Data Visualization using ggplot

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Learning objectives

- Produce boxplots, scatter plots and smoothed plots using ggplot.
- Describe what faceting is and apply faceting in ggplot.
- Modify the aesthetics of an existing ggplot plot (including axis labels and color).
- Build complex and customized plots from data in a data frame.

Building your plots iteratively

- Building plots with ggplot2 is typically an iterative process.
- We start by defining the dataset we'll use, lay out the axes, and choose a geom:
- Then, we start modifying this plot to extract more information from it.
- For instance, we can add transparency (alpha) to avoid overplotting:
- We can also add colors for all the points:
- Or to color each species in the plot differently, you could use a vector as an input to the argument color.
- ggplot2 will provide a different color corresponding to different values in the vector.
 Here is an example where we color with species_id:
- Load required package

library(tidyverse)

Set the directory

setwd("/Users/akamau/Documents/I-StaR/Course 1/Day4/Presentation/")

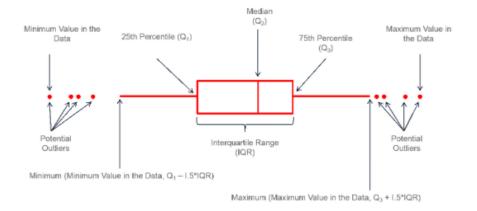
Load the data

```
bw_df <- read.csv("Data/birthweight2.csv")
names(bw_df)</pre>
```

```
## [1] "id" "matage" "ht" "gestwks" "sex" "bweight"
## [7] "ethnic" "lbw" "agegrp" "lbw2" "agegrp1"
```

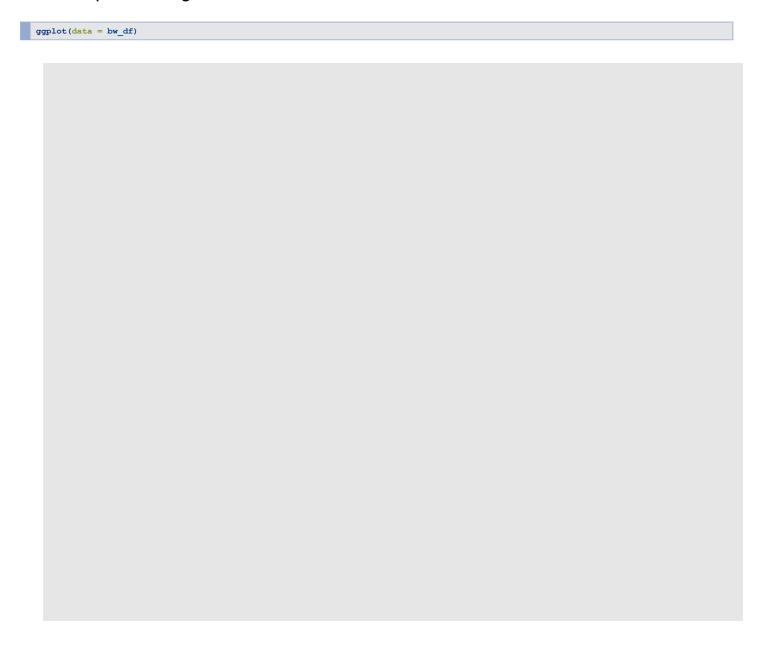
Boxplot

- We will use boxplots to visualize the distribution of birth weight by gender:
- Boxplots provides a standardized way of displaying the distribution of data
- It attempts to provide a visual shape of the data distribution.
- This is based on some summary measures: min, 1^{st} quartile, median, 3^{rd} quartile, max
- Range, IQR, Outliers $3 \times IQR$ above 3^{rd} or below 1^{st} quartiles.



Lets do a Box plot?

