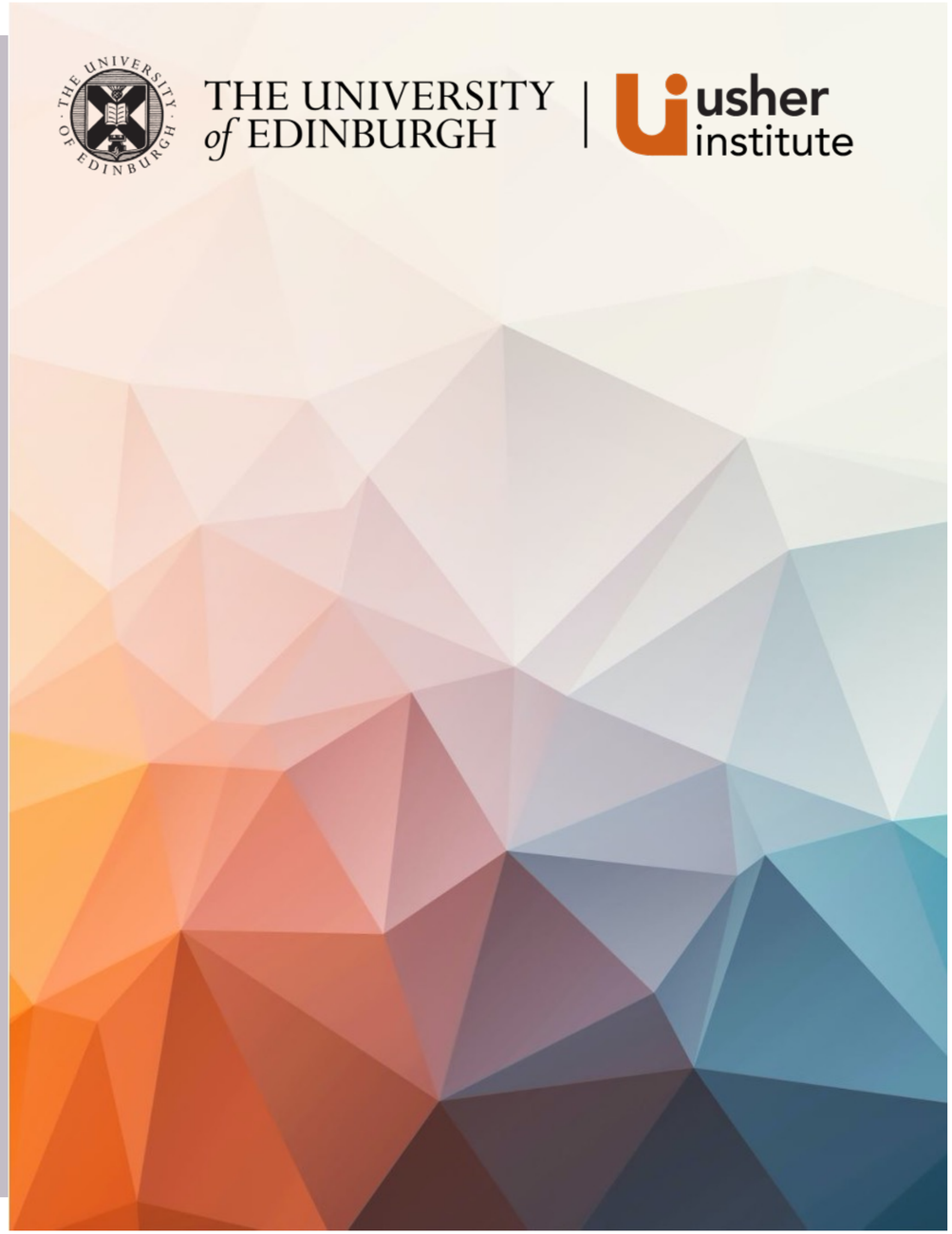
Introduction to data science in health and social care

Week 6

Brittany Blankinship | 2 November 2022



Audio check

Can you hear the presenter talking?

Please type **yes** or **no** in the “Text chat area”

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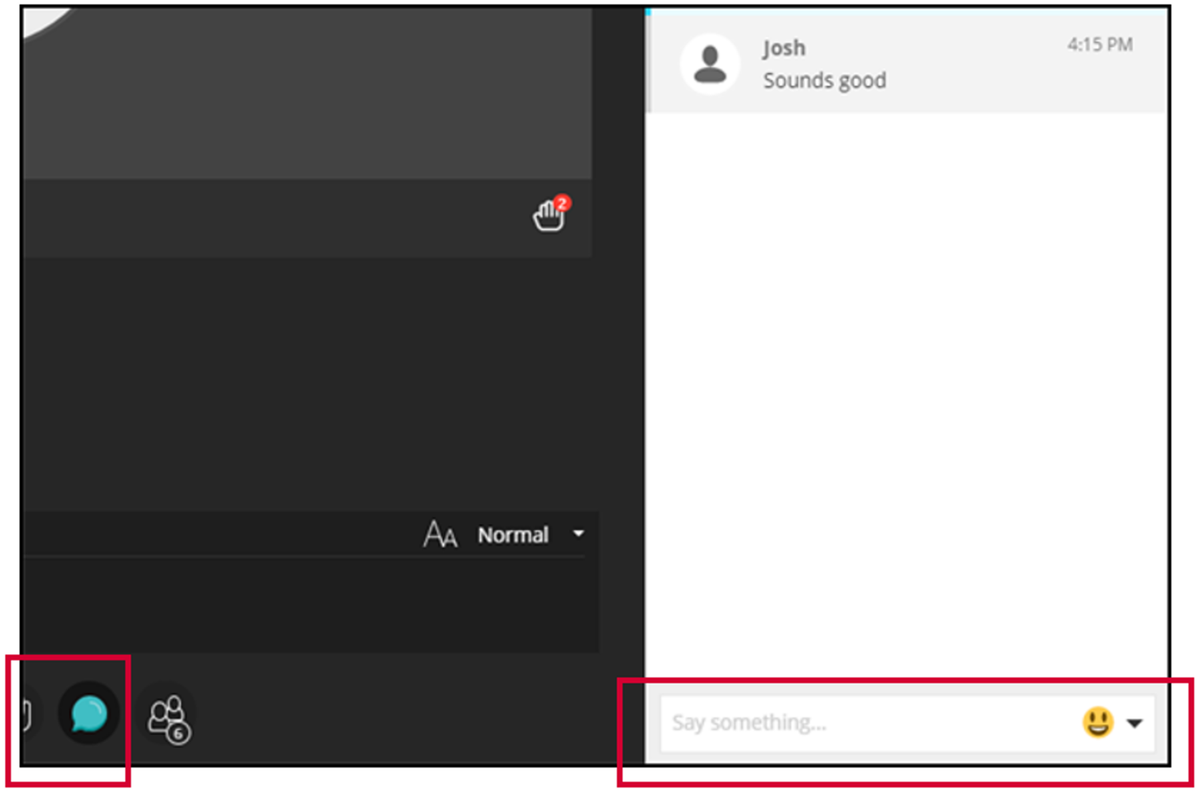
- Check your Audio/Visual settings in the Collaborate Panel
- Try signing out and signing back into the session
- Type into the chat box and a moderator will try to assist you



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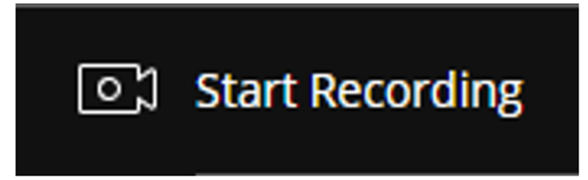

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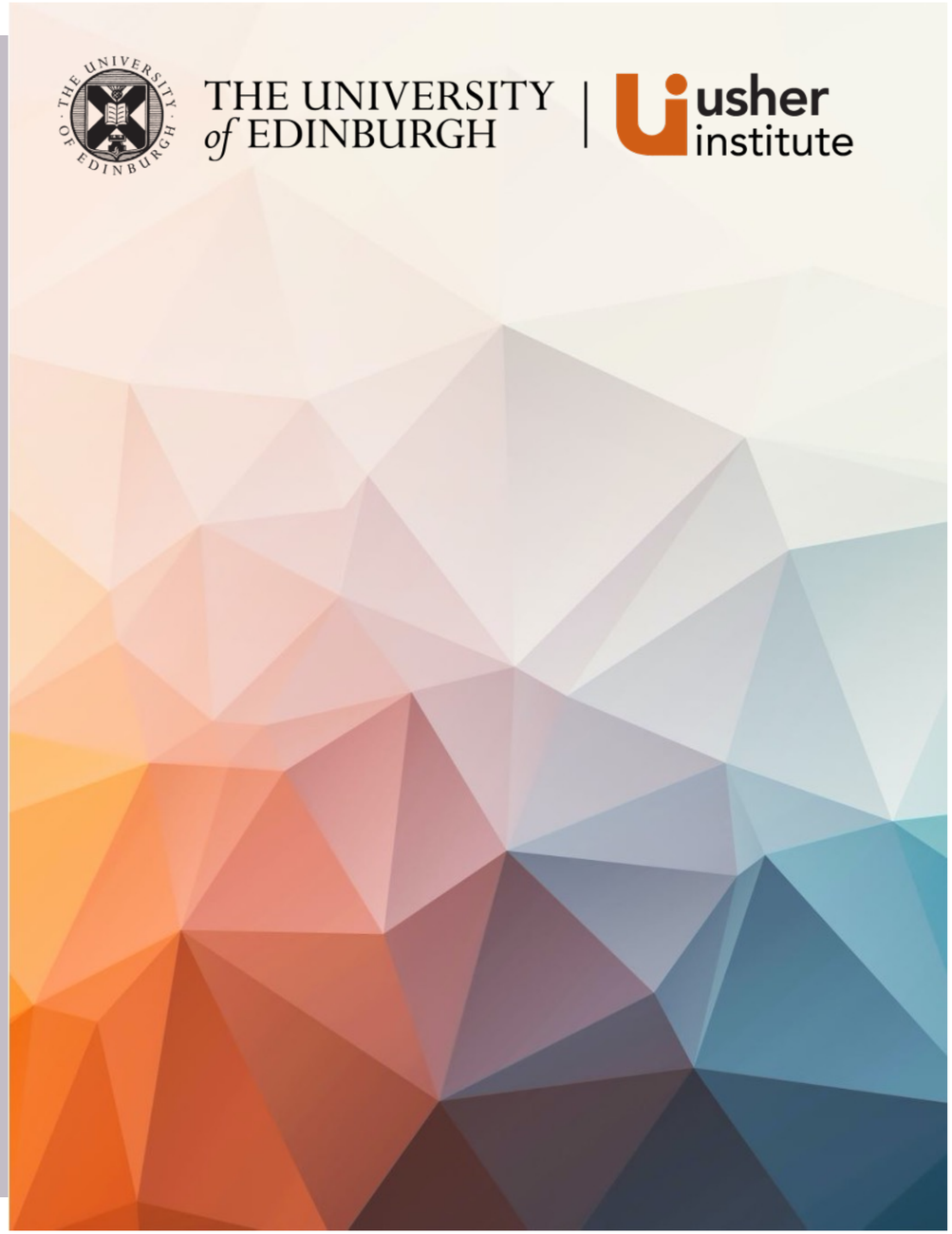
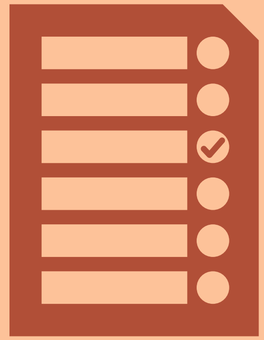
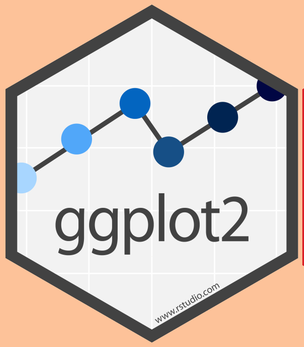
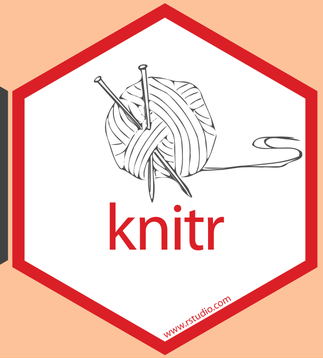


