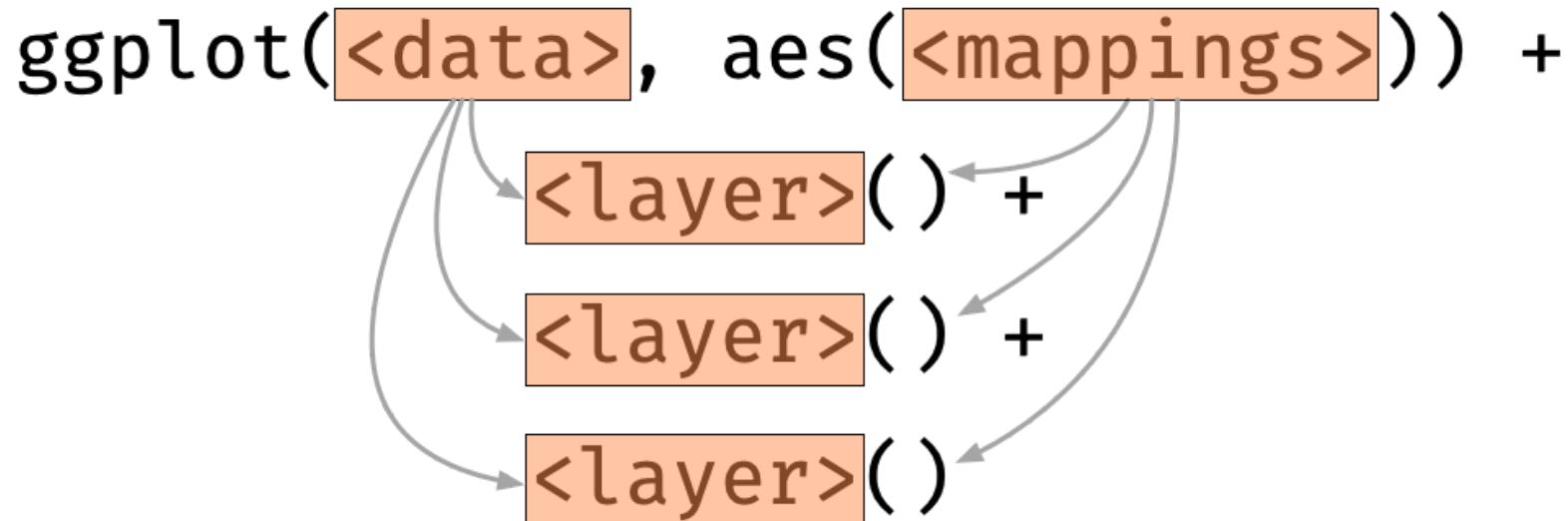


# Data Visualisation with R

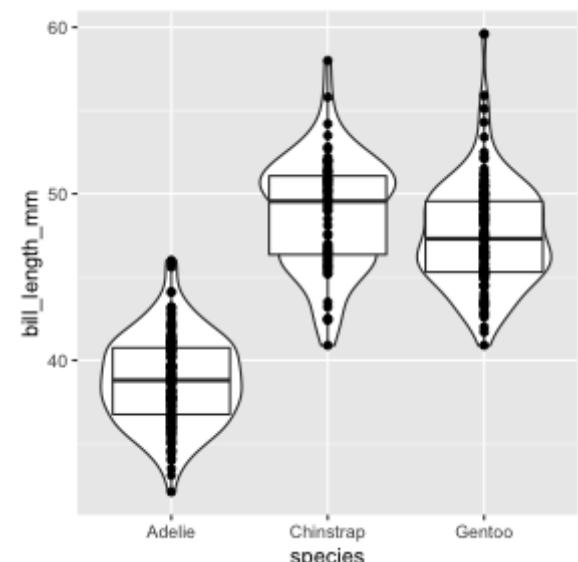
Workshop Part 1

# Add multiple layers



Each layer inherits mapping and data from ggplot by default.

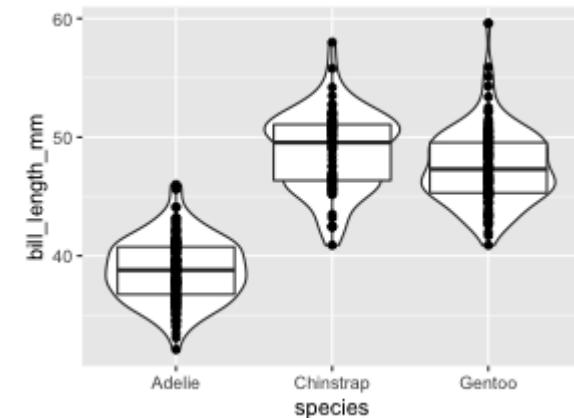
```
ggplot(penguins, aes(x = species, y = bill_length_mm)) +  
  geom_violin() +  
  geom_boxplot() +  
  geom_point()
```