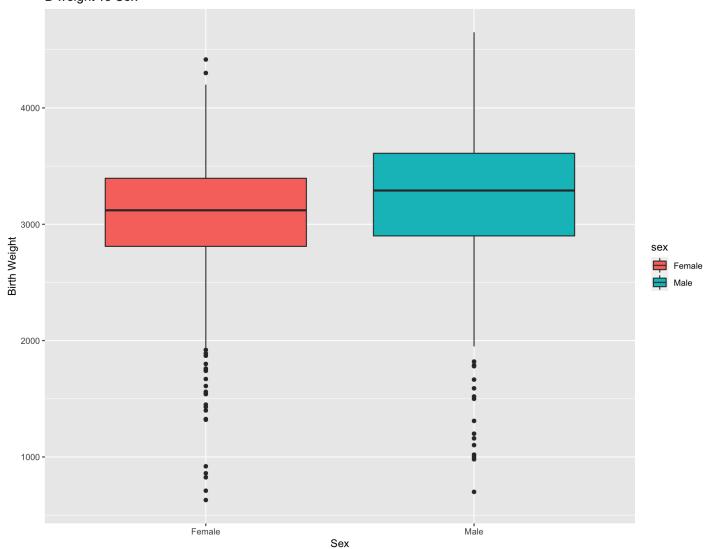
A box plot of bweight vs sex



Adding aesthetics and labels

```
ggplot(data = bw_df) + geom_boxplot(aes(y = bweight, x = sex,
fill = sex)) + ylab("Birth Weight") + xlab("Sex") + ggtitle("B weight vs Sex")
```

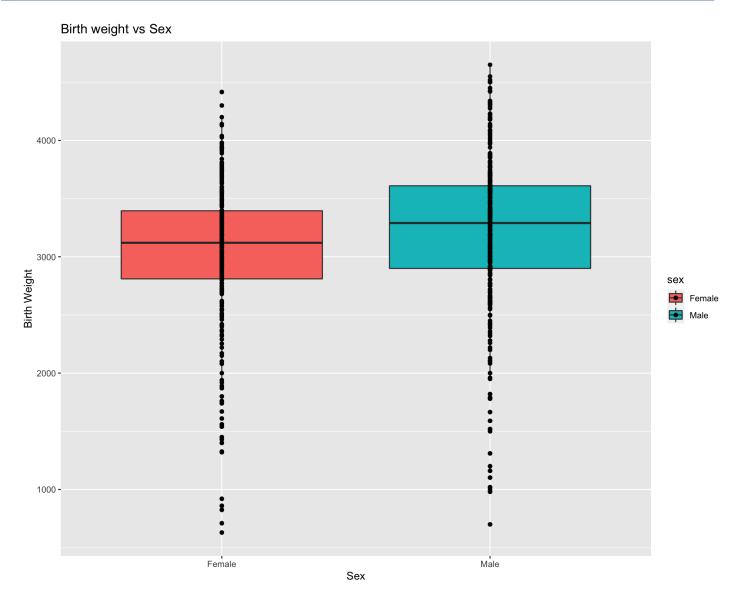




Box plot and add scatter

By adding points to the boxplot, we can have a better idea of the number of measurements and of their distribution:

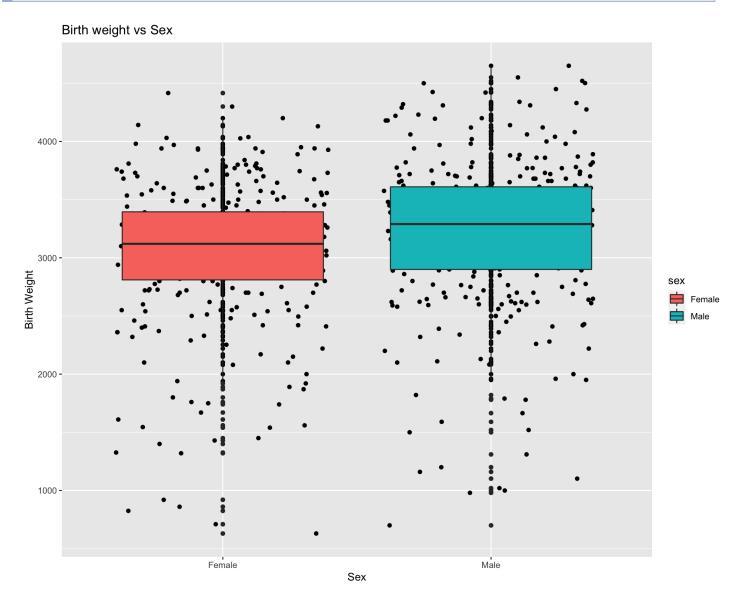
```
ggplot(data = bw_df, mapping = aes(y = bweight, x = sex, fill = sex)) +
geom_boxplot() + geom_point() + ylab("Birth Weight") + xlab("Sex") +
ggtitle("Birth weight vs Sex")
```



