Appendix

2022-12-05

Appendix A: Data Cleaning

```
library(readr)
library(tidyverse)
library(skimr)
library(dplyr)
library(gt)
library(scales)
library(broom)
```

```
disney <- read_csv(
  paste('https://raw.githubusercontent.com/stinalindaa/',
  'disneymovies/main/disney_movies_total_gross.csv', sep = ""))

skim_without_charts(disney)
```

Table 1: Data summary

Name	disney
Number of rows	579
Number of columns	7
Column type frequency:	
character	6
numeric	1
Group variables	None

Variable type: character

skim_variable	n_missing	complete_rate	min	max	empty	n_unique	whitespace
movie_title	0	1.00	2	40	0	573	0
release_date	0	1.00	11	12	0	553	0
genre	17	0.97	5	19	0	12	0
MPAA_rating	56	0.90	1	9	0	5	0
total_gross	0	1.00	2	12	0	576	0
inflation_adjusted_gross	0	1.00	2	14	0	576	0

Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100
index	0	1	289	167.29	0	144.5	289	433.5	578

Clean up variables and drop NA's.

```
disney2 <- disney |>
  mutate(genre = factor(genre),
         rating = factor(MPAA_rating, levels = c("G", "PG", "PG-13", "R")),
         gross = parse_number(inflation_adjusted_gross),
         release_date = as.Date(release_date, format = "%b %d, %Y"),
         release_year = as.numeric(format(release_date, "%Y")),
         gross_million = round(gross/1000000, digits = 1),
         gross_K = round(gross/1000, digits =3)) |>
  select(-total_gross, -inflation_adjusted_gross, -MPAA_rating ) |>
  drop_na() |>
  filter(release_year >= 1992)
head(disney2)
```

```
## # A tibble: 6 x 9
##   index movie_title       release_~1 genre rating  gross relea~2 gross~3 gross_K
##   <dbl> <chr>             <date>     <fct> <fct>   <dbl>   <dbl>   <dbl>   <dbl>
## 1   116 The Hand That Ro~ 1992-01-10 Thri~ R      1.79e8    1992   179.  178831.
## 2   117 Medicine Man      1992-02-07 Drama PG-13  9.13e7    1992    91.3  91304.
## 3   118 Blame it on the ~ 1992-03-06 Come~ PG-13  5.87e6    1992     5.9   5873.
## 4   119 Noises Off...     1992-03-20 Come~ PG-13  4.63e6    1992     4.6   4632.
## 5   120 Straight Talk     1992-04-03 Come~ PG     4.31e7    1992    43.1  43068.
## 6   123 Encino Man        1992-05-22 Come~ PG     8.14e7    1992    81.4  81369.
## # ... with abbreviated variable names 1: release_date, 2: release_year,
## #   3: gross_million
```

```
revenue <- read_csv(
  paste('https://raw.githubusercontent.com/stinalindaa/',
        'disneymovies/main/disney_revenue_1991-2016.csv', sep = ""))

skim_without_charts(revenue)
```

Table 4: Data summary

Name	revenue
Number of rows	26
Number of columns	8
Column type frequency:	
numeric	8
Group variables	None

Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100
index	0	1.00	12.50	7.65	0	6.25	12.5	18.75	25
Year	0	1.00	2003.50	7.65	1991	1997.25	2003.5	2009.75	2016

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100
Studio Entertainment[NI 1]	1	0.96	6445.04	1570.28	2593	5994.00	6701.0	7364.00	9441
Disney Consumer Products[NI 2]	2	0.92	2591.05	877.11	724	2182.25	2475.5	3085.00	4499
Disney Interactive[NI 3][Rev 1]	14	0.46	713.67	386.48	174	341.00	740.0	1002.50	1299
Walt Disney Parks and Resorts	0	1.00	8512.62	4253.95	2794	5143.50	7276.5	11318.25	16974
Disney Media Networks	3	0.88	12877.70	6736.88	359	8540.50	13207.0	17938.00	23689
Total	0	1.00	29459.69	13846.67	6111	22598.75	28906.5	38008.00	55632

```
movies.revenue <- disney2 |>
  mutate(Year = release_year) |>
  inner_join(revenue, by = c("Year" = "Year"))
head(movies.revenue)
```

```
## # A tibble: 6 x 17
##   index.x movie_t~1 release_~2 genre rating  gross relea~3 gross~4 gross_K  Year
##     <dbl> <chr>     <date>     <fct> <fct>   <dbl>   <dbl>   <dbl>   <dbl> <dbl>
## 1     116 The Hand~ 1992-01-10 Thri~ R      1.79e8    1992   179.  178831.  1992
## 2     117 Medicine~ 1992-02-07 Drama PG-13  9.13e7    1992    91.3  91304.  1992
## 3     118 Blame it~ 1992-03-06 Come~ PG-13  5.87e6    1992     5.9   5873.  1992
## 4     119 Noises O~ 1992-03-20 Come~ PG-13  4.63e6    1992     4.6   4632.  1992
## 5     120 Straight~ 1992-04-03 Come~ PG     4.31e7    1992    43.1  43068.  1992
## 6     123 Encino M~ 1992-05-22 Come~ PG     8.14e7    1992    81.4  81369.  1992
## # ... with 7 more variables: index.y <dbl>, `Studio Entertainment[NI 1]` <dbl>,
## #   `Disney Consumer Products[NI 2]` <dbl>,
## #   `Disney Interactive[NI 3][Rev 1]` <dbl>,
## #   `Walt Disney Parks and Resorts` <dbl>, `Disney Media Networks` <dbl>,
## #   Total <dbl>, and abbreviated variable names 1: movie_title,
## #   2: release_date, 3: release_year, 4: gross_million
```

```
yearly.summary <- movies.revenue |>
  group_by(Year, Total) |>
  summarize(movie_count = n()) |>
  rename(total_revenue = Total) |>
  ungroup()
```

```
## `summarise()` has grouped output by 'Year'. You can override using the
## `.groups` argument.
```

```
head(yearly.summary)
```

```
## # A tibble: 6 x 3
##    Year total_revenue movie_count
##   <dbl>         <dbl>       <int>
## 1  1992          7502          19
## 2  1993          8529          24
## 3  1994         10414          27
## 4  1995         12525          32
## 5  1996         18739          27
## 6  1997         22473          23
```

```
movies.revenue2 <- movies.revenue |>
  mutate(action = ifelse(genre == "Action", 1, 0),
         adventure = ifelse(genre == "Adventure",1,0),
         musical = ifelse(genre == "Musical", 1, 0),
         drama = ifelse(genre == "Drama", 1, 0),
         comedy = ifelse(genre == "Comedy", 1, 0)) |>
  filter(Year >= 1992)
head(movies.revenue2)
```

```
## # A tibble: 6 x 22
##   index.x movie_t~1 release_~2 genre rating  gross relea~3 gross~4 gross_K  Year
##     <dbl> <chr>     <date>     <fct> <fct>   <dbl>   <dbl>   <dbl>   <dbl> <dbl>
## 1     116 The Hand~ 1992-01-10 Thri~ R      1.79e8    1992   179.  178831.  1992
## 2     117 Medicine~ 1992-02-07 Drama PG-13  9.13e7    1992    91.3  91304.  1992
## 3     118 Blame it~ 1992-03-06 Come~ PG-13  5.87e6    1992     5.9   5873.  1992
## 4     119 Noises O~ 1992-03-20 Come~ PG-13  4.63e6    1992     4.6   4632.  1992
## 5     120 Straight~ 1992-04-03 Come~ PG     4.31e7    1992    43.1  43068.  1992
## 6     123 Encino M~ 1992-05-22 Come~ PG     8.14e7    1992    81.4  81369.  1992
## # ... with 12 more variables: index.y <dbl>,
## #   `Studio Entertainment[NI 1]` <dbl>, `Disney Consumer Products[NI 2]` <dbl>,
## #   `Disney Interactive[NI 3][Rev 1]` <dbl>,
## #   `Walt Disney Parks and Resorts` <dbl>, `Disney Media Networks` <dbl>,
## #   Total <dbl>, action <dbl>, adventure <dbl>, musical <dbl>, drama <dbl>,
## #   comedy <dbl>, and abbreviated variable names 1: movie_title,
## #   2: release_date, 3: release_year, 4: gross_million
```

```
yearly.summary2 <- movies.revenue2 |>
  group_by(Year, Total) |>
  summarize(movie_count = n(),
            action_count = sum(action),
            adventure = sum(adventure),
            musical = sum(musical),
            drama = sum(drama),
            comedy = sum(comedy)) |>
  rename(total_revenue = Total) |>
  ungroup() |>
  select(-Year)
```

```
## `summarise()` has grouped output by 'Year'. You can override using the
## `.groups` argument.
```

```
head(yearly.summary2)
```

```
## # A tibble: 6 x 7
##   total_revenue movie_count action_count adventure musical drama comedy
##           <dbl>       <int>        <dbl>     <dbl>   <dbl> <dbl>  <dbl>
## 1          7502          19            1         1       0     4     11
## 2          8529          24            2         5       2     2      9
## 3         10414          27            3         3       0     5     13
## 4         12525          32            2         5       0    10      9
## 5         18739          27            2         5       1     7      9
## 6         22473          23            2         1       0     5     11
```

