform	-2.506250	0.563760	-4.446	8.84e-06	***
## Year1982:GenrePlatform	-0.380735	0.328213	-1.160	0.246061	
## Year1983:GenrePlatform	0.692897	0.356090	1.946	0.051695	.
## Year1984:GenrePlatform	0.291456	0.754821	0.386	0.699410	
## Year1985:GenrePlatform	-4.154888	0.611061	-6.799	1.10e-11	***
## Year1986:GenrePlatform	0.928366	0.364942	2.544	0.010975	*
## Year1987:GenrePlatform	0.466434	0.549951	0.848	0.396377	
## Year1988:GenrePlatform	-0.136993	0.485930	-0.282	0.778010	
## Year1989:GenrePlatform	0.458584	0.660375	0.694	0.487426	
## Year1990:GenrePlatform	-0.508429	0.508316	-1.000	0.317221	
## Year1991:GenrePlatform	-0.114500	0.394279	-0.290	0.771512	
## Year1992:GenrePlatform	-0.121041	0.596587	-0.203	0.839226	
## Year1993:GenrePlatform	0.049758	0.339666	0.146	0.883535	
## Year1994:GenrePlatform	0.127083	0.397173	0.320	0.748997	
## Year1995:GenrePlatform	0.298415	0.304749	0.979	0.327493	
## Year1996:GenrePlatform	0.351928	0.282366	1.246	0.212657	
## Year1997:GenrePlatform	0.074912	0.260210	0.288	0.773435	
## Year1998:GenrePlatform	0.005031	0.238468	0.021	0.983169	
## Year1999:GenrePlatform	-0.173259	0.245372	-0.706	0.480132	
## Year2000:GenrePlatform	0.048448	0.239420	0.202	0.839643	
## Year2001:GenrePlatform	-0.013505	0.220423	-0.061	0.951147	
## Year2002:GenrePlatform	-0.006213	0.204480	-0.030	0.975763	
## Year2003:GenrePlatform	0.023950	0.204653	0.117	0.906839	
## Year2004:GenrePlatform	-0.070092	0.206687	-0.339	0.734524	
## Year2005:GenrePlatform	-0.021706	0.201932	-0.107	0.914399	
## Year2006:GenrePlatform	0.246528	0.207167	1.190	0.234070	
## Year2007:GenrePlatform	0.046320	0.212366	0.218	0.827345	
## Year2008:GenrePlatform	0.102279	0.205774	0.497	0.619164	
## Year2009:GenrePlatform	0.140923	0.219082	0.643	0.520080	
## Year2010:GenrePlatform	-0.001489	0.216658	-0.007	0.994515	
## Year2011:GenrePlatform	0.069579	0.213930	0.325	0.745004	
## Year2012:GenrePlatform	0.496432	0.264252	1.879	0.060318	.
## Year2013:GenrePlatform	-0.058471	0.214317	-0.273	0.784993	
## Year2014:GenrePlatform	0.202597	0.252186	0.803	0.421781	
## Year2015:GenrePlatform	0.043893	0.242365	0.181	0.856288	
## Year2016:GenrePlatform	0.034102	0.267402	0.128	0.898522	
## Year2017:GenrePlatform	NA	NA	NA	NA	
## Year2020:GenrePlatform	NA	NA	NA	NA	
## YearN/A:GenrePlatform	NA	NA	NA	NA	
## Year1981:GenrePuzzle	-0.274874	0.425077	-0.647	0.517873	
## Year1982:GenrePuzzle	-2.476279	0.430624	-5.750	9.10e-09	***
## Year1983:GenrePuzzle	NA	NA	NA	NA	
## Year1984:GenrePuzzle	0.236761	0.623363	0.380	0.704090	
## Year1985:GenrePuzzle	-1.116418	0.659615	-1.693	0.090569	.