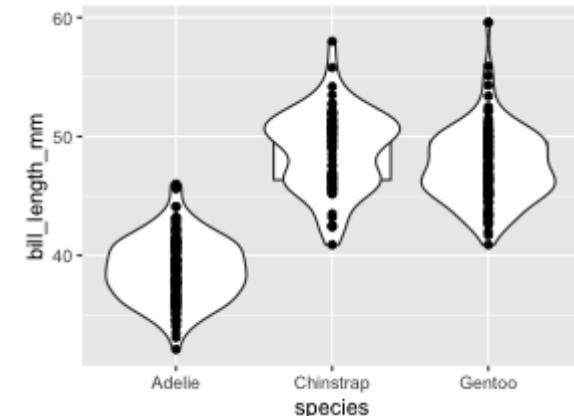
# Order of the layers matters!

Boxplot and violin plot order are switched around.

```
ggplot(penguins, aes(species, bill_length_mm)) +  
  geom_violin() +  
  geom_boxplot() +  
  geom_point()
```



```
ggplot(penguins, aes(species, bill_length_mm)) +  
  geom_boxplot() +  
  geom_violin() +  
  geom_point()
```

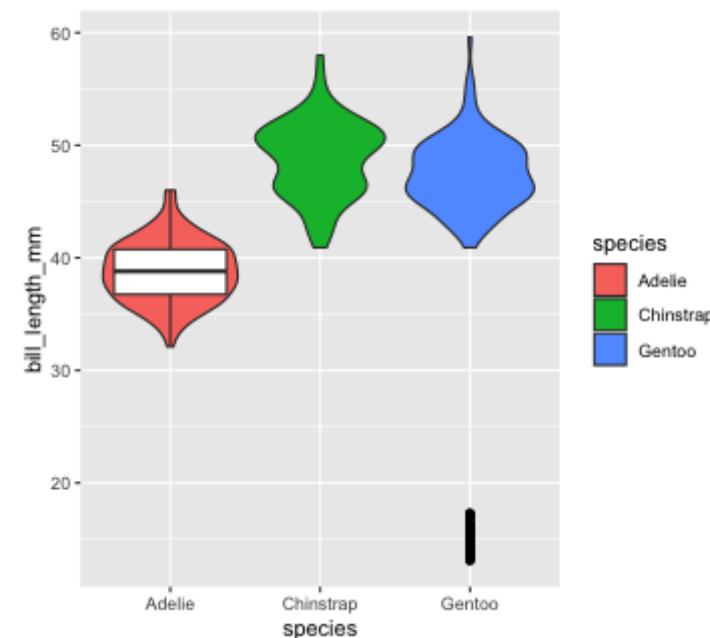


# Layer-specific data and aesthetic mappings

```
ggplot(<data>, aes(<mappings>)) +  
  <layer>(aes(<mappings>)) +  
  <layer>(data = <data>) +  
  <layer>(aes(<mappings>), <data>)
```

For each layer, aesthetic and/or data can be overwritten.

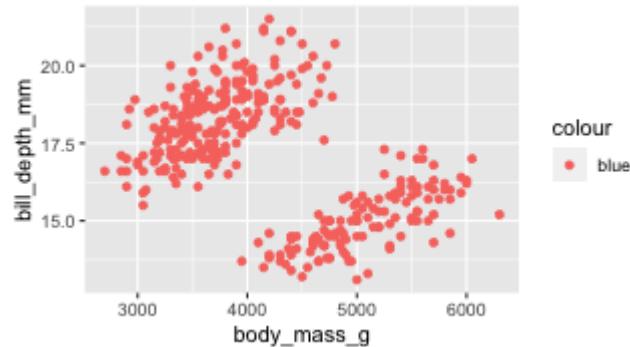
```
ggplot(penguins, aes(species, bill_length_mm)) +  
  geom_violin(aes(fill = species)) +  
  geom_boxplot(data = filter(penguins, species=="Adelie")) +  
  geom_point(data = filter(penguins, species=="Gentoo"),  
             aes(y = bill_depth_mm))
```



