ETC5510: Introduction to Data Analysis

Week 3, part A

Data Visualisation

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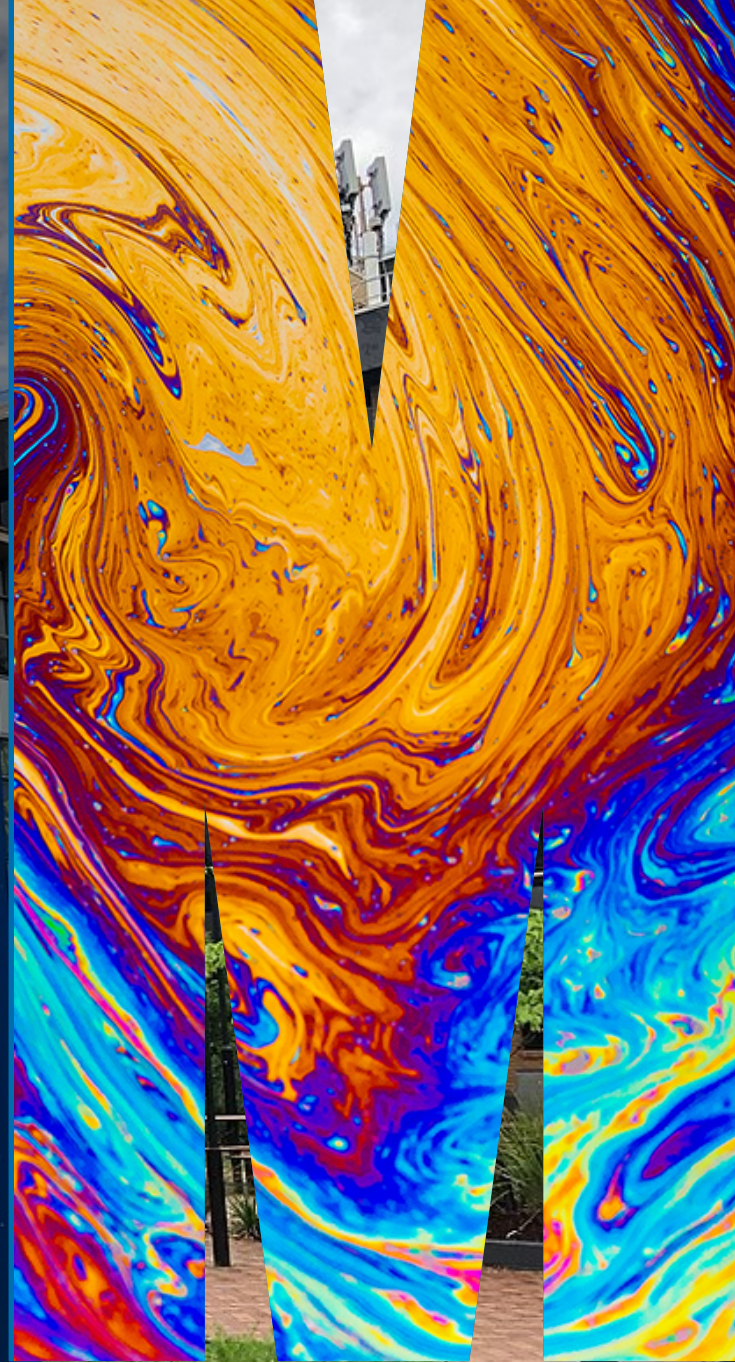
23rd March 2020



Understanding learning

- Growth and fixed mindsets
- Reframe success + failure as opportunities for growth
- Growing area of research by Carol Dweck of Stanford

Reframing

From

> *"I'll never understand"*
>
> *"I just don't get programming"*
>
> *"I'm not a maths person"*

To

> *"I understand more than I did yesterday"*
>
> *"I can learn how to program"*
>
> *"Compared to this last week, I've learnt quite a bit!"*

Overview for today

- Going from tidy data to a data plot, using a grammar
- Mapping of variables from the data to graphical elements
- Using different geoms

Example: Tuberculosis data

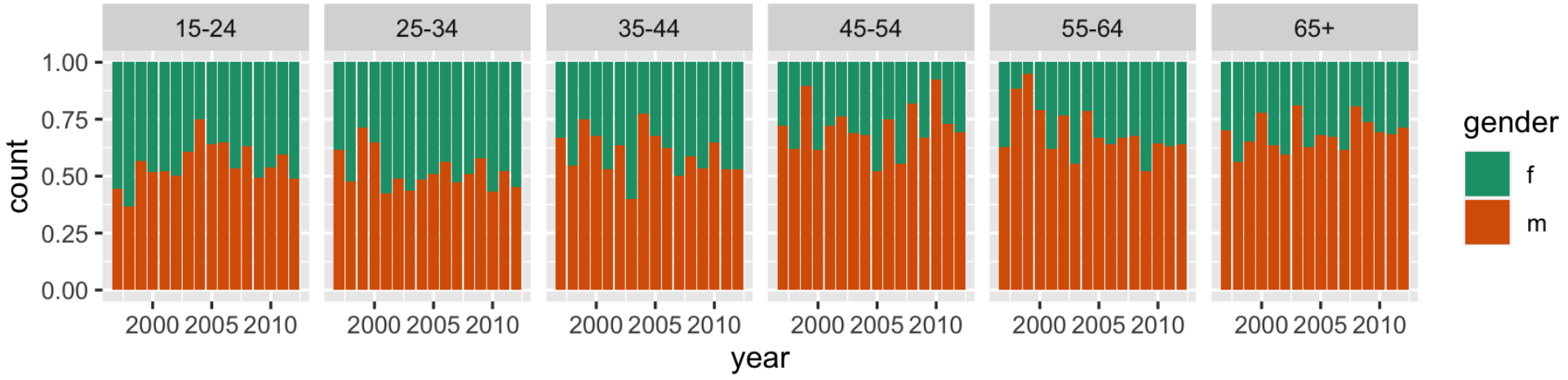
The case notifications table From WHO.

Data is tidied here, with only counts for Australia.

```
tb_au
## # A tibble: 192 x 6
##    country   iso3   year count gender age
##    <chr>     <chr> <dbl> <dbl> <chr>  <chr>
##  1 Australia AUS    1997     8 m      15-24
##  2 Australia AUS    1998    11 m      15-24
##  3 Australia AUS    1999    13 m      15-24
##  4 Australia AUS    2000    16 m      15-24
##  5 Australia AUS    2001    23 m      15-24
##  6 Australia AUS    2002    15 m      15-24
##  7 Australia AUS    2003    14 m      15-24
##  8 Australia AUS    2004    18 m      15-24
##  9 Australia AUS    2005    32 m      15-24
## 10 Australia AUS    2006    33 m      15-24
## # … with 182 more rows
```

The "100% charts"

```
ggplot(tb_au, aes(x = year, y = count, fill = gender)) +
  geom_bar(stat = "identity", position = "fill") +
  facet_grid(~ age) +
  scale_fill_brewer(palette="Dark2")
```



Let's unpack a bit.

