DAS Group Project 2

Group 7

1 Introduction

You can add options to executable code like this

```
film_id    year  length  budget   votes   genre  rating
      0       0      92       0       0       0       0
```

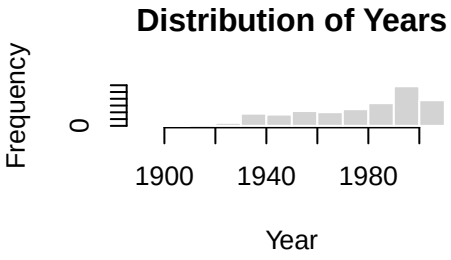
2 EDA

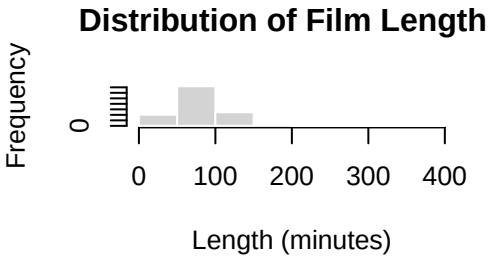
```
Rows: 2,387
Columns: 8
$ film_id <int> 39891, 33810, 20282, 33131, 50633, 37020, 55337, 28037, 13291,~
$ year    <int> 2003, 2004, 1941, 1959, 1917, 1934, 2003, 1988, 1981, 1935, 19~
$ length  <int> 75, 120, 78, 106, 70, 64, 91, 101, 78, 7, 21, 90, 99, 101, 110~
$ budget  <dbl> 10.9, 19.6, 11.7, 12.0, 14.8, 11.6, 12.6, 10.1, 14.2, 6.6, 10.~
$ votes   <int> 17, 21, 14, 14, 9, 8, 182, 274, 61, 10, 5, 8, 349, 24, 20168, ~
$ genre   <chr> "Action", "Documentary", "Action", "Drama", "Drama", "Drama", ~
$ rating  <dbl> 4.4, 7.3, 2.7, 4.9, 5.6, 4.7, 4.4, 4.3, 4.3, 8.8, 7.3, 8.3, 7.~
$ above_7 <dbl> 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 1,~
```

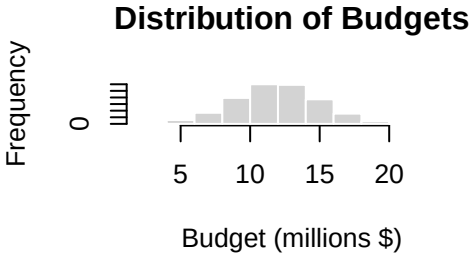
```
    film_id           year          length           budget     
 Min.   :   33   Min.   :1894   Min.   :  1.00   Min.   : 2.10  
 1st Qu.:14799   1st Qu.:1958   1st Qu.: 74.00   1st Qu.:10.00  
 Median :30259   Median :1984   Median : 90.00   Median :12.00  
 Mean   :29942   Mean   :1977   Mean   : 81.75   Mean   :11.95  
 3rd Qu.:44670   3rd Qu.:1998   3rd Qu.:100.00   3rd Qu.:13.90  
 Max.   :58780   Max.   :2005   Max.   :399.00   Max.   :23.70  
     votes           genre               rating         above_7      
 Min.   :     5   Length:2387        Min.   :0.700   Min.   :0.0000  
```