# Aesthetic or Attribute?

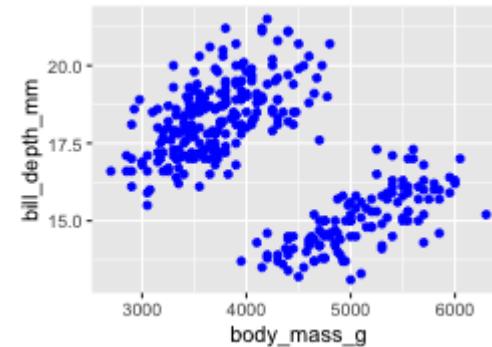
Not what you want

```
ggplot(penguins) +  
  geom_point(aes(body_mass_g,  
                 bill_depth_mm,  
                 color = "blue"))
```



What you want

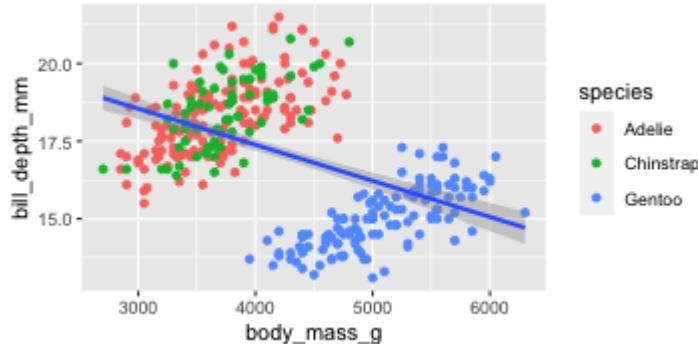
```
ggplot(penguins) +  
  geom_point(aes(body_mass_g,  
                 bill_depth_mm),  
             color = "blue")
```



```
ggplot(penguins) +  
  geom_point(aes(body_mass_g,  
                 bill_depth_mm,  
                 color = I("blue")))
```

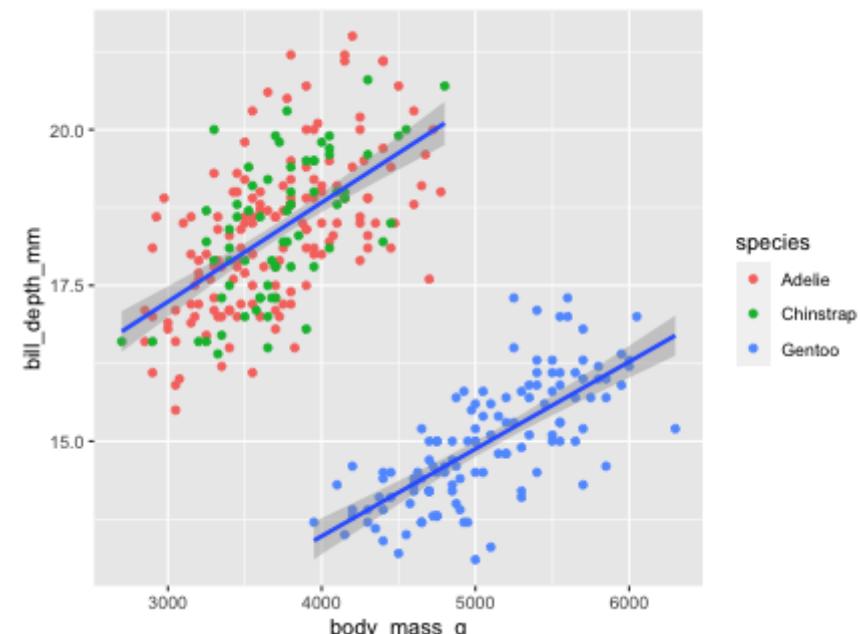
# group in ggplot

```
ggplot(penguins,  
       aes(body_mass_g,  
            bill_depth_mm)) +  
  geom_point(aes(color = species)) +  
  geom_smooth(method = "lm")
```



- This is an obvious case of Simpson's paradox.
- What if we wanted to draw the fit of a simple linear model for each

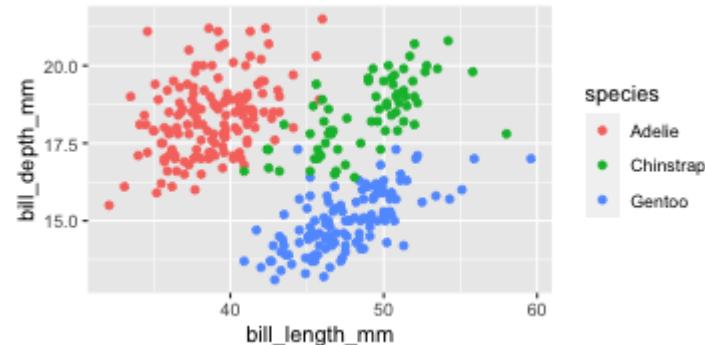
```
ggplot(penguins,  
       aes(body_mass_g,  
            bill_depth_mm)) +  
  geom_point(aes(color = species)) +  
  geom_smooth(method = "lm",  
              aes(group = species=="Gentoo"))
```