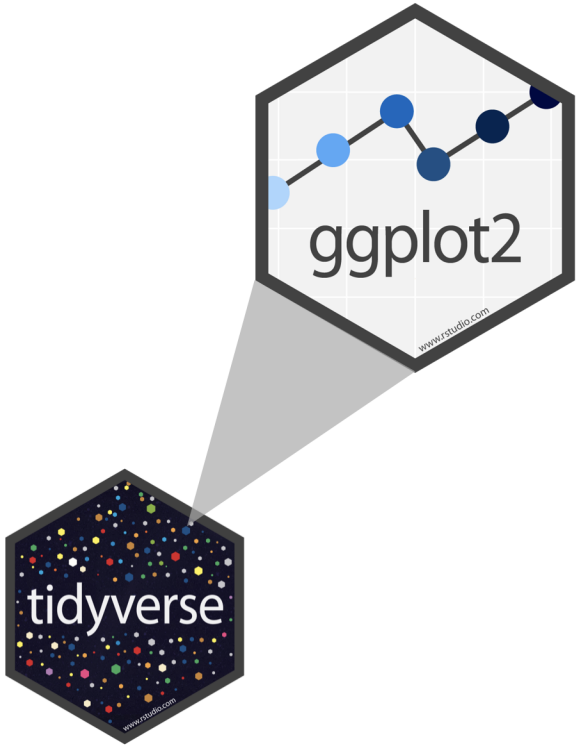
Data Visualisation

> "The simple graph has brought more information to the data analyst’s mind than any other device." — John Tukey

