Week 2: Data Summary and Visualization

5. Putting it together

Stat 140 - 04

Mount Holyoke College

Dr. Shan Shan

Slides posted at *http://sshanshans.github.io/stat140*

Outline

1. Today: Putting it all together

2. Main ideas
    1. Data visualization with ggplot
    2. Data wrangling

Outline

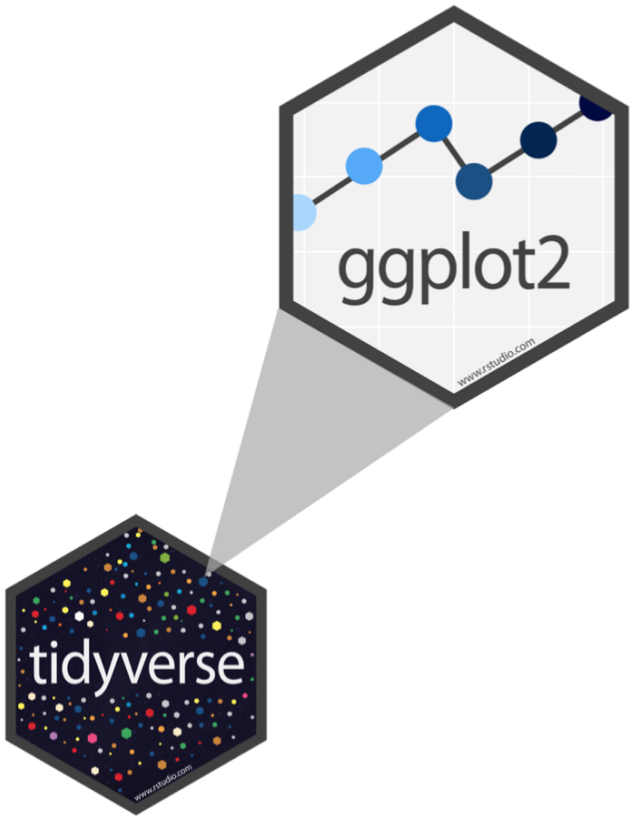
1. Today: Putting it all together

2. Main ideas
    1. Data visualization with ggplot
    2. Data wrangling

Outline

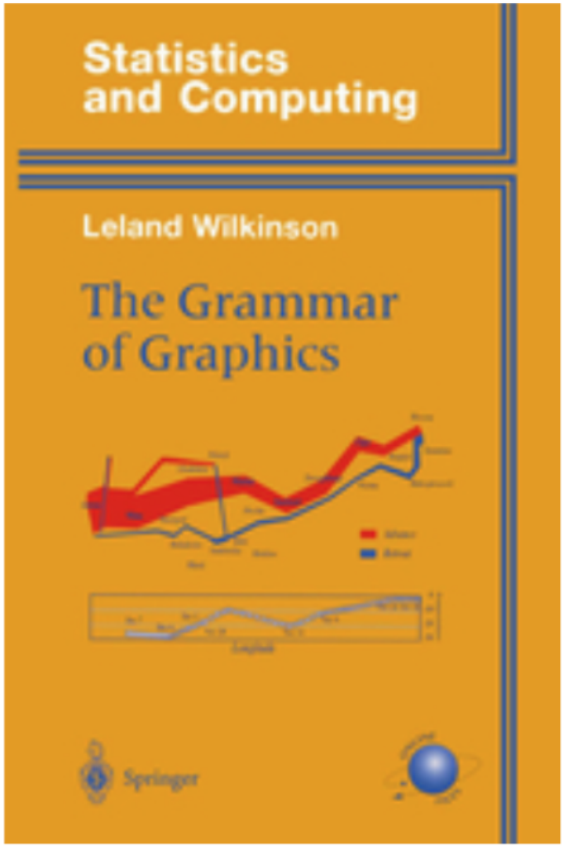
1. Today: Putting it all together

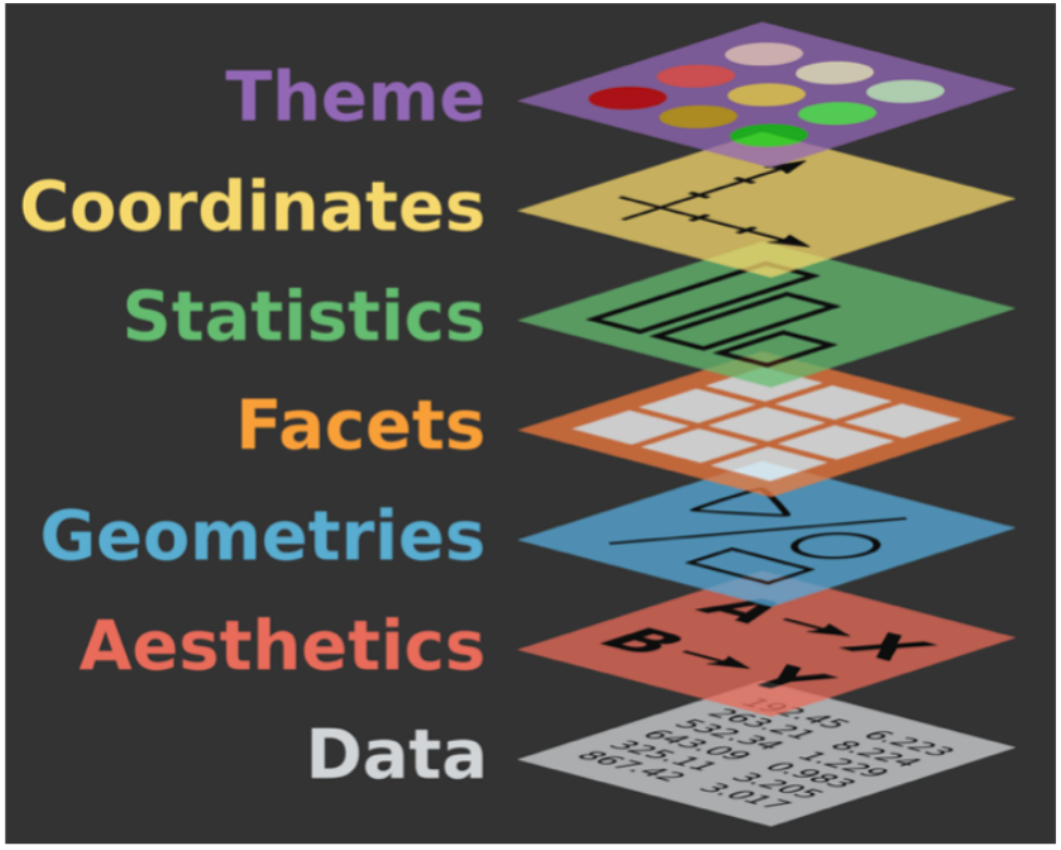
2. Main ideas
    1. Data visualization with ggplot
    2. Data wrangling



- ggplot2 is tidyverse's data visualization package
- The gg in "ggplot2" stands for Grammar of Graphics
- It is inspired by the book Grammar of Graphics by Leland Wilkinson

A grammar of graphics is a tool that enables us to concisely describe the components of a graphic





ggplot() is the main function in ggplot2

Structure of the code for plots can be summarized as

```
ggplot(data = [d], mapping = aes(x = [x-var], y = [y-var])) +
  geom_xxx()
```

A statistical graphic is a **mapping** of **data** variables to **aes**thetic attributes of **geo**metric objects.

To use ggplot2 functions, first load tidyverse

```
library(tidyverse)
```

```
ggplot(data = [d], mapping = aes(x = [x-var], y = [y-var])) +
    geom_xxx()
```

First, we need to tell R that we want to create a ggplot. This is done by using the **ggplot( )** function.

```
ggplot(data = [d], mapping = aes(x = [x-var], y = [y-var])) +
    geom_xxx()
```

First, we need to tell R that we want to create a ggplot. This is done by using the **ggplot( )** function.

Within the parentheses, we can specify the data frame that contains what we want to plot, using the option **data = [d]**.

```
ggplot(data = [d], mapping = aes(x = [x-var], y = [y-var])) +
    geom_xxx()
```

First, we need to tell R that we want to create a ggplot. This is done by using the **ggplot( )** function.

