AE 02: Bechdel + data visualization

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In this mini analysis we work with the data used in the FiveThirtyEight story titled "The Dollar-And-Cents Case Against Hollywood's Exclusion of Women".

This analysis is about the Bechdel test, a measure of the representation of women in fiction.

Getting started

Packages

We start with loading the packages we'll use: **tidyverse** for majority of the analysis and **scales** for pretty plot labels later on.

```
library(tidyverse)
library(scales)
```

Data

The data are stored as a CSV (comma separated values) file in the `data` folder of your repository. Let's read it from there and save it as an object called `bechdel`.

```
bechdel <- read_csv("https://sta199-s24.github.io/data/bechdel.csv")
```

Get to know the data

We can use the `glimpse` function to get an overview (or "glimpse") of the data.

```
bechdel |>
  glimpse()
```

```
Rows: 1,615
Columns: 7
$ title       <chr> "21 & Over", "Dredd 3D", "12 Years a Slave", "2 Guns", "42~
$ year        <dbl> 2013, 2012, 2013, 2013, 2013, 2013, 2013, 2013, 2013, 2013~
$ gross_2013  <dbl> 67878146, 55078343, 211714070, 208105475, 190040426, 18416~
$ budget_2013 <dbl> 13000000, 45658735, 20000000, 61000000, 40000000, 22500000~
$ roi         <dbl> 5.221396, 1.206305, 10.585703, 3.411565, 4.751011, 0.81851~
$ binary      <chr> "FAIL", "PASS", "FAIL", "FAIL", "FAIL", "FAIL", "FAIL", "P~
$ clean_test  <chr> "notalk", "ok", "notalk", "notalk", "men", "men", "notalk"~
```

- What does each observation (row) in the data set represent?

Each observation represents a movie.

- How many observations (rows) are in the data set?

There are 1615 movies in the dataset.

- How many variables (columns) are in the data set?

There are 7 columns in the dataset.

Variables of interest

The variables we'll focus on are the following:

- `budget_2013`: Budget in 2013 inflation adjusted dollars.
- `gross_2013`: Gross (US and international combined) in 2013 inflation adjusted dollars.
- `roi`: Return on investment, calculated as the ratio of the gross to budget.
- `clean_test`: Bechdel test result:
  - `ok` = passes test
  - `dubious`
  - `men` = women only talk about men
  - `notalk` = women don't talk to each other
  - `nowomen` = fewer than two women
- `binary`: Bechdel Test PASS vs FAIL binary

We will also use the `year` of release in data prep and `title` of movie to take a deeper look at some outliers.

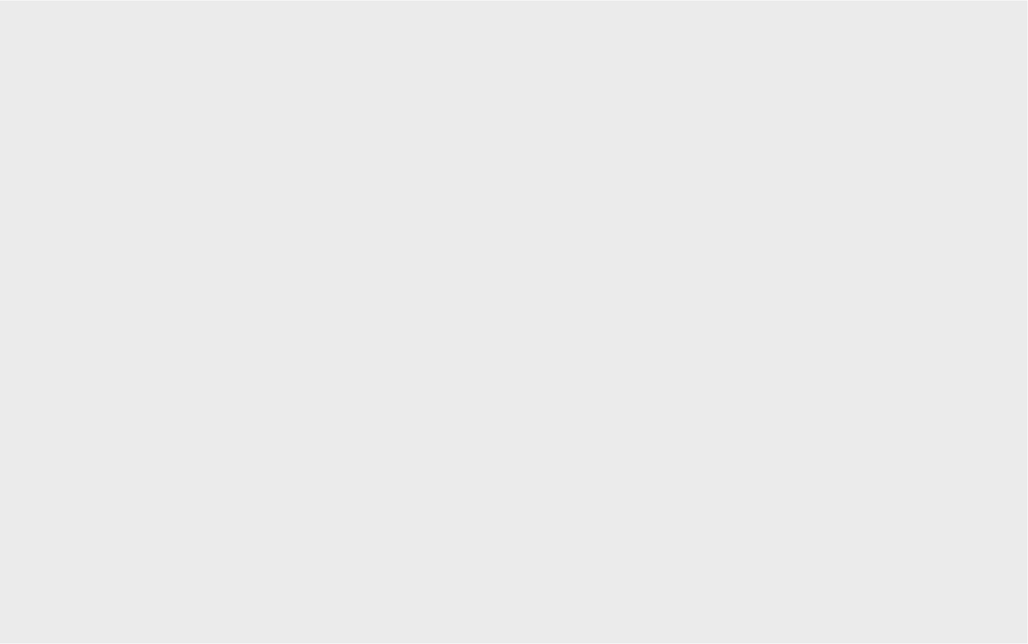
There are a few other variables in the dataset, but we won't be using them in this analysis.

Visualizing data with `ggplot2`

ggplot2 is the package and `ggplot()` is the function in this package that is used to create a plot.