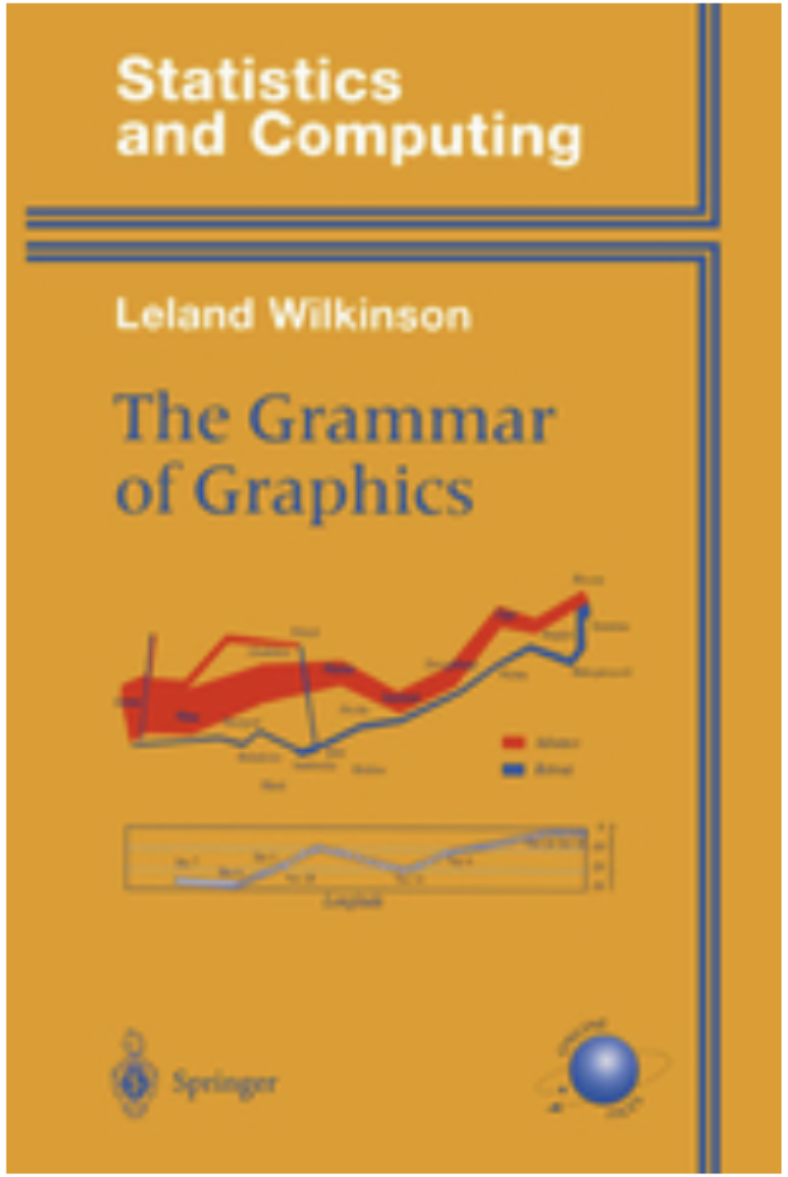
Data Visualisation

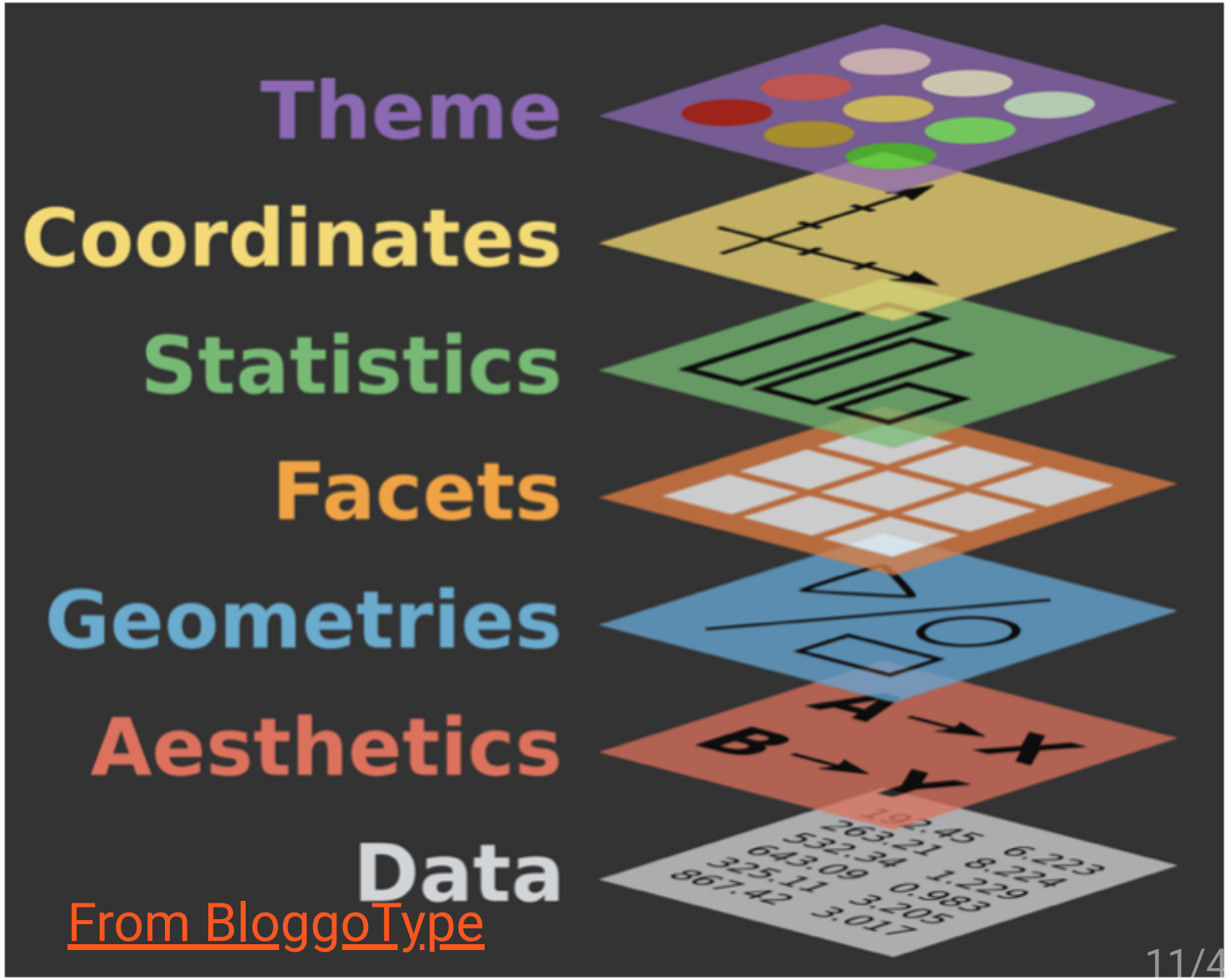
- The creation and study of the visual representation of data.
- Many tools for visualizing data (R is one of them)
- Many approaches/systems within R for making data visualizations (**ggplot2** is one of them, and that's what we're going to use).

ggplot2 ∈ tidyverse



- **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
- (Source: BloggoType)





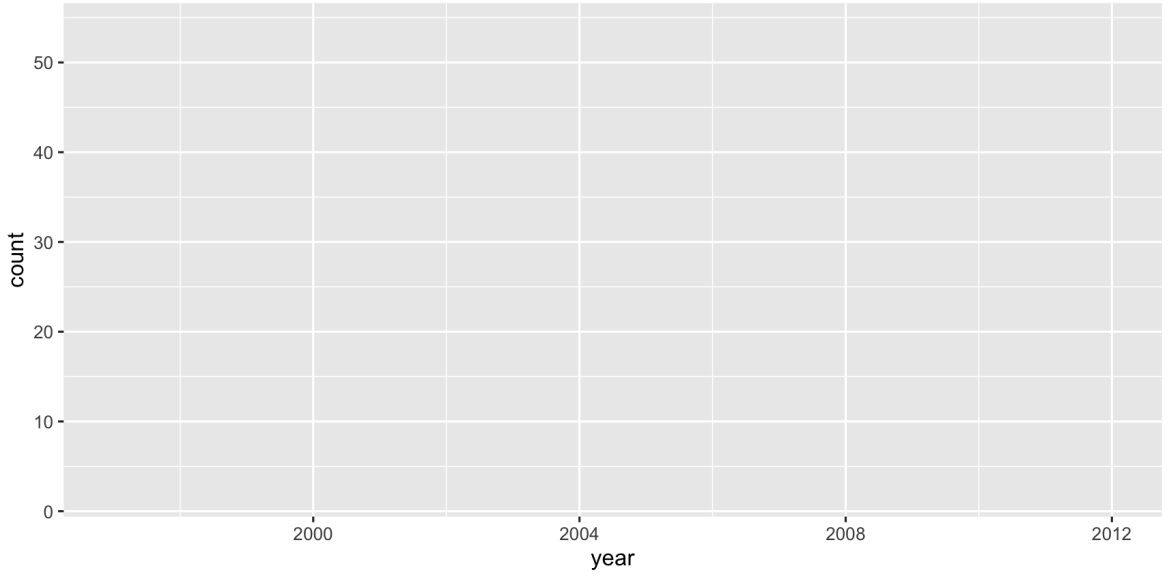
From BloggoType

Our first ggplot!

```
library(ggplot2)
ggplot(tb_au)
```

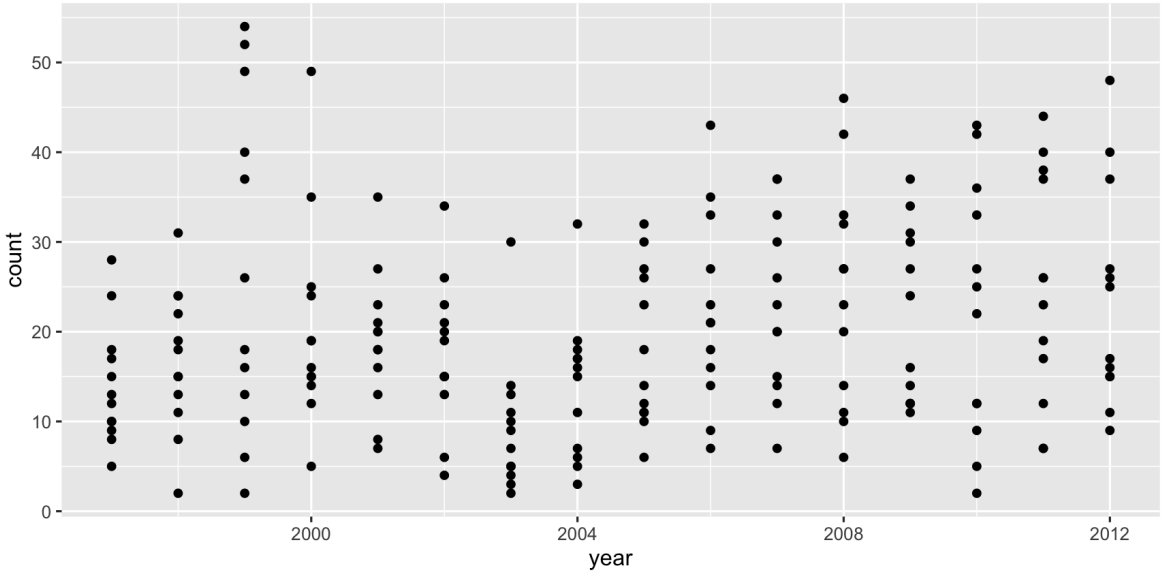
Our first ggplot!

```
library(ggplot2)
ggplot(tb_au,
       aes(x = year,
           y = count))
```



