labQ3.R

mirrien

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```
suppressWarnings(library(rvest))
suppressWarnings(library(lubridate))

suppressWarnings(library(zoo))

suppressWarnings(library(xml2))
suppressWarnings(library(tidyverse))

################################################
# Q3.1

marvel_url = "https://en.wikipedia.org/wiki/List_of_Marvel_Cinematic_Universe_films"

marvel = read_html(marvel_url)

length(html_nodes(marvel, "table"))

## [1] 30

bop <- html_table(html_nodes(marvel, "table")[6])
bop <- bop[[1]]

cpr <- html_table(html_nodes(marvel, "table")[7])
cpr <- cpr[[1]]

# Tidy col_names
for (i in seq_along(names(bop))) {
  if (names(bop)[i] != bop[[i]][1]) {
    colnames(bop)[i] <- paste(bop[[i]][1], names(bop)[i], collapse = "
")
  }
}

for (i in seq_along(names(cpr))) {
  if (names(cpr)[i] != cpr[[i]][1]) {
    colnames(cpr)[i] <- paste(cpr[[i]][1], names(cpr)[i], collapse = "
")
  }
}
```

```r
# Tidy rows
# Delete empty rows, phase indicator rows, and the total row from the t
able bop

bop <- bop[-c(1,2,3,nrow(bop)), ]
bop <- bop[!grepl("Phase\\s",bop$Film),]

cpr <- cpr[-c(1,2,3), ]
cpr <- cpr[!grepl("Phase\\s",cpr$Film),]

df <- merge(bop, cpr, by.x = "Film", by.y = "Film",sort = F)

head(df)
```

```
##                                Film U.S. release date
## 1                          Iron Man       May 2, 2008
## 2                The Incredible Hulk     June 13, 2008
## 3                         Iron Man 2       May 7, 2010
## 4                               Thor       May 6, 2011
## 5 Captain America: The First Avenger     July 22, 2011
## 6              Marvel's The Avengers       May 4, 2012
##   U.S. and Canada Box office gross Other territories Box office gros
s
## 1                      $319,034,126                        $266,762,12
1
## 2                      $134,806,913                        $129,964,08
3
## 3                      $312,433,331                        $311,500,00
0
## 4                      $181,030,624                        $268,295,99
4
## 5                      $176,654,505                        $193,915,26
9
## 6                      $623,357,910                        $895,457,60
5
##   Worldwide Box office gross U.S. and Canada All-time ranking
## 1               $585,796,247                                74
## 2               $264,770,996                               454
## 3               $623,933,331                                80
## 4               $449,326,618                               257
## 5               $370,569,774                               273
## 6             $1,518,815,515                                 8
##   Worldwide All-time ranking             Budget Ref(s)
## 1                        170         $140 million  [267]
## 2                        573         $150 million  [268]
## 3                        151         $200 million  [269]
## 4                        256         $150 million  [270]
## 5                        348         $140 million  [271]
## 6                          8         $220 million  [272]
```

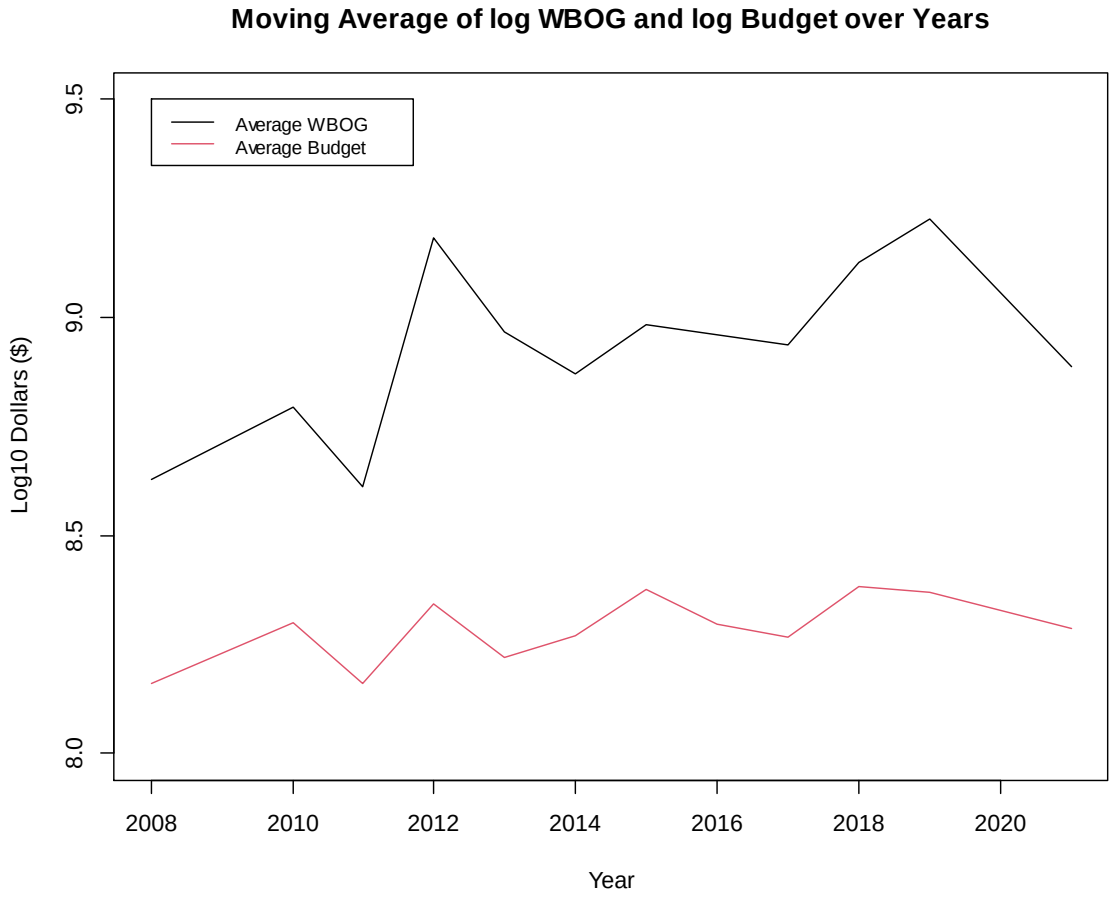
```
##   Rotten Tomatoes Critical  Metacritic Critical CinemaScore[312] Pub
lic
## 1   94% (281 reviews)[313] 79 (38 reviews)[314]
A
## 2   67% (238 reviews)[315] 61 (38 reviews)[316]               A-
## 3   72% (304 reviews)[317] 57 (40 reviews)[318]
A
## 4   77% (291 reviews)[319] 57 (40 reviews)[320]
B+
## 5   80% (274 reviews)[321] 66 (43 reviews)[322]               A-
## 6   91% (362 reviews)[323] 69 (43 reviews)[324]
A+
```