Appendix B: Exporatory Data Analysis

Disney movies total gross

```
skim_without_charts(disney2)
```

Table 6: Data summary

Name	disney2
Number of rows	449
Number of columns	9
Column type frequency:	
character	1
Date	1
factor	2
numeric	5
Group variables	None

Variable type: character

skim_variable	n_missing	complete_rate	min	max	empty	n_unique	whitespace
movie_title	0	1	2	40	0	447	0

Variable type: Date

skim_variable	n_missing	complete_rate	min	max	median	n_unique
release_date	0	1	1992-01-10	2016-12-16	2001-11-21	425

Variable type: factor

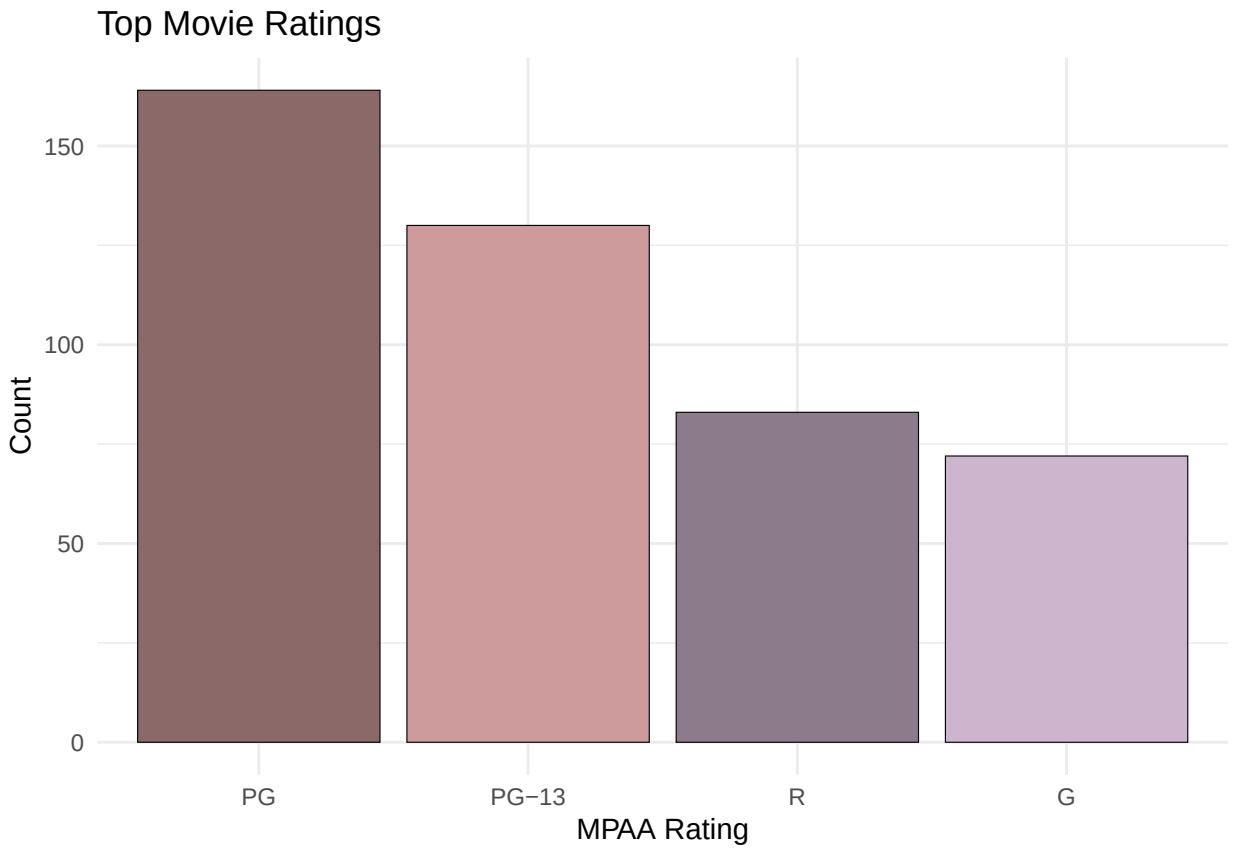
skim_variable	n_missing	complete_rate	ordered	n_unique	top_counts
genre	0	1	FALSE	12	Com: 138, Adv: 109, Dra: 89, Act: 32
rating	0	1	FALSE	4	PG: 164, PG-: 130, R: 83, G: 72