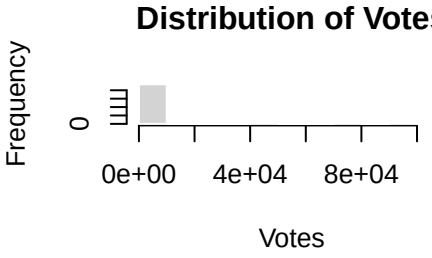
```
 1st Qu.:    12   Class :character   1st Qu.:3.700   1st Qu.:0.0000
 Median :    32   Mode  :character   Median :4.700   Median :0.0000
 Mean   :   659                      Mean   :5.414   Mean   :0.3523
 3rd Qu.:   118                      3rd Qu.:7.800   3rd Qu.:1.0000
 Max.   :103854                      Max.   :9.200   Max.   :1.0000

                          length      budget     votes
Proportion of Outliers 0.1805614 0.004608295 0.1625471

                       length_log      budget  votes_log
Proportion of Outliers  0.1818182 0.004608295 0.03812317

$length
  [1]   7  21   2 153   4   4  30   7   5  10  22   6   7  14   7  15   8   9
 [19]  25  18   8  21 147  17  19 141 170  10   4 146  23  10  12 154 141   6
 [37]  11   8 170 399   8   3  24 156  18  12   7  15  30   7   8  17   7  15
 [55]   7   7  11  17   7 185   7  17   6  18   1   7  15  19  28   1   8 218
 [73]  20  30  17  10  21   3  15 187   8 235  17   6   9  30  17  15   9  10
 [91]  10  13  10   7 311   4  24   8   8  34  20  12   7   5   7  14   7   7
[109]   7  20  27   7   1   9   7   7   3 242  31  30  13  10   8   7   9  17
[127]   6   6  16   5   9   7  13   3   5  13  13   6  19  16  20   7   7   8
[145]   1   8   7   6  19 192 269   6   8  18  19   7   6  29   7  15  32  25
[163]  11  14   7   7  17   6   7  18 155   7   6  10 141   2 160   8   6  33
[181]  30  30  10   7   1   3   7   7  17 145   7   6   7   5  10   7  27   7
[199]  13   8   9   6   8  29  11  10  10 155   3  13  13 142  15   6  15   8
[217] 168   6   3  17   7  10   7   6  20   6  13 210  28 141 140   9  27  15
[235]   6  22 149 181   5  24   7   3   7 152  14   7   7  28  11 179  12   7
[253]   3  30   7  10   7  17   7   5   7  16  30 170  13   3 200  29  10  12
[271]  20   6  20  15  20 160   9   4 175  12  27   4   7   8  20 185  29   7
[289]  13   7   6 178   4  16   8  25 145  15   6   5   8  18   5 185  12  20
[307]  21  10  18  34 188   9   6   7  12  26 152 155  13 156   6   8 240  19
[325]   6   9   8  14  33   7  26   6  27  14   7   6   9 180   2 161   7   9
[343]   9 140 169 142   4  20  14  15   7   7  16   9  25  17 173 140   1  19
[361]  15  29 147   5   5   5   8  12   9  10  10  11   5 170 180   3  17  14
[379]  16  12  30  10  20  10  14   7  10  11   9   2 231  13 155  10   8   2
[397]   9 320   6  20   5   7  11  14   5   3  11   6  28  27   8  11  11 180
[415] 165  26  14   5   9  27   1 157   1   7 145 175  17  15  30   8  25

$budget
 [1]  2.1 22.1 22.1  2.6  4.1 20.0 23.1 22.4  2.6 23.7 20.9

$votes
```