Agenda



- **Course/assessment updates**
- **tables vs figures**
- `ggplot2`
- **data storytelling with data visualisation**





2nd Graded Discussion Post

- Due: **11 November 12:00 UK time**

- Reply to a peer's response to receive full marks
- Can view other posts after submitting yours
  - Submit your response by creating a thread

Marking Criteria

This post is marked out of 10 total points and is worth 10% of your overall grade in the course. You will be assessed on your res

Criteria	Description	Marks
Completion	Submission of a discussion board post	2
Narrative	Describe (a) the data, (b) the health and social context of the data you have chosen, and (c) your intended audience.	3
Reflective practice	Report on why your team has chosen this specific data set, your contributions thus far, and experience thus far working as a team on this project (avoid using individual names, rather refer to team members generally).	3
Online participation	After adding your discussion post, reply to at least one of your peers' posts as well. **Note: this should be a peer in a different team than your own**. By replying to one of your classmates' posts you will receive full points, but you are welcome to respond to as many posts as you would like to.	2

- Example Datathon lead statement, elevator pitch, and group presentation now on Learn under assessments
- Example from last year’s group, using a different set of data around COVID-19

Datathon example group project

Do you think figures or tables are more useful for data visualisation?

Why do graphs and tables matter?

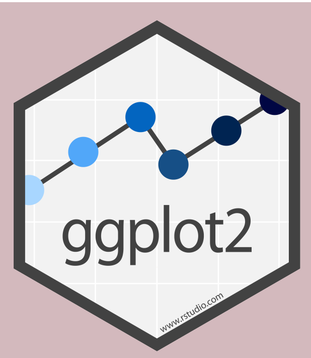
Both graphs AND tables are tools for communication

***Informative* and well-presented graphs & tables ARE better communication**

When to use tables vs graphs?

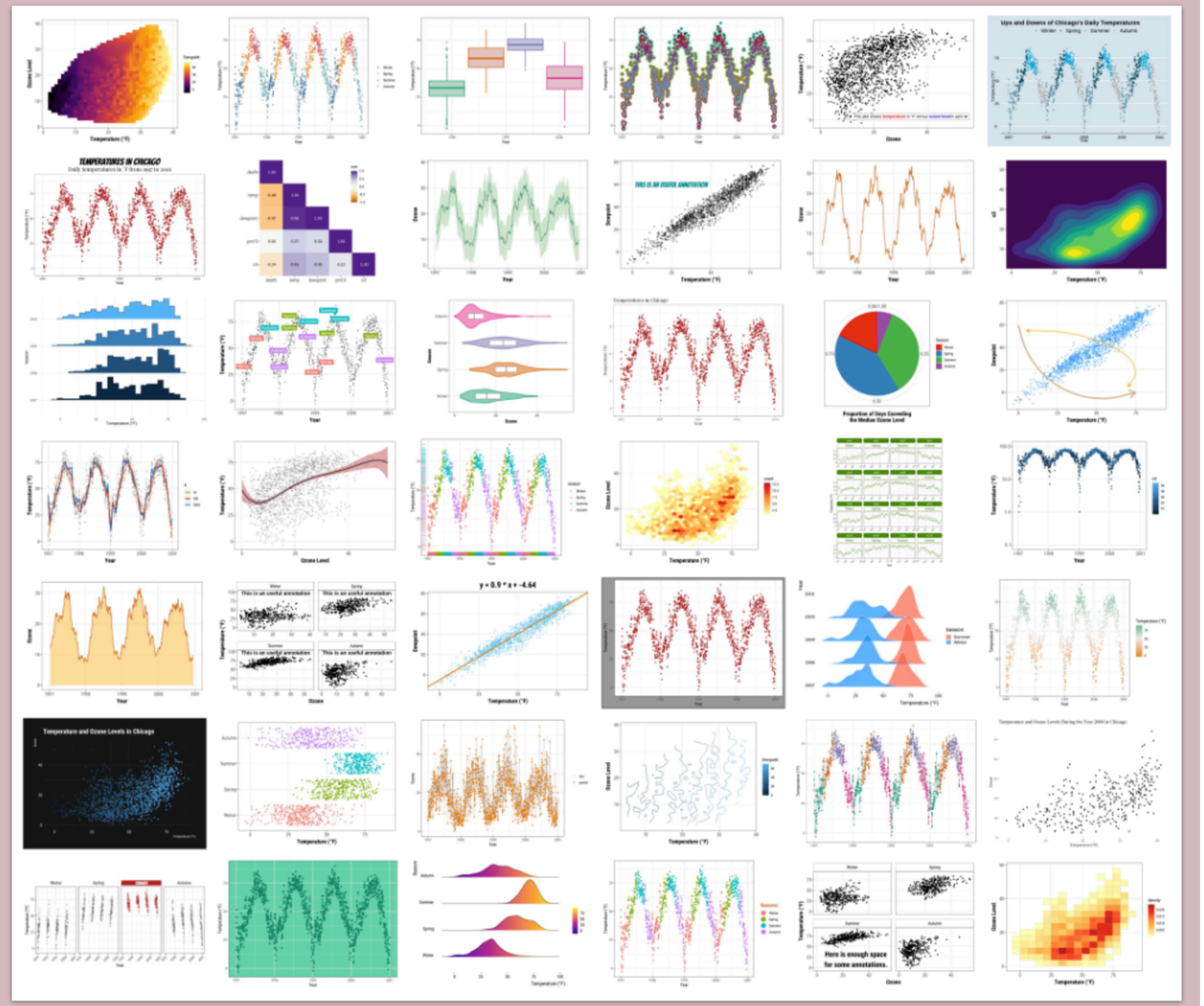
Use Tables When	Use Graphs When
• The display will be used to look up individual values	• The display will be used to reveal relationships among whole sets of values
• It will be used to compare individual values	• The message is contained in the shape of the values (e.g., patterns, trends, exceptions)
• Precise values are required	
• Quantitative values include more than one unit of measure	
• Both detail and summary values are included	

Adapted from:
Few, Stephen. (2012). *Show Me the Numbers: Designing Tables and Graphs to Enlighten*.(4)57



ggplot2

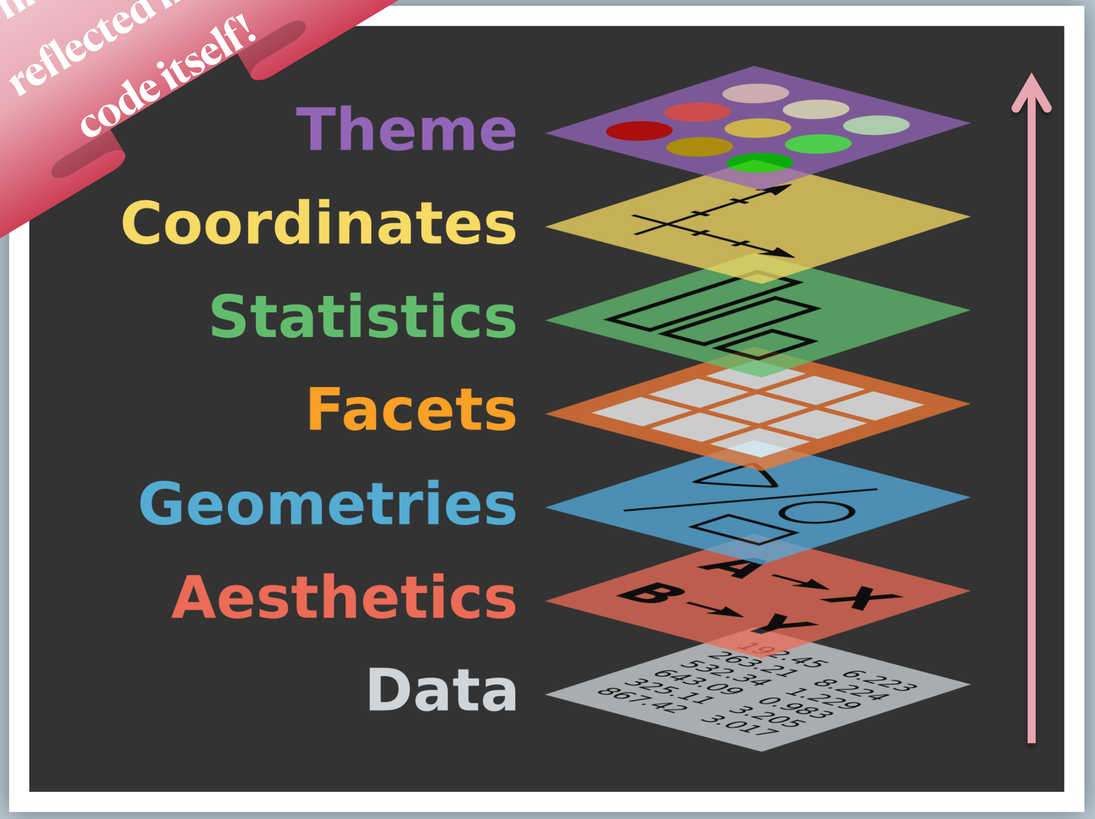
- Application of Leland Wilkinson's [grammar of graphics] for R
- A system for iteratively and declaratively creating graphics
- Just like grammar in a language constructs sentences, grammar of graphics constructs data visualisations



Credit: Cédric Sherer
[ggplot2 in-depth tutorial]

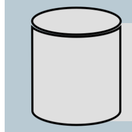
Building blocks of a `ggplot`

This layering is reflected in the code itself!