## Year1986:GenrePuzzle	NA	NA	NA	NA	
## Year1987:GenrePuzzle	NA	NA	NA	NA	
## Year1988:GenrePuzzle	NA	NA	NA	NA	
## Year1989:GenrePuzzle	-1.509188	0.594875	-2.537	0.011193	*
## Year1990:GenrePuzzle	0.416713	0.547250	0.761	0.446392	
## Year1991:GenrePuzzle	0.421875	0.433711	0.973	0.330715	

## Year1992:GenrePuzzle	0.533969	0.594186	0.899	0.368852
## Year1993:GenrePuzzle	0.397986	0.594083	0.670	0.502923
## Year1994:GenrePuzzle	0.382641	0.458671	0.834	0.404162
## Year1995:GenrePuzzle	0.174242	0.299825	0.581	0.561152
## Year1996:GenrePuzzle	-0.080199	0.291924	-0.275	0.783532
## Year1997:GenrePuzzle	0.179067	0.258394	0.693	0.488321
## Year1998:GenrePuzzle	0.116471	0.257973	0.451	0.651647
## Year1999:GenrePuzzle	0.004103	0.358477	0.011	0.990869
## Year2000:GenrePuzzle	0.014374	0.280123	0.051	0.959075
## Year2001:GenrePuzzle	-0.135777	0.241482	-0.562	0.573944
## Year2002:GenrePuzzle	-0.025859	0.226795	-0.114	0.909224
## Year2003:GenrePuzzle	0.169914	0.281207	0.604	0.545702
## Year2004:GenrePuzzle	0.045764	0.217794	0.210	0.833575
## Year2005:GenrePuzzle	0.402235	0.212163	1.896	0.057999 .
## Year2006:GenrePuzzle	0.132143	0.205188	0.644	0.519582
## Year2007:GenrePuzzle	0.072642	0.197024	0.369	0.712358
## Year2008:GenrePuzzle	0.011070	0.196332	0.056	0.955035
## Year2009:GenrePuzzle	-0.020737	0.193650	-0.107	0.914723
## Year2010:GenrePuzzle	-0.002614	0.202262	-0.013	0.989688
## Year2011:GenrePuzzle	-0.019627	0.204148	-0.096	0.923408
## Year2012:GenrePuzzle	0.034582	0.245292	0.141	0.887884
## Year2013:GenrePuzzle	-0.265461	0.409862	-0.648	0.517201
## Year2014:GenrePuzzle	-0.112549	0.268481	-0.419	0.675071
## Year2015:GenrePuzzle	0.017425	0.316729	0.055	0.956127
## Year2016:GenrePuzzle	NA	NA	NA	NA
## Year2017:GenrePuzzle	NA	NA	NA	NA
## Year2020:GenrePuzzle	NA	NA	NA	NA
## YearN/A:GenrePuzzle	NA	NA	NA	NA
## Year1981:GenreRacing	NA	NA	NA	NA
## Year1982:GenreRacing	-0.048413	0.553089	-0.088	0.930251
## Year1983:GenreRacing	NA	NA	NA	NA
## Year1984:GenreRacing	0.165410	0.613117	0.270	0.787330
## Year1985:GenreRacing	NA	NA	NA	NA
## Year1986:GenreRacing	-0.433930	0.575643	-0.754	0.450972
## Year1987:GenreRacing	NA	NA	NA	NA
## Year1988:GenreRacing	NA	NA	NA	NA
## Year1989:GenreRacing	NA	NA	NA	NA
## Year1990:GenreRacing	0.478032	0.648440	0.737	0.461012
## Year1991:GenreRacing	0.012198	0.594681	0.021	0.983636
## Year1992:GenreRacing	1.443504	0.648432	2.226	0.026022 *
## Year1993:GenreRacing	NA	NA	NA	NA
## Year1994:GenreRacing	0.100956	0.383151	0.263	0.792178
## Year1995:GenreRacing	0.164561	0.301861	0.545	0.585657
## Year1996:GenreRacing	-0.085027	0.223824	-0.380	0.704039
## Year1997:GenreRacing	0.058083	0.198367	0.293	0.769676
## Year1998:GenreRacing	-0.027914	0.182305	-0.153	0.878310
## Year1999:GenreRacing	-0.079331	0.185436	-0.428	0.668799
## Year2000:GenreRacing	-0.104976	0.186673	-0.562	0.573885
## Year2001:GenreRacing	-0.013406	0.174163	-0.077	0.938644
## Year2002:GenreRacing	-0.075048	0.159025	-0.472	0.636986
## Year2003:GenreRacing	0.016781	0.157819	0.106	0.915323
## Year2004:GenreRacing	0.029354	0.162787	0.180	0.856901
## Year2005:GenreRacing	-0.112518	0.160219	-0.702	0.482521
## Year2006:GenreRacing	-0.036513	0.161604	-0.226	0.821253

## Year2007:GenreRacing	0.051455	0.158076	0.326	0.744804
## Year2008:GenreRacing	0.117931	0.158164	0.746	0.455909
## Year2009:GenreRacing	0.014456	0.156498	0.092	0.926406
## Year2010:GenreRacing	