Variable type: numeric

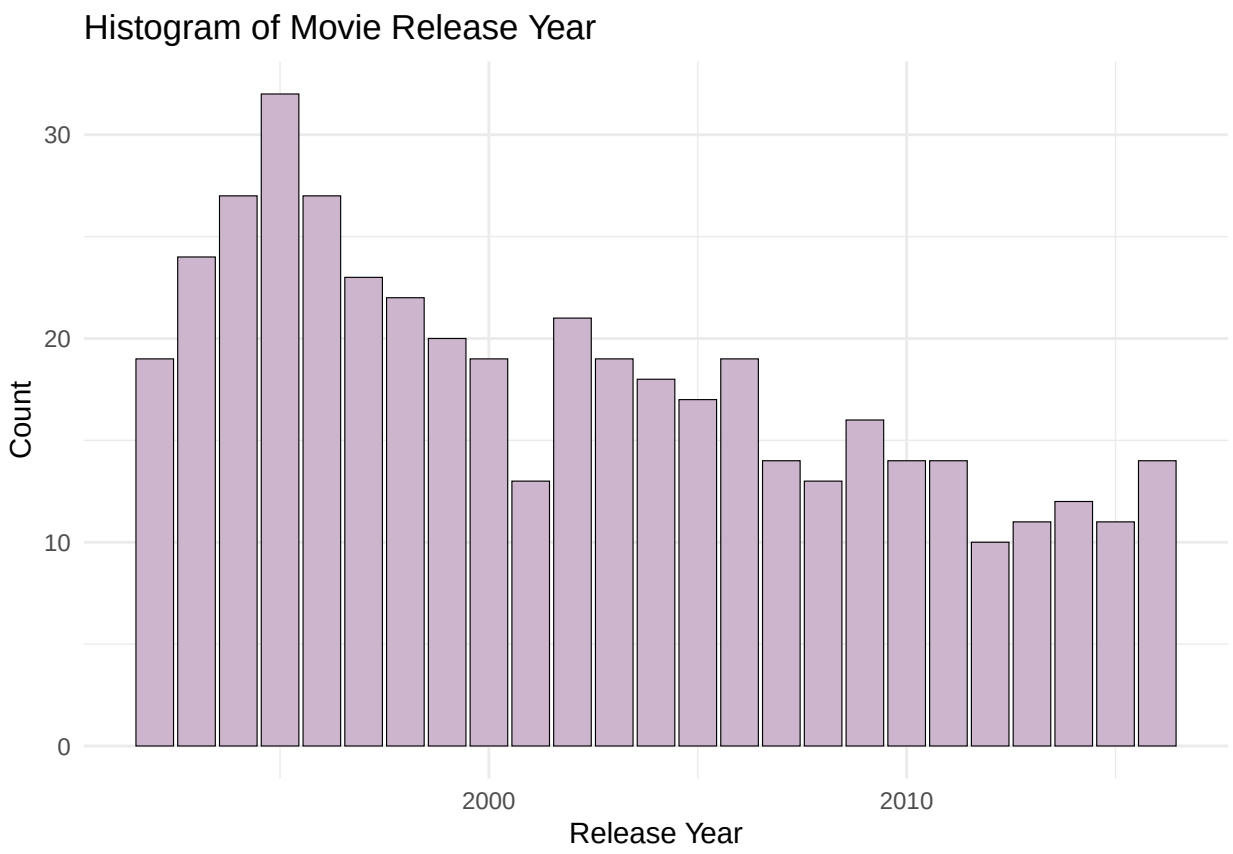
skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100
index	0	1	351.10	1.32770e+02	116.00	237.00	352.00	466.0	578.0
gross	0	1	98410523.66	1.19627e+08	2984.00	24267154.00	55961409.00	116965668.0	936662225.0
release_year	0	1	2002.14	7.03000e+01	1992.00	1996.00	2001.00	2008.0	2016.0
gross_million	0	1	98.41	1.19630e+02	0.00	24.30	56.00	117.0	936.7
gross_K	0	1	98410.52	1.19627e+05	2.98	24267.15	55961.41	116965.7	936662.2

```
colors = c("thistle3", "thistle4", "rosybrown3", "rosybrown4")
disney2 |>
  group_by(rating) |>
  summarize(n = n()) |>
  ggplot(aes(x = reorder(rating, -n), y = n)) +
  geom_col(aes(fill = reorder(rating,n)), color = "black", size = 0.2) +
  scale_fill_manual(values = colors) +
  ggtitle("Top Movie Ratings")+ labs(x = "MPAA Rating", y = "Count") +
  theme_minimal() + theme(legend.position = "none")
```

```
## Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
## i Please use `linewidth` instead.
```

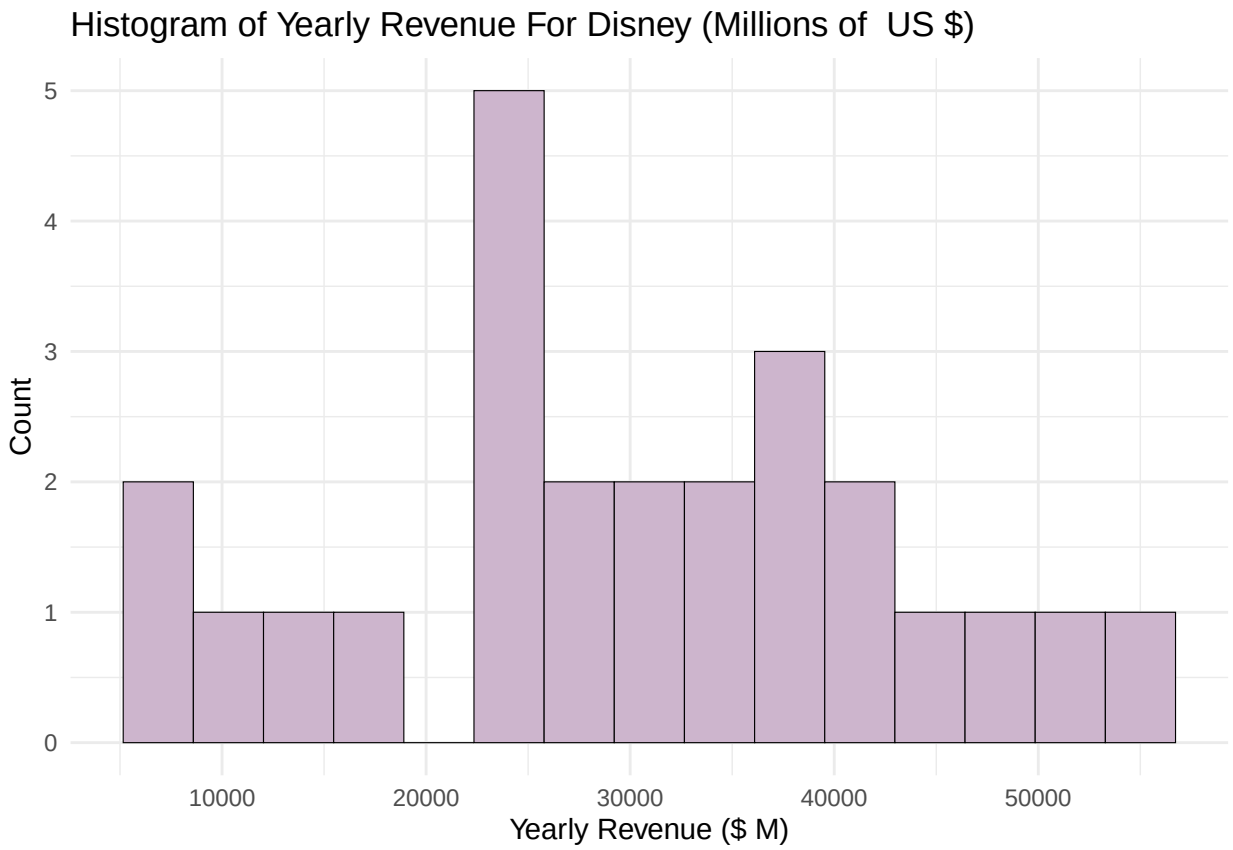



```
disney2 |>
  select(release_year) |>
  filter(release_year >= 1991) |>
  group_by(release_year) |>
  summarise(n = n()) |>
  ggplot(aes(x = release_year, y = n)) +
  geom_col(fill = "thistle3", color = "black", size = 0.2)+
  ggtitle("Histogram of Movie Release Year") +
  theme_minimal() + labs(x = "Release Year", y = "Count")
```