```r
################################################
# Q3.2

# Tidy data, convert to corresponding types

df$`U.S. and Canada Box office gross` <-
  as.numeric(gsub("\\D","",df$`U.S. and Canada Box office gross`))

df$`Other territories Box office gross` <-
  as.numeric(gsub("\\D","",df$`Other territories Box office gross`))

df$`Worldwide Box office gross` <-
  as.numeric(gsub("\\D","",df$`Worldwide Box office gross`))

df$Budget <- gsub("\\D","",df$Budget)

# if Budget is a range (i.e., nchar==6), split string and find mean
for (i in seq_along(df$Budget)) {
  if (nchar(df$Budget[i]) == 6) {
    df$Budget[i] <- gsub("\\D","",
                         mean(c(as.numeric(str_sub(df$Budget[i],1,3)),
                           as.numeric(str_sub(df$Budget[i],-3,-1))
                            )
                           )
                         )
  }
}

# if Budget has no decimal, replace "million" with "000000"
# if Budget has one decimal, remove ".", replace "million with "00000"
for (i in seq_along(df$Budget)){
  if (nchar(df$Budget[i]) == 3) {
    df$Budget[i] <- paste0(df$Budget[i],"000000",collapse = "")
  }
  else if (nchar(df$Budget[i]) == 4) {
    df$Budget[i] <- paste0(df$Budget[i],"00000",collapse = "")
  }
}

# Convert to integer
df$Budget <- as.integer(df$Budget)

# convert Rotten Tomatoes score (%) into doubles (e.g., 0.90)
df$`Rotten Tomatoes Critical` <- as.numeric(gsub("\\%\\s.*\\]$","",df$`
Rotten Tomatoes Critical`))/100

# Convert Matecritic score into integers
df$`Metacritic Critical` <- as.numeric(gsub("\\s.*\\]$","",df$`Metacrit
ic Critical`))
```

```r
# Select required columns, extract only years
df1 <- df %>% select(`Worldwide Box office gross`,
              Budget,
              `Rotten Tomatoes Critical`,
              `Metacritic Critical`
                     ) %>%
      mutate(Year = year(mdy(df$`U.S. release date`)))