0.130671	0.165966	0.787	0.431102
## Year2011:GenreRacing	-0.039851	0.160826	-0.248	0.804302
## Year2012:GenreRacing	0.080786	0.184778	0.437	0.661971
## Year2013:GenreRacing	0.112561	0.198741	0.566	0.571152
## Year2014:GenreRacing	-0.017484	0.187894	-0.093	0.925862
## Year2015:GenreRacing	0.111088	0.193751	0.573	0.566414
## Year2016:GenreRacing	-0.078811	0.197905	-0.398	0.690469
## Year2017:GenreRacing	NA	NA	NA	NA
## Year2020:GenreRacing	NA	NA	NA	NA
## YearN/A:GenreRacing	NA	NA	NA	NA
## Year1981:GenreRole-Playing	NA	NA	NA	NA
## Year1982:GenreRole-Playing	NA	NA	NA	NA
## Year1983:GenreRole-Playing	NA	NA	NA	NA
## Year1984:GenreRole-Playing	NA	NA	NA	NA
## Year1985:GenreRole-Playing	NA	NA	NA	NA
## Year1986:GenreRole-Playing	1.177245	0.577934	2.037	0.041671 *
## Year1987:GenreRole-Playing	1.534347	0.538008	2.852	0.004353 **
## Year1988:GenreRole-Playing	1.934675	0.494882	3.909	9.30e-05 ***
## Year1989:GenreRole-Playing	1.317058	0.650462	2.025	0.042908 *
## Year1990:GenreRole-Playing	2.241909	0.538046	4.167	3.11e-05 ***
## Year1991:GenreRole-Playing	0.427992	0.394723	1.084	0.278259
## Year1992:GenreRole-Playing	1.351301	0.585719	2.307	0.021066 *
## Year1993:GenreRole-Playing	0.339662	0.324528	1.047	0.295287
## Year1994:GenreRole-Playing	0.118973	0.363069	0.328	0.743153
## Year1995:GenreRole-Playing	0.370423	0.265371	1.396	0.162778
## Year1996:GenreRole-Playing	0.705205	0.224447	3.142	0.001682 **
## Year1997:GenreRole-Playing	0.384718	0.217464	1.769	0.076899 .
## Year1998:GenreRole-Playing	0.337858	0.206224	1.638	0.101383
## Year1999:GenreRole-Playing	0.278097	0.201301	1.381	0.167149
## Year2000:GenreRole-Playing	0.579125	0.214439	2.701	0.006929 **
## Year2001:GenreRole-Playing	-0.021512	0.188059	-0.114	0.908933
## Year2002:GenreRole-Playing	0.043522	0.174339	0.250	0.802871
## Year2003:GenreRole-Playing	0.049255	0.175283	0.281	0.778714
## Year2004:GenreRole-Playing	0.130534	0.172697	0.756	0.449751
## Year2005:GenreRole-Playing	-0.003919	0.169448	-0.023	0.981548
## Year2006:GenreRole-Playing	0.043874	0.164377	0.267	0.789544
## Year2007:GenreRole-Playing	-0.040475	0.163781	-0.247	0.804812
## Year2008:GenreRole-Playing	-0.020819	0.162996	-0.128	0.898366
## Year2009:GenreRole-Playing	-0.005285	0.162818	-0.032	0.974107
## Year2010:GenreRole-Playing	0.099788	0.164333	0.607	0.543709
## Year2011:GenreRole-Playing	-0.012867	0.164675	-0.078	0.937723
## Year2012:GenreRole-Playing	-0.014187	0.167412	-0.085	0.932468
## Year2013:GenreRole-Playing	0.002119	0.171629	0.012	0.990148
## Year2014:GenreRole-Playing	-0.113306	0.165939	-0.683	0.494737
## Year2015:GenreRole-Playing	-0.048104	0.165722	-0.290	0.771614
## Year2016:GenreRole-Playing	-0.086440	0.182899	-0.473	0.636499
## Year2017:GenreRole-Playing	-0.101243	0.650461	-0.156	0.876313
## Year2020:GenreRole-Playing	NA	NA	NA	NA
## YearN/A:GenreRole-Playing	NA	NA	NA	NA
## Year1981:GenreShooter	-0.130635	0.241192	-0.542	0.588087
## Year1982:GenreShooter	-0.109443	0.353247	-0.310	0.756703