Yearly summary

```
yearly.summary |>
  ggplot(aes(x = total_revenue)) +
  geom_histogram(bins = 15, fill = "thistle3", color = "black", size = 0.2)+
  ggtitle("Histogram of Yearly Revenue For Disney (Millions of  US $)") +
  theme_minimal() + labs(x = "Yearly Revenue ($ M)", y = "Count")
```



Appendix C: What are the highest and lowest grossing movies?

Highest

```
movies.revenue2 |>
  select(movie_title,genre,rating,Year,gross_million) %>%
  arrange(desc(gross_million)) %>%
  head(8) %>%
  gt(rowname_col = "movie_title") %>%
  tab_header(
    title = md("Summary of the **$ Gross Revenue Per Movie** from 1992 to 2016"),
    subtitle = md("Million US $")) %>%
  tab_source_note(
    source_note = md("This file contains data on the Revenue and Gross of the Walt Disney Company from
  tab_caption(
    caption = md("Source: Disney Character Success from Kaggle")) %>%
  tab_stubhead(label = md("Movies")) %>%
  opt_table_font(font = google_font("Mouse Memoirs"), weight = 100) %>%
  cols_label(genre = "Genre",
             rating = "Rating",
             gross_million = "$ Gross") %>%
  data_color(
    columns = gross_million,
    fn = scales::col_numeric(
      palette = "RdPu",
      domain = c(1000, 480)))
```

Summary of the **$ Gross Revenue Per Movie** from 1992 to 2016

Million US $

Movies	Genre	Rating	Year	$ Gross
Star Wars Ep. VII: The Force Awakens	Adventure	PG-13	2015	936.7
The Lion King	Adventure	G	1994	761.6
The Avengers	Action	PG-13	2012	660.1
Pirates of the Caribbean: Dead Man'...	Adventure	PG-13	2006	544.8
Rogue One: A Star Wars Story	Adventure	PG-13	2016	529.5
Finding Nemo	Adventure	G	2003	518.1
Finding Dory	Adventure	PG	2016	486.3
The Sixth Sense	Thriller/Suspense	PG-13	1999	485.4

This file contains data on the Revenue and Gross of the Walt Disney Company from 1992 to 2016

Lowest

```
movies.revenue2 |>
  select(movie_title,genre,rating,Year,gross_million) %>%
  arrange(gross_million) %>%
  head(8) %>%
  gt(rowname_col = "movie_title") %>%
  tab_header(
    title = md("Summary of the **Gross Revenue Per Movie** from 1992 to 2016"),
    subtitle = md("Million US $")) %>%
  tab_source_note(
    source_note = md("This file contains data on the Revenue and Gross of the Walt Disney Company from
  tab_caption(
    caption = md("Source: Disney Character Success from Kaggle")) %>%
  tab_stubhead(label = md("Movies")) %>%
  opt_table_font(font = google_font("Mouse Memoirs"), weight = 100) %>%
  cols_label(genre = "Genre",
             rating = "Rating",
             gross_million = "$ Gross") %>%
  data_color(
    columns = gross_million,
    fn = scales::col_numeric(
      palette = "magma",
      domain = c(0, 0.8)))
```

