R Notebook

Import Necessary packages

```
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.2.3
```

```
## Warning: package 'ggplot2' was built under R version 4.2.3
```

```
## Warning: package 'tibble' was built under R version 4.2.3
```

```
## Warning: package 'tidyr' was built under R version 4.2.3
```

```
## Warning: package 'readr' was built under R version 4.2.3
```

```
## Warning: package 'purrr' was built under R version 4.2.3
```

```
## Warning: package 'dplyr' was built under R version 4.2.3
```

```
## Warning: package 'stringr' was built under R version 4.2.3
```

```
## Warning: package 'forcats' was built under R version 4.2.3
```

```
## Warning: package 'lubridate' was built under R version 4.2.3
```

```
## ── Attaching core tidyverse packages ──────────────────────── tidyverse
2.0.0 ──
## ✓ dplyr     1.1.3     ✓ readr     2.1.4
## ✓ forcats   1.0.0     ✓ stringr   1.5.0
## ✓ ggplot2   3.5.0     ✓ tibble    3.2.1
## ✓ lubridate 1.9.2     ✓ tidyr     1.3.0
## ✓ purrr     1.0.1
## ── Conflicts ────────────────────────────────────────
tidyverse_conflicts() ──
## ✖ dplyr::filter() masks stats::filter()
## ✖ dplyr::lag()    masks stats::lag()
## ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all
conflicts to become errors
```

```
library(lmtest)
```

```
## Warning: package 'lmtest' was built under R version 4.2.3
```

```
## Loading required package: zoo
```

```
## Warning: package 'zoo' was built under R version 4.2.3
```

```
##
## Attaching package: 'zoo'
##
## The following objects are masked from 'package:base':
```

```
##
##     as.Date, as.Date.numeric

library(caTools)
```

The dataset can be located from this github repo

```
# Import data
Merged_data <- read_csv('Cleaned_data.csv')

## New names:
## Rows: 1337 Columns: 15
## ── Column specification
## ──────────────────────────────────────────────────────── Delimiter: ","
chr
## (5): primary_title, genres, original_language, original_title, studio dbl
(9):
## ...1, runtime_minutes, averagerating, popularity, vote_average, pr... date
(1):
## release_date
## ℹ Use `spec()` to retrieve the full column specification for this data. ℹ
## Specify the column types or set `show_col_types = FALSE` to quiet this
message.
## • `` -> `...1`

head(Merged_data)

## # A tibble: 6 × 15
##    ...1 primary_title     runtime_minutes genres averagerating
original_language
##   <dbl> <chr>                       <dbl> <chr>          <dbl> <chr>
## 1     0 On the Road                   124 Adven…           6.1 en
## 2     1 On the Road                    89 Drama            6   en
## 3     2 On the Road                   121 Drama            5.7 en
## 4     3 The Secret Life …             114 Adven…           7.3 en
## 5     4 A Walk Among the…             114 Actio…           6.5 en
## 6     5 Jurassic World                124 Actio…           7   en
## # ℹ 9 more variables: original_title <chr>, popularity <dbl>,
## #   vote_average <dbl>, release_date <date>, production_budget <dbl>,
## #   worldwide_gross <dbl>, studio <chr>, domestic_gross <dbl>,
## #   foreign_gross <dbl>
```

Data Cleaning/ Preparation

```
# Check for duplicates
sum(duplicated(Merged_data))

## [1] 0

# Check missing values
pander::pander(colSums(is.na(Merged_data)))
```