## Year1983:GenreShooter	0.047343	0.567511	0.083	0.933518
## Year1984:GenreShooter	-6.399743	0.612931	-10.441	< 2e-16 ***
## Year1985:GenreShooter	-1.761213	0.743744	-2.368	0.017897 *
## Year1986:GenreShooter	0.559755	0.387650	1.444	0.148771
## Year1987:GenreShooter	0.294280	0.646169	0.455	0.648812
## Year1988:GenreShooter	-0.081170	0.646166	-0.126	0.900037
## Year1989:GenreShooter	0.916260	0.742412	1.234	0.217163
## Year1990:GenreShooter	NA	NA	NA	NA
## Year1991:GenreShooter	0.145735	0.592208	0.246	0.805618
## Year1992:GenreShooter	0.272944	0.610882	0.447	0.655024
## Year1993:GenreShooter	0.088561	0.451344	0.196	0.844445
## Year1994:GenreShooter	0.105069	0.367952	0.286	0.775227
## Year1995:GenreShooter	0.158770	0.249310	0.637	0.524243
## Year1996:GenreShooter	0.052656	0.215175	0.245	0.806682
## Year1997:GenreShooter	-0.066579	0.197541	-0.337	0.736094
## Year1998:GenreShooter	0.033510	0.193892	0.173	0.862787
## Year1999:GenreShooter	-0.058457	0.207144	-0.282	0.777791
## Year2000:GenreShooter	0.004574	0.206191	0.022	0.982302
## Year2001:GenreShooter	-0.031789	0.174682	-0.182	0.855598
## Year2002:GenreShooter	0.029503	0.153599	0.192	0.847682
## Year2003:GenreShooter	0.098279	0.152473	0.645	0.519220
## Year2004:GenreShooter	-0.057136	0.151616	-0.377	0.706292
## Year2005:GenreShooter	0.012525	0.146914	0.085	0.932060
## Year2006:GenreShooter	0.049845	0.151987	0.328	0.742952
## Year2007:GenreShooter	0.099883	0.147159	0.679	0.497311
## Year2008:GenreShooter	0.027875	0.149920	0.186	0.852502
## Year2009:GenreShooter	0.049319	0.147021	0.335	0.737289
## Year2010:GenreShooter	0.072089	0.147855	0.488	0.625867
## Year2011:GenreShooter	0.113974	0.146184	0.780	0.435605
## Year2012:GenreShooter	0.177504	0.155638	1.140	0.254104
## Year2013:GenreShooter	0.020565	0.157552	0.131	0.896151
## Year2014:GenreShooter	0.176336	0.158092	1.115	0.264702
## Year2015:GenreShooter	0.308667	0.169151	1.825	0.068054 .
## Year2016:GenreShooter	0.139339	0.175120	0.796	0.426235
## Year2017:GenreShooter	NA	NA	NA	NA
## Year2020:GenreShooter	NA	NA	NA	NA
## YearN/A:GenreShooter	NA	NA	NA	NA
## Year1981:GenreSimulation	0.202886	0.555119	0.365	0.714758
## Year1982:GenreSimulation	NA	NA	NA	NA
## Year1983:GenreSimulation	NA	NA	NA	NA
## Year1984:GenreSimulation	NA	NA	NA	NA
## Year1985:GenreSimulation	-1.607750	0.750046	-2.144	0.032089 *
## Year1986:GenreSimulation	NA	NA	NA	NA
## Year1987:GenreSimulation	NA	NA	NA	NA
## Year1988:GenreSimulation	0.242973	0.653422	0.372	0.710013
## Year1989:GenreSimulation	NA	NA	NA	NA
## Year1990:GenreSimulation	NA	NA	NA	NA
## Year1991:GenreSimulation	0.326275	0.600130	0.544	0.586675
## Year1992:GenreSimulation	0.169664	0.748751	0.227	0.820742
## Year1993:GenreSimulation	0.136994	0.588868	0.233	0.816045
## Year1994:GenreSimulation	0.219455	0.399577	0.549	0.582864
## Year1995:GenreSimulation	0.092567	0.304695	0.304	0.761283
## Year1996:GenreSimulation	0.115637	0.251276	0.460	0.645382
## Year1997:GenreSimulation	0.323495	0.228084	1.418	0.156123