Summary of the **Gross Revenue Per Movie** from 1992 to 2016

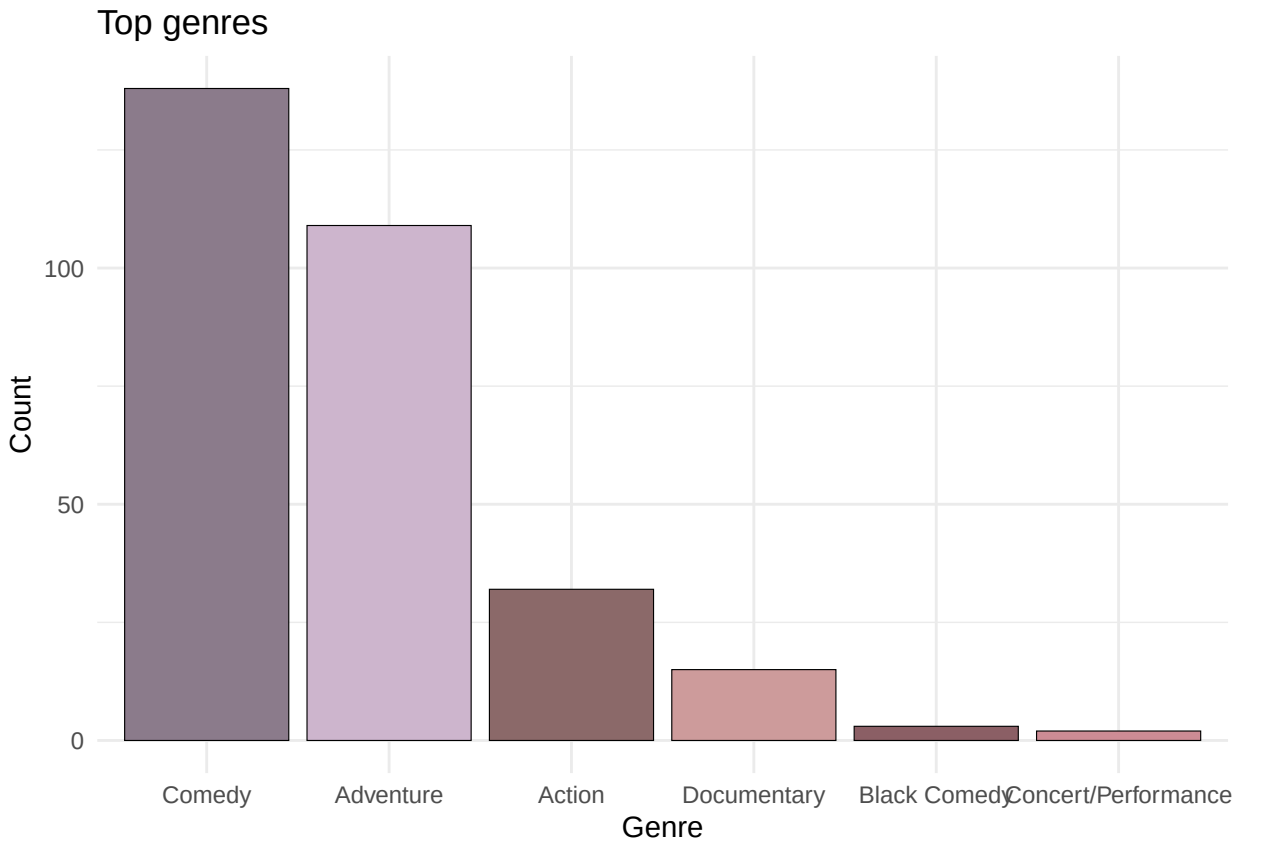
Million US $

Movies	Genre	Rating	Year	$ Gross
Walt and El Grupo	Documentary	PG	2009	0.0
Zokkomon	Adventure	PG	2011	0.0
An Alan Smithee Film: Burn Hollywood ...	Comedy	R	1998	0.1
Waking Sleeping Beauty	Documentary	PG	2010	0.1
Gedo Senki (Tales from Earthsea)	Adventure	PG-13	2010	0.1
Breakfast of Champions	Comedy	R	1999	0.3
Goal! 2: Living the Dream...	Drama	PG-13	2008	0.3
Morning Light	Documentary	PG	2008	0.3

This file contains data on the Revenue and Gross of the Walt Disney Company from 1992 to 2016

Appendix D: What is the most common genre produced by Disney?

```
colors4 = c("thistle4", "thistle3", "rosybrown4", "rosybrown3", "lightpink4", "lightpink3")
disney2 |>
  select(genre) |>
  group_by(genre) |>
  summarise(n = n()) |>
  head(6) |>
  ggplot(aes(x = reorder(genre, -n), y = n)) +
  geom_col(aes(fill = reorder(genre, -n)), color = "black", size = .2) +
  scale_fill_manual(values = colors4) +
  ggtitle("Top genres") + labs(x = "Genre", y = "Count") +
  theme_minimal() + theme(legend.position = "none")
```



Appendix E: Which variables best predict the actual revenue per year?

Variable selection:

```
n = nrow(yearly.summary2)
mod0 = lm(total_revenue ~ 1, data = yearly.summary2)
mod.all = lm(total_revenue ~., data = yearly.summary2)
step(mod0, scope = list(lower = mod0, upper = mod.all))
```

```
## Start:  AIC=475.64
## total_revenue ~ 1
```

```
##
##                Df  Sum of Sq        RSS    AIC
## + comedy        1 3511904893  714385033 433.20
## + movie_count   1 2832168601 1394121325 449.92
## + drama         1 1193650237 3032639688 469.35
## + adventure     1  858021438 3368268488 471.97
## + action_count  1  498819240 3727470685 474.50
## <none>                       4226289926 475.64
## + musical       1  169228624 4057061301 476.62
##
## Step:  AIC=433.2
## total_revenue ~ comedy
##
##                Df  Sum of Sq        RSS    AIC
## + movie_count   1  105911512  608473521 431.19
## <none>                       714385033 433.20
## + drama         1   50188455  664196578 433.38
## + musical       1   42135833  672249199 433.68
## + adventure     1   24703606  689681427 434.32
## + action_count  1    2234042  712150991 435.12
## - comedy        1 3511904893 4226289926 475.64
##
## Step:  AIC=431.19
## total_revenue ~ comedy + movie_count
##
##                Df Sum of Sq        RSS    AIC
## <none>                      608473521 431.19
## + musical       1  23449554  585023967 432.21
## + action_count  1  19633920  588839601 432.37
## + adventure     1   5720004  602753516 432.95
## + drama         1    137329  608336192 433.18
## - movie_count   1 105911512  714385033 433.20
## - comedy        1 785647804 1394121325 449.92
```

```
##
## Call:
## lm(formula = total_revenue ~ comedy + movie_count, data = yearly.summary2)
##
## Coefficients:
## (Intercept)       comedy  movie_count
##     55173.2      -2511.2       -607.9
```

AIC Model:

```
mod.full <- yearly.summary2 |>
  lm(formula = total_revenue ~ comedy + movie_count)
summary(mod.full)
```

```
##
## Call:
## lm(formula = total_revenue ~ comedy + movie_count, data = yearly.summary2)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -9454.0 -3619.1   706.5  3128.4  8969.2
##
```

```
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  55173.2     4001.6  13.788 2.64e-12 ***
## comedy       -2511.2      471.2  -5.330 2.38e-05 ***
## movie_count   -607.9      310.6  -1.957   0.0632 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5259 on 22 degrees of freedom
## Multiple R-squared:  0.856,  Adjusted R-squared:  0.8429
## F-statistic:  65.4 on 2 and 22 DF,  p-value: 5.509e-10
```

Check interaction terms:

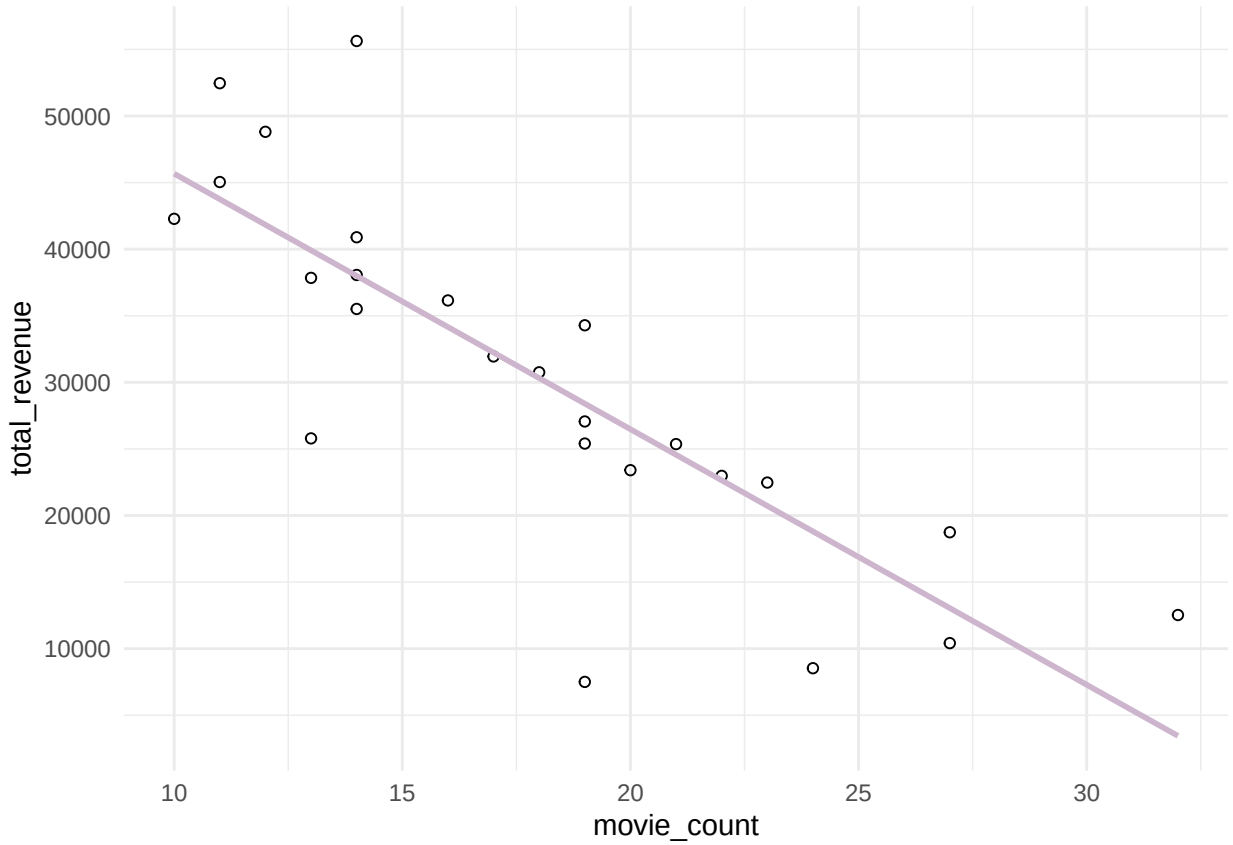
```
add1(mod.full, ~.+comedy*movie_count, test = 'F')
```

```
## Single term additions
##
## Model:
## total_revenue ~ comedy + movie_count
##                     Df Sum of Sq       RSS    AIC F value Pr(>F)
## <none>                           608473521 431.19
## comedy:movie_count  1  45954919 562518602 431.23  1.7156 0.2044
```