Box plot and add scatter points that are jittered

- We will jitter points to reduce overplotting
- Notice how the boxplot layer is behind the jitter layer? What do you need to change in the code to put the boxplot in front of the points such that it's not hidden?

```
ggplot(data = bw_df, mapping = aes(y = bweight, x = sex, fill = sex)) +
geom_point() + geom_jitter() + geom_boxplot() + ylab("Birth Weight") +
xlab("Sex") + ggtitle("Birth weight vs Sex")
```

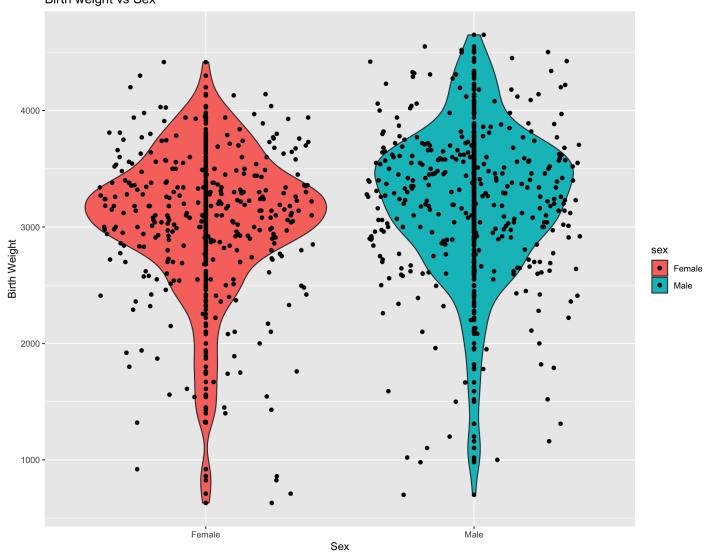


- Boxplots are useful summaries, but hide the shape of the distribution.
- For example, if there is a bimodal distribution, it would not be observed with a boxplot.
- An alternative to the boxplot is the violin plot (sometimes known as a beanplot), where the shape (of the density of points) is drawn.
- Replace the box plot with a violin plot; see geom_violin().

Violin plot

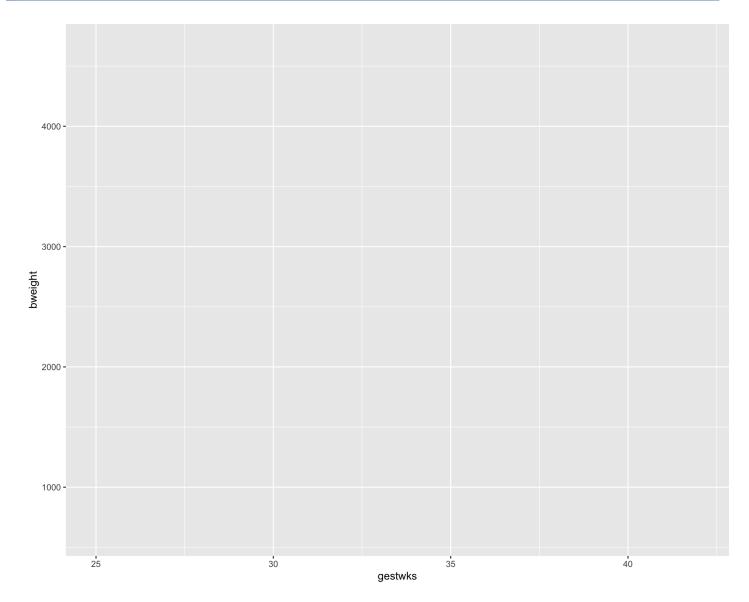
```
ggplot(data = bw_df, mapping = aes(y = bweight, x = sex, fill = sex)) +
  geom_violin() + geom_point() + geom_jitter() + ylab("Birth Weight") +
  xlab("Sex") + ggtitle("Birth weight vs Sex")
```