## Year1998:GenreSimulation	0.243924	0.279649	0.872	0.383088
## Year1999:GenreSimulation	0.343038	0.219296	1.564	0.117779
## Year2000:GenreSimulation	0.088386	0.233833	0.378	0.705445
## Year2001:GenreSimulation	0.058287	0.210506	0.277	0.781870
## Year2002:GenreSimulation	0.011563	0.221636	0.052	0.958394
## Year2003:GenreSimulation	0.069119	0.192319	0.359	0.719305
## Year2004:GenreSimulation	0.040796	0.199185	0.205	0.837719
## Year2005:GenreSimulation	0.541477	0.192185	2.817	0.004848 **
## Year2006:GenreSimulation	0.128292	0.183426	0.699	0.484300
## Year2007:GenreSimulation	0.059666	0.178104	0.335	0.737625
## Year2008:GenreSimulation	0.021514	0.174158	0.124	0.901686
## Year2009:GenreSimulation	-0.016267	0.172322	-0.094	0.924791
## Year2010:GenreSimulation	0.054194	0.178214	0.304	0.761062
## Year2011:GenreSimulation	0.010941	0.183369	0.060	0.952420
## Year2012:GenreSimulation	0.417417	0.212347	1.966	0.049351 *
## Year2013:GenreSimulation	0.122467	0.211843	0.578	0.563205
## Year2014:GenreSimulation	0.263991	0.247267	1.068	0.285705
## Year2015:GenreSimulation	0.065822	0.222712	0.296	0.767582
## Year2016:GenreSimulation	0.032495	0.249730	0.130	0.896473
## Year2017:GenreSimulation	NA	NA	NA	NA
## Year2020:GenreSimulation	NA	NA	NA	NA
## YearN/A:GenreSimulation	NA	NA	NA	NA
## Year1981:GenreSports	0.339756	0.401726	0.846	0.397712
## Year1982:GenreSports	-0.034244	0.406962	-0.084	0.932942
## Year1983:GenreSports	2.238054	0.564233	3.967	7.33e-05 ***
## Year1984:GenreSports	1.216292	0.643286	1.891	0.058680 .
## Year1985:GenreSports	NA	NA	NA	NA
## Year1986:GenreSports	0.169773	0.382794	0.444	0.657405
## Year1987:GenreSports	1.445666	0.485419	2.978	0.002905 **
## Year1988:GenreSports	1.212643	0.643295	1.885	0.059446 .
## Year1989:GenreSports	0.936662	0.643288	1.456	0.145402
## Year1990:GenreSports	0.766864	0.485472	1.580	0.114217
## Year1991:GenreSports	0.233548	0.343352	0.680	0.496390
## Year1992:GenreSports	-0.291715	0.643346	-0.453	0.650244
## Year1993:GenreSports	0.282499	0.323302	0.874	0.382248
## Year1994:GenreSports	0.129531	0.343076	0.378	0.705766
## Year1995:GenreSports	0.109120	0.241748	0.451	0.651725
## Year1996:GenreSports	0.045169	0.185530	0.243	0.807652
## Year1997:GenreSports	0.079611	