Check Model assumptions:

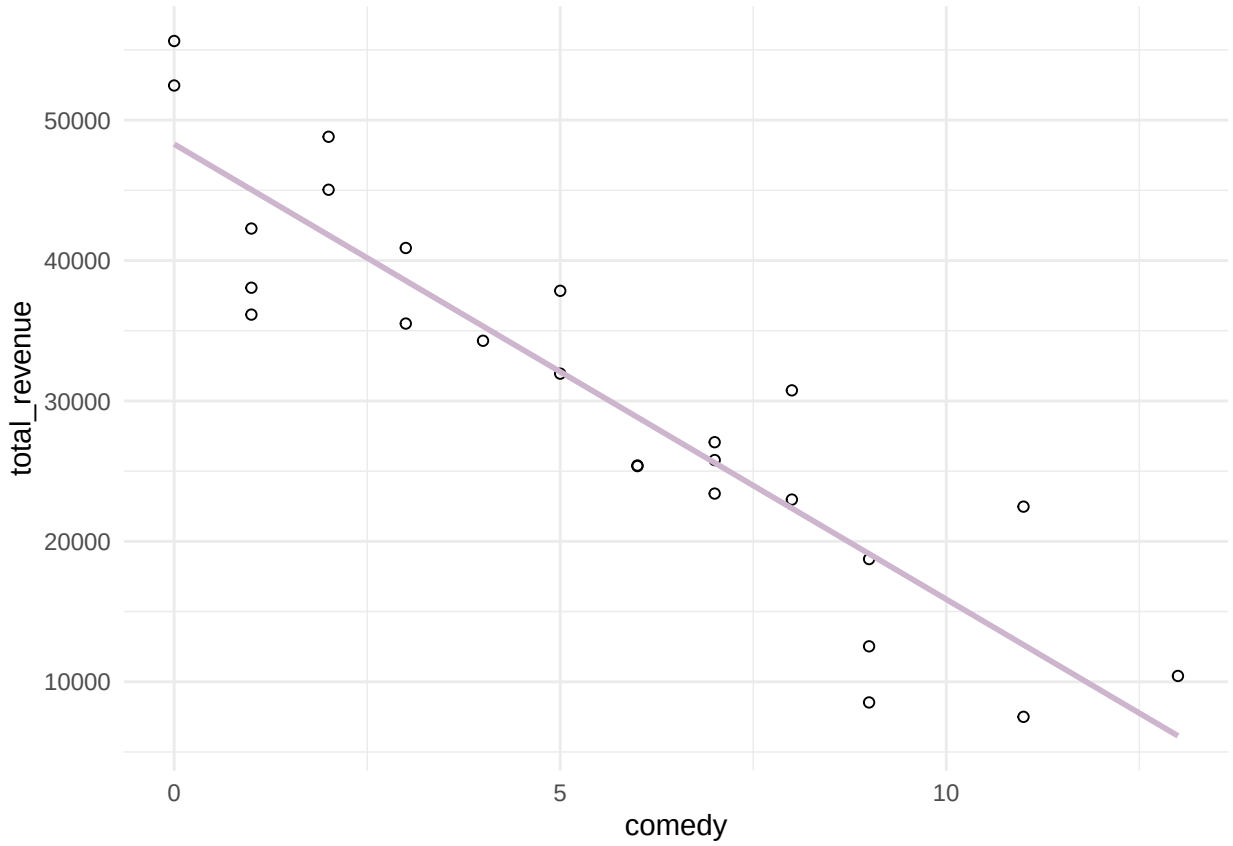
```
yearly.summary2 |>
  ggplot(aes(x = movie_count, y = total_revenue)) +
  geom_point(shape = 21, color = "black") +
  geom_smooth(color = "thistle3", method = "lm", se = FALSE) +
  theme_minimal()
```

```
## `geom_smooth()` using formula = 'y ~ x'
```