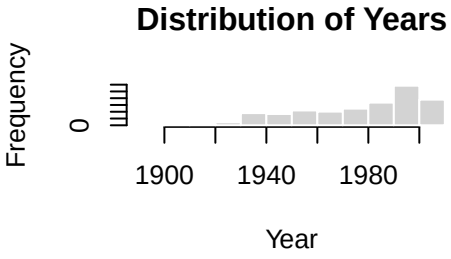
[1]	349	20168	326	642	462	1113	507	2268	528	11127
[11]	22214	779	780	1098	1813	1521	575	815	470	987
[21]	862	381	5509	630	1258	808	723	649	2046	307
[31]	18169	1234	7184	1475	312	5008	5605	1737	1771	585
[41]	4389	20966	640	305	1596	3468	5128	986	849	2904
[51]	1222	590	906	350	2541	5440	811	4050	563	323
[61]	1430	385	342	362	319	7728	648	344	304	2505
[71]	2542	307	969	1863	4235	3656	475	1218	5022	1274
[81]	810	6938	315	5846	407	529	1243	2572	310	4231
[91]	5152	2111	13765	431	405	10065	3651	8340	340	2928
[101]	779	3533	2102	1040	19100	1087	602	2697	1612	325
[111]	731	522	2023	3423	2283	1506	370	5652	4027	668
[121]	1084	462	399	1350	1489	287	458	5774	400	338
[131]	1062	300	662	446	369	579	2379	2216	15565	9196
[141]	2873	14575	1047	2004	455	908	332	298	8371	280
[151]	291	406	1037	2755	416	1601	890	330	5640	339
[161]	6892	6058	2495	51961	1966	282	329	1884	2068	33188
[171]	590	598	980	999	466	9592	1024	9324	8738	1120
[181]	2723	11887	593	459	1742	18277	3530	354	14997	592
[191]	2269	793	7916	1452	308	103854	642	444	577	21462
[201]	466	836	4954	1860	900	2065	998	597	8526	446
[211]	418	565	1364	459	5893	917	1585	322	69600	15539
[221]	12923	2633	959	449	2844	4231	285	1172	295	654
[231]	1010	751	333	377	2291	2492	478	343	2566	619
[241]	1728	411	2336	307	299	1355	1640	400	372	297
[251]	461	4339	1397	7593	743	544	690	5066	1407	755
[261]	3735	322	787	764	1803	1103	10797	360	548	322
[271]	7279	1106	1322	406	2942	4190	9155	1280	627	352
[281]	280	2458	513	2541	391	411	920	316	343	7933
[291]	2778	292	799	2221	283	401	5020	421	384	707
[301]	1373	499	497	288	951	352	2670	7123	325	319
[311]	1718	11483	281	817	4316	13989	3694	449	316	462
[321]	9038	100267	366	334	581	464	2662	5039	1165	1564
[331]	1065	3288	20690	368	407	2019	2250	1252	877	970
[341]	3563	496	5811	288	1567	1509	1211	4294	352	396
[351]	4590	496	7247	603	2612	757	17521	582	529	385
[361]	1757	616	497	448	84488	735	1323	1306	301	618
[371]	1195	1775	391	3794	7771	297	8830	1327	1257	35648
[381]	1112	733	5044	306	17166	773	1386	4646		

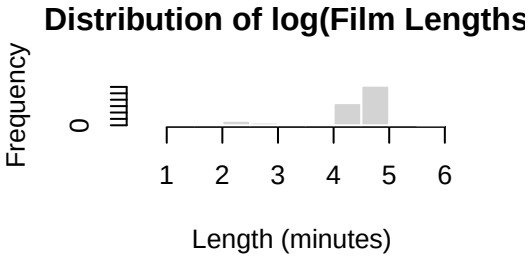

Distribution of Years
Frequency
0
1900
1940
1980
Year

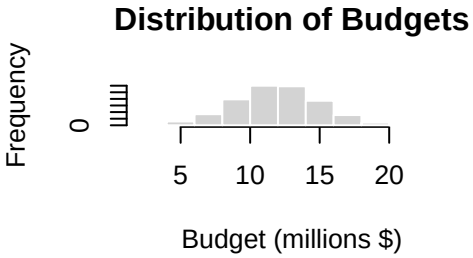

Distribution of Film Lengths
Frequency
0
0
100
200
300
400
Length (minutes)

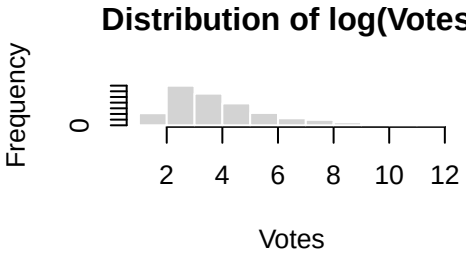

Distribution of Budgets
Frequency
0
5
10
15
20
Budget (millions $)

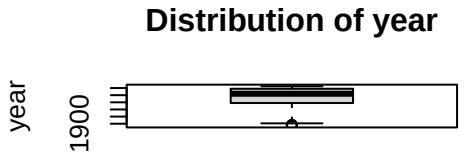

Distribution of Votes
Frequency
0
0e+00
4e+04
8e+04
Votes

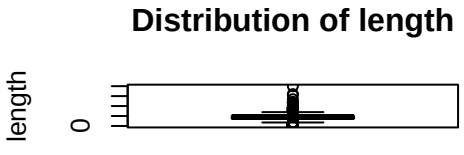

Distribution of Years
Frequency
0
1900
1940
1980
Year

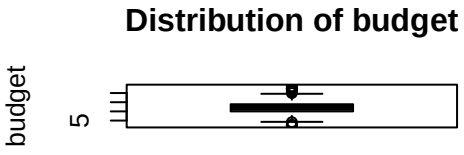

Distribution of log(Film Lengths
Frequency
0
1
2
3
4
5
6
Length (minutes)