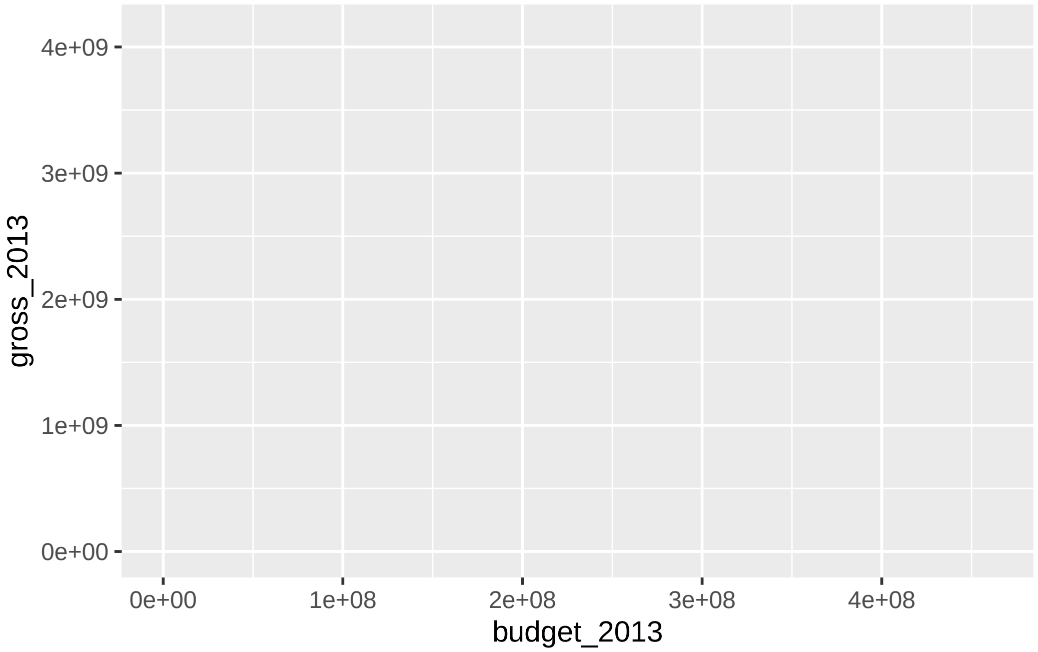
- `ggplot()` creates the initial base coordinate system, and we will add layers to that base. We first specify the data set we will use with `data = bechdel`.

```
ggplot(data = bechdel)
```



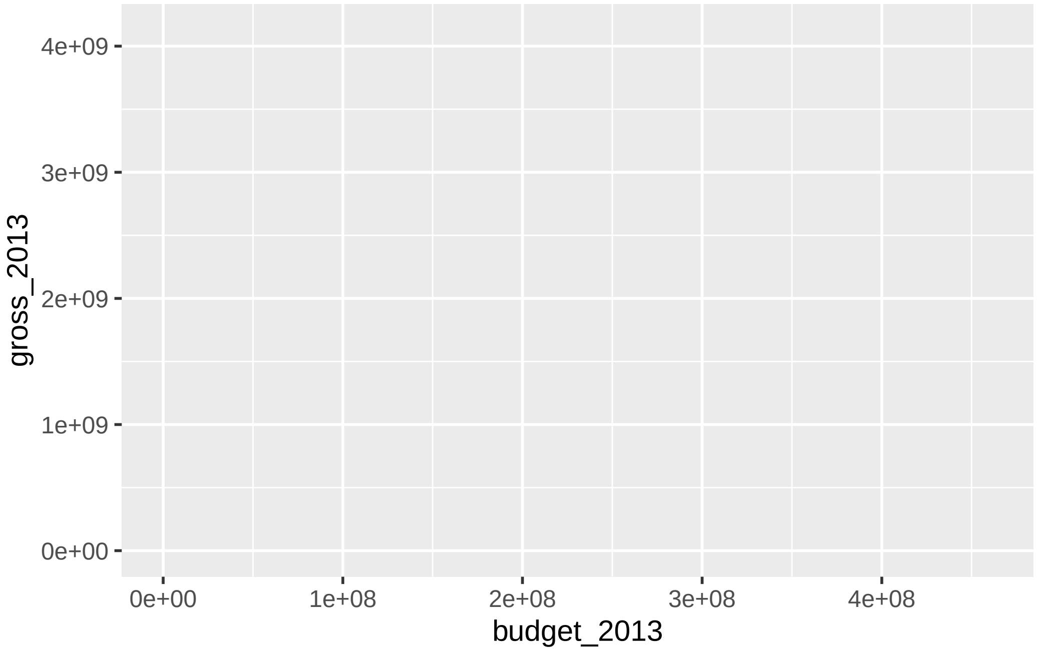
- The `mapping` argument is paired with an aesthetic (`aes()`), which tells us how the variables in our data set should be mapped to the visual properties of the graph.

```
ggplot(
  data = bechdel,
  mapping = aes(x = budget_2013, y = gross_2013)
)
```



As we previously mentioned, we often omit the names of the first two arguments in R functions. So you'll often see this written as:

```
ggplot(bechdel, aes(x = budget_2013, y = gross_2013))
```