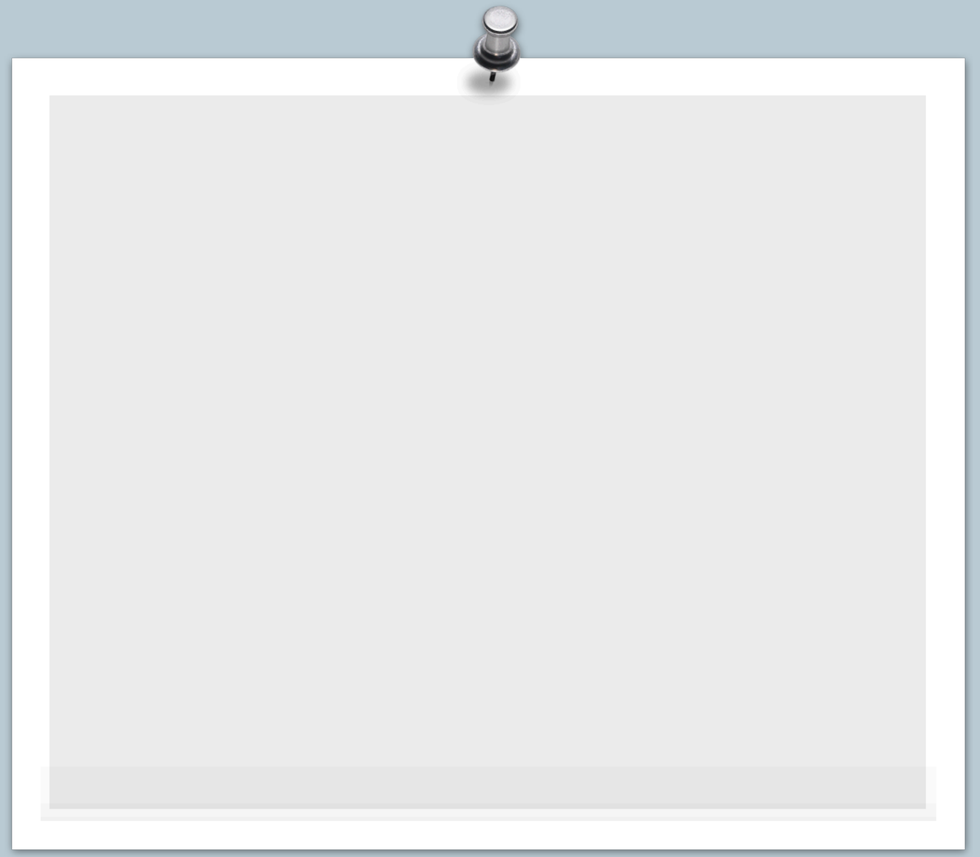
Element	Description	Code
Data	The dataset being plotted	`ggplot(data = ,`
Aesthetics	The scales onto which we map our data	`aes(x, y, fill, color))`
Geometries	The visual elements used for our data	`+ geom_()`
Facets	Plotting small multiples	`+ facet_()`
Statistics	Representations of our data to aid understanding	`+ stat_()`
Coordinates	The space on which the data will be plotted	`+ coord_()`
Themes	All non-data ink, design elements	`+ theme_()`

The key ingredients

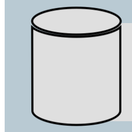


```
ggplot(data = cancelled ,
```

data layer use the data cancelled THEN



The key ingredients



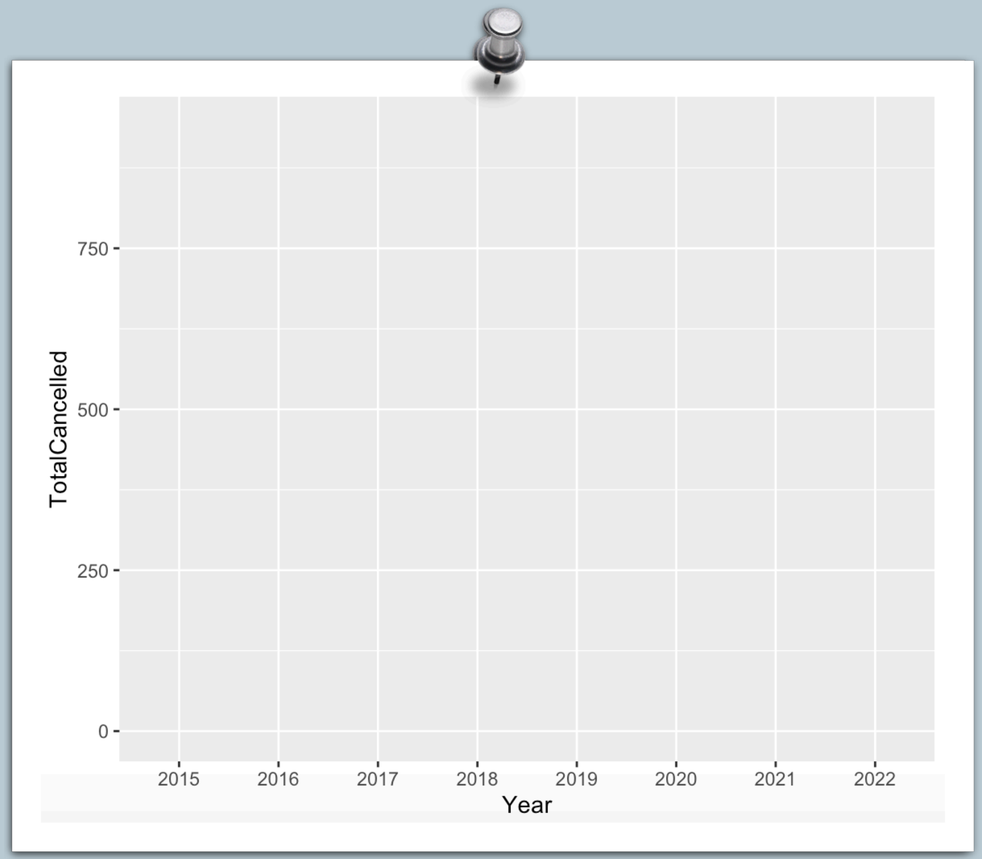
```
ggplot(data = cancelled ,
```

data layer — use the data cancelled — THEN

```
aes(x = Year, y = TotalCancelled))   +
```

use the X axis to show “Year” then the Y axis to show ”Total Cancelled” — AND

aesthetics layer



The key ingredients

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ggplot(data = cancelled ,
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data layer — use the data cancelled — THEN

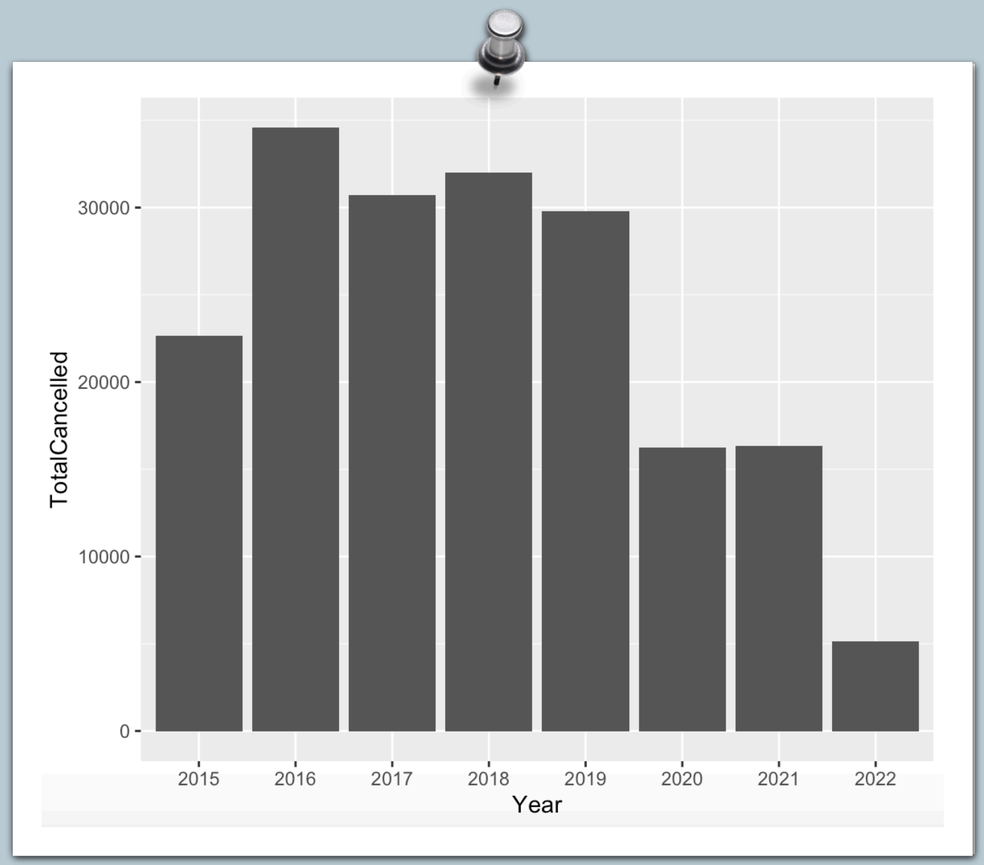
```
aes(x = Year, y = TotalCancelled))  +
```

use the X axis to show “Year” then the Y axis to show ”Total Canceled” — AND

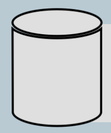
aesthetics layer

```
geom_bar()
```

geometry layer — …. take all that and make a bar chart



The key ingredients



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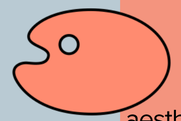

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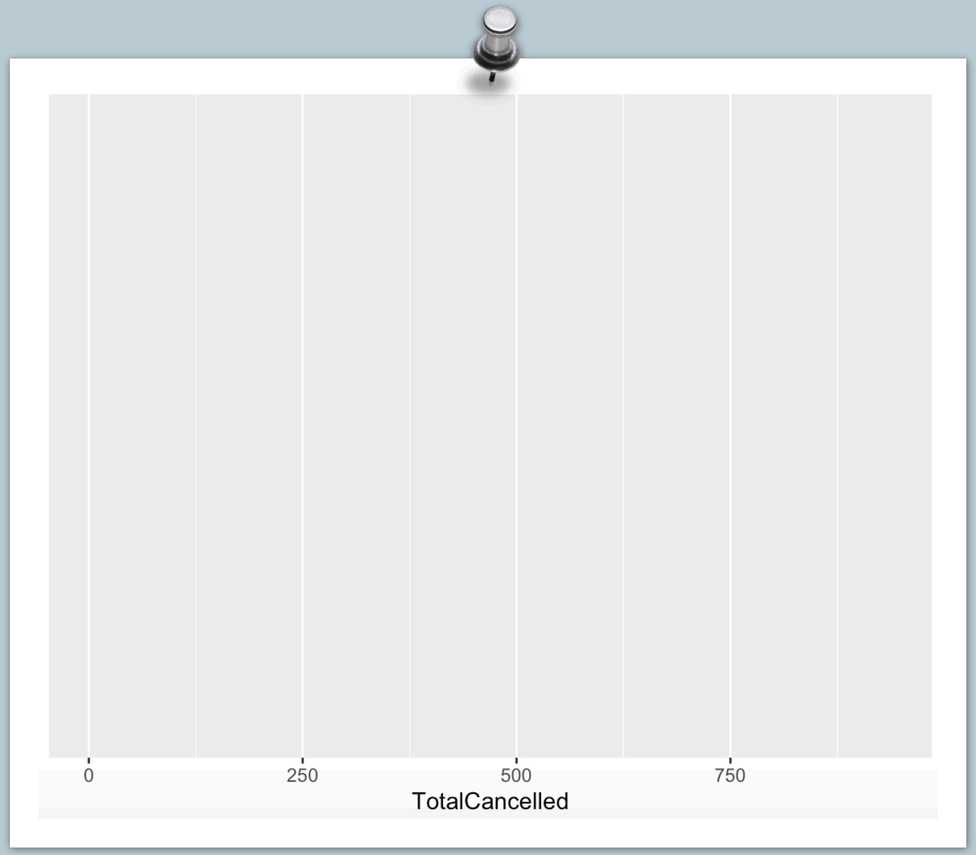