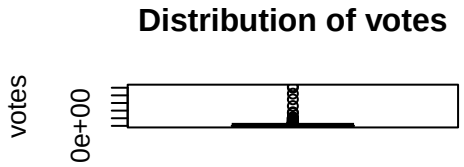

Distribution of Budgets
Frequency
0
5
10
15
20
Budget (millions $)

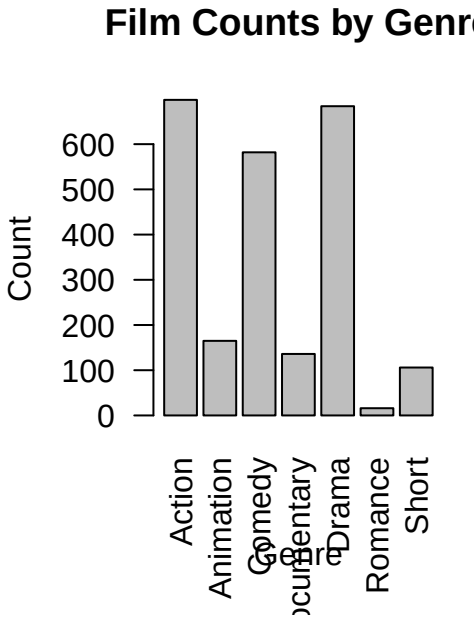

Distribution of log(Votes)
Frequency
0
2
4
6
8
10
12
Votes

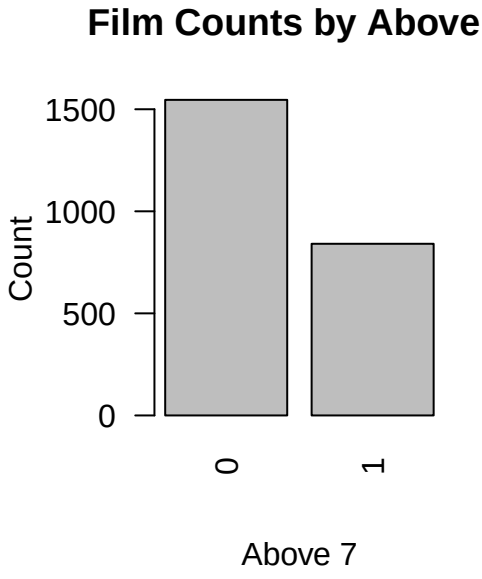

Distribution of year
year
1900

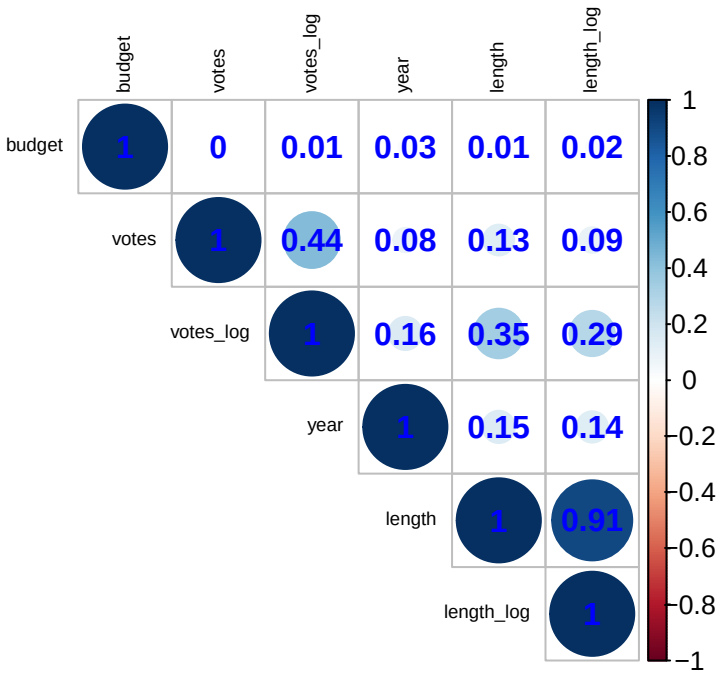

Distribution of length
length
0

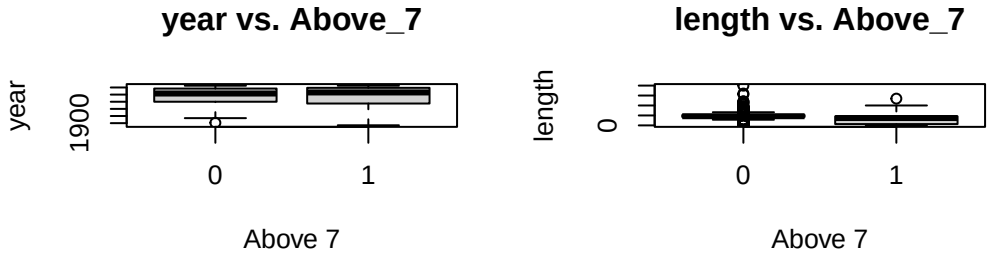

Distribution of budget
budget
5


Distribution of votes
votes
0e+00