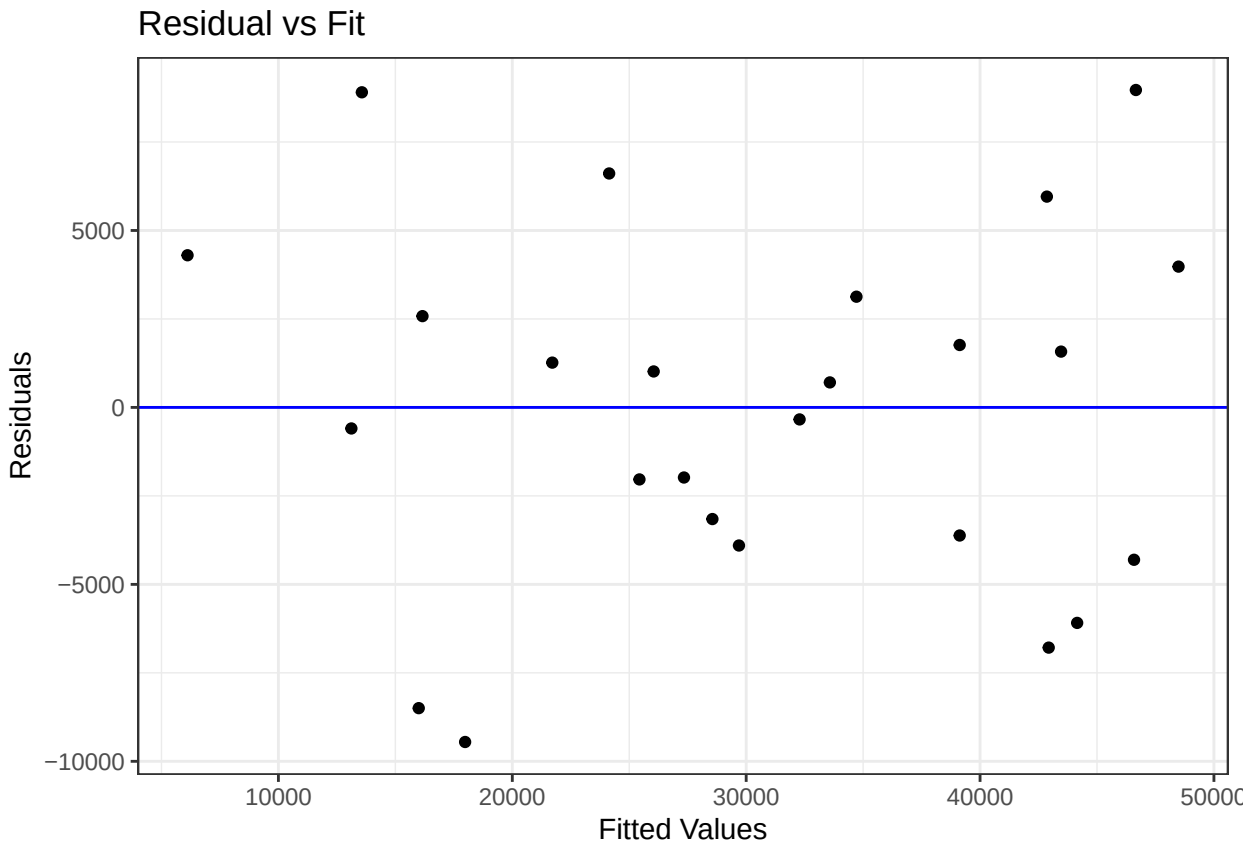



```
yearly.summary2 |>
  ggplot(aes(x = comedy, y = total_revenue)) +
  geom_point(shape = 21, color = "black") +
  geom_smooth(color = "thistle3", method = "lm", se = FALSE) +
  theme_minimal()
```

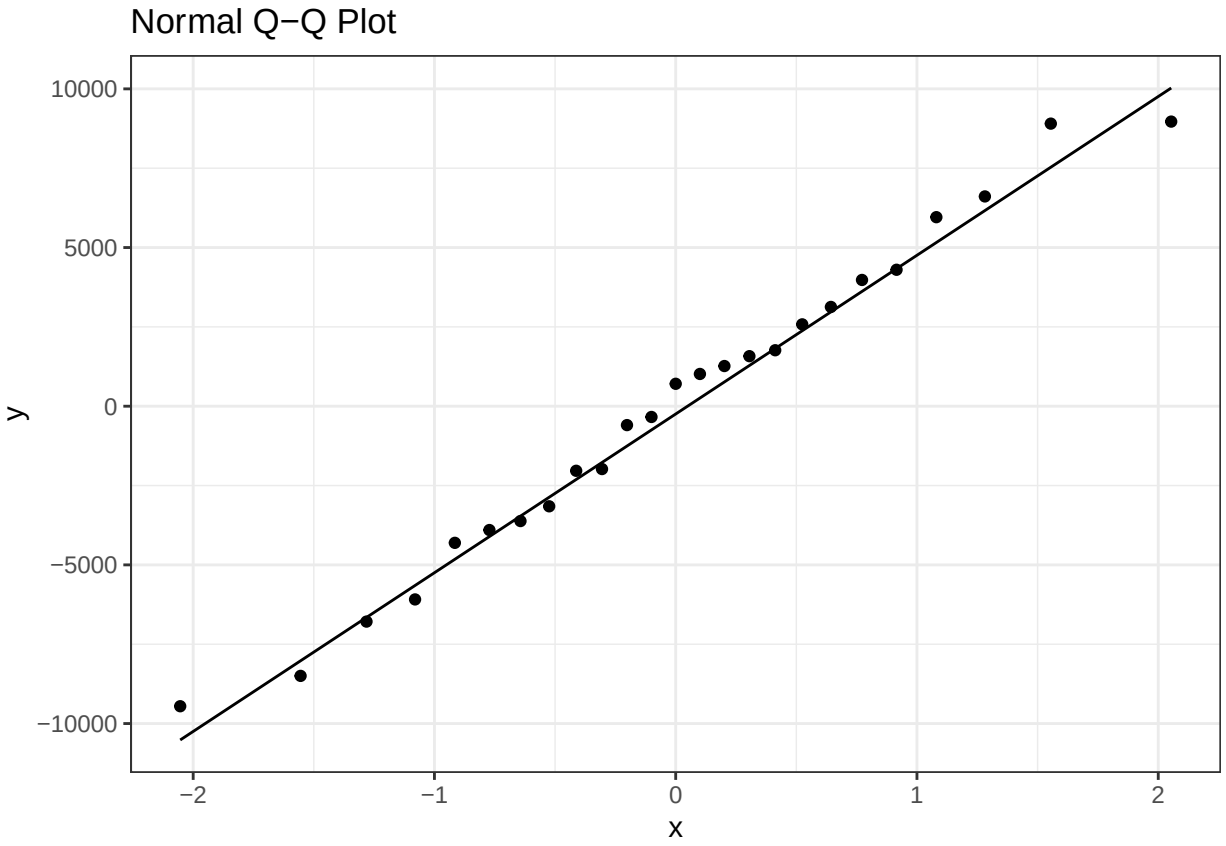
```
## `geom_smooth()` using formula = 'y ~ x'
```




```
mod.full |>
  augment() |>
  ggplot(aes(x = .fitted, y = .resid)) +
  geom_point() +
  geom_hline(yintercept = 0, colour = 'blue') +
  labs(x = 'Fitted Values', y = 'Residuals') +
  ggtitle('Residual vs Fit') +
  theme_bw()
```




```
mod.full |>
  augment() |>
ggplot(aes(sample = .resid)) +
  stat_qq() +
  stat_qq_line() +
  ggtitle('Normal Q-Q Plot') +
  theme_bw()
```