The key ingredients

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ggplot(data = cancelled ,
```

data layer — use the data cancelled — THEN

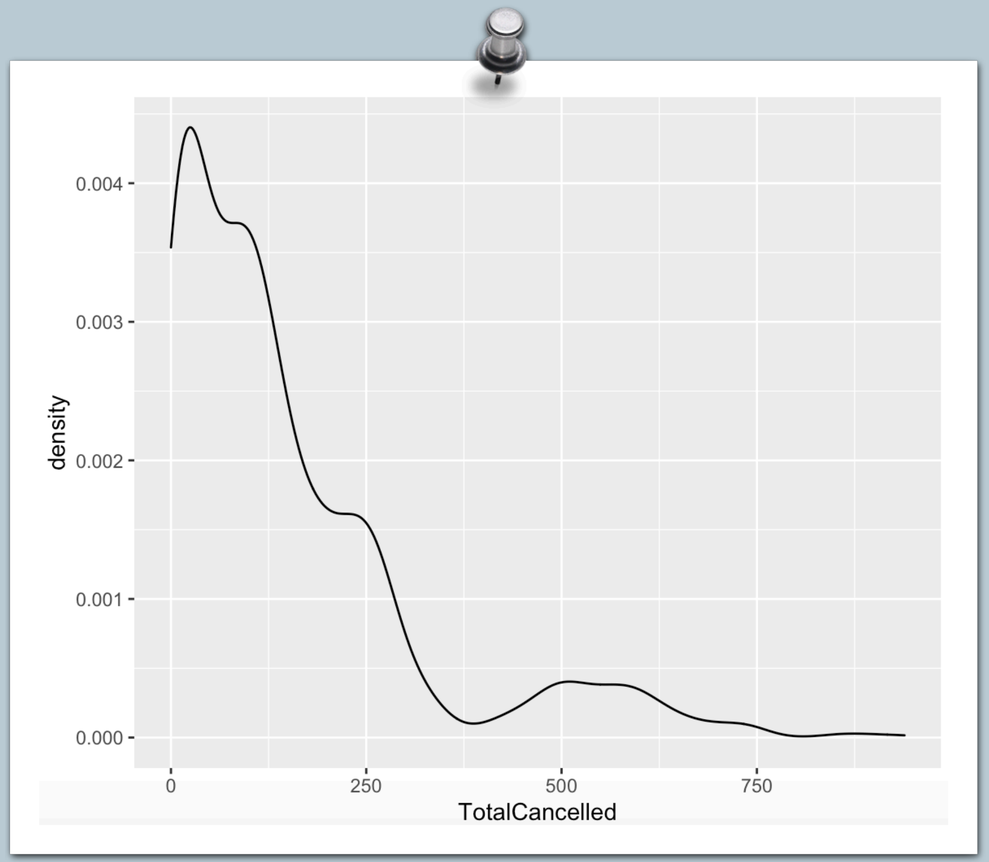
```
aes(x = TotalCancelled))   +
```

use the X axis to show "Total Cancelled" — AND

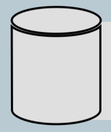
aesthetics layer