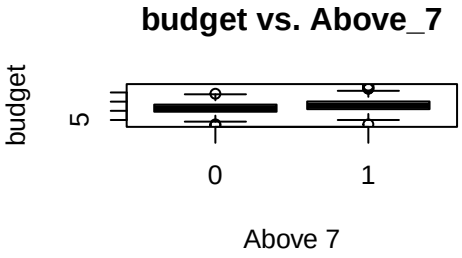

Film Counts by Genre
Count
0
100
200
300
400
500
600
Action
Animation
Comedy
Documentary
Drama
Romance
Short
Genre

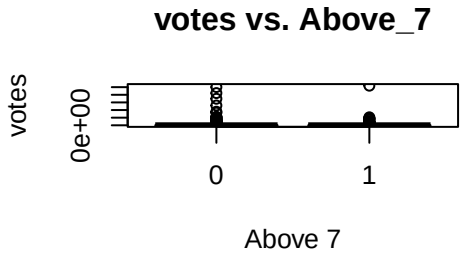

Film Counts by Above 7
Count
0
500
1000
1500
0
1
Above 7

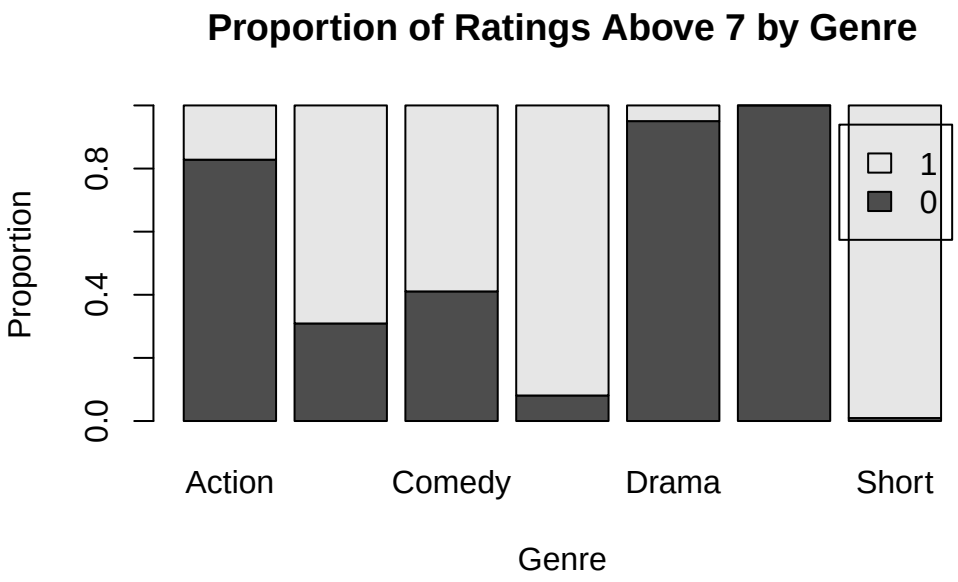

budget
votes
votes_log
year
length
length_log
1
0
0.01
0.03
0.01
0.02
0.44
0.08
0.13
0.09
0.16
0.35
0.29
0.15
0.14
0.91
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1