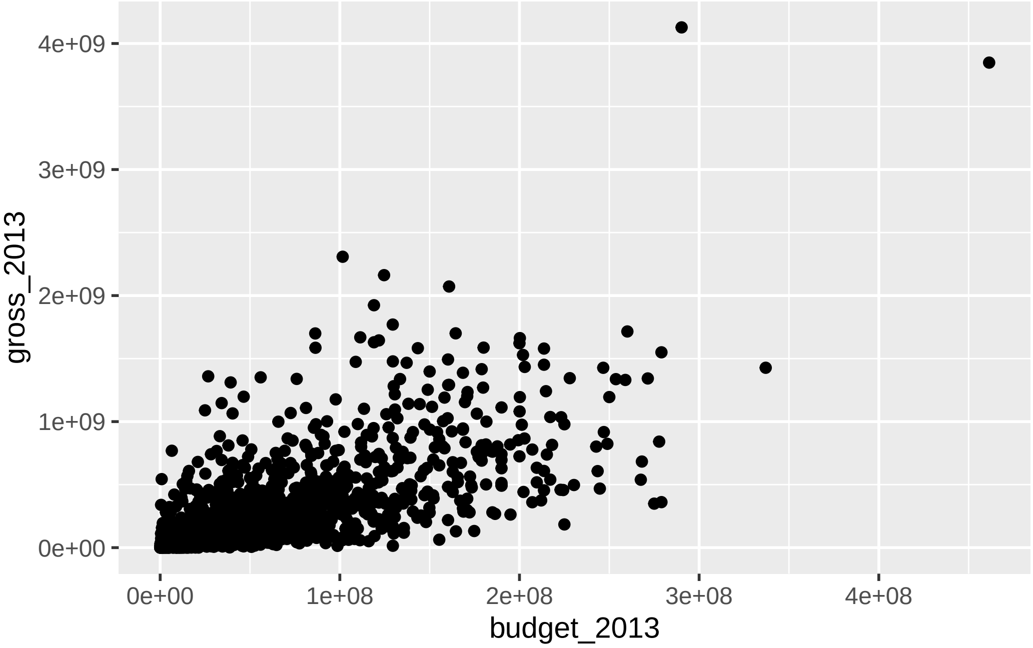


Note that the result is exactly the same.

- The `geom_xx` function specifies the type of plot we want to use to represent the data. In the code below, we use `geom_point` which creates a plot where each observation is represented by a point.

```
ggplot(bechdel, aes(x = budget_2013, y = gross_2013)) +
  geom_point()
```

```
Warning: Removed 15 rows containing missing values or values outside the scale range
(`geom_point()`).
```



Note that this results in a warning as well. What does the warning mean?

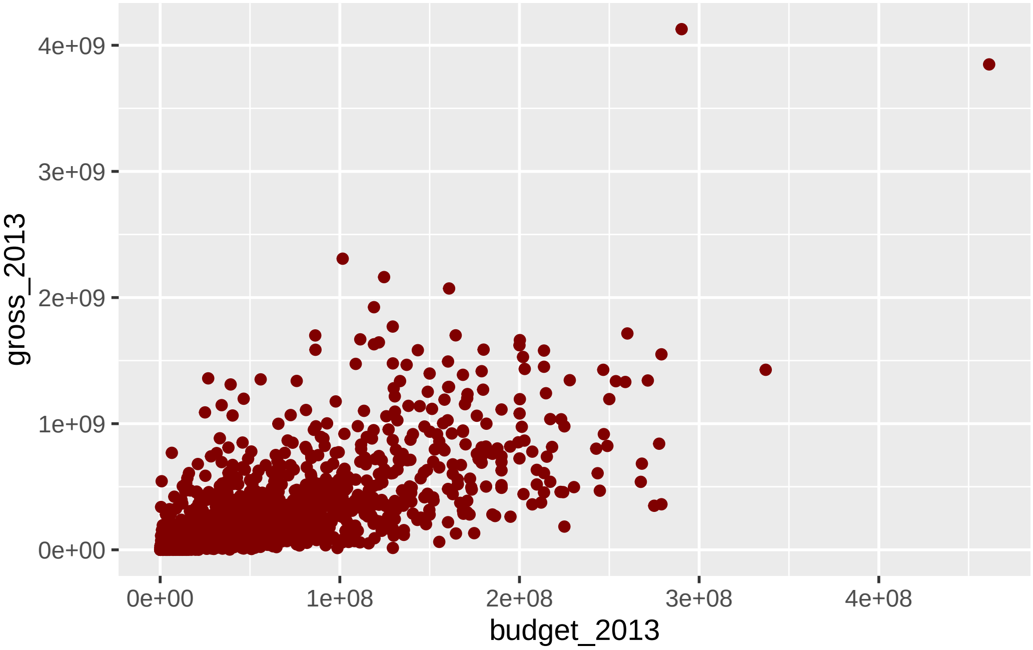
Gross revenue vs. budget

Step 1 - Your turn

Modify the following plot to change the color of all points to a different color.

> Tip
>
> See http://www.stat.columbia.edu/~tzheng/files/Rcolor.pdf for many color options you can use by name in R or use the hex code for a color of your choice.

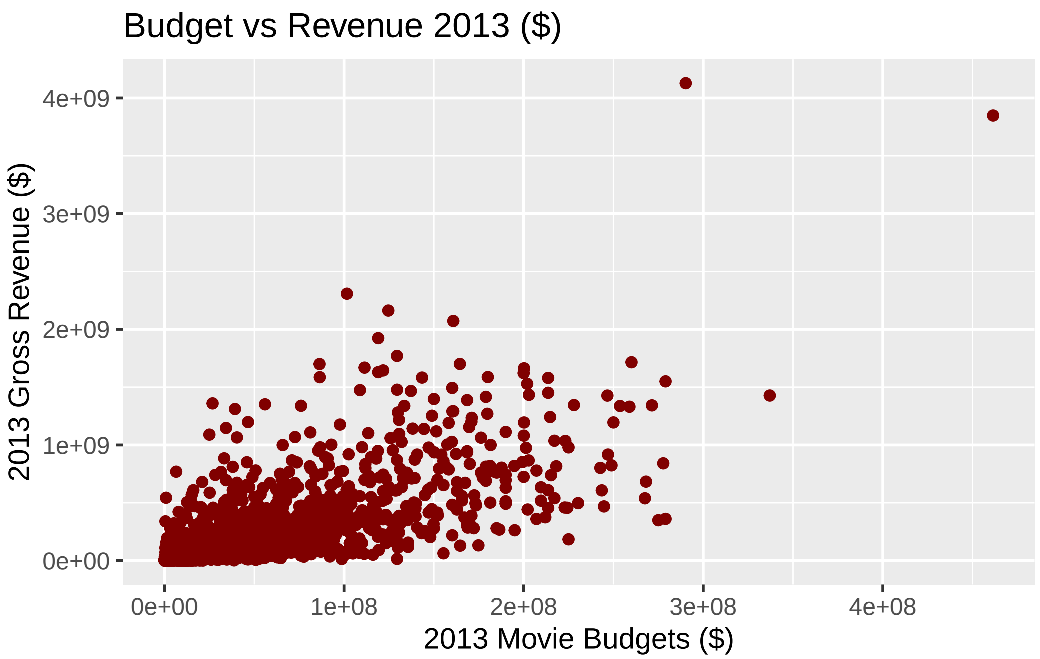
```
ggplot(bechdel, aes(x = budget_2013, y = gross_2013)) +
  geom_point(color = "#800000")
```