```
geom_density()
```

geometry layer .... take all that and make a density chart



The key ingredients



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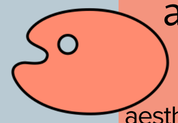
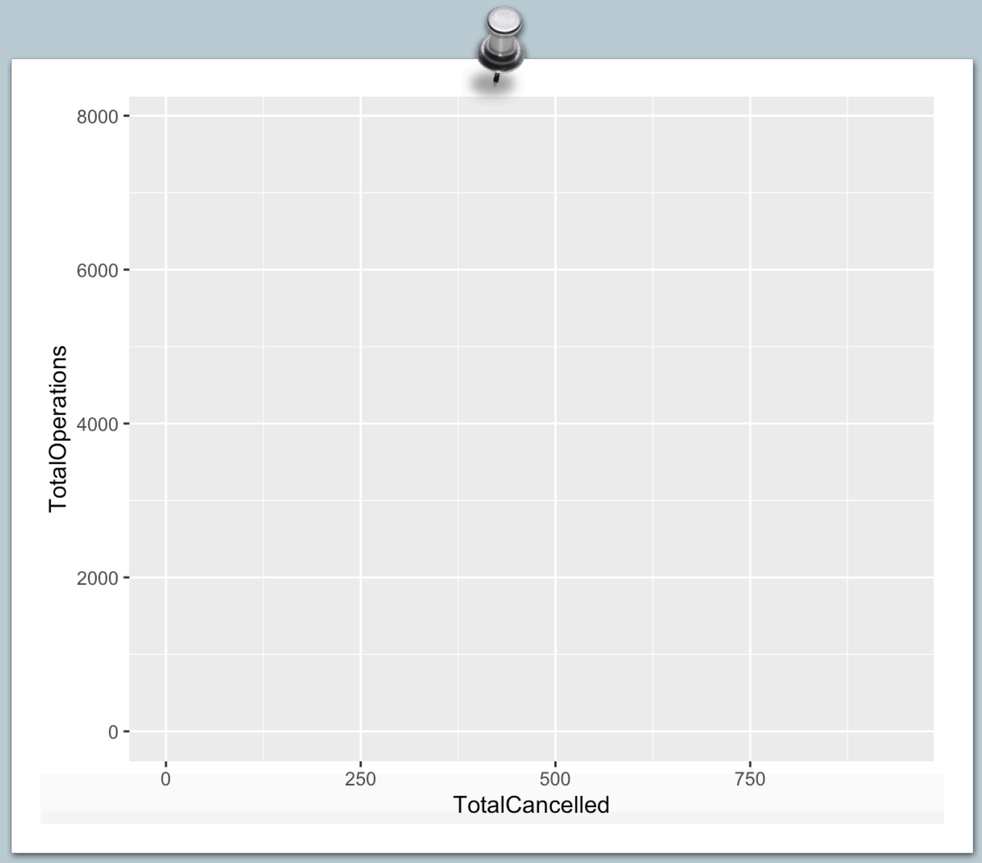


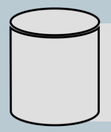
```
aes(x = TotalCancelled, y = TotalOperations))  +
```

use the X axis to show “Total Cancelled” then the Y axis to show ”Total Operations” AND

aesthetics layer



The key ingredients



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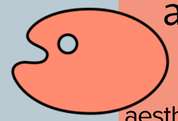

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use the X axis to show “Total Cancelled” then the Y axis to show ”Total Operations” AND

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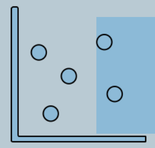
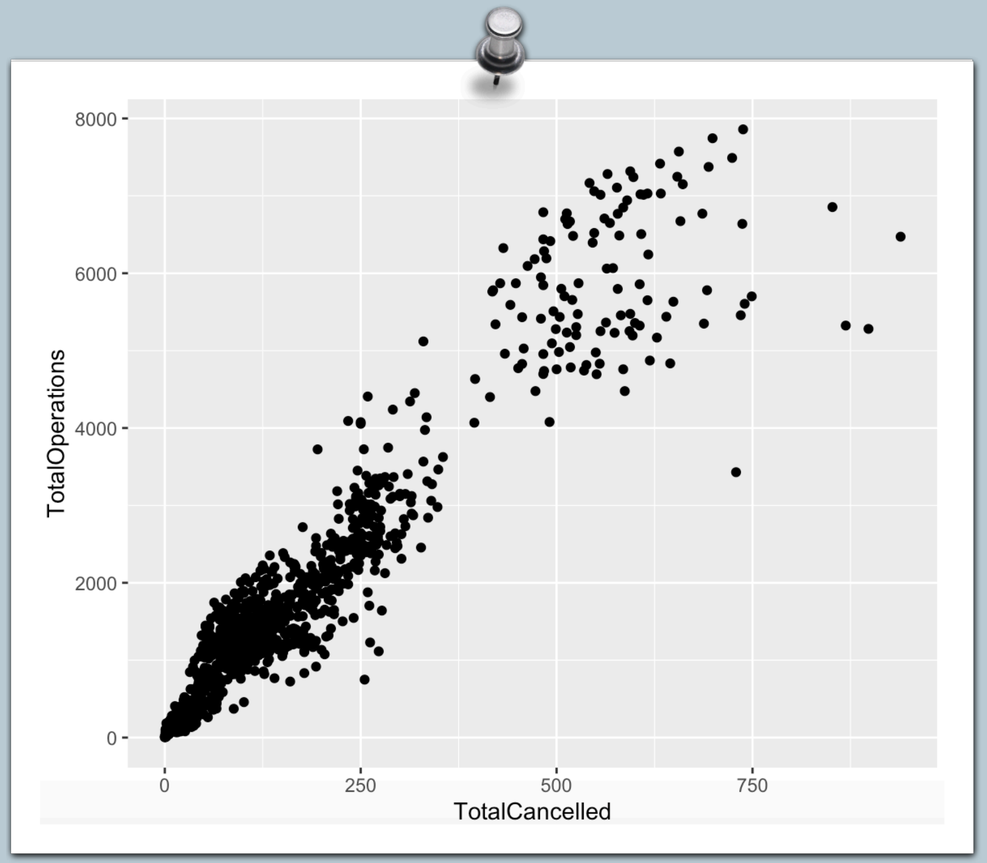


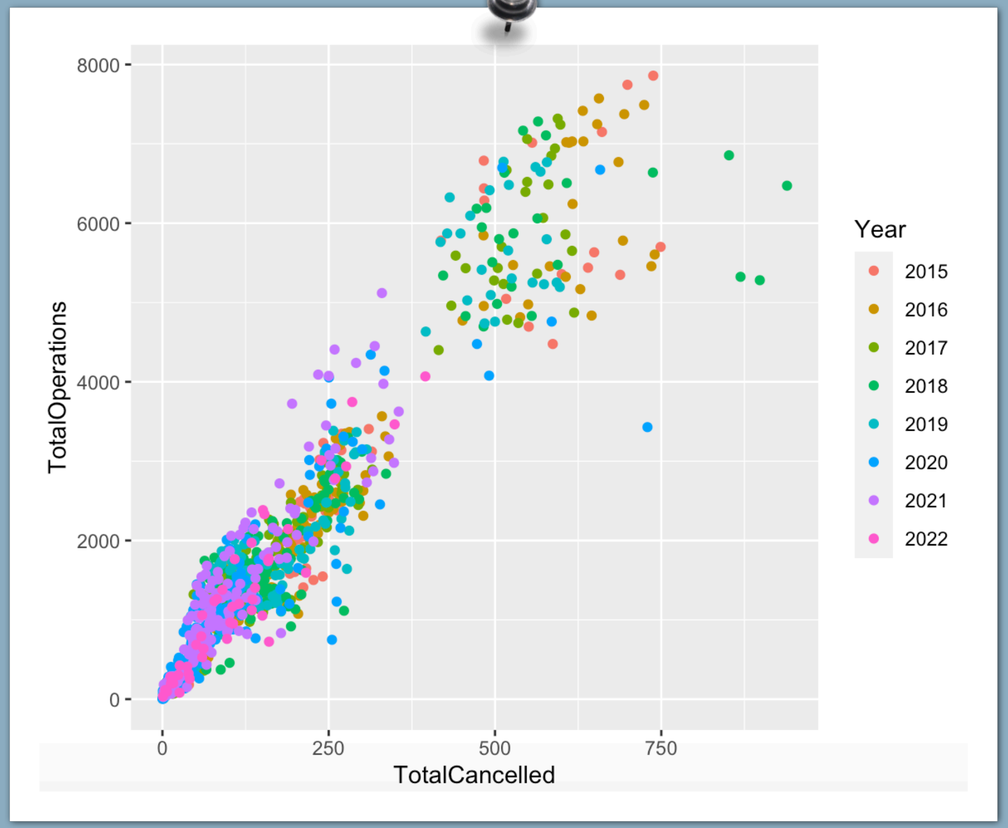
```
geom_point()
```

geometry layer .... take all that and make a scatter plot

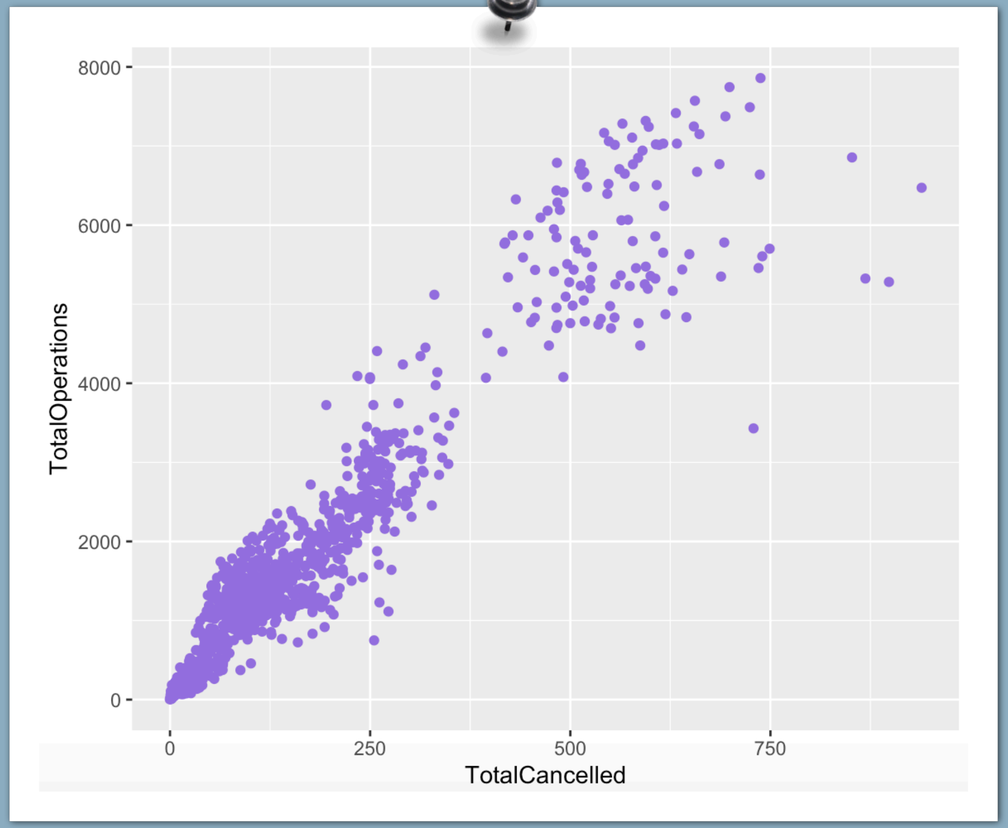


Aesthetics: Inside, Outside, or both

- **Within** `aes()`: the argument changes based on the values of the variable

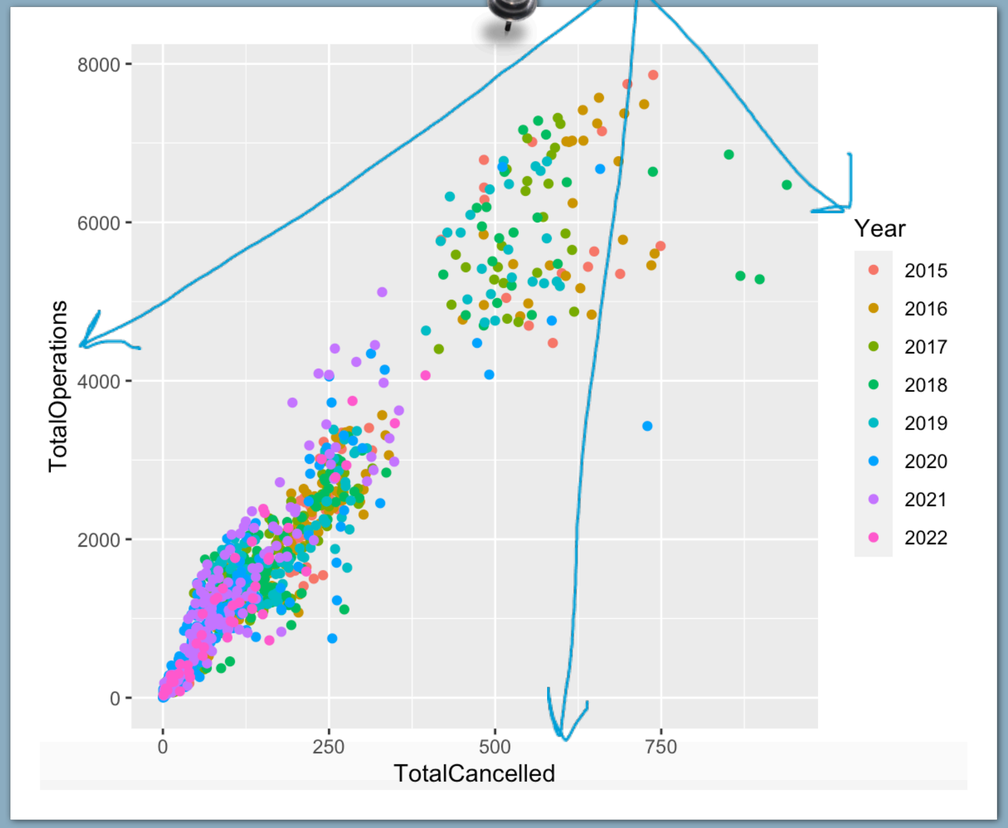


- **Outside** `aes()`: the argument is given a single value and *doesn't* change based on the values of the variable

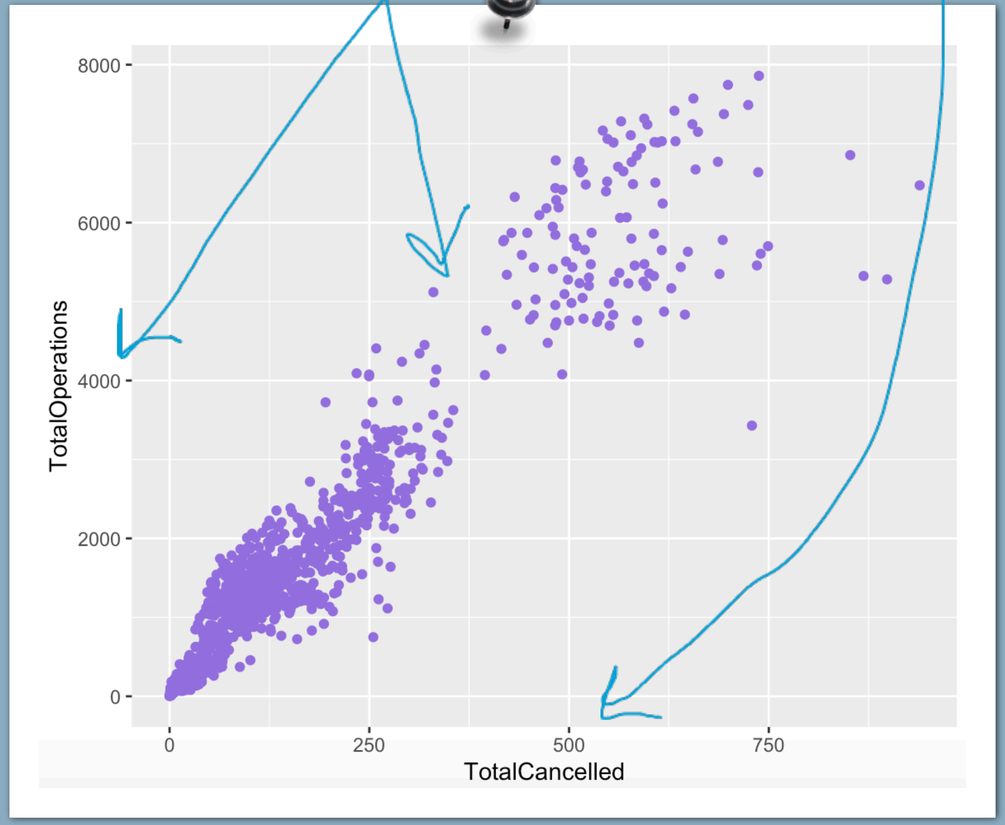


Aesthetics: Inside vs Outside

```
ggplot(cancelled, aes(x = TotalCancelled, y = TotalOperations,
                      color = Year)) +
  geom_point()
```



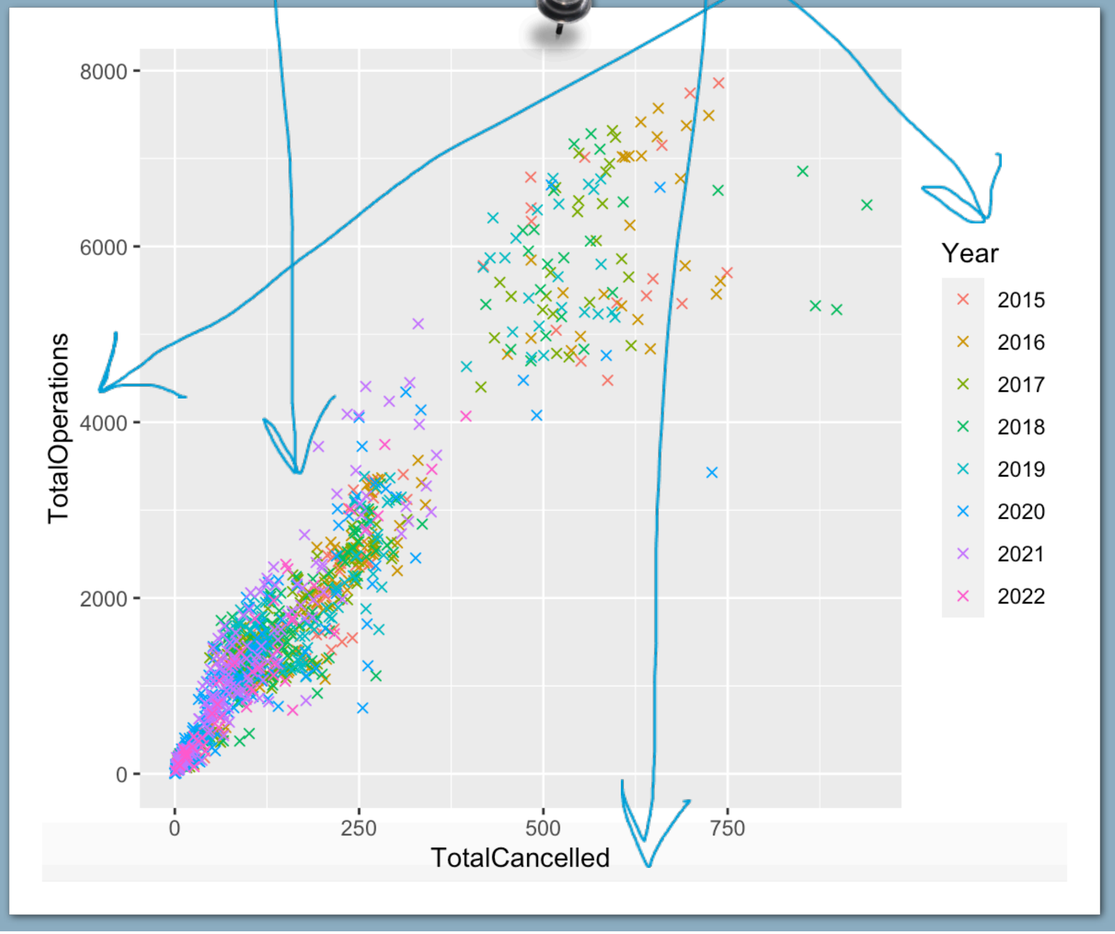