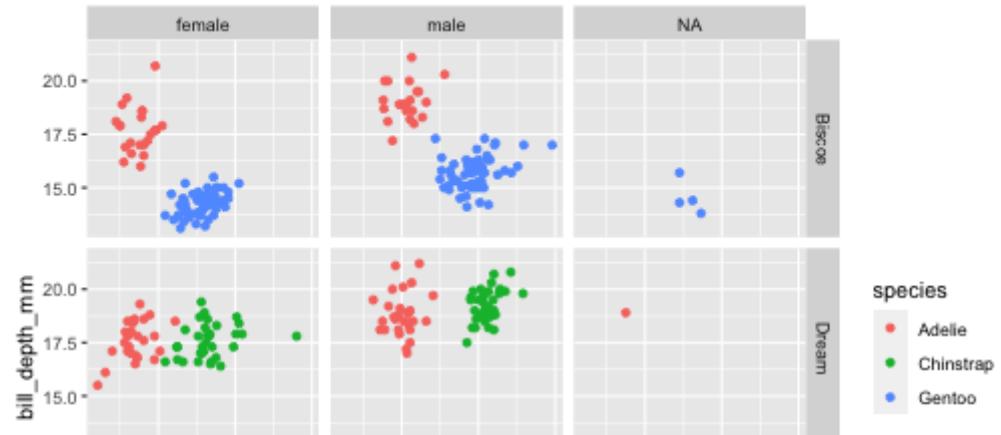
# Facetting

```
g <- ggplot(penguins, aes(bill_length_mm, bill_depth_mm, color = species)) + geom_point()
```

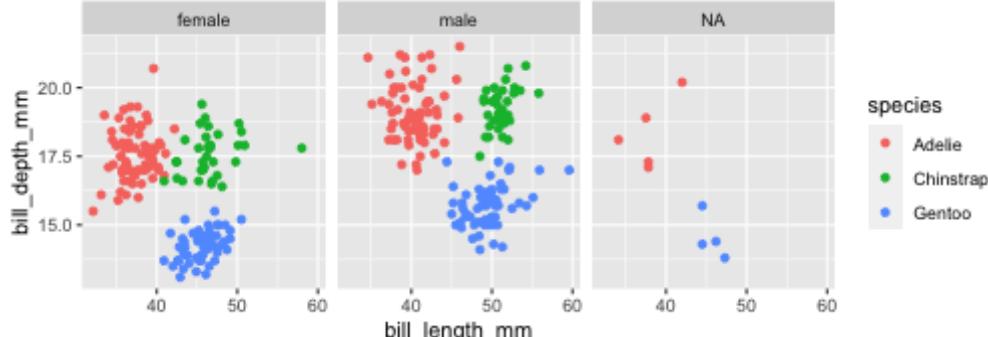
g



g + facet\_grid(island ~ sex)

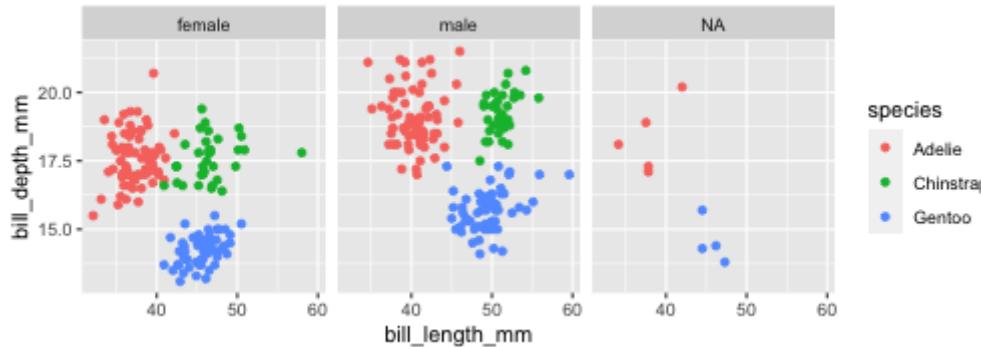


g + facet\_wrap(~sex)