Step 2 - Your turn

Add labels for the title and x and y axes.

```
ggplot(bechdel, aes(x = budget_2013, y = gross_2013))+
  geom_point(color = "#800000") +
  labs(
    x = "2013 Movie Budgets ($)",
    y = "2013 Gross Revenue ($)",
    title = "Budget vs Revenue 2013 ($)"
  )
```



Step 3 - Your turn

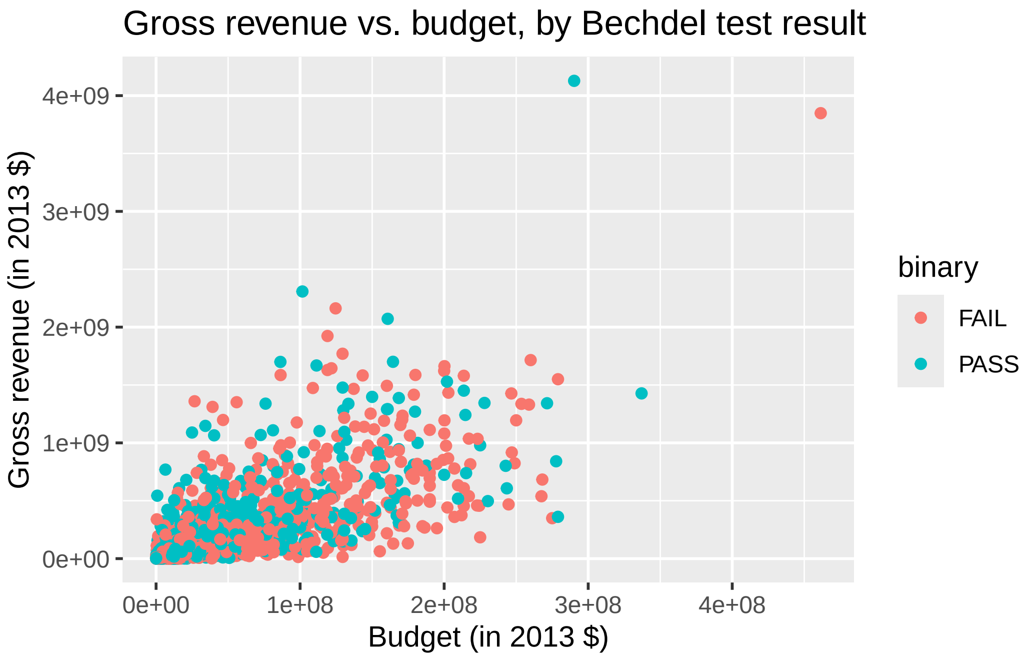
An aesthetic is a visual property of one of the objects in your plot. Commonly used aesthetic options are:

- color
- fill
- shape
- size
- alpha (transparency)

Modify the plot below, so the `color` of the points is based on the variable `binary`.

```
ggplot(bechdel, aes(x = budget_2013, y = gross_2013, colour = binary)) +
  geom_point() +
  labs(
    x = "Budget (in 2013 $)",
    y = "Gross revenue (in 2013 $)",
    title = "Gross revenue vs. budget, by Bechdel test result"
  )
```

```
Warning: Removed 15 rows containing missing values or values outside the scale range
(`geom_point()`).
```