```
ggplot(cancelled, aes(x = TotalCancelled,
                      y = TotalOperations) +
  geom_point(color = "mediumpurple")
```



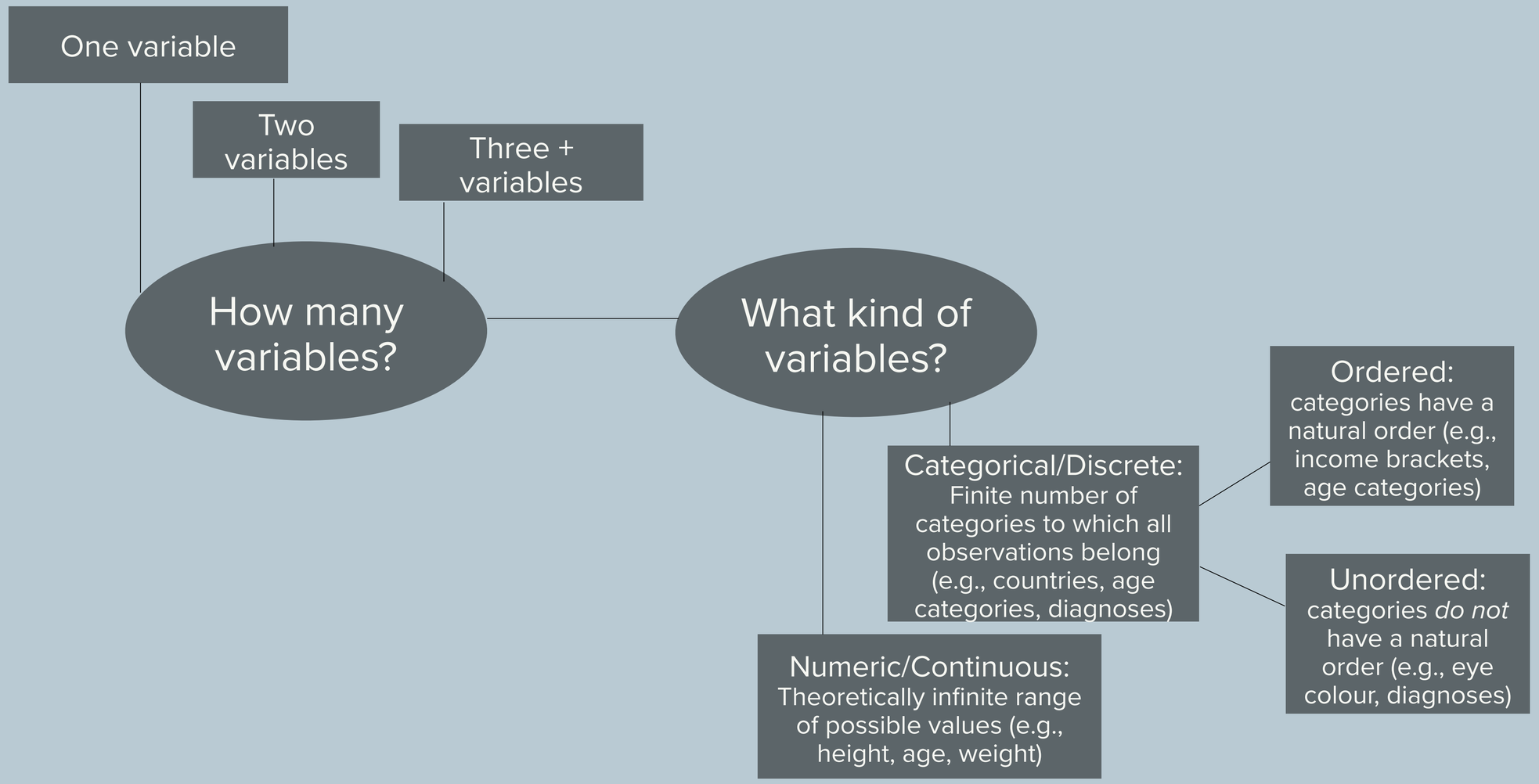
Aesthetics: Inside, Outside, or both

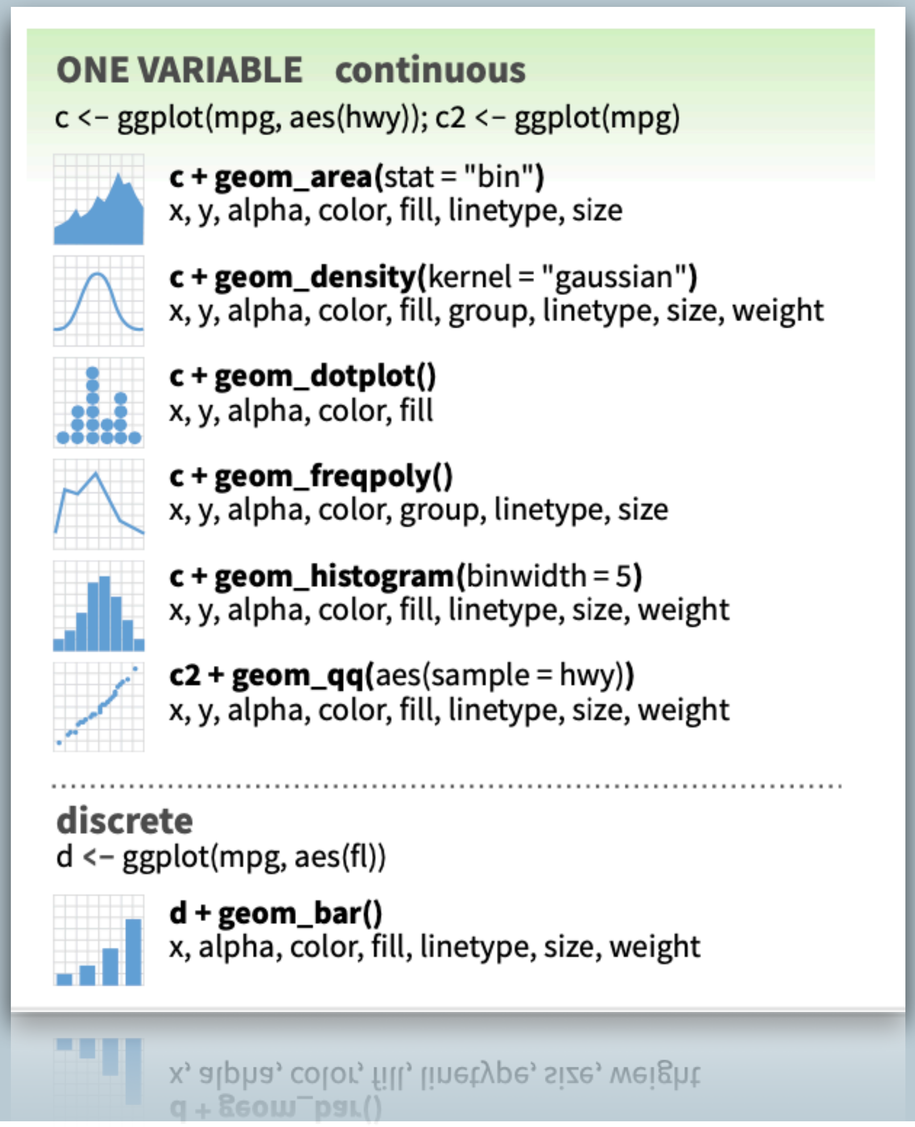
- To learn more about the different aesthetic specifications
- For a list of colors in R