0.174319	0.457	0.647899
## Year1998:GenreSports	-0.004997	0.160179	-0.031	0.975113
## Year1999:GenreSports	0.058391	0.160231	0.364	0.715554
## Year2000:GenreSports	0.010191	0.159039	0.064	0.948906
## Year2001:GenreSports	-0.010929	0.148871	-0.073	0.941478
## Year2002:GenreSports	0.074090	0.131054	0.565	0.571856
## Year2003:GenreSports	0.069267	0.133781	0.518	0.604632
## Year2004:GenreSports	-0.084330	0.136753	-0.617	0.537472
## Year2005:GenreSports	0.007843	0.131741	0.060	0.952529
## Year2006:GenreSports	0.080999	0.130790	0.619	0.535726
## Year2007:GenreSports	0.101964	0.128557	0.793	0.427709
## Year2008:GenreSports	0.067718	0.126743	0.534	0.593148
## Year2009:GenreSports	0.091203	0.126055	0.724	0.469374
## Year2010:GenreSports	0.040978	0.126910	0.323	0.746784
## Year2011:GenreSports	-0.005470	0.130491	-0.042	0.966566
## Year2012:GenreSports	-0.046976	0.143716	-0.327	0.743775

```

## Year2013:GenreSports      -0.054352  0.145780 -0.373 0.709276
## Year2014:GenreSports      0.082759  0.142842  0.579 0.562348
## Year2015:GenreSports      0.113711  0.139399  0.816 0.414671
## Year2016:GenreSports      0.049045  0.159258  0.308 0.758118
## Year2017:GenreSports       NA        NA        NA        NA
## Year2020:GenreSports       NA        NA        NA        NA
## YearN/A:GenreSports       NA        NA        NA        NA
## Year1981:GenreStrategy    NA        NA        NA        NA
## Year1982:GenreStrategy    NA        NA        NA        NA
## Year1983:GenreStrategy    NA        NA        NA        NA
## Year1984:GenreStrategy    NA        NA        NA        NA
## Year1985:GenreStrategy    NA        NA        NA        NA
## Year1986:GenreStrategy    NA        NA        NA        NA
## Year1987:GenreStrategy    NA        NA        NA        NA
## Year1988:GenreStrategy    NA        NA        NA        NA
## Year1989:GenreStrategy    NA        NA        NA        NA
## Year1990:GenreStrategy    NA        NA        NA        NA
## Year1991:GenreStrategy    0.180151  0.446722  0.403 0.686754
## Year1992:GenreStrategy    NA        NA        NA        NA
## Year1993:GenreStrategy    0.091047  0.603647  0.151 0.880113
## Year1994:GenreStrategy    0.005702  0.632478  0.009 0.992807