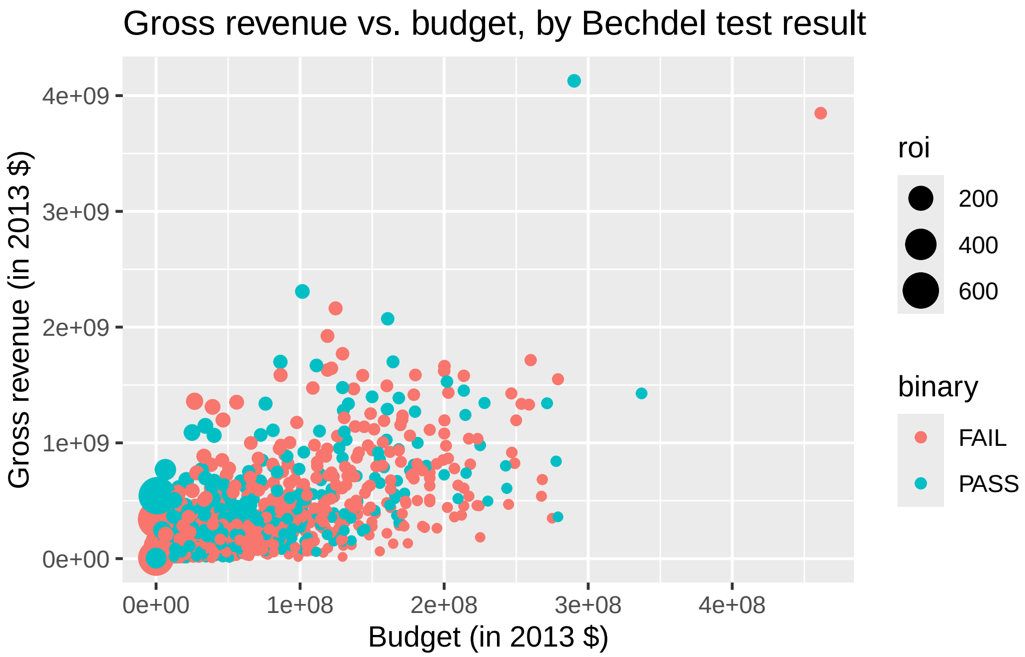


Step 4 - Your turn

Expand on your plot from the previous step to make the size of your points based on `roi`.

```
ggplot(bechdel, aes(x = budget_2013, y = gross_2013, colour = binary, size = roi)) +
  geom_point() +
  labs(
    x = "Budget (in 2013 $)",
    y = "Gross revenue (in 2013 $)",
    title = "Gross revenue vs. budget, by Bechdel test result"
  )
```

```
Warning: Removed 15 rows containing missing values or values outside the scale range
(`geom_point()`).
```

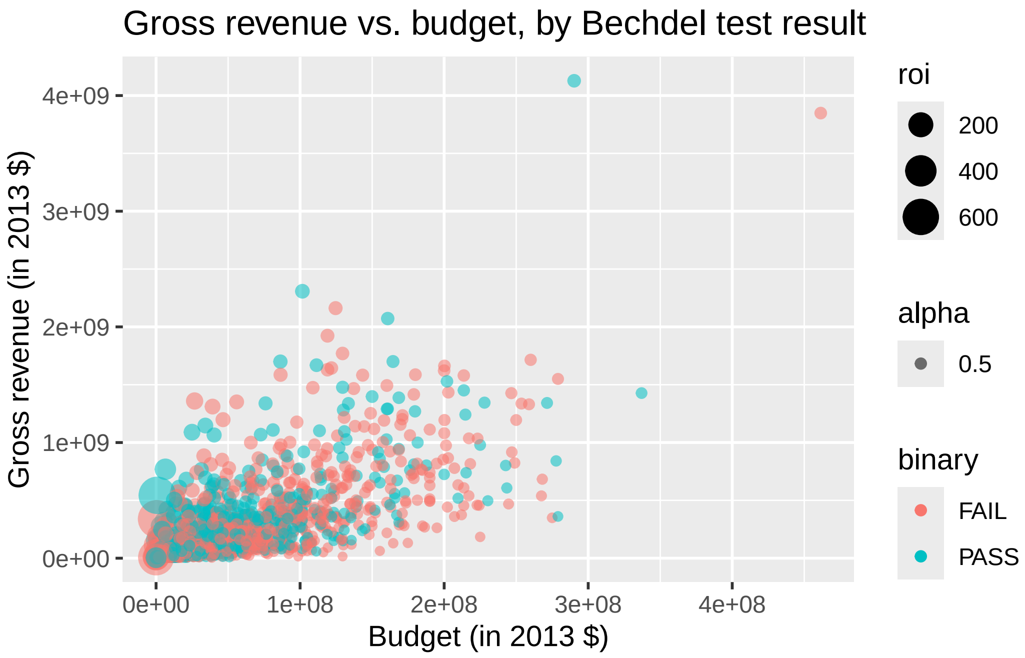


Step 5 - Your turn

Expand on your plot from the previous step to make the transparency (`alpha`) of the points 0.5.

```
ggplot(bechdel, aes(x = budget_2013, y = gross_2013, colour = binary, size = roi, alpha = 0.5
  geom_point() +
  labs(
    x = "Budget (in 2013 $)",
    y = "Gross revenue (in 2013 $)",
    title = "Gross revenue vs. budget, by Bechdel test result"
  )
```

```
Warning: Removed 15 rows containing missing values or values outside the scale range
(`geom_point()`).
```