Within the parentheses, we can specify the data frame that contains what we want to plot, using the option **data = [d]**.

We also have to tell ggplot what columns of the data frame to actually plot – we do this with the argument that stands for aesthetics: **aes( )**.

```
ggplot(data = [d], mapping = aes(x = [x-var], y = [y-var])) +
    geom_xxx()
```

First, we need to tell R that we want to create a ggplot. This is done by using the **ggplot( )** function.

Within the parentheses, we can specify the data frame that contains what we want to plot, using the option **data = [d]**.

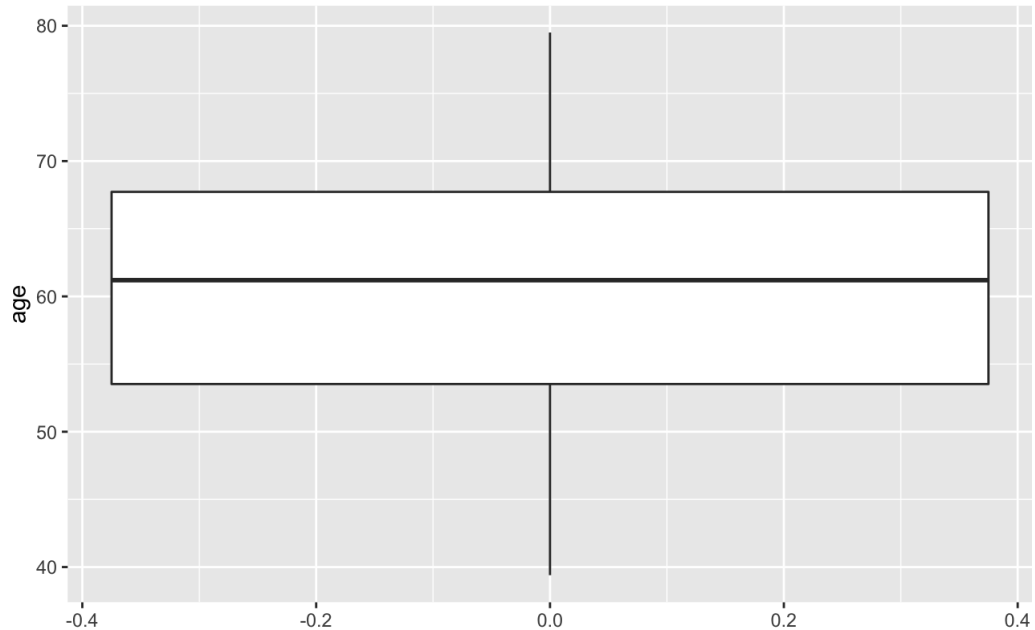
We also have to tell ggplot what columns of the data frame to actually plot – we do this with the argument that stands for aesthetics: **aes( )**.

Finally, add a geom layer, which will determine the type of visual representation that will be used for the data. We use **geom_point**

Code:

```
ggplot(data = senate_113, mapping = aes(y = age)) +
    geom_boxplot()
```

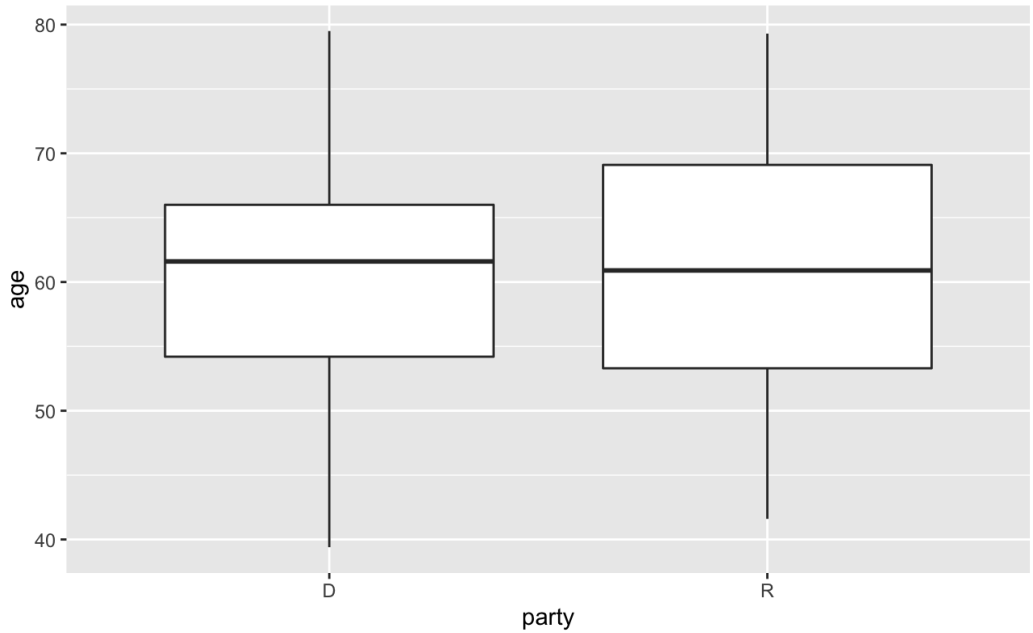
Plot:



Code:

```
ggplot(data = senate_113, mapping = aes(x = party, y = age))
+ geom_boxplot()
```

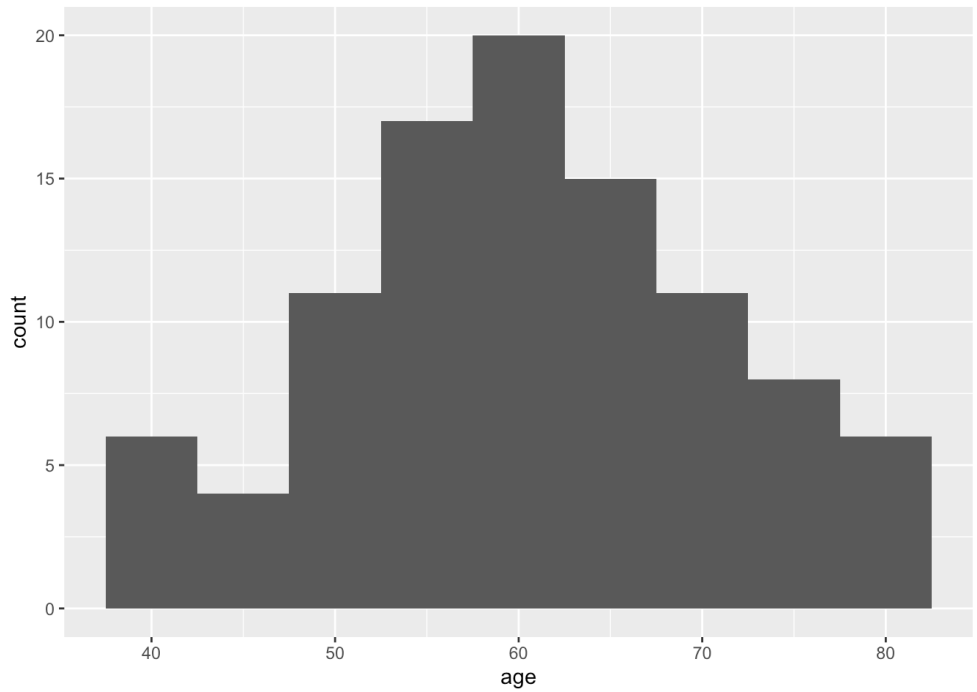
Plot:



Code:

```
ggplot(data = senate_113, mapping = aes(x = age)) +
    geom_histogram(binwidth = 5)
```