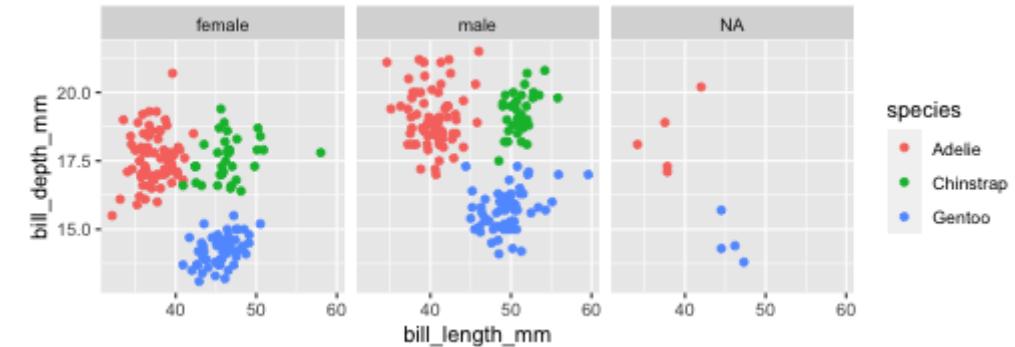


# facet\_wrap and facet\_grid

```
g + facet_wrap( ~ sex)
```



```
g + facet_grid(. ~ sex)
```



```
g + facet_wrap( ~ sex, ncol = 1)
```

```
g + facet_grid(sex ~ .)
```

# HELP!

- RStudio > Help > Cheatsheets
- R4DS Community Slack
- Twitter with hashtag #rstats
- RStudio Community
- Stackoverflow

# Data Visualization with ggplot2 :: CHEAT SHEET



## Basics

ggplot2 is based on the **grammar of graphics**, the idea that you can build every graph from the same components: a **data set**, a **coordinate system**, and geoms—visual marks that represent data points.



To display values, map variables in the data to visual properties of the geom (**aesthetics**) like **size**, **color**, and **x** and **y** locations.



Complete the template below to build a graph.

```
ggplot(data = <DATA>) +
  <GEOM_FUNCTION>(mapping = aes(<MAPPINGS>),
  stat = <STAT>, position = <POSITION>) +
  <COORDINATE_FUNCTION>+
  <FACET_FUNCTION>+
  <SCALE_FUNCTION>+
  <THEME_FUNCTION>
```

**ggplot(data = mpg, aes(x = cty, y = hwy))** Begins a plot that you finish by adding layers to. Add one geom function per layer.

**aesthetic mappings**    **data**    **geom**  
**qplot(x = cty, y = hwy, data = mpg, geom = "point")** Creates a complete plot with given data, geom, and mappings. Supplies many useful defaults.

**last\_plot()** Returns the last plot

**ggsave("plot.png", width = 5, height = 5)** Saves last plot as 5' x 5' file named "plot.png" in working directory. Matches file type to file extension.

## Geoms

Use a geom function to represent data points, use the geom's aesthetic properties to represent variables. Each function returns a layer.

### GRAPHICAL PRIMITIVES

```
a <- ggplot(economics, aes(date, unemploy))
b <- ggplot(seals, aes(x = long, y = lat))
```

**a + geom\_blank()** (Useful for expanding limits)

**b + geom\_curve(aes(yend = lat + 1,
xend = long + 1, curvature = z))** - x, xend, y, yend, alpha, angle, color, curvature, linetype, size

**a + geom\_path(lineend = "butt", linejoin = "round",
linemetre = 1)** x, y, alpha, color, group, linetype, size

**a + geom\_polygon(aes(group = group))** x, y, alpha, color, fill, group, linetype, size

**b + geom\_rect(aes(xmin = long + 1, ymin = lat + 1, xmax = long + 1, ymax = lat + 1))** - xmax, xmin, ymax, ymin, alpha, color, fill, linetype, size

**a + geom\_ribbon(aes(ymmin = unemploy - 900,
yamax = unemploy + 900))** - x, ymax, ymin, alpha, color, fill, group, linetype, size

### LINE SEGMENTS

common aesthetics: x, y, alpha, color, linetype, size

**b + geom\_abline(aes(intercept = 0, slope = 1))**  
**b + geom\_hline(aes(yintercept = lat))**  
**b + geom\_vline(aes(xintercept = long))**

**b + geom\_segment(aes(yend = lat + 1, xend = long + 1))**  
**b + geom\_spoke(aes(angle = 1:1155, radius = 1))**

### ONE VARIABLE continuous

```
c <- ggplot(mpg, aes(hwy)); c2 <- ggplot(mpg)
```

**c + geom\_area(stat = "bin")** x, y, alpha, color, fill, linetype, size

**c + geom\_density(kernel = "gaussian")** x, y, alpha, color, fill, group, linetype, size, weight

**c + geom\_dotplot()** x, y, alpha, color, fill

**c + geom\_freqpoly()** x, y, alpha, color, group, linetype, size

**c + geom\_histogram(binwidth = 5)** x, y, alpha, color, fill, linetype, size, weight

**c2 + geom\_qq(aes(sample = hwy))** x, y, alpha, color, fill, linetype, size, weight

### discrete

**d <- ggplot(mpg, aes(f1))**

**d + geom\_bar()** x, alpha, color, fill, linetype, size, weight

### TWO VARIABLES

**continuous x , continuous y**  
**continuous x , discrete y**

**e + geom\_label(aes(label = cty), nudge\_x = 1,
nudge\_y = 1, check\_overlap = TRUE)** x, y, label, alpha, angle, color, family, fontface, hjust, lineheight, size, vjust