## Year1995:GenreStrategy    0.328710  0.339465  0.968 0.332904
## Year1996:GenreStrategy    0.128826  0.291926  0.441 0.659004
## Year1997:GenreStrategy    0.039515  0.260748  0.152 0.879547
## Year1998:GenreStrategy    0.145082  0.246622  0.588 0.556356
## Year1999:GenreStrategy    0.077950  0.254820  0.306 0.759684
## Year2000:GenreStrategy    0.224282  0.272056  0.824 0.409730
## Year2001:GenreStrategy    -0.025921 0.254818 -0.102 0.918978
## Year2002:GenreStrategy    0.155788  0.252995  0.616 0.538052
## Year2003:GenreStrategy    0.068753  0.233680  0.294 0.768595
## Year2004:GenreStrategy    0.050262  0.240380  0.209 0.834380
## Year2005:GenreStrategy    0.052252  0.236691  0.221 0.825282
## Year2006:GenreStrategy    0.057736  0.231971  0.249 0.803447
## Year2007:GenreStrategy    0.038119  0.223428  0.171 0.864535
## Year2008:GenreStrategy    0.064507  0.228835  0.282 0.778030
## Year2009:GenreStrategy    0.029851  0.223354  0.134 0.893683
## Year2010:GenreStrategy    0.042107  0.227289  0.185 0.853030
## Year2011:GenreStrategy    -0.038550 0.228595 -0.169 0.866085
## Year2012:GenreStrategy    0.013901  0.259169  0.054 0.957226
## Year2013:GenreStrategy    -0.086142 0.250003 -0.345 0.730428
## Year2014:GenreStrategy    -0.063240 0.299836 -0.211 0.832957
## Year2015:GenreStrategy    -0.051351 0.253066 -0.203 0.839204
## Year2016:GenreStrategy    -0.028302 0.276181 -0.102 0.918381
## Year2017:GenreStrategy     NA        NA        NA        NA
## Year2020:GenreStrategy     NA        NA        NA        NA
## YearN/A:GenreStrategy     NA        NA        NA        NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.517 on 12892 degrees of freedom
## Multiple R-squared:  0.8774, Adjusted R-squared:  0.8738
## F-statistic: 239.7 on 385 and 12892 DF,  p-value: < 2.2e-16

```

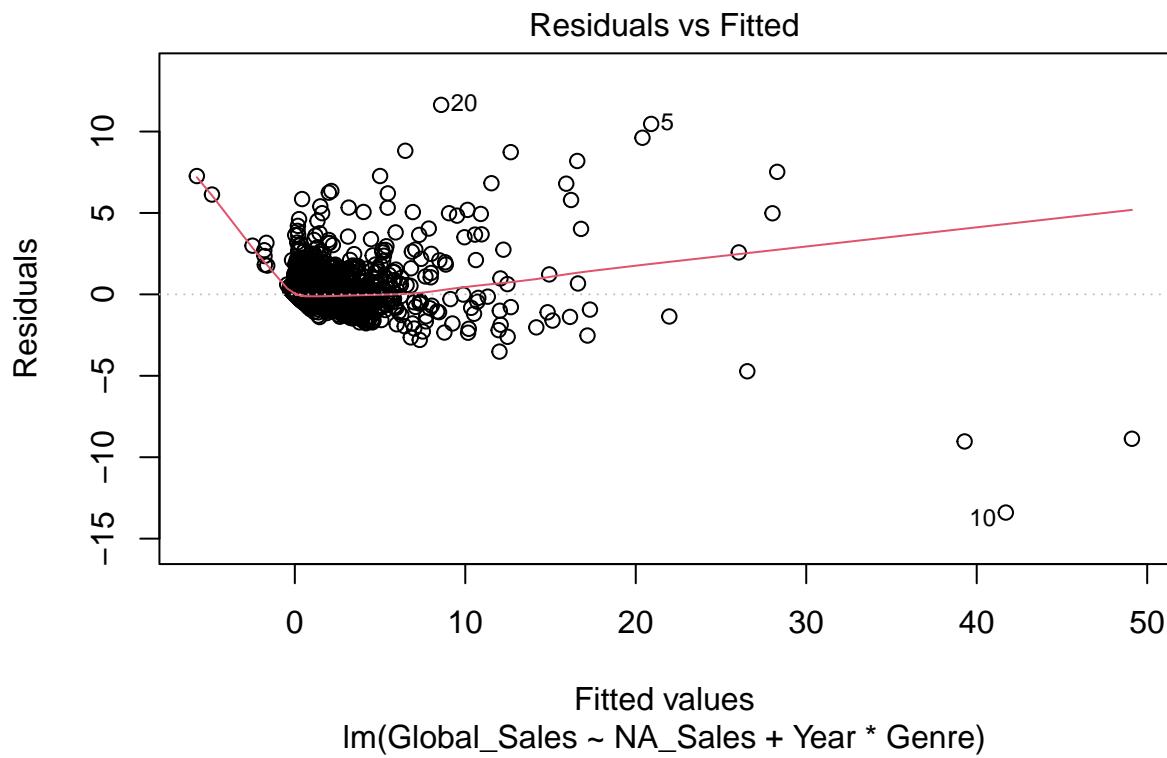
## Plot Residuals

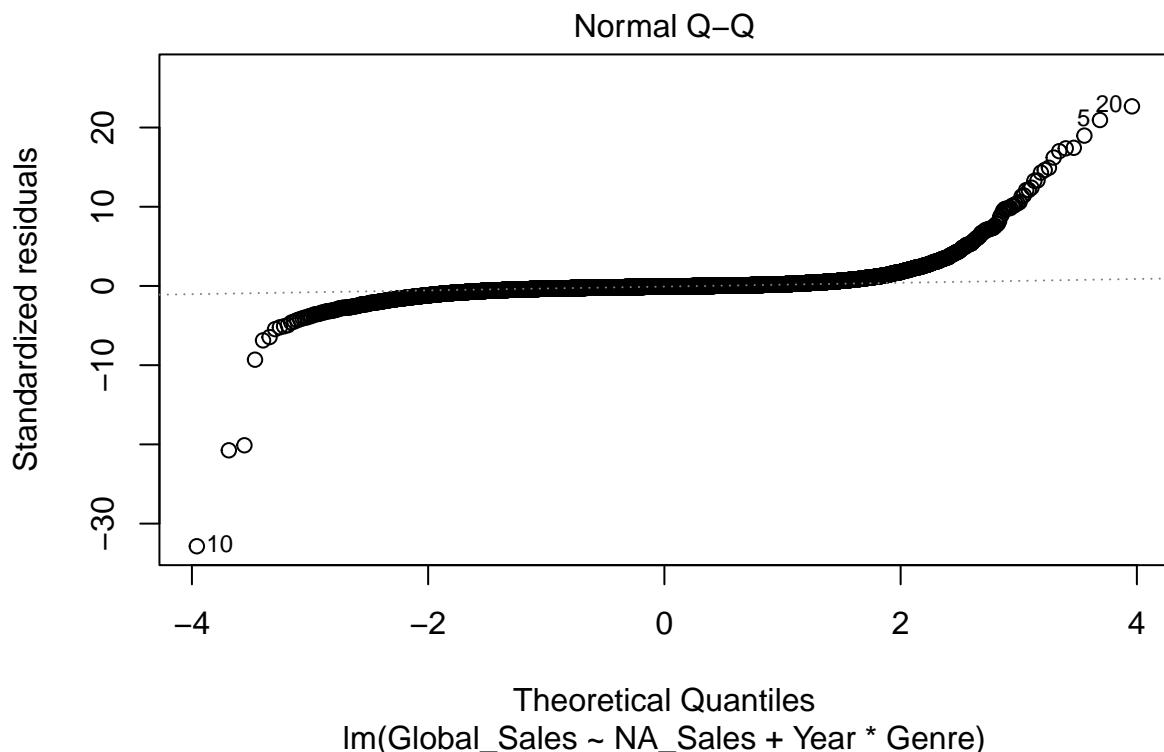
We are plotting the residuals of the `vgSalesModel3` using the `plot` function. We create a plot for the Residuals vs the Fitted Values, the Normal Q-Q plot, and the Scale-Location Plot. These come from the `c(1,2,3)` values passed to the `which` parameter

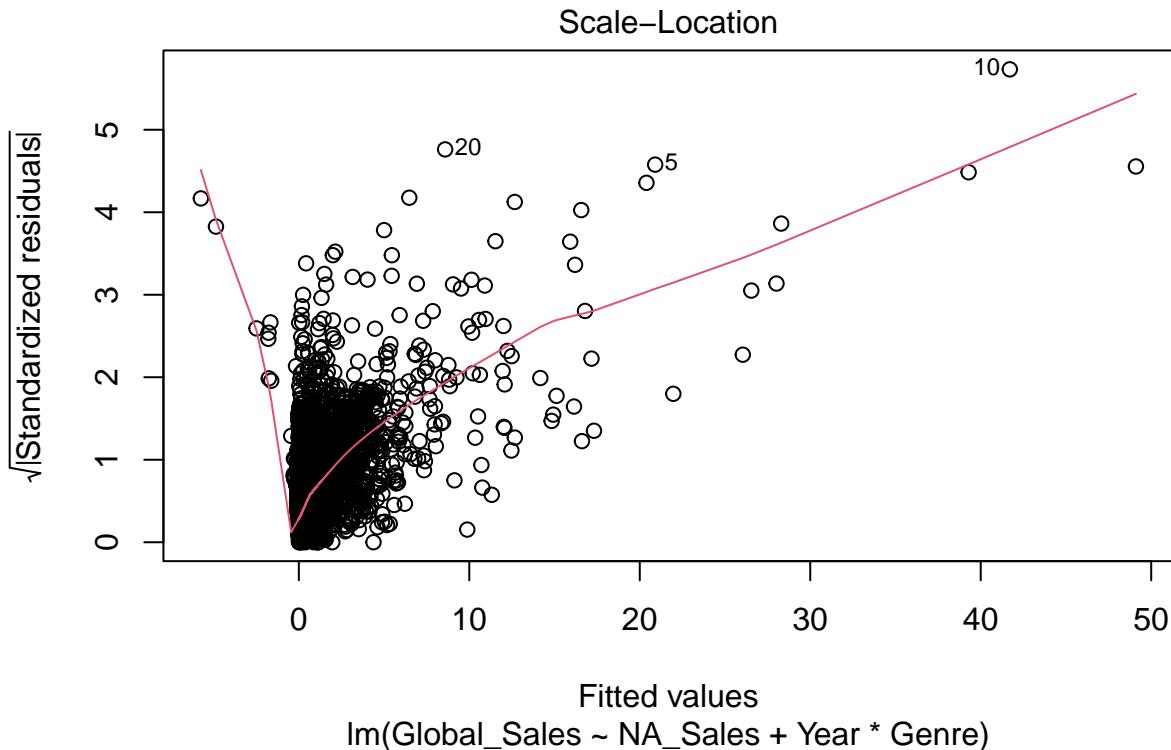
```
plot(vgSalesModel3, which = c(1, 2, 3))