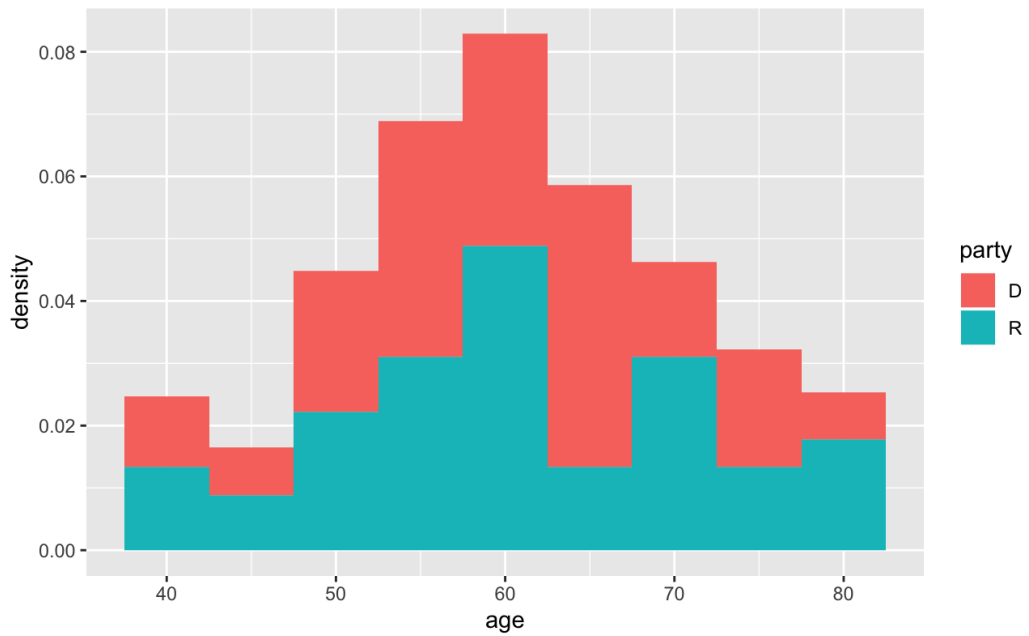
Plot:



Code:

```
ggplot(data = senate_113, mapping = aes(x = age, fill = party)) + geom_histogram(binwidth = 5)
```

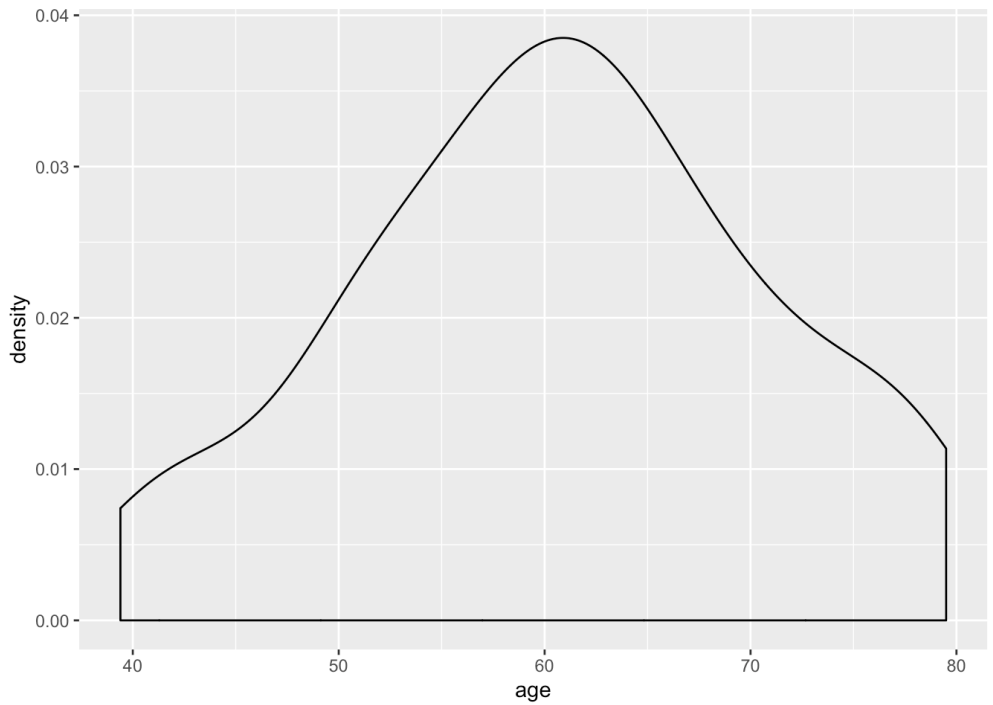
Plot:



Code:

```
ggplot(data = senate_113, mapping = aes(x = age)) +
    geom_density()
```