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

**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, check\_overlap = TRUE)** x, y, label, alpha, angle, color, family, fontface, hjust, lineheight, size, vjust

**discrete x , continuous y**  
**continuous x , discrete y**

**f + geom\_col()** x, y, alpha, color, fill, group, linetype, size

**f + geom\_boxplot()** x, y, lower, middle, upper, ymin, ymax, 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

**discrete x , discrete y**

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

**g + geom\_count()** x, y, alpha, color, fill, shape, size, stroke

### THREE VARIABLES

**sealsSz <- with(seals, sqrt(delta\_long^2 + delta\_lat^2))** l <- ggplot(seals, aes(long, lat))

**l + geom\_contour(aes(z = z))** x, y, alpha, colour, group, linetype, size, weight

**l + geom\_raster(aes(fill = z), hijust = 0.5, vjust = 0.5,**  
**interpolate = FALSE)** x, y, alpha, fill

**l + geom\_tile(aes(fill = z))** x, y, alpha, color, fill, linetype, size, width



2

# Tidying your data

# Weight gain in pigs for different treatments

The `crampton.pig` is from the `agridat` 

```
library(agridat)
glimpse(crampton.pig)

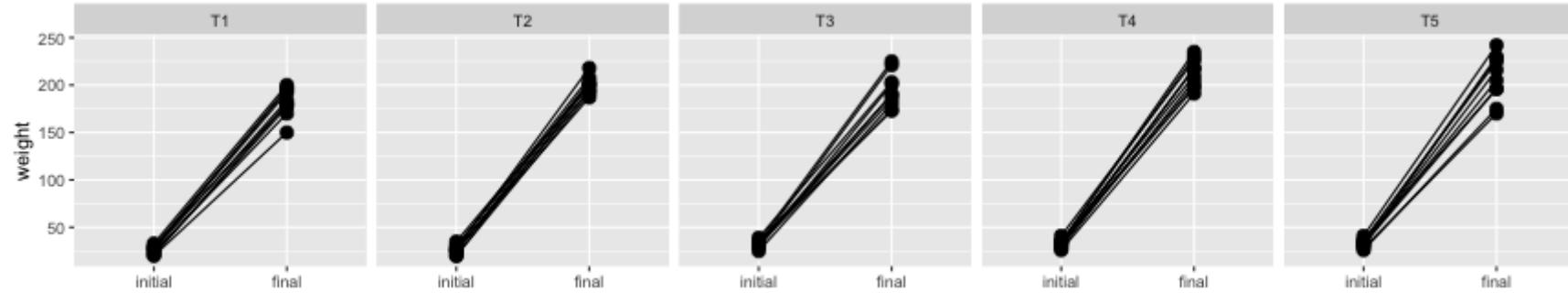
## Rows: 50
## Columns: 5
## $ treatment <fct> T1, T2, T2, T2, T2,
## $ rep       <fct> R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R1, R2, R3, R4, R5
## $ weight1   <int> 30, 21, 21, 33, 27, 24, 20, 29, 28, 26, 26, 24, 20, 35, 25,
## $ feed      <int> 674, 628, 661, 694, 713, 585, 575, 638, 632, 637, 699, 626,
## $ weight2   <int> 195, 177, 180, 200, 197, 170, 150, 180, 192, 184, 194, 204,
```

`weight1` is initial weight and `weight2` is final weight

Wright (2018). `agridat`: Agricultural Datasets. R package version 1.16. <https://CRAN.R-project.org/package=agridat>

Crampton and Hopkins (1934). The Use of the Method of Partial Regression in the Analysis of Comparative Feeding Trial Data, Part II. *The Journal of Nutrition* 8 113-123.

```
names(crampton.pig)  
## [1] "treatment" "rep"      "weight1"    "feed"       "weight2"
```