# Reorder the result data frame
df1 <- df1[,c(1,2,5,3,4)]

# print the first 10 rows
head(df1,n=10)
```

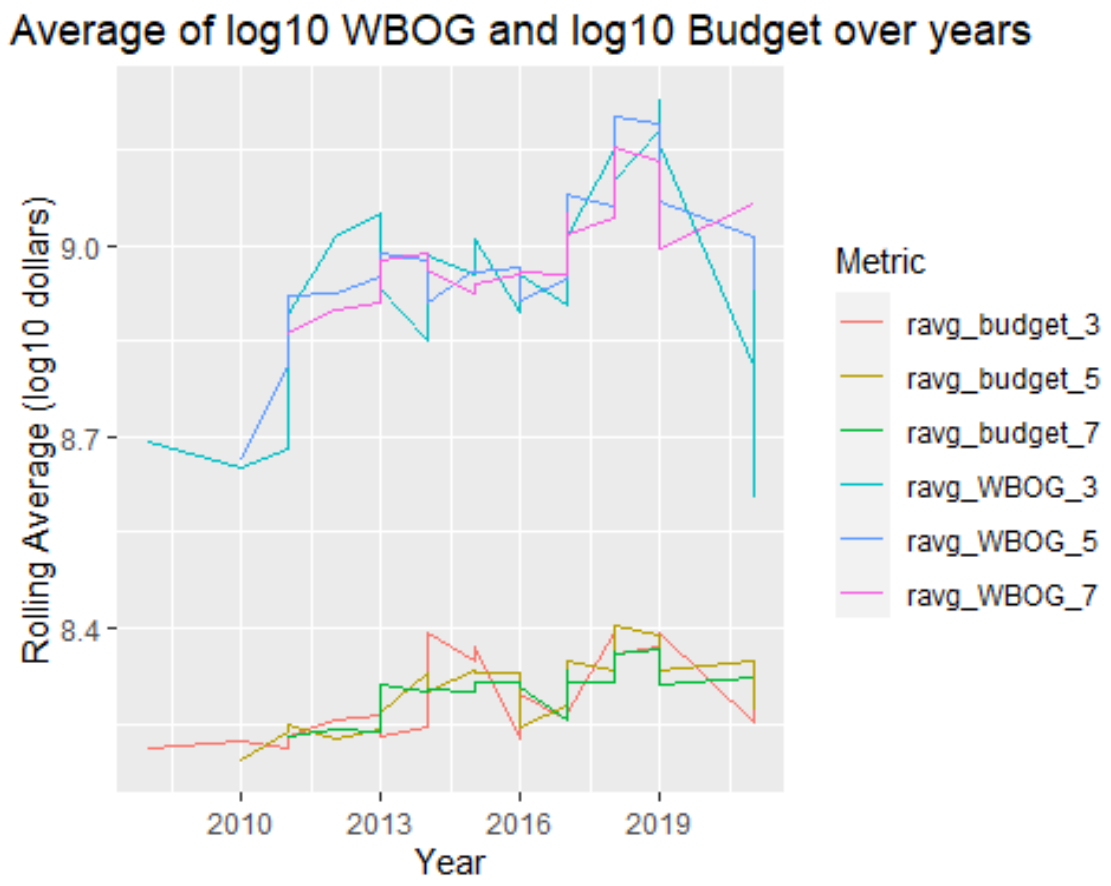
```
##    Worldwide Box office gross    Budget Year Rotten Tomatoes Critica
l
## 1                   585796247 140000000 2008                      0.9
4
## 2                   264770996 150000000 2008                      0.6
7
## 3                   623933331 200000000 2010                      0.7
2
## 4                   449326618 150000000 2011                      0.7
7
## 5                   370569774 140000000 2011                      0.8
0
## 6                  1518815515 220000000 2012                      0.9
1
## 7                  1214811252 178400000 2013                      0.7
9
## 8                   644783140 152700000 2013                      0.6
6
## 9                   714421503 177000000 2014                      0.9
0
## 10                  773350147 195900000 2014                      0.9
2
##    Metacritic Critical
## 1                   79
## 2                   61
## 3                   57
## 4                   57
## 5                   66
## 6                   69
## 7                   62
## 8                   54
## 9                   70
## 10                  76
```

```r
##################################################
# Q3.3

# The question was confusing.
# First, is the "time" in year or in date? In the first part I will ass
ume
# it in year. In the second part I will assume it in date.

# Second, the moving averages could be understood in 2 ways:

# (1) moving averages for each group of years, where we can use group_b
y()
# and calculate means for each group of years. By doing this, we can ha
ve one
# mean for each year for each variable, and its graph will not contain
# any vertical line segment (i.e., one x will only have one y).

# (2) rolling averages with a certain rolling window width such as 3, 5
,
# or 7 which is not given in the question. In this case, we may have mu
ltiple
# means for one year and many NAs, which results in a plot with many ve
rtical
# line segments. The plot will be too jagged.

# Part I.

# (1) Create a new data frame for moving averages for each group of yea
rs
df2 <- df1 %>%
        group_by(Year) %>%
        summarise(average_budget = mean(Budget),
                  average_gross = mean(`Worldwide Box office gross`))