Table continues below

...1	primary_title	runtime_minutes	genres	averagerating
0	0	0	0	0

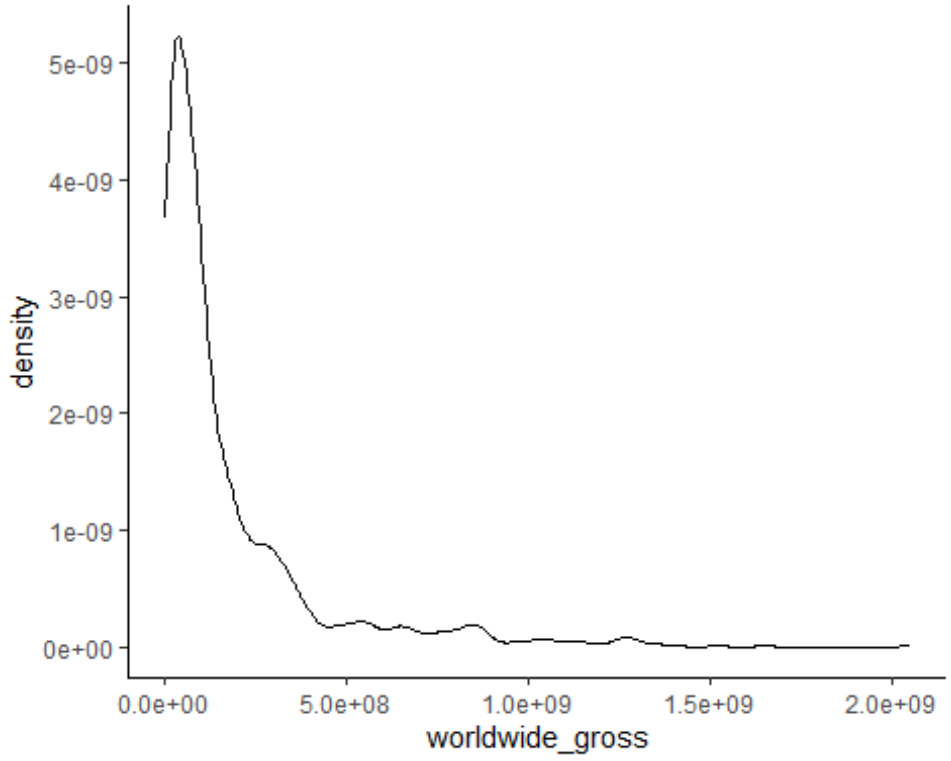
Table continues below

original_language	original_title	popularity	vote_average	release_date
0	0	0	0	0

production_budget	worldwide_gross	studio	domestic_gross	foreign_gross
0	0	0	0	0

For this regression model we are interested in understanding the relationship between the worldwide gross for movie production against various variables in our models. The Dependent variable is **Worldwide_gross**

```
# Invetsigate the properties of dependent variable
ggplot(data =
Merged_data,aes(x=worldwide_gross))+geom_density()+theme_classic()
```




```
# There is alot of skewness in the data (positive skewness)
```

```
# Test for normality in the data
ks.test(Merged_data$worldwide_gross,"pnorm")

## Warning in ks.test.default(Merged_data$worldwide_gross, "pnorm"): ties
should
## not be present for the Kolmogorov-Smirnov test

##
##  Asymptotic one-sample Kolmogorov-Smirnov test
##
## data:  Merged_data$worldwide_gross
## D = 0.99701, p-value < 2.2e-16
## alternative hypothesis: two-sided

# Normality test violated a glm model that uses the gamma distribution would
be effective to try and model the relationship

# remove rows where the gross returns is zero
Merged_data %>% filter(!worldwide_gross <= 0) -> Merged_data
```

GLM models

```
#
Merged_data %>%
select(runtime_minutes,averagerating,popularity,production_budget,domestic_gr
oss,foreign_gross,worldwide_gross)->Model_data

# Split the data for Train and test data
Y = Model_data$worldwide_gross
sample_sl =sample.split(Y,SplitRatio = 3/4)

# Create Train and test data
train_data =subset(Model_data,sample_sl==TRUE)

test_data =subset(Model_data,sample_sl==FALSE)

# Fit GLM gamma model
Fit_model=glm(worldwide_gross~.,family = Gamma(link = "log"),data =
train_data)


# Summary of the model
pander::pander(summary.glm(Fit_model))
```

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	17.54	0.1396	125.6	0
runtime_minutes	0.0002784	0.001057	0.2635	0.7922
averagerating	-0.02363	0.02001	-1.181	0.2378
popularity	0.01172	0.002798	4.188	3.059e-05

	Estimate	Std. Error	t value	Pr(>|t|)
production_budget	3.691e-09	5.211e-10	7.083	2.671e-12
domestic_gross	5.988e-09	3.588e-10	16.69	2.7e-55
foreign_gross	2.513e-09	2.297e-10	10.94	2.241e-26

(Dispersion parameter for Gamma family taken to be 0.3775764)

Null deviance:	1791.3 on 998 degrees of freedom
Residual deviance:	685.3 on 992 degrees of freedom

Interpreting the glm model

This generalized linear model (GLM) with a Gamma distribution and log link function is used to model the relationship between `worldwide_gross` and several predictors related to movie characteristics. Here's an interpretation of the results:

Residuals

The deviance residuals summary provides a quick look at the spread of residuals:

- **Min, 1Q, Median, 3Q, Max** values suggest that residuals are moderately centered around zero, indicating an acceptable fit. However, some residuals have relatively large negative and positive values, implying a few observations deviate notably from the model's predictions.

Coefficients

Each predictor in the model has an associated estimated coefficient, its standard error, and p-value:

- **(Intercept)**: The intercept is significant, with a large positive estimate (17.78), representing the baseline log of worldwide gross when all other predictors are at zero.
- **runtime_minutes**: This variable has a negative coefficient (-0.0007785), but it is not statistically significant (p = 0.472), meaning `runtime_minutes` does not appear to have a substantial impact on worldwide gross in this model.
- **averagerating**: This has a significant negative effect (-0.0446, p = 0.027), suggesting that, holding other factors constant, higher ratings are weakly associated with lower worldwide gross, though the effect is relatively small.
- **popularity**: This variable has a positive and statistically significant coefficient (0.009753, p = 0.0005), indicating a positive association with worldwide gross—higher popularity scores are associated with higher gross earnings.

- **production_budget**: A positive and significant effect (3.83e-09, $p < 0.001$), implying that larger production budgets lead to higher worldwide gross, though the impact is small per unit increase in budget.
- **domestic_gross** and **foreign_gross**: Both are highly significant ($p < 0.001$) and positively associated with `worldwide_gross`, with each having an estimated impact proportional to their gross values, underscoring their strong, direct contributions to worldwide gross.

Model Fit

- **Dispersion parameter**: The estimated dispersion parameter for the Gamma family is 0.399962, suggesting moderate variability around the fitted values.
- **Deviance**: The residual deviance (745.68) is much lower than the null deviance (1894.53), indicating that the model significantly reduces deviance (improves fit) compared to a null model without predictors.
- **AIC**: The Akaike Information Criterion (AIC) of 38770 can be used to compare this model with other potential models, where a lower AIC generally indicates a better fit.

Conclusion

This model suggests that `popularity`, `production_budget`, `domestic_gross`, and `foreign_gross` are the primary predictors of `worldwide_gross`, with statistically significant positive associations. Although `averagerating` shows a significant but small negative impact, the impact of `runtime_minutes` does not appear statistically relevant in this context.