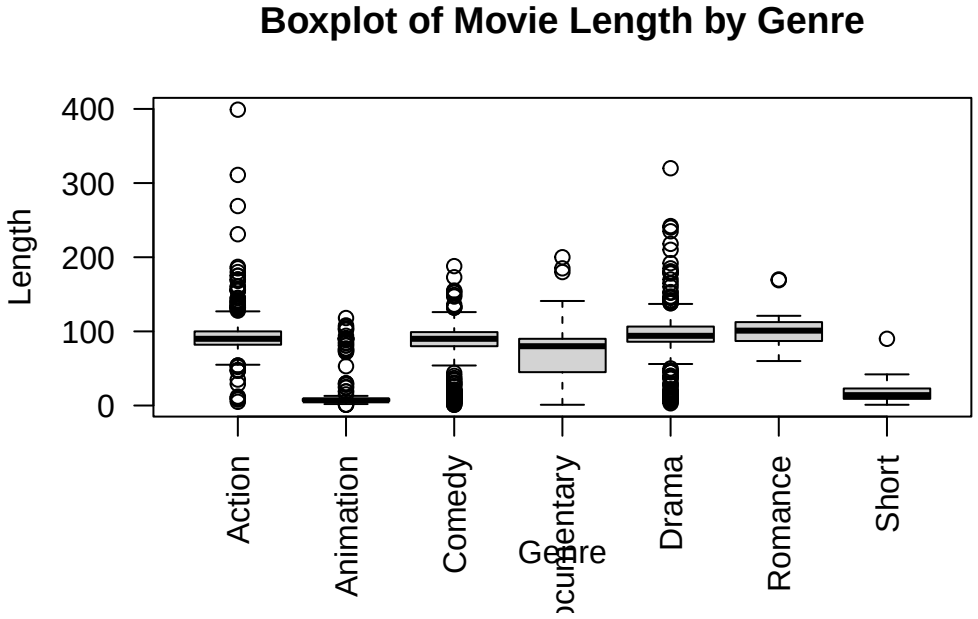

year vs. Above_7
year
1900
0
1
Above 7

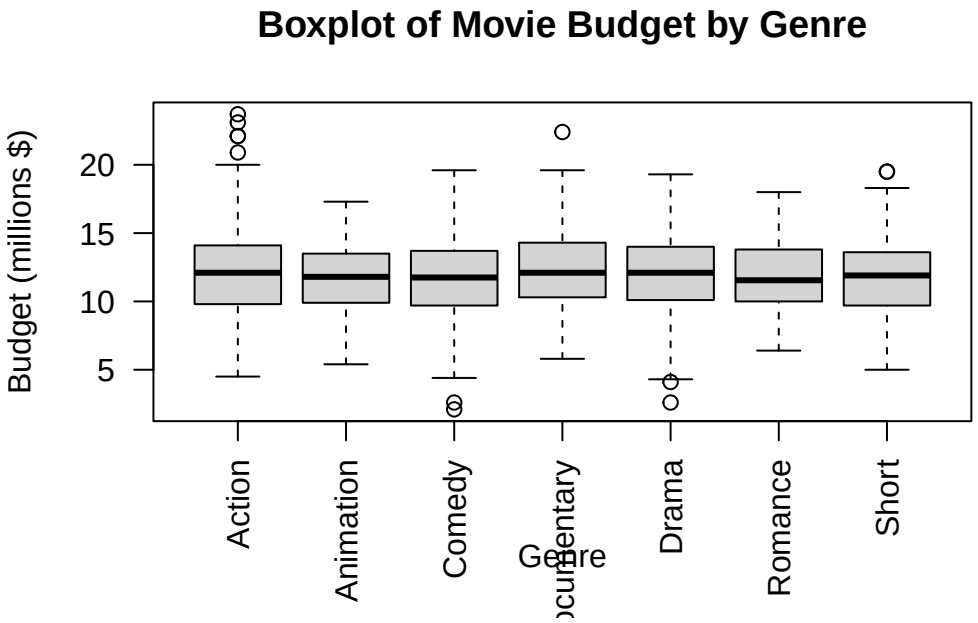
length vs. Above_7
length
0
0
1
Above 7

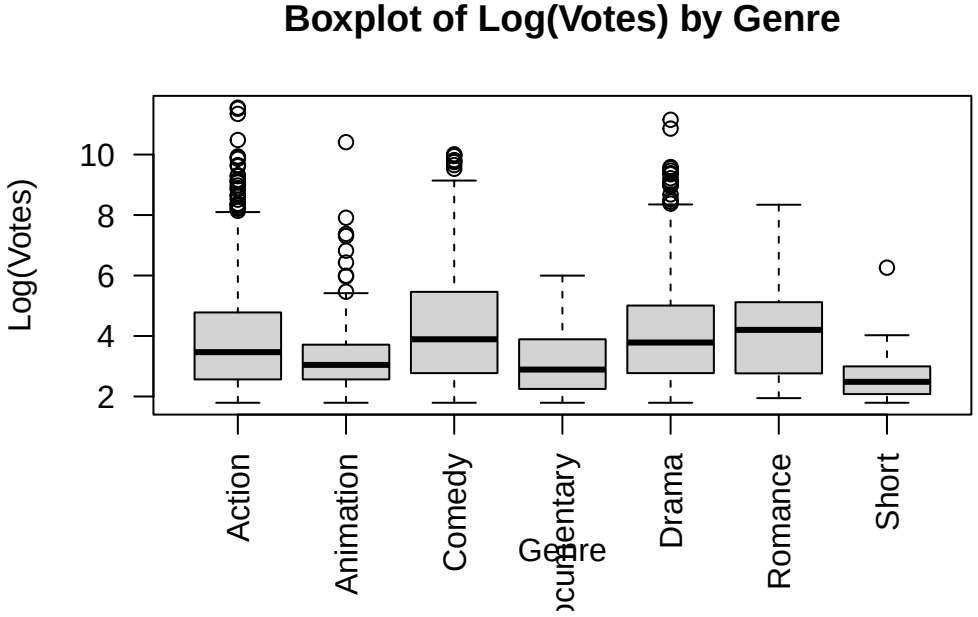

budget vs. Above_7
budget
5
0
1
Above 7


votes vs. Above_7
votes
0e+00
0
1
Above 7


Proportion of Ratings Above 7 by Genre
Proportion
0.0
0.4
0.8
1
0
Action
Comedy
Drama
Short
Genre


Boxplot of Movie Length by Genre
Length
400
300
200
100
0
Action
Animation
Comedy
Drama
Romance
Short
Genre


Boxplot of Movie Budget by Genre
Budget (millions $)
5
10
15
20
Action
Animation
Comedy
Documentary
Drama
Romance
Short
Genre


Boxplot of Log(Votes) by Genre
Log(Votes)
2
4
6
8
10
Action
Animation
Comedy
Documentary
Drama
Romance
Short
Genre

3 Formal Analysis

```
                            Accuracy Sensitivity Specificity    AUC      BIC
Full Model                    0.8659      0.8624      0.8734 0.9350 992.8782
Full model with Log           0.8869      0.8912      0.8777 0.9451 956.8562
Model without Year            0.8855      0.8871      0.8821 0.9457 950.4586
Model without Year and Votes  0.8883      0.8871      0.8908 0.9450 950.8248
```

```
Call:
glm(formula = above_7 ~ length_log + budget + votes_log + genre,
    family = binomial, data = train_data)

Coefficients:
                   Estimate Std. Error z value Pr(>|z|)