Birth weight vs Sex

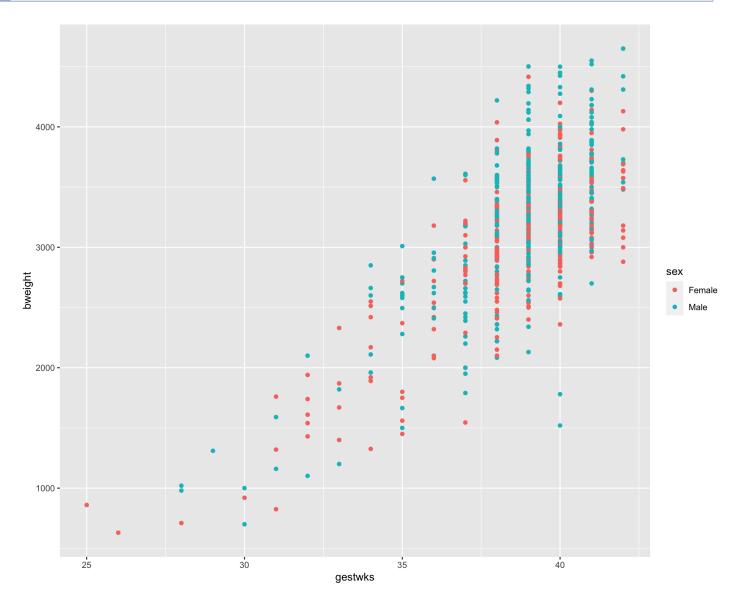


Scatter plot with ggplot2

- We can build a plot sequentially to see how each grammatical layer changes the appearance
- Start with data and aesthetics