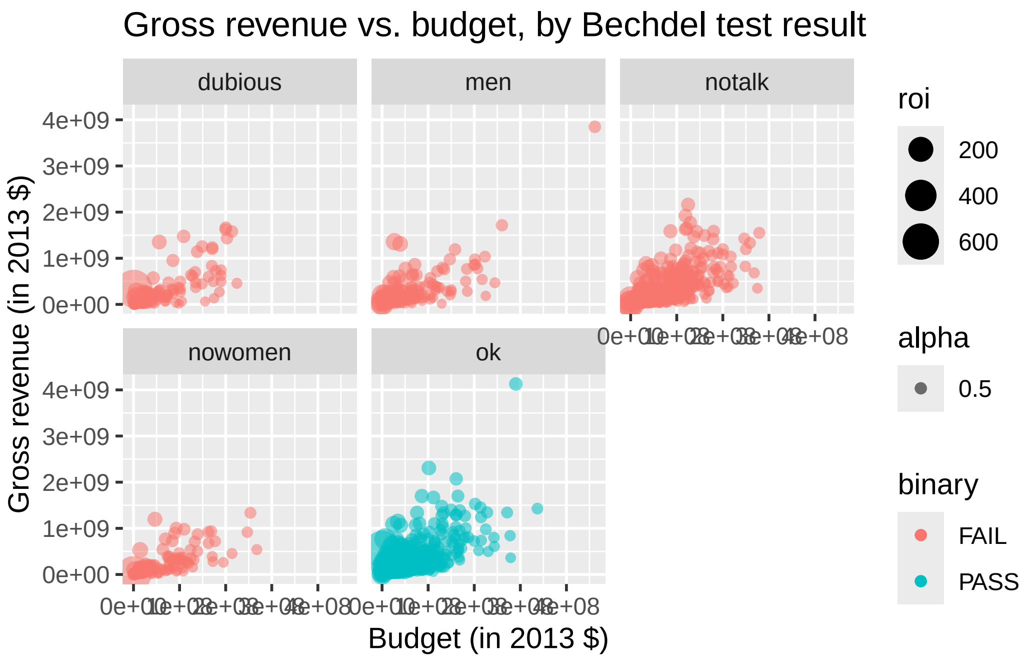


Step 6 - Your turn

Expand on your plot from the previous step by using `facet_wrap` to display the association between budget and gross for different values of `clean_test`.

```
ggplot(bechdel, aes(x = budget_2013, y = gross_2013, colour = binary, size = roi, alpha = 0.5
  geom_point() +
  facet_wrap(~ clean_test) +
  labs(
    x = "Budget (in 2013 $)",
    y = "Gross revenue (in 2013 $)",
    title = "Gross revenue vs. budget, by Bechdel test result"
  )
```

```
Warning: Removed 15 rows containing missing values or values outside the scale range
(`geom_point()`).
```



Step 7 - Demo

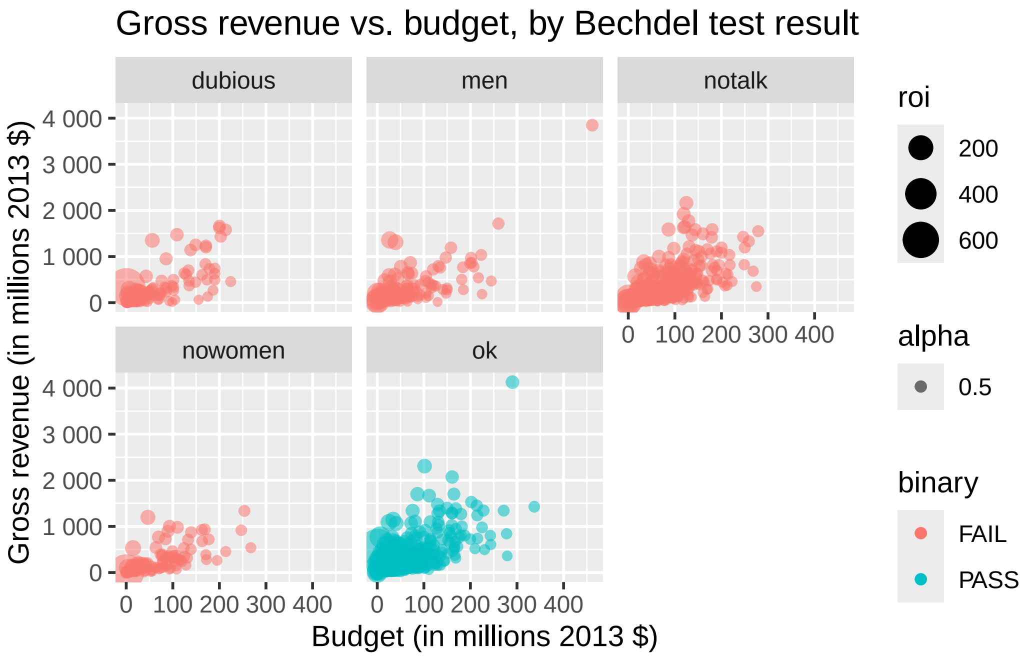
Improve your plot from the previous step by making the x and y scales more legible.

Tip

Make use of the **scales** package, specifically the `scale_x_continuous()` and `scale_y_continuous()` functions.

```
ggplot(bechdel, aes(x = budget_2013, y = gross_2013, colour = binary, size = roi, alpha = 0.5
  geom_point() +
  facet_wrap(~ clean_test) +
  labs(
    x = "Budget (in millions 2013 $)",
    y = "Gross revenue (in millions 2013 $)",
    title = "Gross revenue vs. budget, by Bechdel test result"
  ) +
  scale_x_continuous(label = label_number(scale = 1/1000000)) +
scale_y_continuous(label = label_number(scale = 1/1000000))
```

```
Warning: Removed 15 rows containing missing values or values outside the scale range
(`geom_point()`).
```