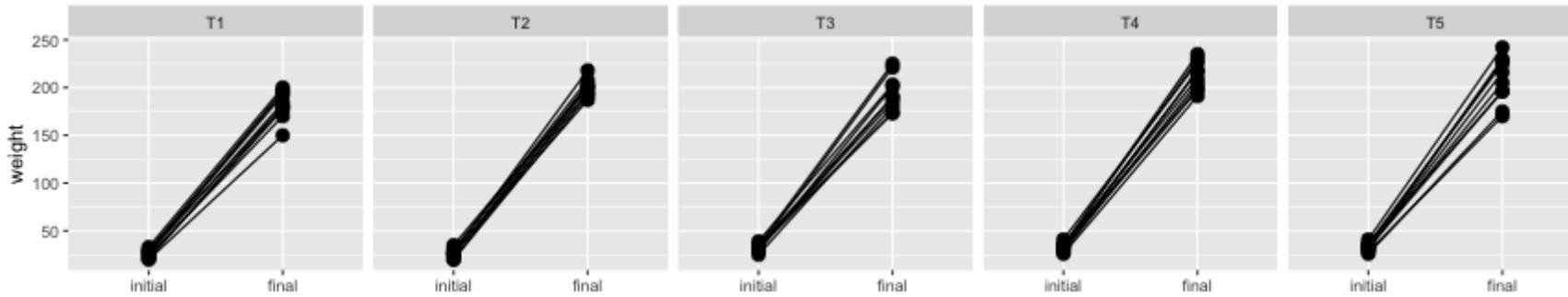


What are the mappings to get the above graph? 🤔

```
ggplot(crampton.pig, aes(x = ???, y = ???)) +  
  geom_point() +  
  geom_line() +  
  facet_grid(. ~ treatment)
```



# Getting the data in the right form



- The x-axis is the time when pig was weighed
- The y-axis is the weight
- The facetting is by treatment

```
## # A tibble: 100 × 5
##   treatment feed id    when      weight
##   <fct>     <int> <chr> <fct>     <int>
## 1 T1         674  pig1 initial     30
## 2 T1         674  pig1 final      195
## 3 T1         628  pig2 initial     21
## 4 T1         628  pig2 final      150
## 5 T2         674  pig3 initial     45
## 6 T2         674  pig3 final      205
## 7 T2         675  pig4 initial     40
## 8 T2         675  pig4 final      210
## 9 T2         676  pig5 initial     40
## 10 T2        676  pig5 final      220
## # ... with 90 more rows
```

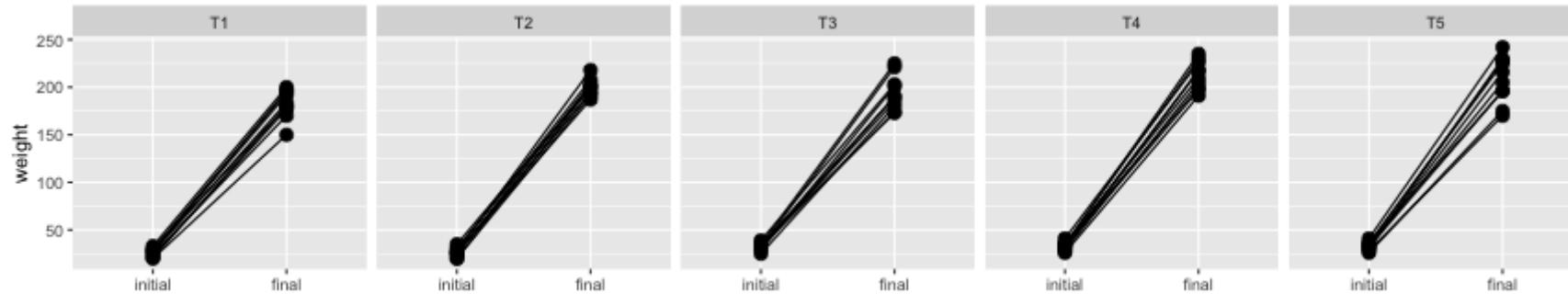
How I wrangled this data

```
pig_df <- crampton.pig %>%
  mutate(id = paste0("pig", 1:n())) %>%
  pivot_longer(c(weight1, weight2),
               names_to = "when",
               values_to = "weight") %>%
  mutate(when = factor(when,
                      levels = c("weight1", "weight2"),
                      labels = c("initial", "final")))
```

(note: teaching wrangling is not part of this workshop, please see [here](#) if you want to learn more)