(Intercept)         5.08479    1.16889   4.350 1.36e-05 ***
length_log         -3.14990    0.28168 -11.183  < 2e-16 ***
budget              0.52035    0.03921  13.272  < 2e-16 ***
votes_log           0.13636    0.04896   2.785  0.00535 **
genreAnimation     -2.82857    0.66752  -4.237 2.26e-05 ***
genreComedy         2.60473    0.21686  12.011  < 2e-16 ***
genreDocumentary    4.72592    0.44982  10.506  < 2e-16 ***
genreDrama         -2.29767    0.34875  -6.588 4.45e-11 ***
genreRomance      -16.87365 1494.07345  -0.011  0.99099
genreShort         17.31928  566.97080   0.031  0.97563
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 2195.45  on 1670  degrees of freedom
Residual deviance:  876.25  on 1661  degrees of freedom
AIC: 896.25

Number of Fisher Scoring iterations: 17
```

From the summary of the Generalized Linear Model (GLM) analysis, we can draw the following findings and conclusions:

1. **Length of Movies (length_log)**: There is a significant negative relationship between the log-transformed length of movies and their likelihood of being rated above 7. This suggests that longer movies are less likely to receive high ratings, potentially indicating

viewer preferences for shorter films or perhaps an association with certain film types or genres that are longer but less popular.