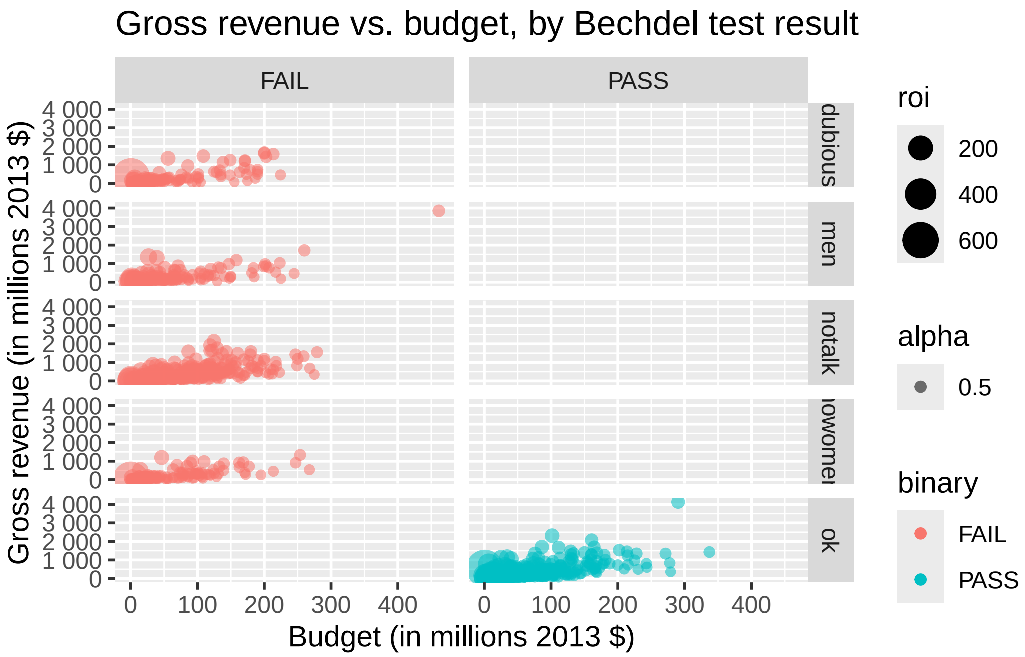


Step 8 - Your turn

Expand on your plot from the previous step by using `facet_grid` to display the association between budget and gross for different combinations of `clean_test` and `binary`. Comment on whether this was a useful update.

```
ggplot(bechdel, aes(x = budget_2013, y = gross_2013, colour = binary, size = roi, alpha = 0.5
  geom_point() +
  facet_grid(rows = vars(clean_test), cols = vars(binary)) +
  labs(
    x = "Budget (in millions 2013 $)",
    y = "Gross revenue (in millions 2013 $)",
    title = "Gross revenue vs. budget, by Bechdel test result"
  ) +
  scale_x_continuous(label = label_number(scale = 1/1000000)) +
scale_y_continuous(label = label_number(scale = 1/1000000))
```

```
Warning: Removed 15 rows containing missing values or values outside the scale range
(`geom_point()`).
```

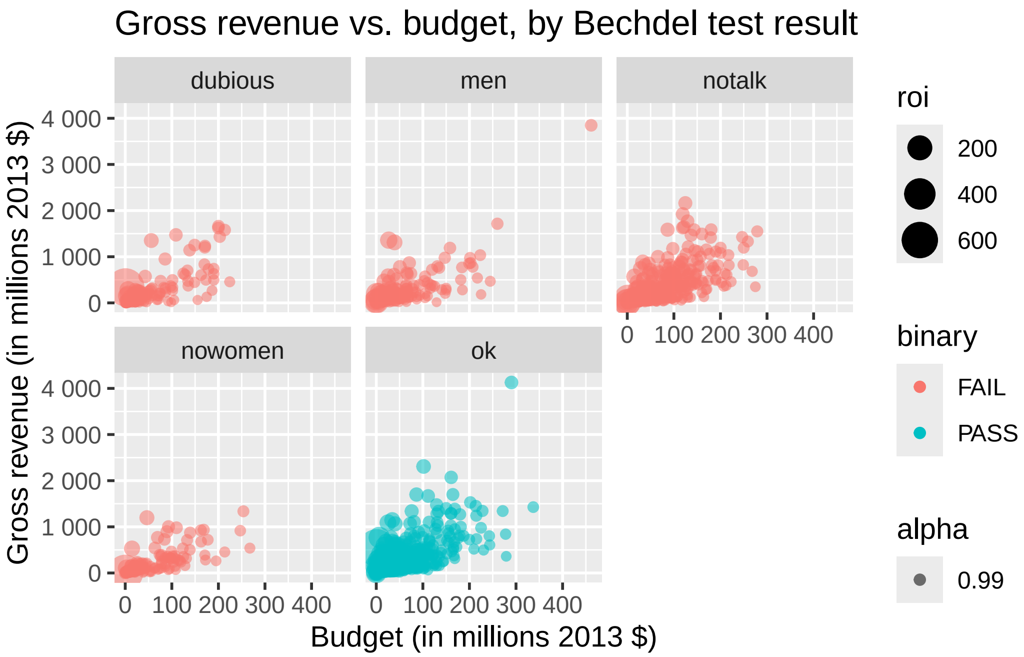


This update only added more visual clutter that made reading the graphs more confusing, the data added also wasn't really helpful.

Step 9 - Demo

What other improvements could we make to this plot?

```
ggplot(bechdel, aes(x = budget_2013, y = gross_2013, colour = binary, size = roi, alpha = 0.
  geom_point() +
  facet_wrap(~ clean_test) +
  labs(
    x = "Budget (in millions 2013 $)",
    y = "Gross revenue (in millions 2013 $)",
    title = "Gross revenue vs. budget, by Bechdel test result"
  ) +
  scale_x_continuous(label = label_number(scale = 1/1000000)) +
scale_y_continuous(label = label_number(scale = 1/1000000))
```



Render, commit, and push

1. If you made any changes since the last render, render again to get the final version of the AE.
2. Check the box next to each document in the Git tab (this is called "staging" the changes). Commit the changes you made using a simple and informative message.
3. Use the **green arrow** to push your changes to your repo on GitHub.
4. Check your repo on GitHub and see the updated files. Once your updated files are in your repo on GitHub, you're good to go!