Our first ggplot!

```
library(ggplot2)
ggplot(tb_au,
       aes(x = year,
           y = count))  +
  geom_point()
```

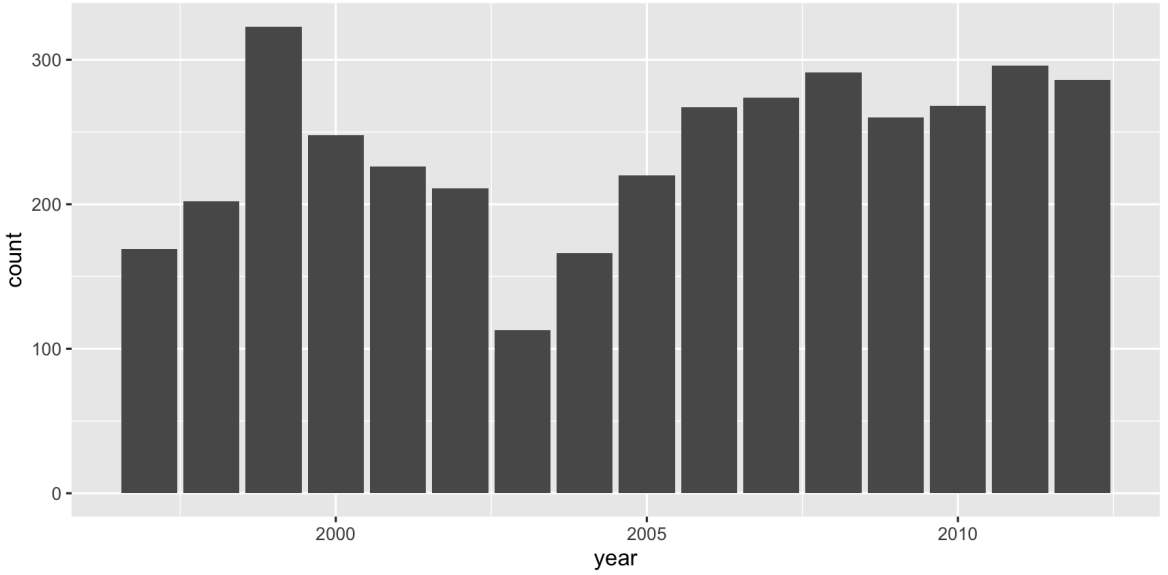


Our first ggplot! (what's the data again?)

country	iso3	year	count	gender	age
Australia	AUS	1997	8	m	15-24
Australia	AUS	1998	11	m	15-24
Australia	AUS	1999	13	m	15-24
Australia	AUS	2000	16	m	15-24
Australia	AUS	2001	23	m	15-24
Australia	AUS	2002	15	m	15-24
Australia	AUS	2003	14	m	15-24
Australia	AUS	2004	18	m	15-24
Australia	AUS	2005	32	m	15-24
Australia	AUS	2006	33	m	15-24

Our first ggplot!

```
library(ggplot2)
ggplot(tb_au,
       aes(x = year,
           y = count))  +
  geom_col()
```



Our first ggplot!

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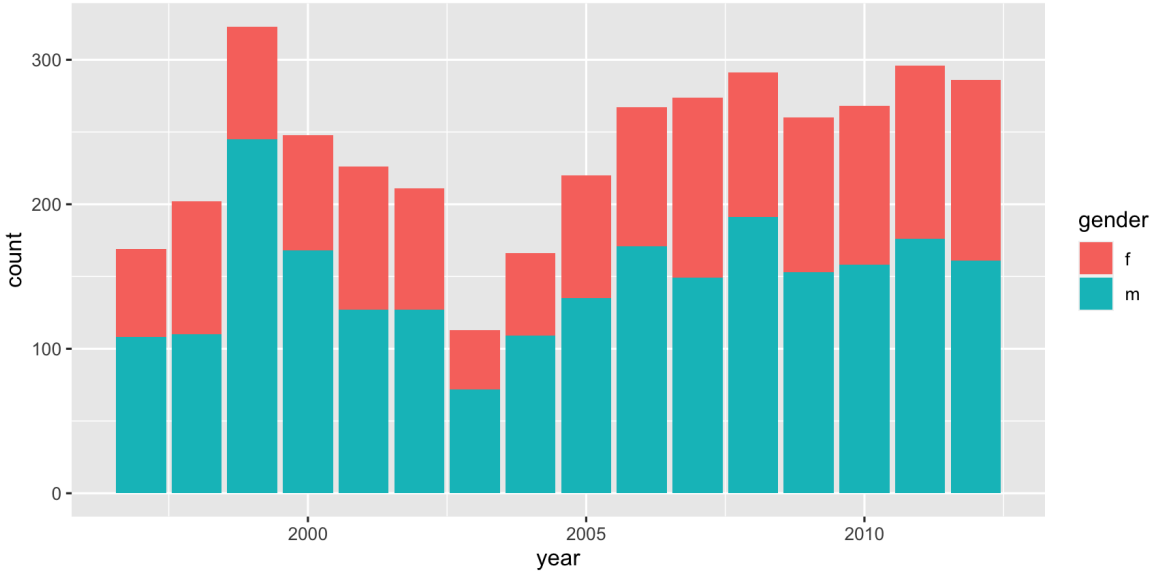
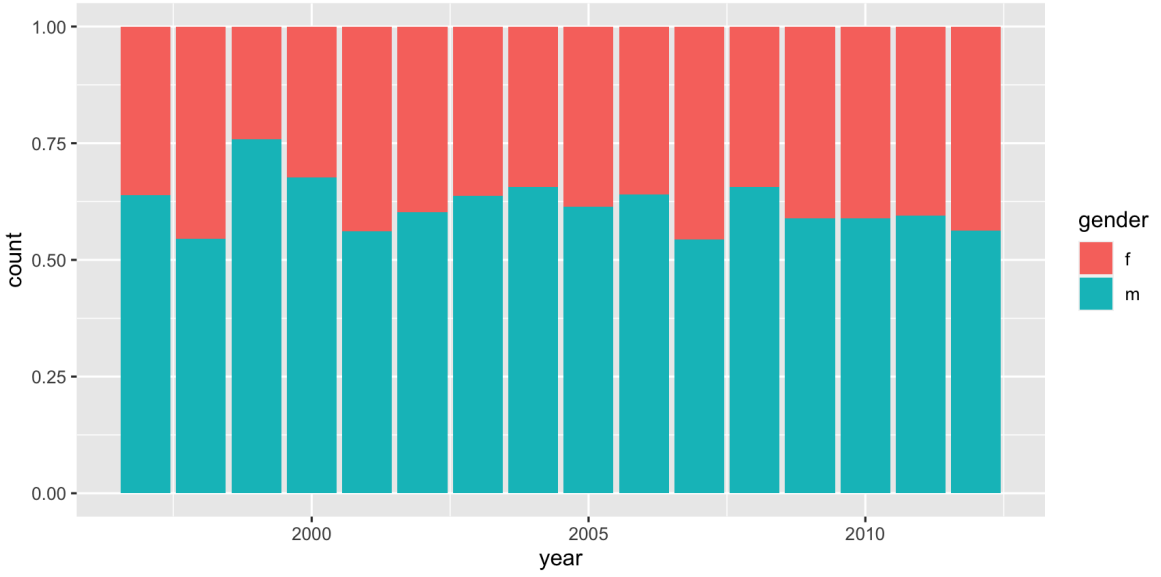
library(ggplot2)
ggplot(tb_au,
       aes(x = year,
           y = count,
           fill = gender))  +
  geom_col()
```



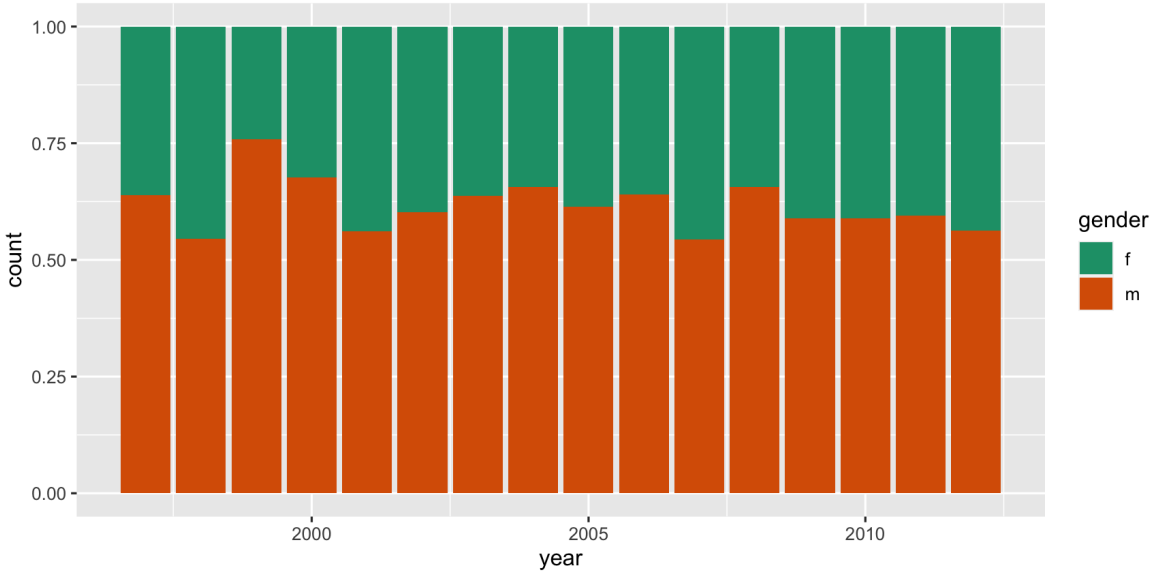
Our first ggplot!