# use base r
windows(7,7)
plot(x=df2$Year,y=log10(df2$average_gross),
     type = "l",
     ylim = c(8,9.5),
     xlab = "Year",
     ylab = "Log10 Dollars ($)",
     main = "Moving Average of log WBOG and log Budget over Years",
     col = 1)
lines(x=df2$Year,y=log10(df2$average_budget),col=2)
legend(2008, 9.5, c("Average WBOG","Average Budget"),
       col=1:2, lty=c(1,1), cex=0.8)
```

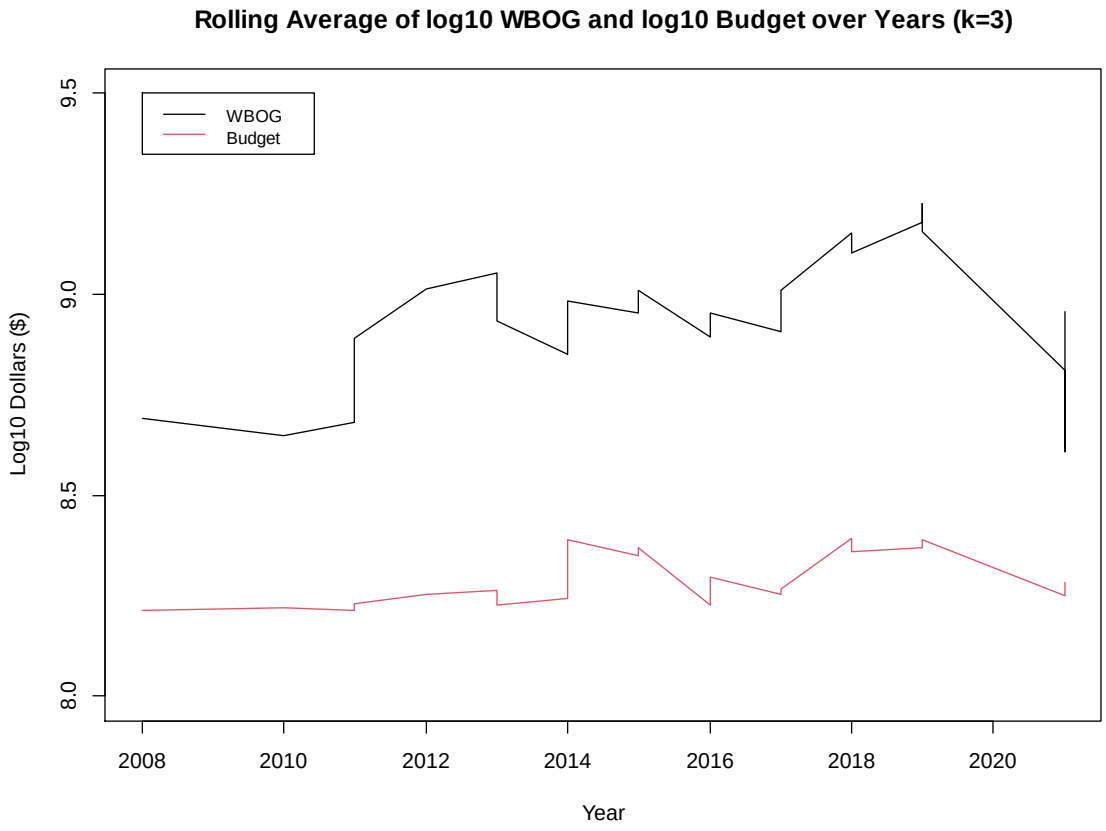



```
# (2) Create a new data frame for rolling average and use rollmean()
# Since the rolling window width is not given, we will try k=3, 5, and
7.
# Though we have a very small data set (n=27), k=3 is preferable.

# Note that the table has an ascending year already

df2_2 <- df1 %>%
  mutate(ravg_budget_3 = rollmean(Budget,3,fill=NA),
         ravg_budget_5 = rollmean(Budget,5,fill=NA),
         ravg_budget_7 = rollmean(Budget,7,fill=NA),
         ravg_WBOG_3 = rollmean(`Worldwide Box office gross`,3,fill=NA)
,
         ravg_WBOG_5 = rollmean(`Worldwide Box office gross`,5,fill=NA)
,
         ravg_WBOG_7 = rollmean(`Worldwide Box office gross`,7,fill=NA)
) %>%
  select(!contains("Critical"))

# use ggplot to plot rolling average of all three widths for budgets an
d WBOG
```

```r
# tidy the data first:
df2_2 %>% pivot_longer(names_to = "rolling_mean_key",
                       values_to = "rolling_mean_value",
                       cols = c(ravg_budget_3,
                                ravg_budget_5,
                                ravg_budget_7,
                                ravg_WBOG_3,
                                ravg_WBOG_5,
                                ravg_WBOG_7)) %>%
  ggplot(aes(x = Year,
             y = log10(rolling_mean_value),
             color = rolling_mean_key)) +
  geom_line() +
  labs(color = "Metric",
       x = "Year",
       y = "Rolling Average (log10 dollars)",
       title = "Rolling Average of log10 WBOG and log10 Budget over yea
rs") +
  theme(plot.title = element_text(hjust = 0.5))