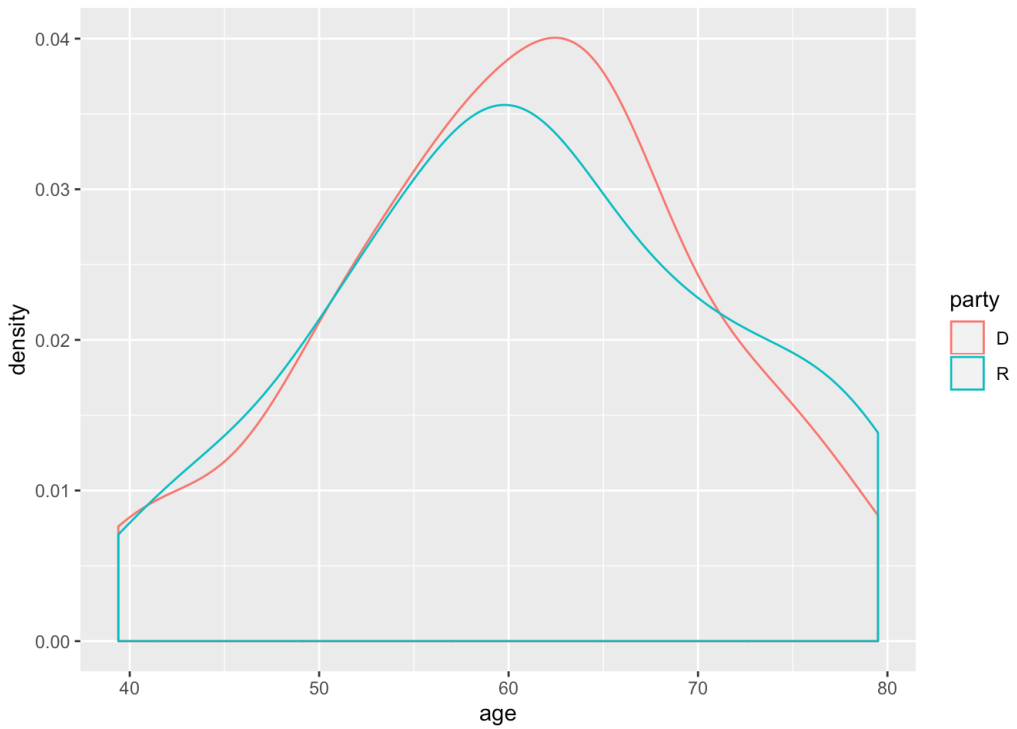
Plot:



Code:

```
ggplot(data = senate_113, mapping = aes(x = age, color = party)) + geom_density()
```

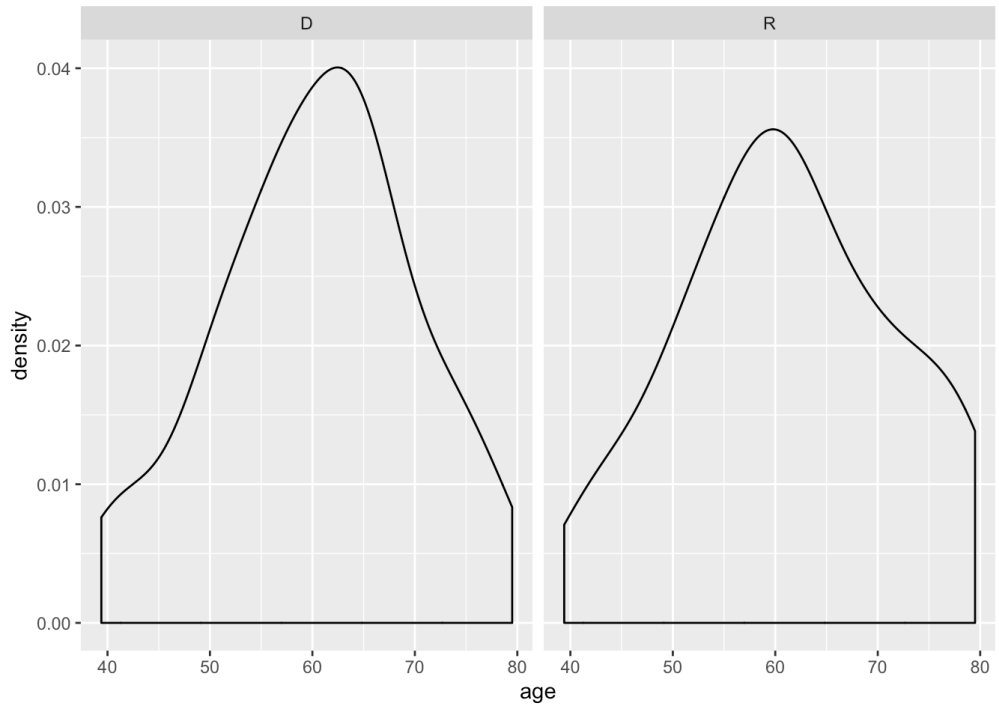
Plot:



Code:

```
ggplot(data = senate_113, mapping = aes(x = age)) +
    geom_density() +
    facet_wrap(~ party)
```

Plot:



Outline

1. Today: Putting it all together

2. Main ideas
    1. Data visualization with ggplot
    2. Data wrangling

`https://en.wikipedia.org/wiki/The_Treachery_of_Images`

Rene Magritte, 1929

dplyr functions work with pipes and expect **tidy data**. In tidy data:

&

Each **variable** is in its own **column**

Each **observation**, or **case**, is in its own **row**

pipes

x %>% f(y) becomes **f(x, y)**

Slides from Ben Baumer

The expression

```
mydata %>%
verb(arguments)
```

is the same as

```
verb(mydata, arguments)
```

Thus,

```
function(x, args)
```

has the same effect as

```
x %>%
function(args)
```

Slides from Ben Baumer

Instead of having to read/write:

```
select(filter(mutate(data, args1), args2), args3)
```

You can write:

```
data %>%
    mutate(args1) %>%
    filter(args2) %>%
    select(args3)
```

Slides from Ben Baumer

https://youtu.be/R6xKM-H2awE

Slides from Ben Baumer

Nested form:

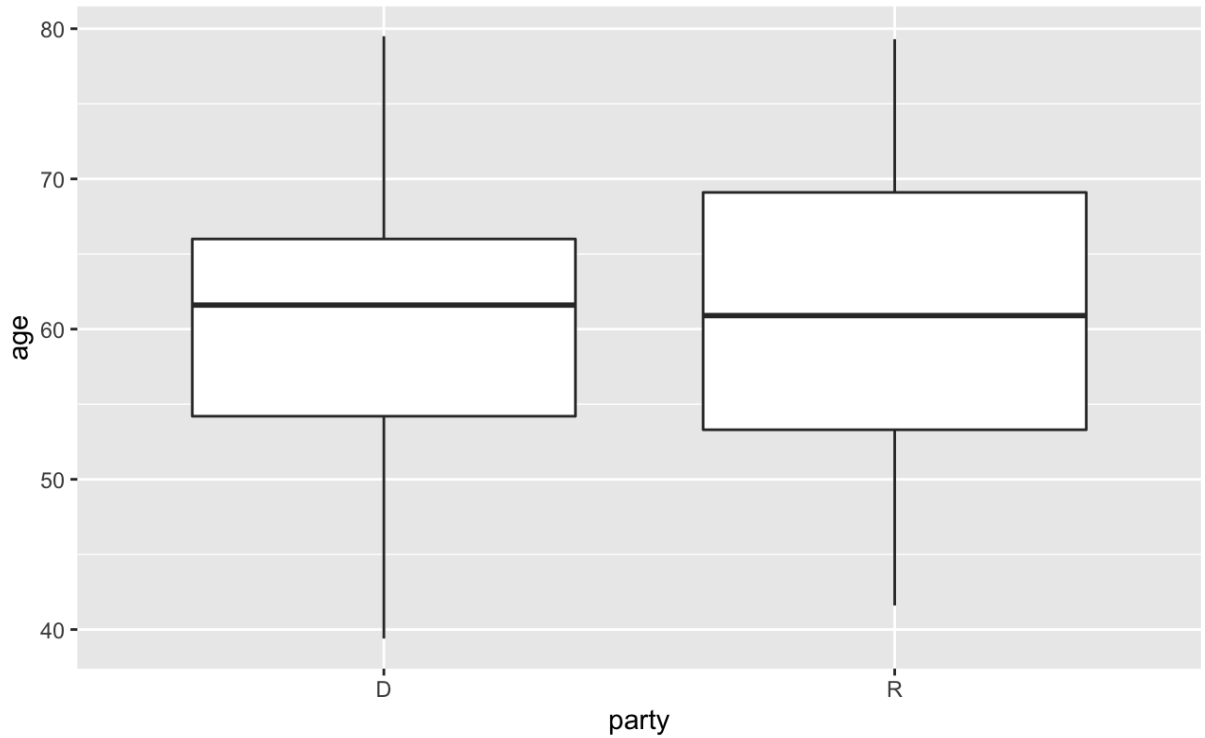
```
bop(scoop(hop(foo_foo, through = forest), up = field_mice), on = head)
```