```
library(ggplot2)
ggplot(tb_au,
       aes(x = year,
           y = count,
           fill = gender))  +
  geom_col(position = "fill")
```



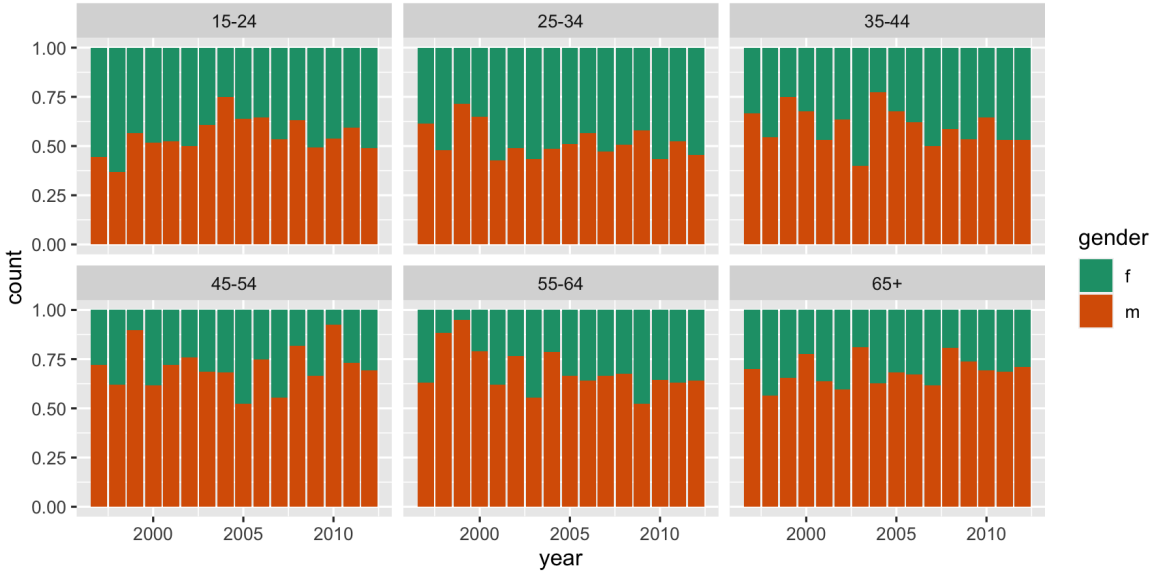
Our first ggplot!

```
library(ggplot2)
ggplot(tb_au,
       aes(x = year,
           y = count,
           fill = gender))  +
  geom_col(position = "fill") +
  scale_fill_brewer(
    palette = "Dark2"
    )
```



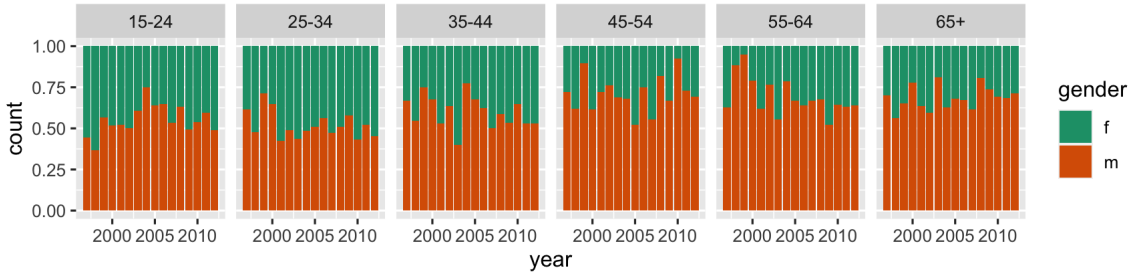
Our first ggplot!