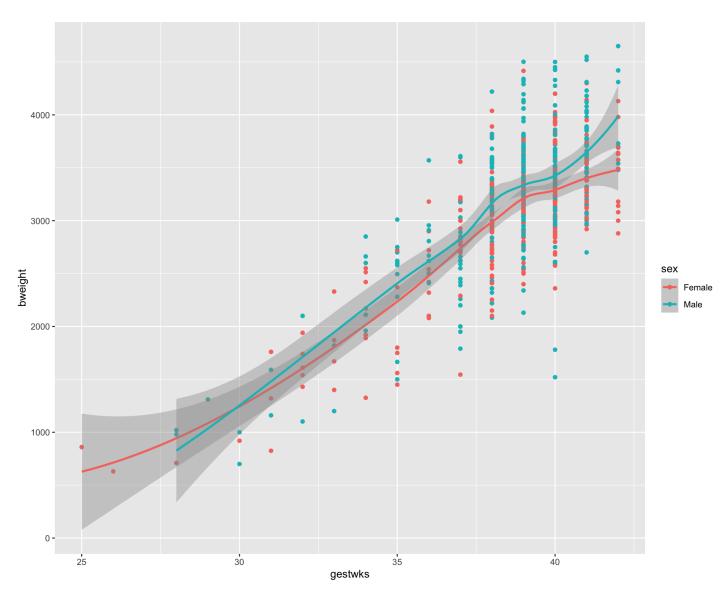
Add a point geom



Add a smooth geom

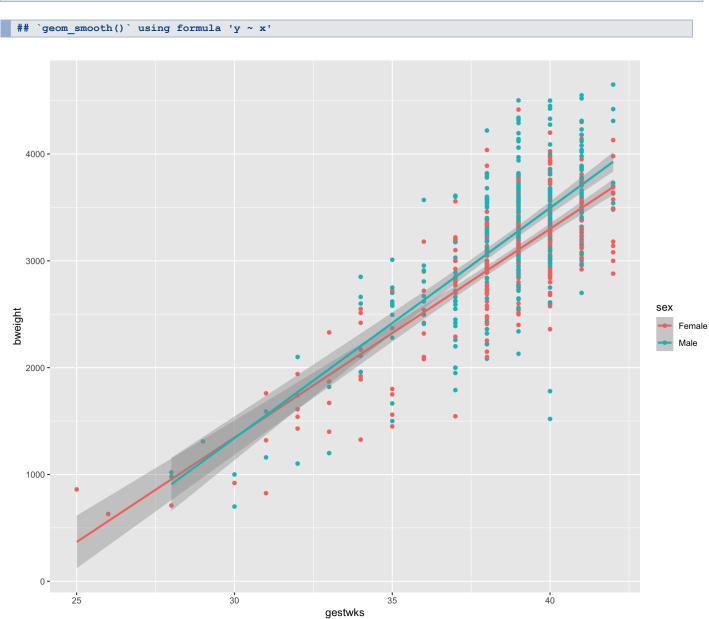
To add a regression line on a scatter plot, use the function geom_smooth()





Make the smooth geom straight

geom_smooth() is used in combination with the argument method = Im. Im stands for linear model.

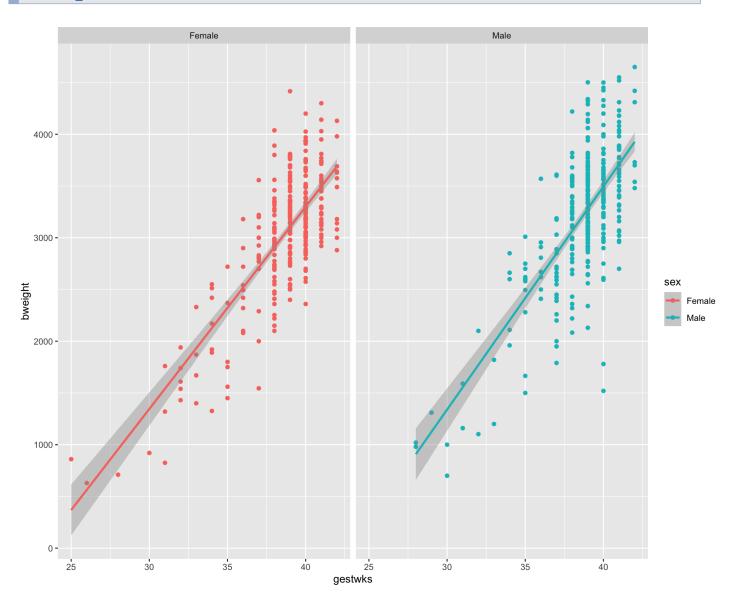


Faceting

- ggplot has a special technique called faceting that allows the user to split one plot into multiple plots based on a factor included in the dataset.
- We will use it to make a scatter plot of birth weight vs gestwks stratified by gender:
- Now we would like to split each plot by the sex of each individual measured.
- You can also organise the panels only by columns (or only by rows):