## Warning: Removed 24 row(s) containing missing values (geom_path).
```

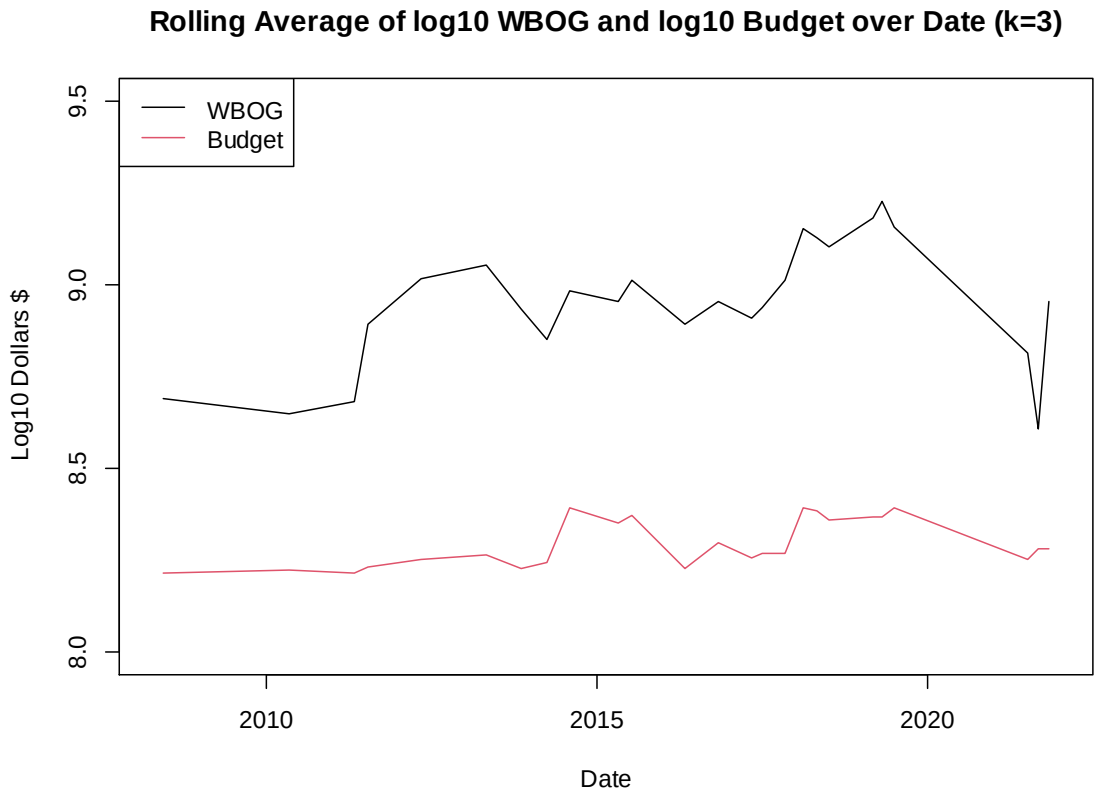


```r
# Reference: https://www.storybench.org/how-to-calculate-a-rolling-aver
age-in-r/


# use base r to plot rolling averages with k=3
windows(7,7)
plot(x=df2_2$Year,y=log10(df2_2$ravg_WBOG_3),
     type = "l",
     ylim = c(8,9.5),
     xlab = "Year",
     ylab = "Log10 Dollars ($)",
     main = "Rolling Average of log10 WBOG and log10 Budget over Years
(k=3)",
     col = 1)
lines(x=df2_2$Year,y=log10(df2_2$ravg_budget_3),col=2)
legend(2008, 9.5, c("WBOG","Budget"),
       col=1:2, lty=c(1,1), cex=0.8)
```

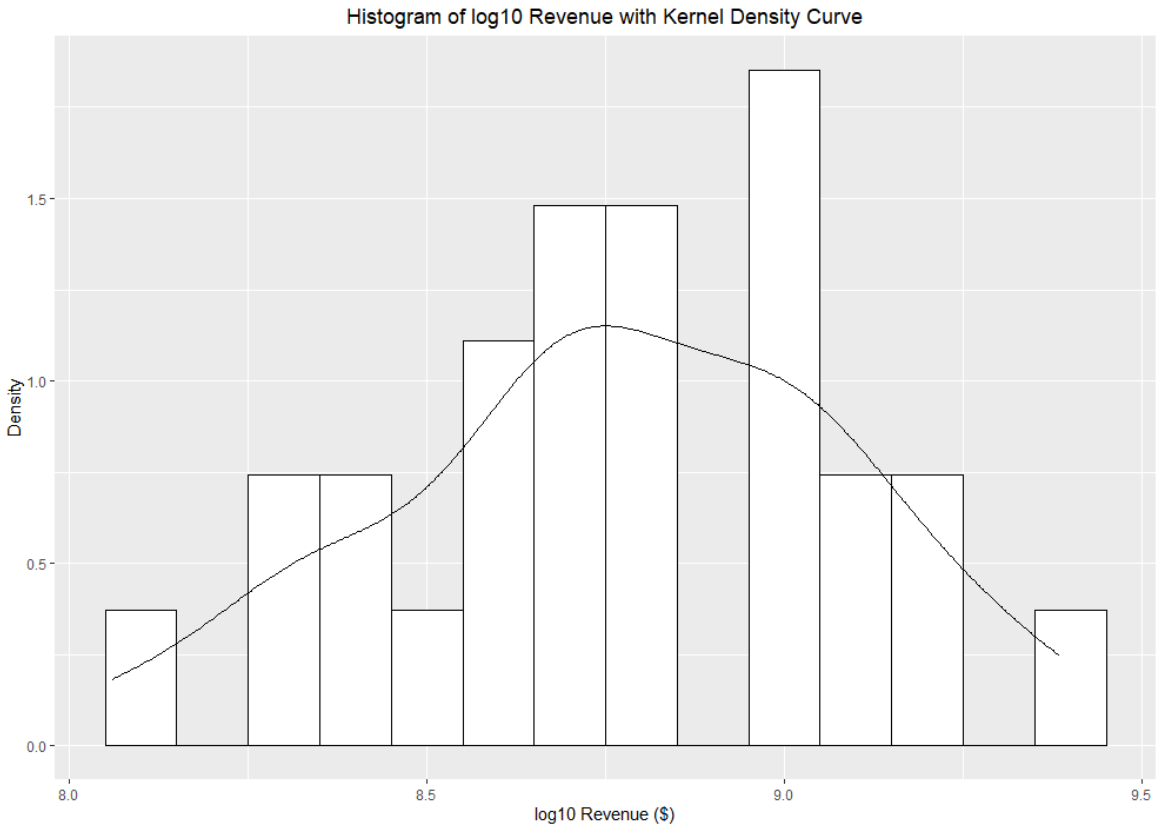