```
library(ggplot2)
ggplot(tb_au,
       aes(x = year,
           y = count,
           fill = gender))  +
  geom_col(position = "fill") +
  scale_fill_brewer(
    palette = "Dark2"
    ) +
  facet_wrap(~ age)
```



The "100% charts"

```
ggplot(tb_au, aes(x = year, y = count, fill = gender)) +
  geom_bar(stat = "identity", position = "fill") +
  facet_grid(~ age) +
  scale_fill_brewer(palette="Dark2")
```



What do we learn

What do we learn?

- Focus is on **proportion** in each category.
- Across (almost) all ages, and years, the proportion of males having TB is higher than females
- These proportions tend to be higher in the older age groups, for all years.

Code structure of ggplot

- `ggplot()` is the main function
- Plots are constructed in layers
- Structure of code for plots can often be summarised as

```
ggplot(data = [dataset],
       mapping = aes(x = [x-variable],
                     y = [y-variable])) +
   geom_xxx() +
   other options
```

How to use ggplot

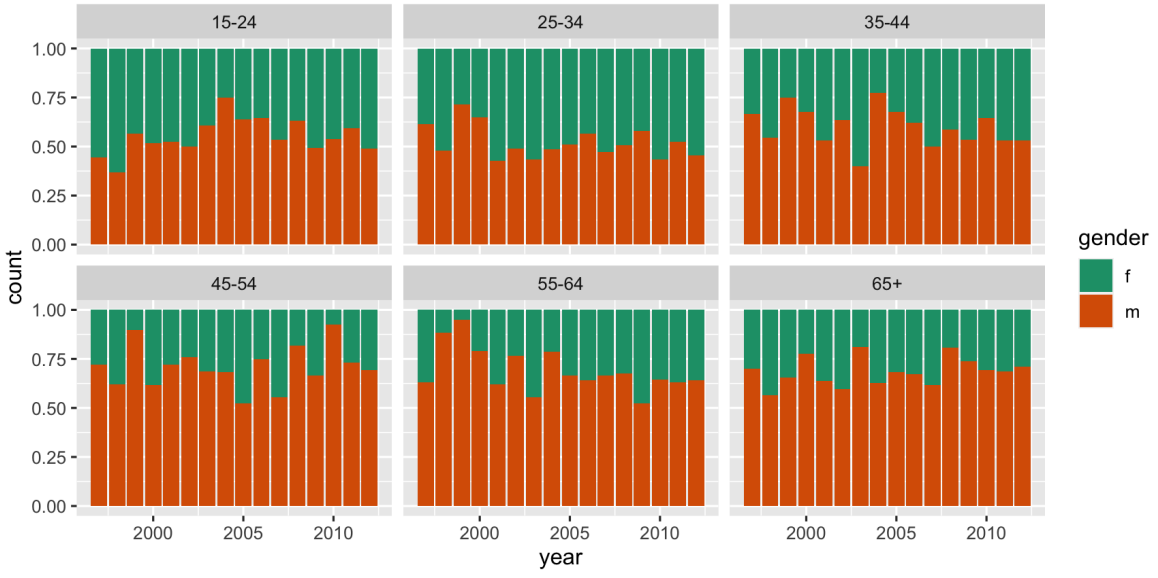
- To use ggplot2 functions, first load tidyverse

```
library(tidyverse)
```

- For help with the ggplot2, see ggplot2.tidyverse.org

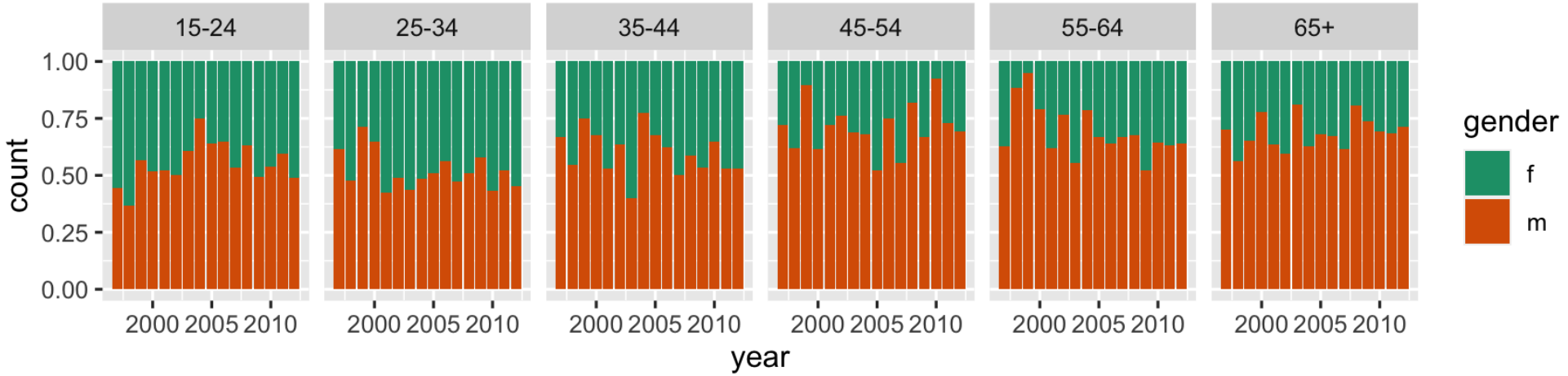
Let's look at some more options to emphasise different features

```
ggplot(tb_au,
       aes(x = year,
           y = count,
           fill = gender))  +
  geom_col(position = "fill") +
  scale_fill_brewer(
    palette = "Dark2"
    ) +
  facet_wrap(~ age)
```



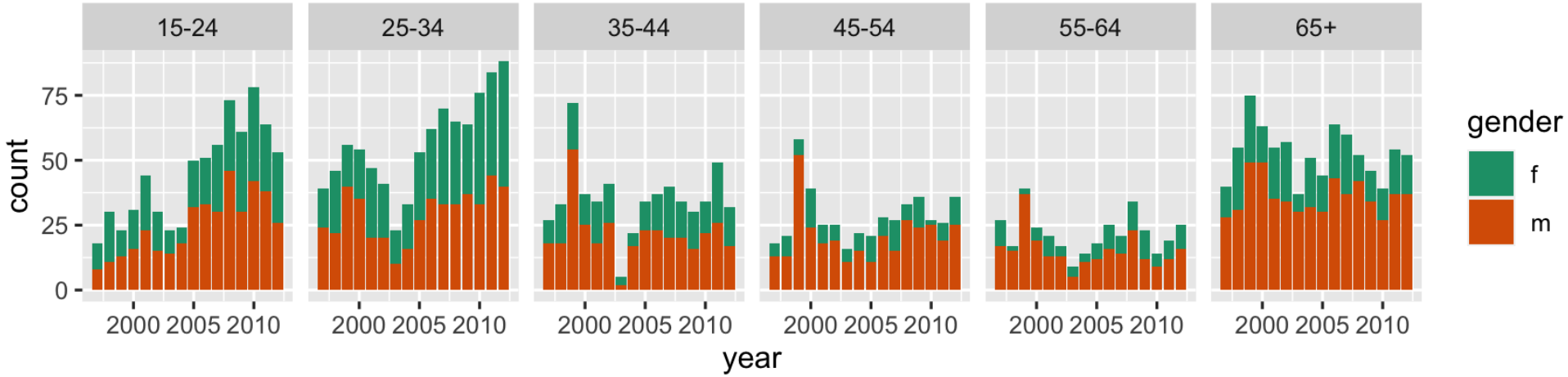
Emphasizing different features with ggplot2