```
ggplot(cancelled, aes(x = TotalCancelled, y = TotalOperations,
                      color = Year)) +
  geom_point(shape = 4)
```



Geoms: decisions, decisions





One variable geoms

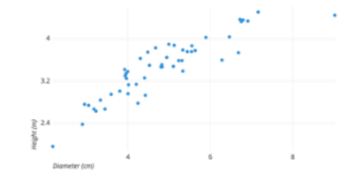
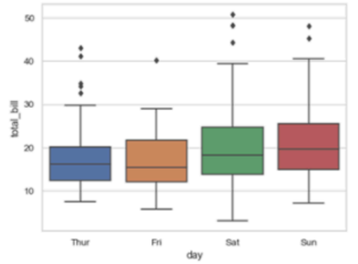
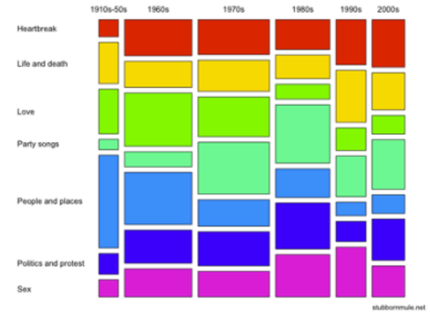
Continuous/numeric X

- Histogram
- Density plot
- Dot plot
- Etc.

Discrete/Categorical X

- Bar charts

When visualising 2 variables

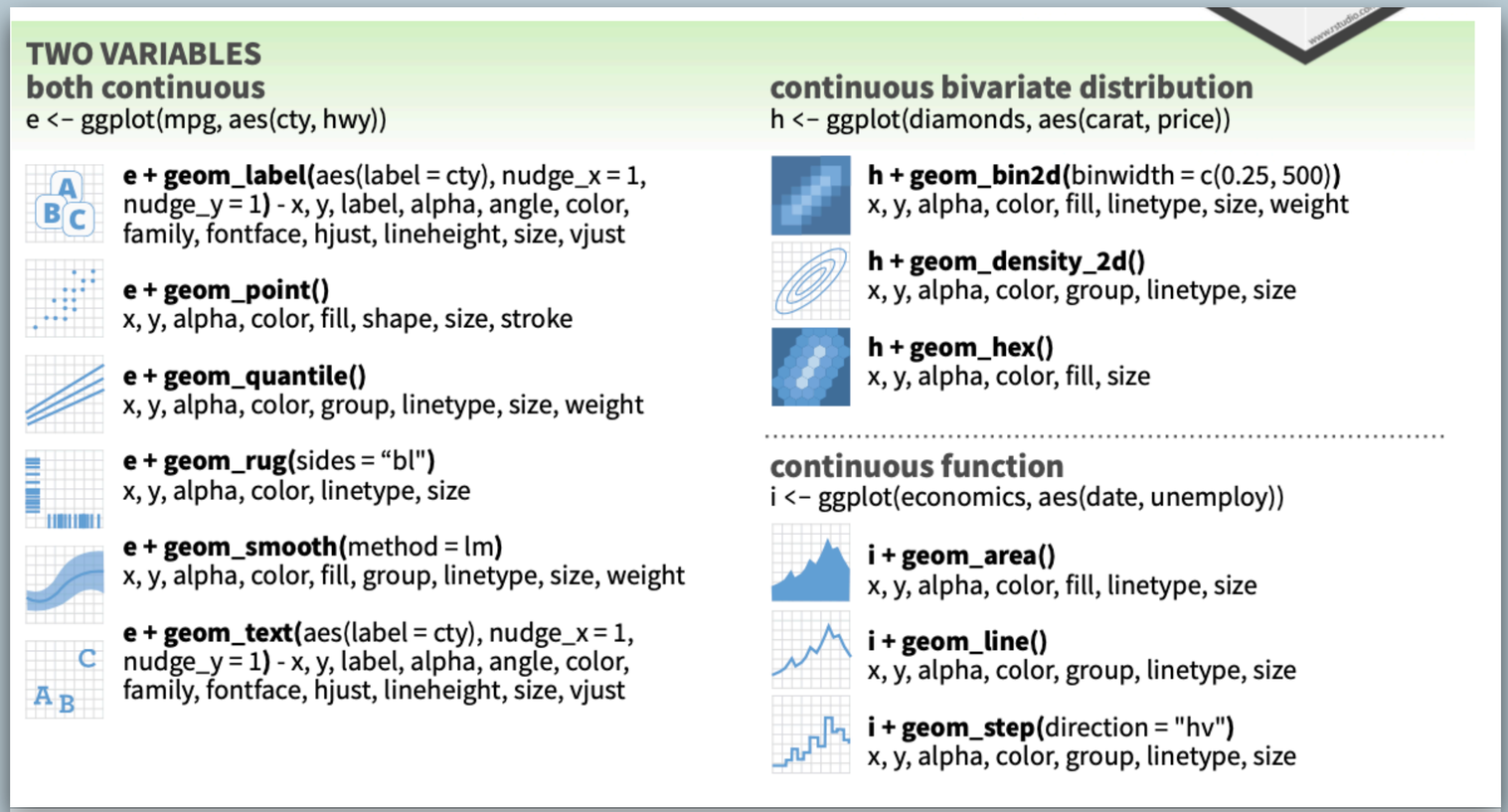
	Numerical	Categorical
Numerical	 • Scatter plot (point) • 2D binning (bin2d, hex) • Contour plot (density2d) • Quantiles (quantile, qq) • Lines (line, smooth) • Ribbons (ribbon, area)	 • Boxplot (boxplot, violin) • Counts (count, tile) • Error bars (errorbar) • Columns (col)
Categorical	***Which ggplot2 data viz is right for your data?*** (geoms in parentheses)	 • Mosaic (ggmosaic::geom_mosaic) • Counts (count, tile)

From Dr Sam Tyner's guest lecture optional video

2 variable geoms: numeric

Continuous/numeric X & Y

- Line chart
- Scatter plot
- Etc.



TWO VARIABLES
both continuous
e <- ggplot(mpg, aes(cty, hwy))

e + geom_label(aes(label = cty), nudge_x = 1, nudge_y = 1**)** - x, y, label, alpha, angle, color, family, fontface, hjust, lineheight, size, vjust

e + geom_point()
x, y, alpha, color, fill, shape, size, stroke

e + geom_quantile()
x, y, alpha, color, group, linetype, size, weight

e + geom_rug(sides = "bl"**)**
x, y, alpha, color, linetype, size

e + geom_smooth(method = lm**)**
x, y, alpha, color, fill, group, linetype, size, weight

e + geom_text(aes(label = cty), nudge_x = 1, nudge_y = 1**)** - x, y, label, alpha, angle, color, family, fontface, hjust, lineheight, size, vjust

continuous bivariate distribution
h <- ggplot(diamonds, aes(carat, price))

h + geom_bin2d(binwidth = c(0.25, 500)**)**
x, y, alpha, color, fill, linetype, size, weight

h + geom_density_2d()
x, y, alpha, color, group, linetype, size

h + geom_hex()
x, y, alpha, color, fill, size

continuous function
i <- ggplot(economics, aes(date, unemploy))

i + geom_area()
x, y, alpha, color, fill, linetype, size

i + geom_line()
x, y, alpha, color, group, linetype, size

i + geom_step(direction = "hv"**)**
x, y, alpha, color, group, linetype, size

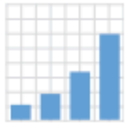
2 variable geoms: numeric & categorical

Continuous/numeric X & Discrete/Categorical Y
- Bar chart

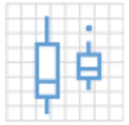
Discrete/Categorical X & Continuous/numeric Y
- Box plot
- Dot plot
- Violin chart

one discrete, one continuous

f <- ggplot(mpg, aes(class, hwy))



f + geom_col()
x, y, alpha, color, fill, group, linetype, size



f + geom_boxplot()
x, y, lower, middle, upper, ymax, ymin, alpha, color, fill, group, linetype, shape, size, weight

f + geom_dotplot(binaxis = "y", stackdir = “center"**)**
x, y, alpha, color, fill, group

f + geom_violin(scale = “area"**)**
x, y, alpha, color, fill, group, linetype, size, weight

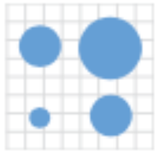
2 variable geoms: categorical

Discrete/categorical X & Y

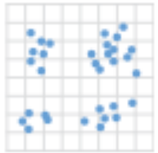
- Mosaic charts
- Counts

both discrete

g <- ggplot(diamonds, aes(cut, color))



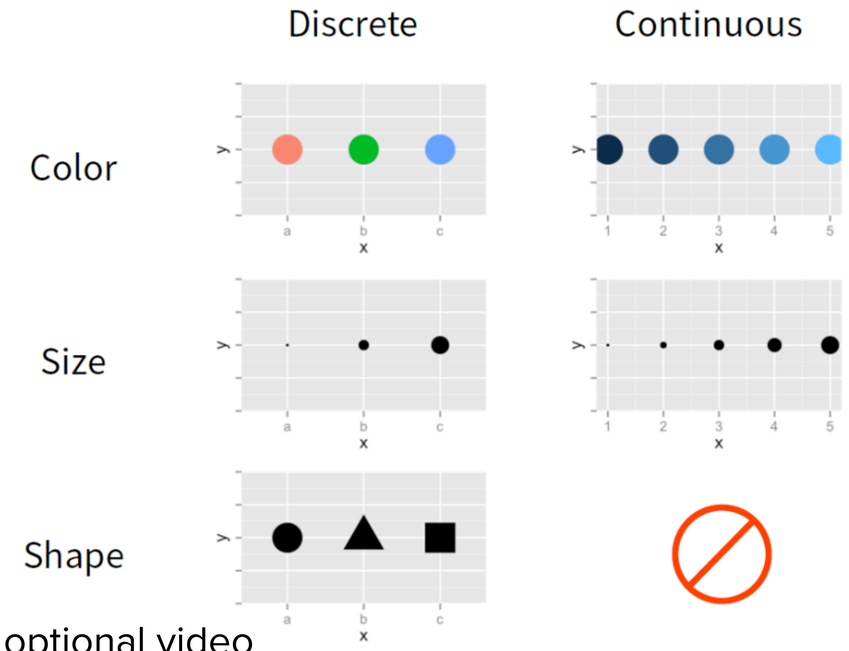
g + geom_count()
x, y, alpha, color, fill, shape, size, stroke



e + geom_jitter(height = 2, width = 2**)**
x, y, alpha, color, fill, shape, size

When visualising 3 variables

Start with a 2-variable visualization, then add color, shape, or size:

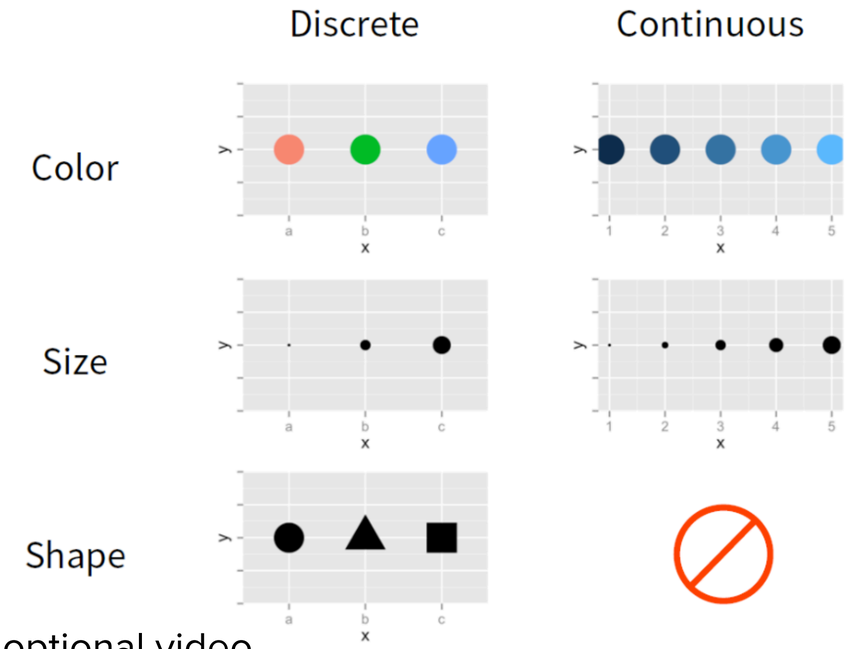


From Dr Sam Tyner's guest lecture optional video

When visualising 3+ variables

Start with a 2-variable visualization, then add color, shape, or size:

Add another variable with Facets



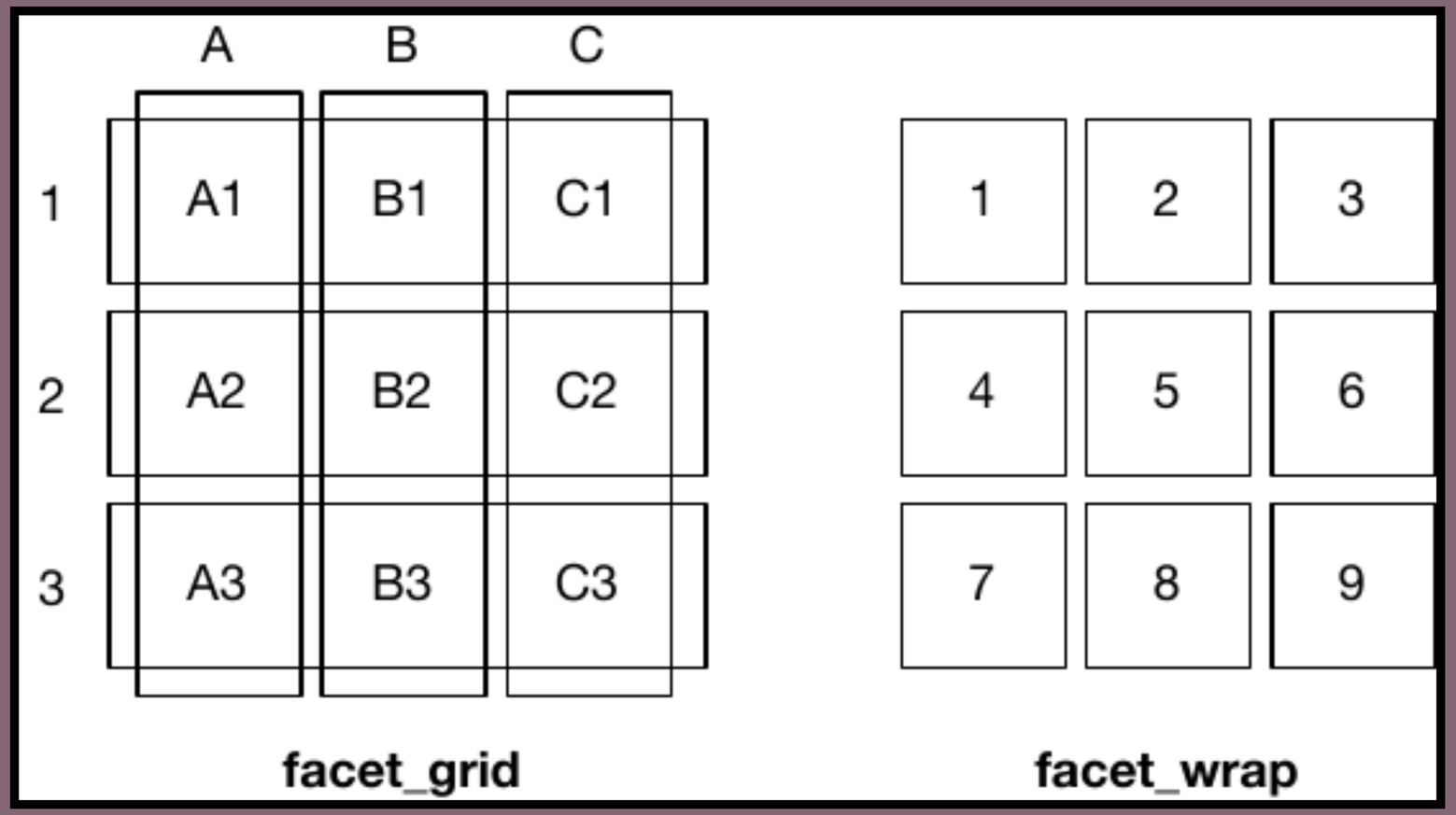
From Dr Sam Tyner's guest lecture optional video

Visualising 3+ variables: Facets

Fundamentally 2 dimensional

`+facet_grid(row ~ column)`

Makes a matrix of panels by row & column faceting variables



Fundamentally 1 dimensional

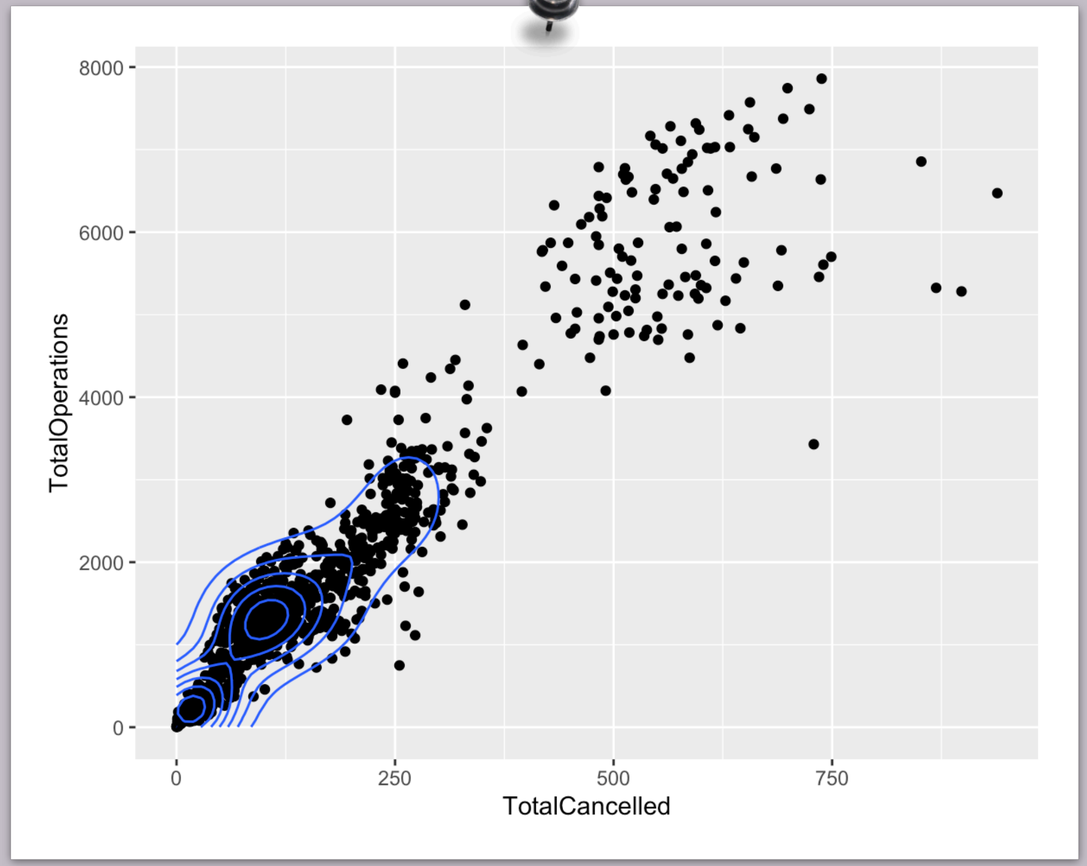
`+facet_wrap(variable)`

Makes a long ribbon of panels

ggplot2 layers

- Stacked in order of code appearance
- Important to keep in mind as elements written later in your code may hide or overwrite previous elements