2. **Budget (budget)**: The budget of a movie shows a significant positive association with the likelihood of being rated above 7. This might imply that higher-budget movies, which can afford better production quality, actors, and marketing, are more likely to be well-received by audiences.

3. **Votes (votes_log)**: The log-transformed number of votes is positively correlated with a movie being rated above 7. This indicates that movies that engage more viewers to vote are likely to have higher ratings. It could reflect higher viewer engagement or broader appreciation.

4. **Genre Differences**:

   - **Animation**: Compared to the baseline genre, animation films are significantly less likely to be rated above 7. This could reflect specific audience preferences or the standards by which animation is judged.
   - **Comedy and Documentary**: These genres show a significant positive association with higher ratings, suggesting they are generally well-received or cater to specific audience segments that rate them favorably.
   - **Drama**: Dramas are less likely to score above 7, indicating perhaps a critical standard or audience expectation that is harder to meet.
   - **Romance and Short**: These genres do not show significant effects, possibly due to a smaller sample size, less variation in ratings, or other model limitations.

5. **Model Performance**:

   - The model has demonstrated high accuracy (88.55%), indicating a strong ability to classify films correctly as having ratings above or below 7. This level of accuracy suggests that the variables chosen, including movie length, budget, number of votes, and genre, are significant indicators of a film's rating performance.
   - Sensitivity (88.71%) and specificity (88.21%) values are both high, showing that the model is proficient not only in identifying true positives (correctly predicting films rated above 7) but also in recognizing true negatives (correctly predicting films not rated above 7). This balance is crucial for ensuring the model's reliability across different film scenarios.
   - The AUC (Area Under the Curve) of 0.9457 signifies excellent model discrimination ability, meaning it has a high capability in distinguishing between films rated above 7 and those that are not.

6. **Model Fit and Data Quality**:

   - The substantial gap between null and residual deviance indicates that the model fits the data well beyond a mere intercept-only model.

- However, the BIC of 950.4586, while providing a measure of model quality, suggests room for improvement or simplification, considering it penalizes complex models. The relatively high BIC compared to the model's predictive success (e.g., AUC) indicates that while the model is effective, it could be made more efficient or tailored.

7. **Practical Implications**:

   - Filmmakers and producers can leverage insights from this model, particularly around film length, budget, and targeted genre, to optimize their projects for higher audience ratings.
   - The significant predictors offer a blueprint for aligning movie projects with characteristics correlated with success, though considerations of artistic intent and narrative integrity remain paramount.

8. **Further Research and Limitations**:

   - The disparities observed in genre impacts necessitate deeper investigation, potentially requiring broader datasets to ensure nuanced understandings.
   - While the GLM offers robust insights, it's essential to remember that correlation does not guarantee causation; additional factors not included in the model may influence movie ratings.
   - Future research should address the data limitations, particularly for underrepresented genres, and explore external factors beyond the scope of the current model to provide a more comprehensive understanding.

Conclusions: - The results suggest that specific attributes associated with movies, such as their duration, budget, and genre, significantly influence their ratings. - However, the effect of genre on movie ratings can vary widely, indicating that audience preferences and perceptions can differ markedly between different types of films. - The significant predictors in this model can be leveraged by filmmakers and producers to align their projects more closely with attributes associated with higher-rated films. However, it's essential to approach these findings with a nuanced understanding that correlation does not imply causation, and other unmeasured factors could also be influencing movie ratings. - The anomalies observed for certain genres highlight the need for further investigation, potentially with a larger or more balanced dataset, to understand these relationships better.

Overall, while log transformations and GLM have provided meaningful insights, it's crucial to consider these findings within the broader context of movie production and audience reception, and where possible, to validate these conclusions with additional data or through experimental approaches.