```
ggplot(tb_au,
       aes(x = year,
           y = count,
           fill = gender))  +
  geom_col(position = "fill") +
  scale_fill_brewer( palette = "Dark2") +
  facet_grid(~ age)
```



Emphasise ... ?

```
ggplot(tb_au,
       aes(x = year,
           y = count,
           fill = gender))  +
  geom_col() +
  scale_fill_brewer( palette = "Dark2") +
  facet_grid(~ age)
```

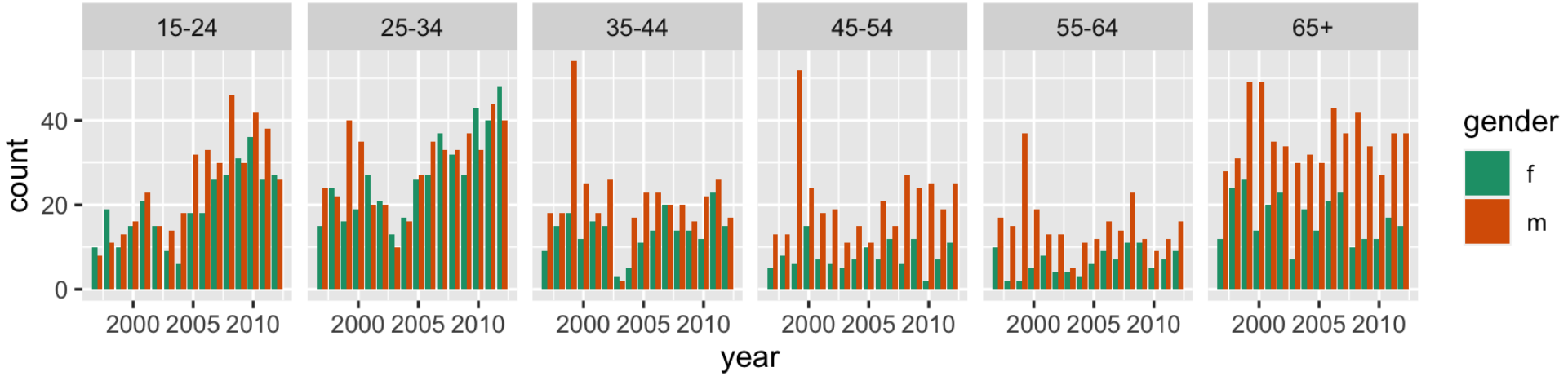


What do we learn?

- `, position = "fill"` was removed
- Focus is on **counts** in each category.
- Different across ages, and years, counts tend to be lower in middle age (45-64)
- 1999 saw a bit of an outbreak, in most age groups, with numbers doubling or tripling other years.
- Incidence has been increasing among younger age groups in recent years.

Emphasise ... ?

```
ggplot(tb_au,
       aes(x = year,
           y = count,
           fill = gender)) +
  geom_col(position = "dodge") +
  scale_fill_brewer(palette = "Dark2") +
  facet_grid(~ age)
```

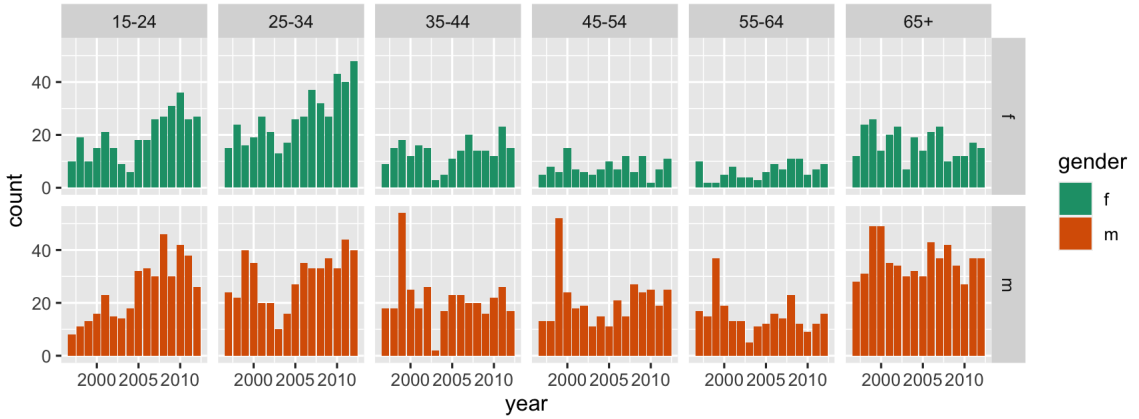


What do we learn?

- `, position="dodge"` is used in `geom_col`
- Focus is on **counts by gender**, predominantly male incidence.
- Incidence among males relative to females is from middle age on.
- There is similar incidence between males and females in younger age groups.

Separate bar charts

```
ggplot(tb_au,
       aes(x = year, y = count, fill = gender)) +
  geom_col() +
  scale_fill_brewer(palette = "Dark2") +
  facet_grid(gender ~ age)
```

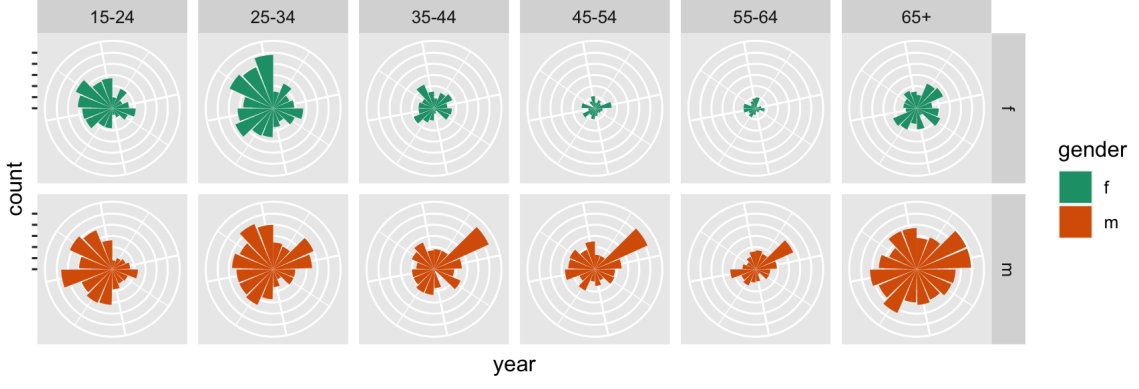


What do we learn?

- `facet_grid(gender ~ age) +` faceted by gender as well as age
- note `facet_grid` vs `facet_wrap`
- Easier to focus separately on males and females.
- 1999 outbreak mostly affected males.
- Growing incidence in the 25-34 age group is still affecting females but seems to be have stablised for males.

~~Pie charts?~~ Rose Charts