```

```
## Warning: not plotting observations with leverage one:
```

```
##    137, 326, 557, 2546, 2683, 4121, 5767, 6039, 6132, 6291, 6327, 6648, 7314, 7793, 7822, 7885, 8423,
```







## Comparing the Models

When comparing the three models, it is clear that Linear Regression Model 3 is the best model. This is due to the R value being 0.8745 as compared to the other R values. I believe that by stating that the **Year** should vary based on the **Genre** by doing **Year\*Genre** in the third model, we get the better R-value. As for the other models, it makes sense that the less complicated the formula, the less the R value is. I believe that this is due to the fact that there is so much data and the release year would typically affect the global sales.

## Predicting the Models

```

pred1 <- predict(vgSalesModel, newdata = testing)
pred2 <- predict(vgSalesMultiModel, newdata = testing)
pred3 <- predict(vgSalesModel3, newdata = testing)

## Warning in predict.lm(vgSalesModel3, newdata = testing): prediction from a
## rank-deficient fit may be misleading

cor1 <- cor(testing$Global_Sales, pred1)
cor2 <- cor(testing$Global_Sales, pred2)
cor3 <- cor(testing$Global_Sales, pred3)

mse1 <- mean((testing$Global_Sales - pred1)^2)

```

```

mse2 <- mean((testing$Global_Sales - pred2)^2)
mse3 <- mean((testing$Global_Sales - pred3)^2)

cat("\n")

cat("Model 1 Correlation:", cor1, "MSE:", mse1, "\n")

## Model 1 Correlation: 0.9744165 MSE: 0.2281166

cat("Model 2 Correlation:", cor2, "MSE:", mse2, "\n")

## Model 2 Correlation: 0.9744989 MSE: 0.2257565

cat("Model 3 Correlation:", cor3, "MSE:", mse3, "\n")

## Model 3 Correlation: 0.9727349 MSE: 0.2215923

```

From this output, we can see that the highest correlation is model 1. This might be because of the linear relation between North America Sales and Global Sales. The next highest correlation is model 2. This might be because there are different independent variables like Year and Genre. The lowest correlation is model 3. This might be because of the complexity of the formula that is somewhat non-linear. As for the MSE values, they were the opposite of the correlation. The lowest was model 1 and highest was model 3.