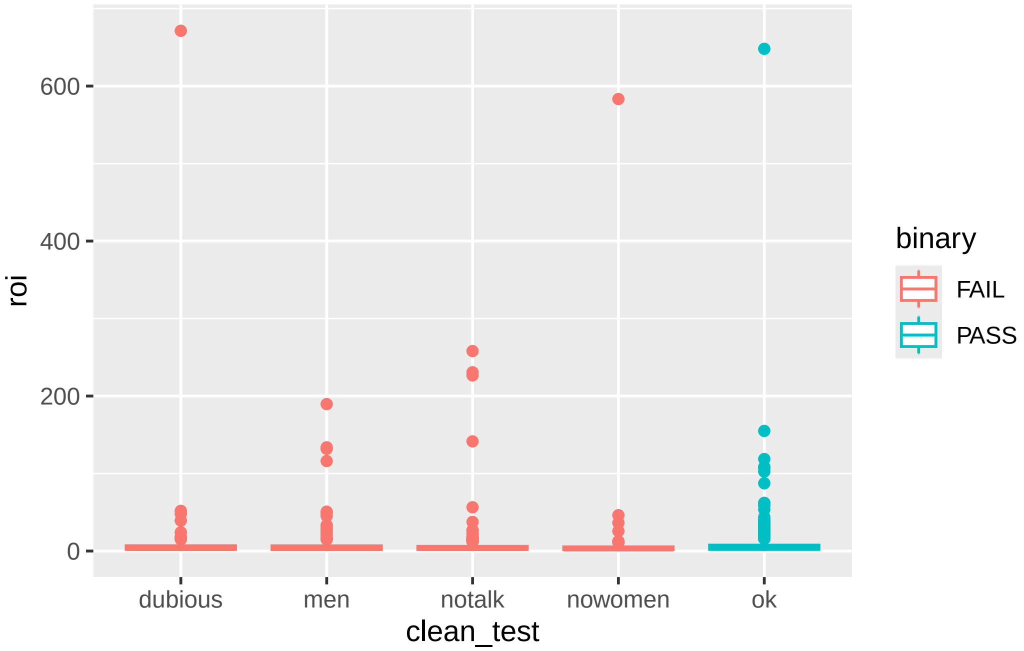
Return-on-investment

Finally, let's take a look at return-on-investment (ROI).

Step 1 - Your turn

Create side-by-side box plots of `roi` by `clean_test` where the boxes are colored by `binary`.

```
ggplot(bechdel, aes(x = clean_test, y = roi, color = binary)) + geom_boxplot()
```



What are those movies with *very* high returns on investment?

```
bechdel |>
  filter(roi > 400) |>
  select(title, roi, budget_2013, gross_2013, year, clean_test)
```

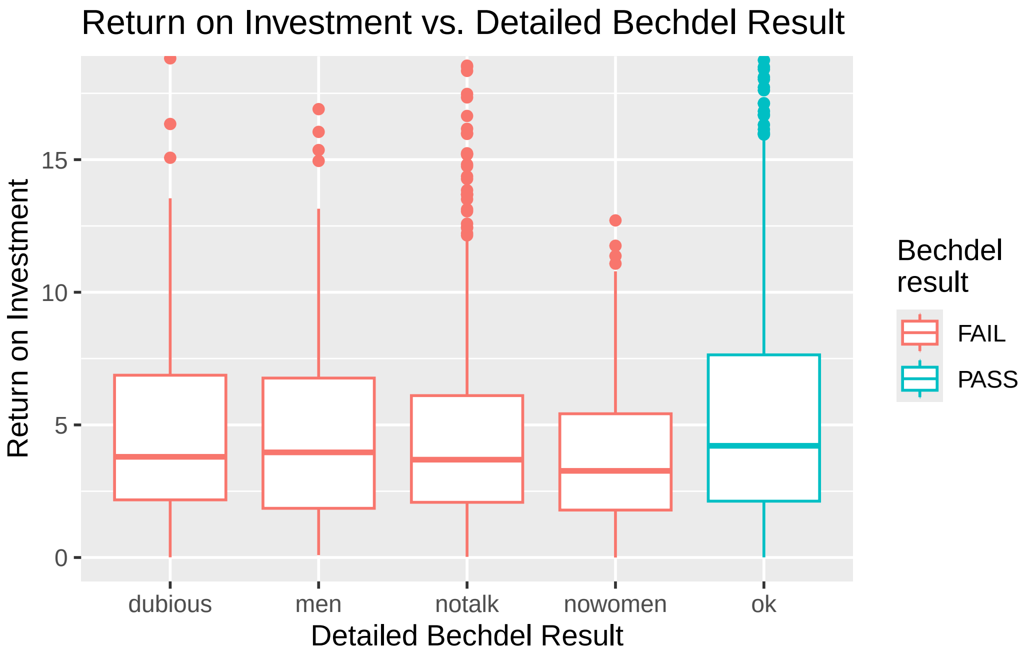
```
# A tibble: 3 x 6
  title                       roi budget_2013 gross_2013  year clean_test
  <chr>                     <dbl>       <dbl>      <dbl> <dbl> <chr>
1 Paranormal Activity        671.      505595  339424558  2007 dubious
2 The Blair Witch Project    648.      839077  543776715  1999 ok
3 El Mariachi                583.       11622    6778946  1992 nowomen
```

Step 2 - Demo

Expand on your plot from the previous step to zoom in on movies with `roi < ___` to get a better view of how the medians across the categories compare.

```
ggplot(bechdel, aes(x = clean_test, y = roi, color = binary)) + geom_boxplot() +
 labs(x = "Detailed Bechdel Result",
    y = "Return on Investment",
    title = "Return on Investment vs. Detailed Bechdel Result", color = "Bechdel\nresult"
```

```
  ) +
  coord_cartesian(ylim = c(0,18))
```



What does this plot say about return-on-investment on movies that pass the Bechdel test?

There is not much difference between the groups, although it could be seen that movies that pass have a slightly greater chance of having a better roi than movies which fail.

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4. Check your repo on GitHub and see the updated files. Once your updated files are in your repo on GitHub, you’re good to go!