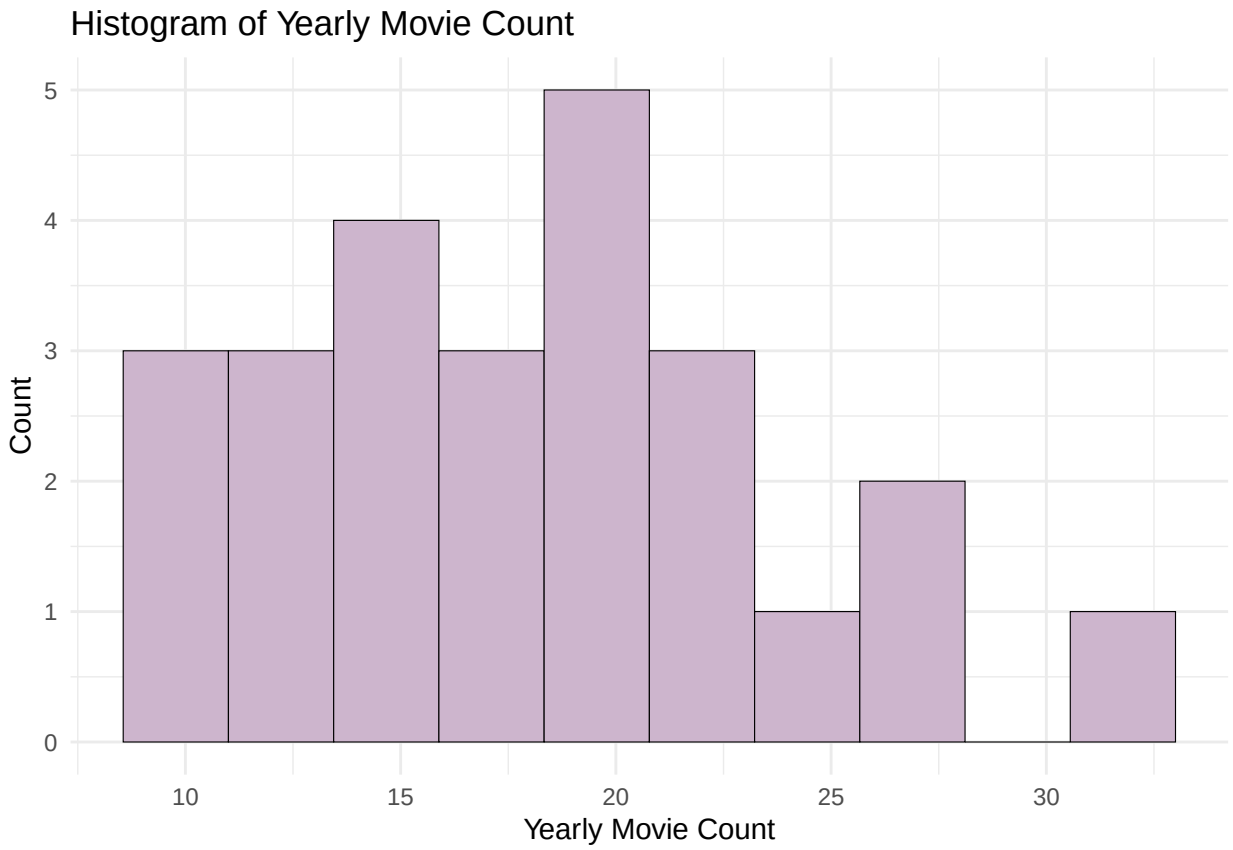



```
shapiro.test(resid(mod.full))
```

```
##
##  Shapiro-Wilk normality test
##
## data:  resid(mod.full)
## W = 0.98134, p-value = 0.9102
```

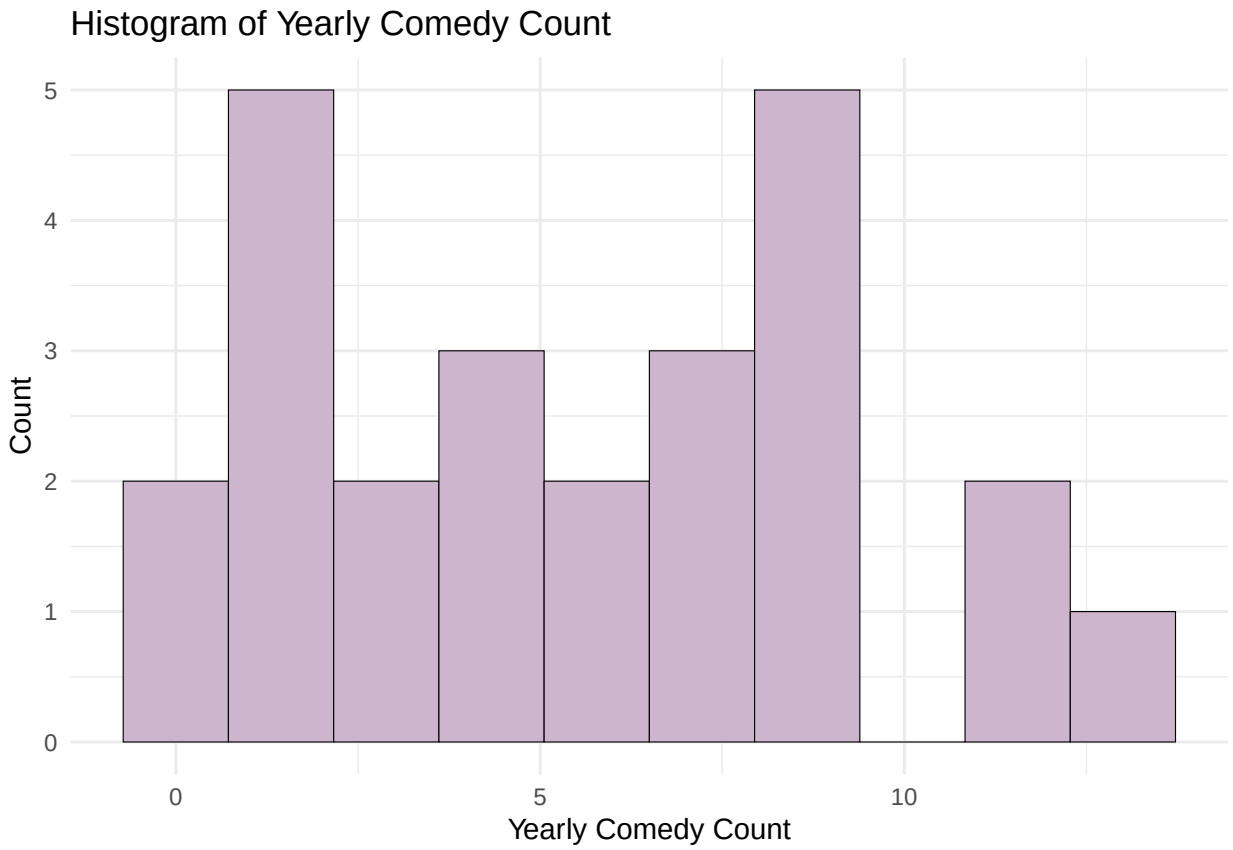
Histogram of movie count

```
yearly.summary2 |>
  ggplot(aes(x = movie_count)) +
  geom_histogram(bins = 10, fill = "thistle3", color = "black", size = 0.2)+
  ggtitle("Histogram of Yearly Movie Count") +
  theme_minimal() + labs(x = "Yearly Movie Count", y = "Count")
```



Histogram of comedy count

```
yearly.summary2 |>
  ggplot(aes(x = comedy)) +
  geom_histogram(bins = 10, fill = "thistle3", color = "black", size = 0.2)+
  ggtitle("Histogram of Yearly Comedy Count") +
  theme_minimal() + labs(x = "Yearly Comedy Count", y = "Count")
```



Appendix F: What is Disney's expected total revenue in a year where they release 10 movies and 2 of them are comedies?

```
new = data.frame(comedy = 2, movie_count = 10)
prediction = predict(mod.full,new,interval = "prediction", level = 0.95)
prediction
```

```
##        fit      lwr     upr
## 1 44071.91 32500.31 55643.5
```