```r
# Part II.
# Assume that we take "Date" instead of "Year".
# Also assume that moving averages is rolling averages.

windows(8,6)
```

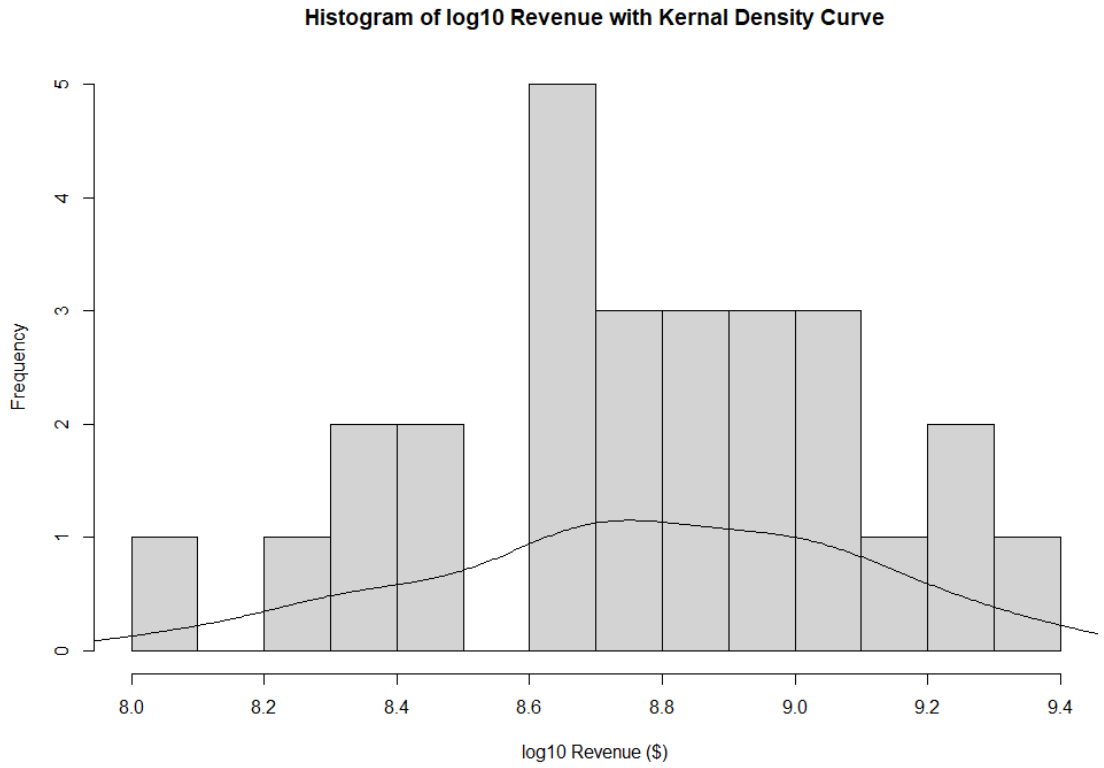
```r
df2_3 <- df %>%
  mutate(ravg_budget_3 = rollmean(Budget,3,fill=NA),
         ravg_WBOG_3 = rollmean(`Worldwide Box office gross`,3,fill=NA)
,
         date = mdy(`U.S. release date`)) %>%
  select(date,ravg_budget_3,ravg_WBOG_3,)

plot(x=df2_3$date,y=log10(df2_3$ravg_WBOG_3),
     type = "l",
     ylim = c(8,9.5),
     xlab = "Date",
     ylab = "Log10 Dollars $",
     main = "Rolling Average of log10 WBOG and log10 Budget over Date (
k=3)",
     col = 1)
lines(x=df2_3$date,y=log10(df2_3$ravg_budget_3),col=2)
legend("topleft", c("WBOG","Budget"),
       col=1:2, lty=c(1,1), cex=1)
```