```
ggplot(tb_au,
       aes(x = year, y = count, fill = gender)) +
  geom_col() +
  scale_fill_brewer(palette="Dark2") +
  facet_grid(gender ~ age) +
  coord_polar() +
  theme(axis.text = element_blank())
```

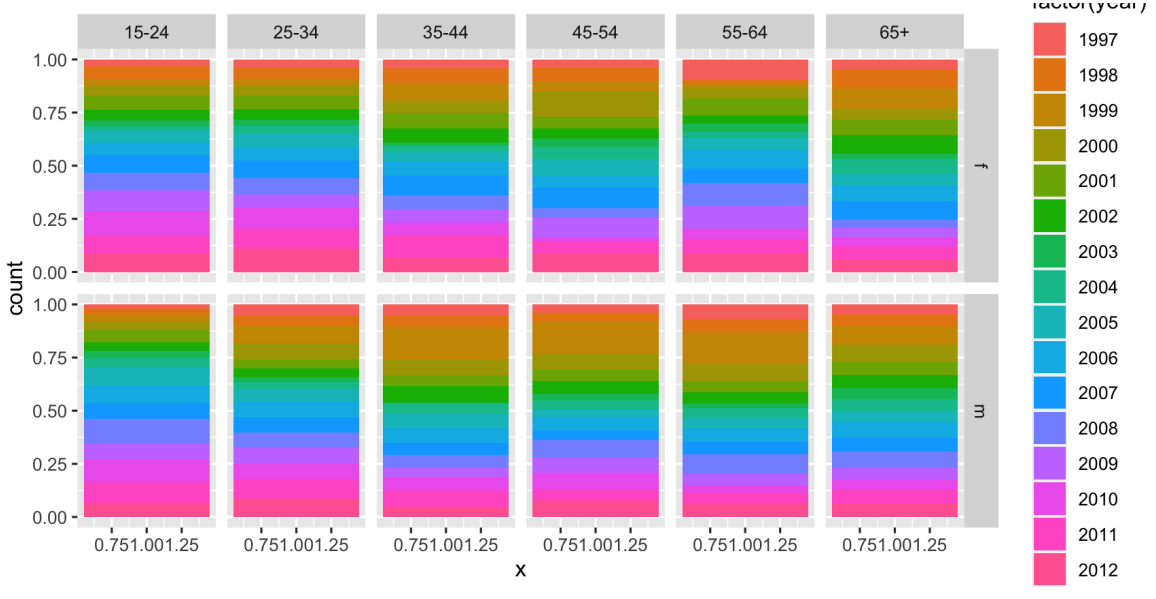


What do we learn?

- Bar charts in polar coordinates produce rose charts.
- `coord_polar()` + plot is made in polar coordinates, rather than the default Cartesian coordinates
- Emphasizes the middle years as low incidence.

Rainbow charts?

```
ggplot(tb_au, aes(x = 1,
                  y = count,
                  fill = factor(year))) +
  geom_col(position = "fill") +
  facet_grid(gender ~ age)
```



What do we see in the code??

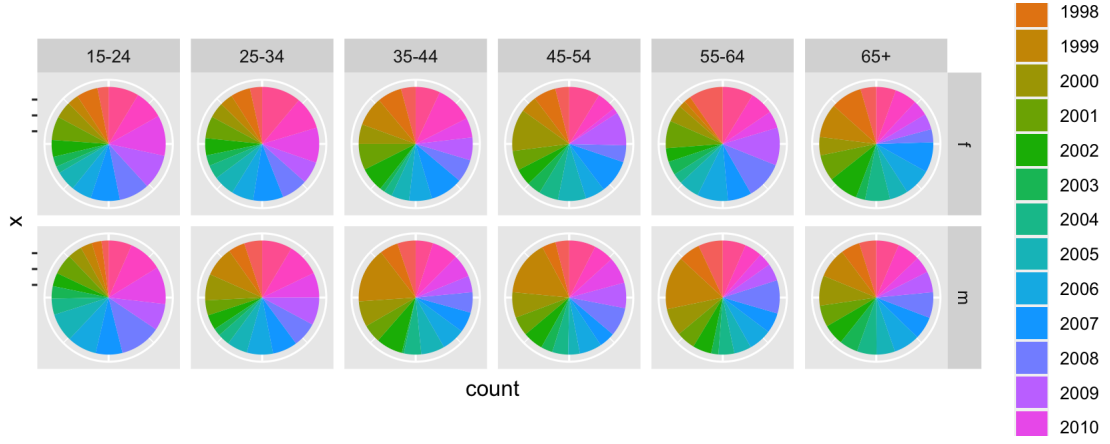
- A single stacked bar, in each facet.
- Year is mapped to colour.
- Notice how the mappings are different. A single number is mapped to x, that makes a single stacked bar chart.
- year is now mapped to colour (that's what gives us the rainbow charts!)

What do we learn?

- Pretty chart but not easy to interpret.

(Actual) Pie charts

```
ggplot(tb_au, aes(x = 1, y = count, fill = factor(year))) +
  geom_col(position = "fill") +
  facet_grid(gender ~ age) +
  coord_polar(theta = "y") +
  theme(axis.text = element_blank())
```



What is different in the code?

- `coord_polar(theta="y")` is using the y variable to do the angles for the polar coordinates to give a pie chart.

What do we learn?

- Pretty chart but not easy to interpret, or make comparisons across age groups.

Why?

The various looks of David Bowie

- Using named plots, eg pie chart, bar chart, scatterplot, is like seeing animals in the zoo.
- The grammar of graphics allows you to define the mapping between variables in the data, with elements of the plot.
- It allows us to see and understand how plots are similar or different.
- And you can see how variations in the definition create variations in the plot.

Your Turn:

- Do the lab exercises
- Take the lab quiz
- Use the rest of the lab time to coordinate with your group on the first assignment.

References

- Chapter 3 of R for Data Science
- Data made available from WHO
- Garret Aden Buie's gentle introduction to ggplot2
- Mine Çetinkaya-Rundel's introduction to ggplot using star wars.