```
ggplot(cancelled, aes(TotalCancelled, TotalOperations)) +
  geom_point() +
  geom_density2d()
```

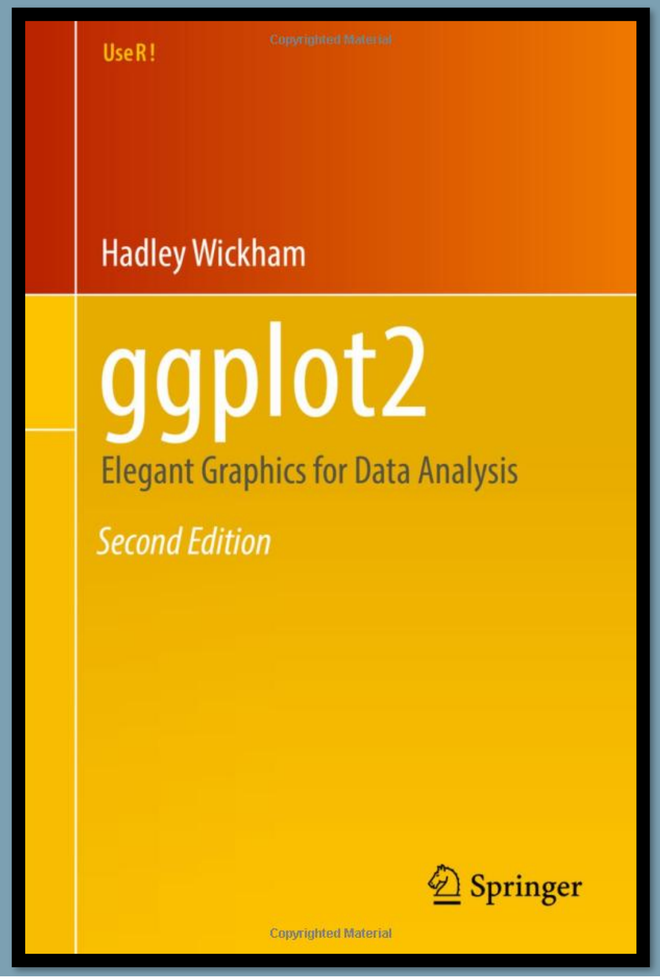


To RStudio!

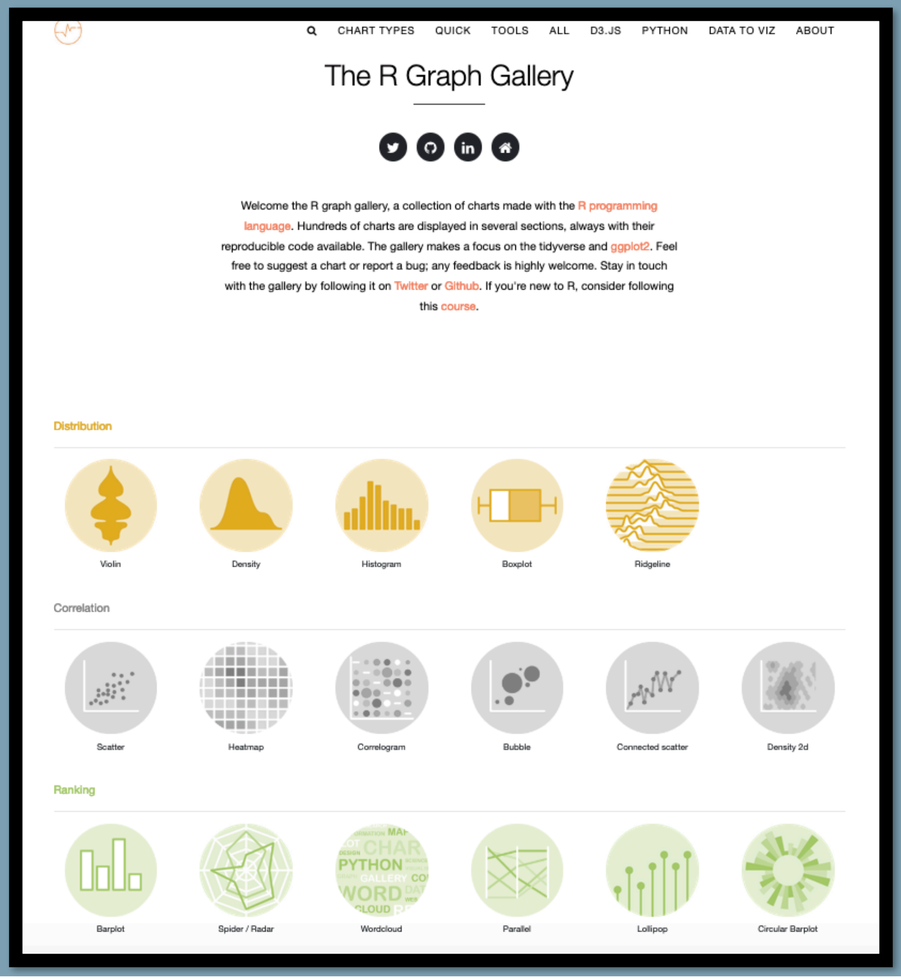
data storytelling with data visualisation

Further Resources

(free!) ggplot2 book



R Graph Gallery



Questions?