```
##################################################
# Q3.4

# create a new data frame for revenue
df3<- df1 %>%
    mutate(Revenue = `Worldwide Box office gross` - Budget)

# The following two methods both show the distribution of revenue for e
ach film

# 1. use ggplot to plot histogram overlaid with kernel density curve
# Note that we use density instead of count on y-axis

ggplot(df3, aes(x=log10(Revenue))) +
  geom_histogram(aes(y=..density..),
                 binwidth=.1,
                 colour="black", fill="white") +
  geom_density(alpha=.2) +
  labs(x = "log10 Revenue ($)", y = "Density",
       title = "Histogram of log10 Revenue with Kernel Density Curve")
+
  theme(plot.title = element_text(hjust = 0.5))
```

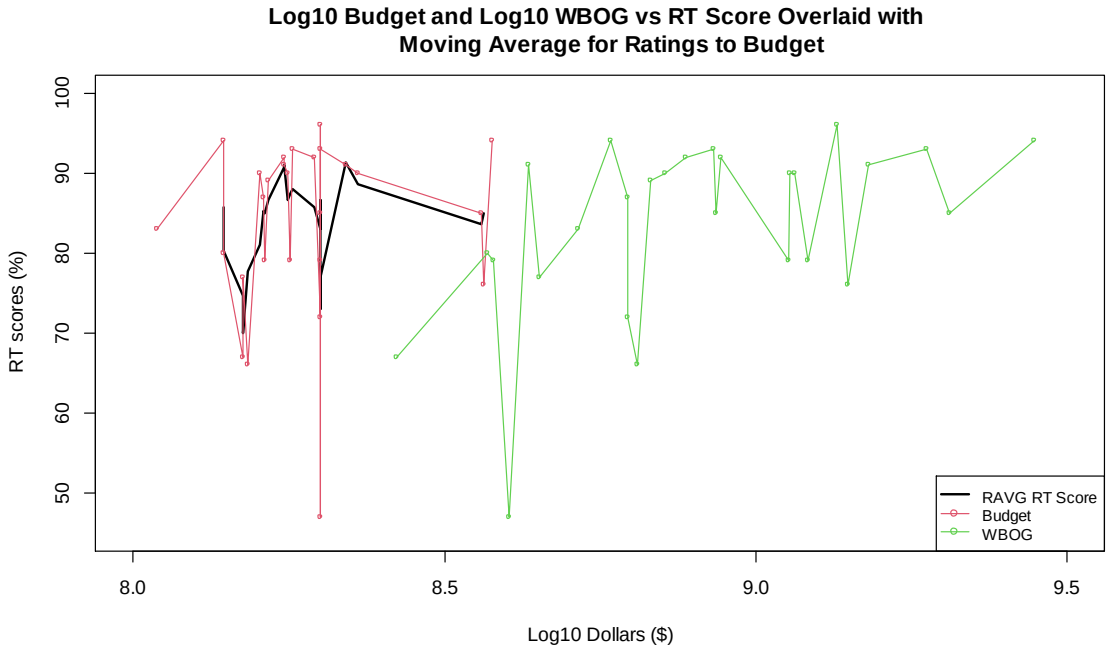


```r
# 2. use base r to plot histogram overlaid with kernel density curve
# In this plot, we use count instead of density on y-axis