With pipes:

```
foo_foo %>%
    hop(through = forest) %>%
    scoop(up = field_mouse) %>%
    bop(on = head)
```

Slides from Ben Baumer

Recall the data set called ‘senate 113‘ with information about the senators in the 113th US Senate. Below is a side by side box plot of the ‘age‘ variable across two parties: Democrats and Republicans.



Code:

```
senate_113 %>%
    group_by(party) %>%
    summarize(
        mean_wt = mean(age),
        median_wt = median(age),
        q1_wt = quantile(age, probs = 0.25),
        q3_wt = quantile(age, probs = 0.75),
        iqr_wt = IQR(age),
        var_wt = var(age),
        sd_wt = sd(age)
    )
```

Output:

party <chr>	mean_wt <dbl>	median_wt <dbl>	q1_wt <dbl>	q3_wt <dbl>	iqr_wt <dbl>	var_wt <dbl>	sd_wt <dbl>
D	60.38679	61.6	54.2	66.0	11.8	94.52694	9.722496
R	61.20000	60.9	53.3	69.1	15.8	110.61773	10.517496

Code:

```
senate_113 %>%
    arrange(age) %>%
    head()
```

Output:

firstname <chr>	**middlename** <chr>	**lastname** <chr>	**birthday** <date>	**state** <chr>	**party** <chr>	**age** <dbl>
Christopher	S.	Murphy	1973-08-03	CT	D	39.4
Brian	Emanuel	Schatz	1972-10-20	HI	D	40.2
Martin	*NA*	Heinrich	1971-10-17	NM	D	41.2
Marco	*NA*	Rubio	1971-05-28	FL	R	41.6
Mike	*NA*	Lee	1971-06-04	UT	R	41.6
Ted	*NA*	Cruz	1970-12-22	TX	R	42.0

Code:

```
senate_113 %>%
    arrange(desc(age)) %>%
    head()
```

Output:

firstname <chr>	**middlename** <chr>	**lastname** <chr>	**birthday** <date>	**state** <chr>	**party** <chr>	**age** <dbl>
Dianne	*NA*	Feinstein	1933-06-22	CA	D	79.5
Charles	E.	Grassley	1933-09-17	IA	R	79.3
Orrin	G.	Hatch	1934-03-22	UT	R	78.8
Richard	C.	Shelby	1934-05-06	AL	R	78.7
Carl	*NA*	Levin	1934-06-28	MI	D	78.5
James	M.	Inhofe	1934-11-17	OK	R	78.1

Code:

```
senate_113 %>%
    mutate(age = floor(age)) %>%
    head()
```

Output:

firstname <chr>	**middlename** <chr>	**lastname** <chr>	**birthday** <date>	**state** <chr>	**party** <chr>	**age** <dbl>
Dianne	*NA*	Feinstein	1933-06-22	CA	D	79
Charles	E.	Grassley	1933-09-17	IA	R	79
Orrin	G.	Hatch	1934-03-22	UT	R	78
Richard	C.	Shelby	1934-05-06	AL	R	78
Carl	*NA*	Levin	1934-06-28	MI	D	78
James	M.	Inhofe	1934-11-17	OK	R	78