Facet by sex

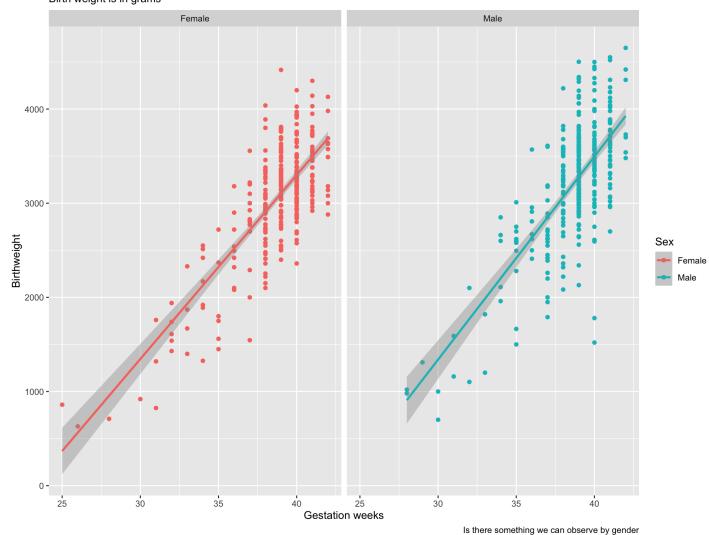
```
## `geom_smooth()` using formula 'y ~ x'
```



add labels

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

Lower gestation weeks leads to low birthweight Birth weight is in grams

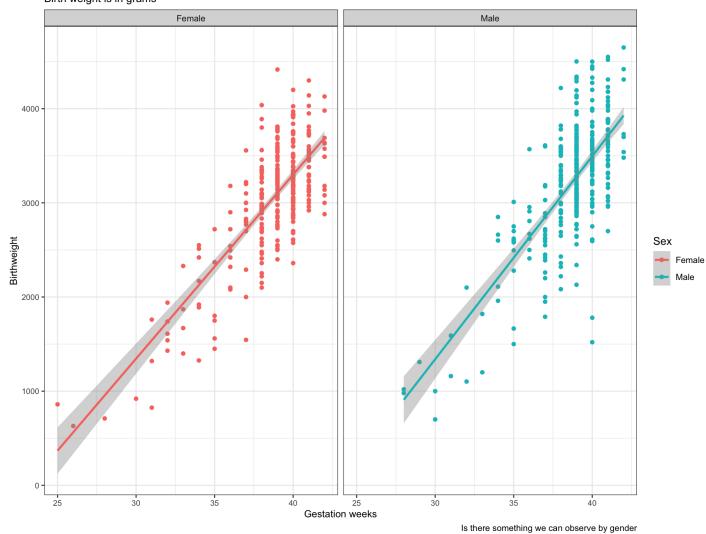


adding ggplot2 themes

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

Lower gestation weeks leads to low birthweight

Birth weight is in grams



Exporting plots

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

Useful link and resource with examples and code

https://www.data-to-viz.com/

Break out session - Exercises

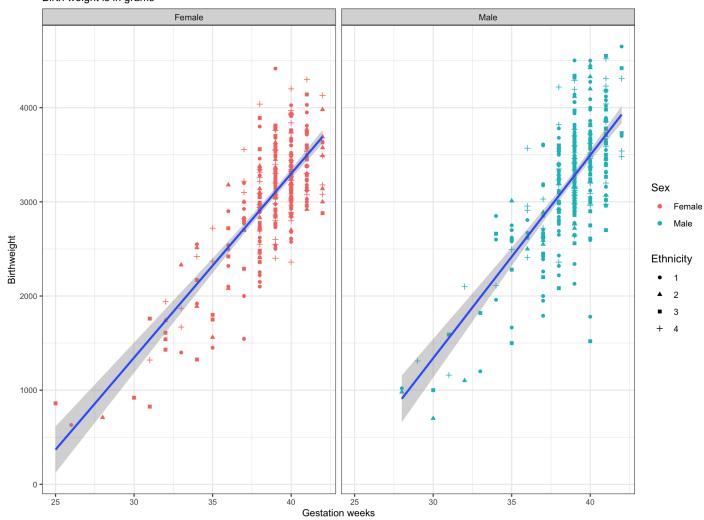
- Replicate the plot above
- Can you make the shape of the points in the scatter plot vary with ethnicity?
- add a scale shape attribute. Hint use: scale_shape_discrete(name="legend title")
- Instead of having multiple smoothing lines for each ethnic group, integrate them all under one line.

Solution

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

Lower gestation weeks leads to low birthweight

Birth weight is in grams



Is there something we can observe by gender