hist(log10(df3$Revenue),
     breaks=12,
     xlab="log10 Revenue ($)",
     main = "Histogram of log10 Revenue with Kernal Density Curve")
lines(density(log10(df3$Revenue)))
```

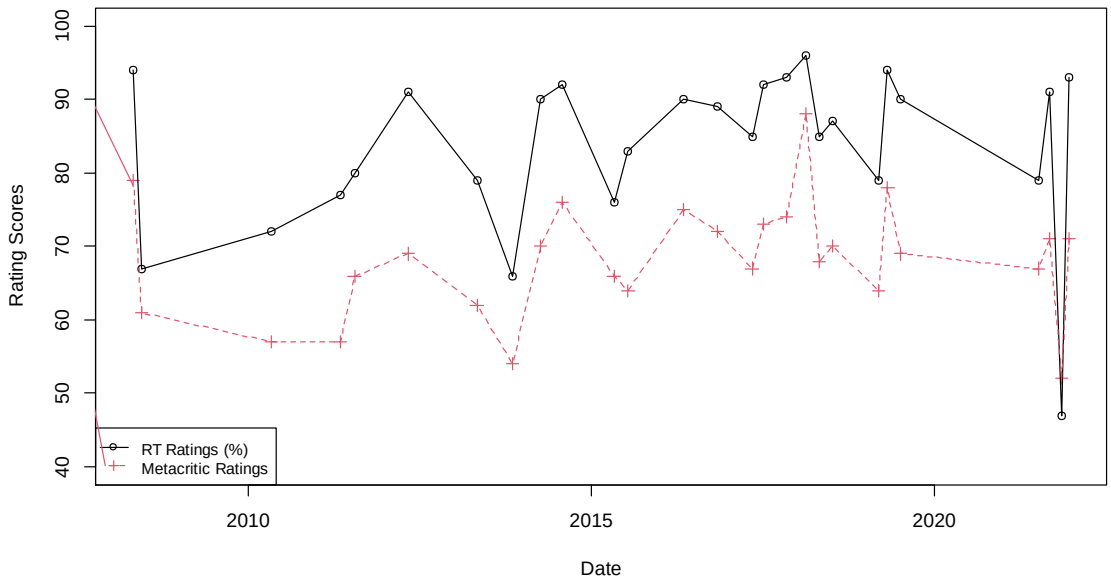


```r
################################################
# Q3.5

# The relationship between budget and Rotten Tomatoes (RT) scores is no
t
# intuitive. The visualization helps.

# Note that the question requires a moving average for ratings over bud
get,
# we assume here the moving average refers to a rolling average, otherw
ise
# it would be meaningless to group by budget.
# We will be using a window of width k=3.

# New data frame with Budget sorted with respect to the scores
# Mutate a new column with rolling means for RT ratings
df4 <- df3 %>%  select(-c(`Metacritic Critical`,Revenue)) %>%
  arrange(Budget) %>% # sort budget to establish its relationship with
ratings
  mutate(ravg_score_3 = rollmean(`Rotten Tomatoes Critical`,3,fill=NA))

# Additional data frame with WBOG sorted with respect to the scores
df4_2 <- df4 %>% arrange(`Worldwide Box office gross`)

# Note that the original ratings are in percentage form and were
# converted into doubles (i.e., 90% -> 0.90). For clarity, we will mult
iply
# them by 100 and include its unit (%).

windows(10,6)
plot(x=log10(df4$Budget),y=100*(df4$ravg_score_3),
     type = "l",
     xlim = c(8,9.5),
     ylim = c(45,100),
     xlab = "Log10 Dollars ($)",
     ylab = "RT scores (%)",
     main = "Log10 Budget and Log10 WBOG vs RT Score Overlaid with
     Moving Average for Ratings to Budget ",
     col = 1,
     lwd = 2)

# The question did not request a point or a line plot, where we will pl
ot both.
# If line plot, we need to make sure x-axis is sorted with respect to t
he score
lines(x=log10(df4$Budget),
      y=100*(df4$`Rotten Tomatoes Critical`),col=2)

points(x=log10(df4$Budget),
```

```
      y=100*(df4$`Rotten Tomatoes Critical`),
      col=2,
      cex = 0.5)


lines(x=log10(df4_2$`Worldwide Box office gross`),
      y=100*(df4_2$`Rotten Tomatoes Critical`),col=3)

points(x=log10(df4_2$`Worldwide Box office gross`),
      y=100*(df4_2$`Rotten Tomatoes Critical`),
      col=3,
      cex = 0.5)


legend("bottomright",
       c("RAVG RT Score","Budget","WBOG"),
       col=c(1,2,3),
       lty=c(1,1,1),
       pch = c(NA,1,1),
       lwd = c(2,1,1),
       cex=0.8)
```



```r
################################################
# Q3.6
# First we plot points of RT and Metacritic ratings vs time (assumed to be date)
df5 <- df %>% mutate(date = mdy(`U.S. release date`)) %>%
  select(date,`Rotten Tomatoes Critical`,`Metacritic Critical`)

windows(10,6)
plot(df5$date,100*df5$`Rotten Tomatoes Critical`,
     xlab = "Date",
     ylab = "Rating Scores",
     col=1,
     ylim=c(40,100))
points(df5$date,df5$`Metacritic Critical`,
       col = 2,
       pch = 3)


lines(df5$date,100*df5$`Rotten Tomatoes Critical`,
      col=1)
lines(df5$date,df5$`Metacritic Critical`,
       col = 2,
       lty = 2)

legend("bottomleft",
       c("RT Ratings", "Metacritic Ratings"),
       col = c(1,2),
       pch = c(1,3),
       lty = c(1,2))
```



```
# From the plot, it's difficult to describe a general pattern of the
# relationship between ratings and time as the scores fluctuates over t
ime.
# But the ratings from two companies follow similar trends.
```