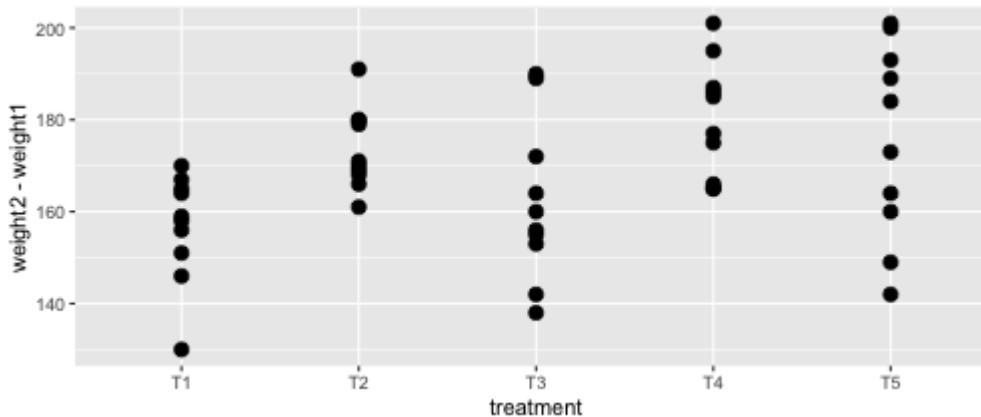
# Putting it all together

```
ggplot(pig_df, aes(when, weight)) + # tidying your data for plotting  
  geom_point(size = 3) + # attribute not aesthetic  
  geom_line(aes(group = id)) + # grouping  
  facet_grid(. ~ treatment) + # facetting  
  labs(x = "") # we'll learn this in the last session
```



# Meaningfully order categorical variables

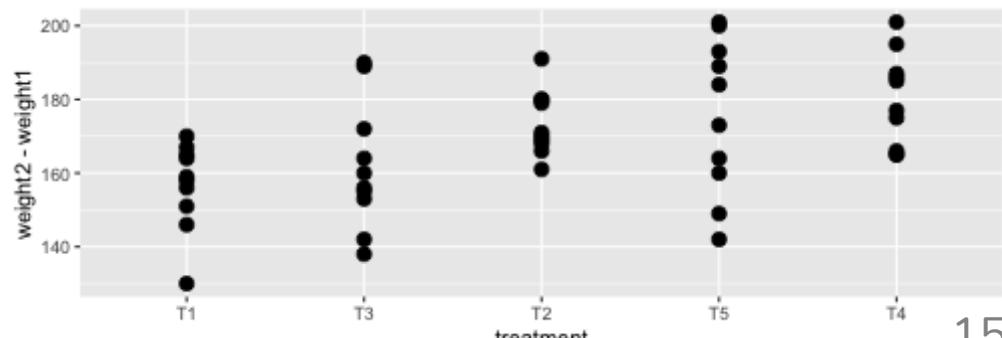
```
ggplot(crampton.pig,  
       aes(treatment, weight2 - weight1)) +  
       geom_point(size = 3)
```



- Treatments are ordered alphabetically by default
- It's better to order categorical variables meaningfully

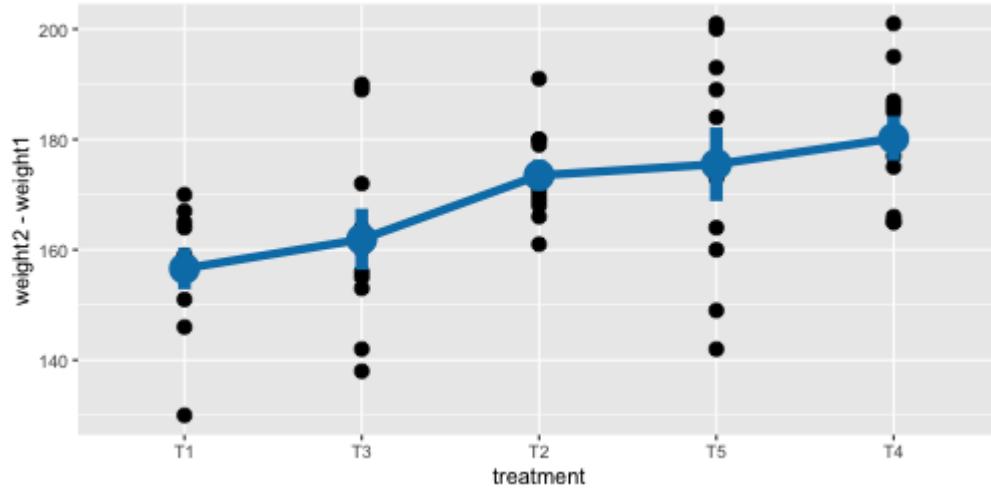
Order factor levels by the mean of the weight difference.

```
library(forcats) # for easy factor manipulation  
crampton.pig2 <- crampton.pig %>%  
  mutate(  
    treatment = fct_reorder(treatment,  
                             weight2 - weight1,  
                             mean))  
  
ggplot(crampton.pig2,  
       aes(treatment, weight2 - weight1)) +  
       geom_point(size = 3)
```



# Plotting auxilliary data

Plot you may want:

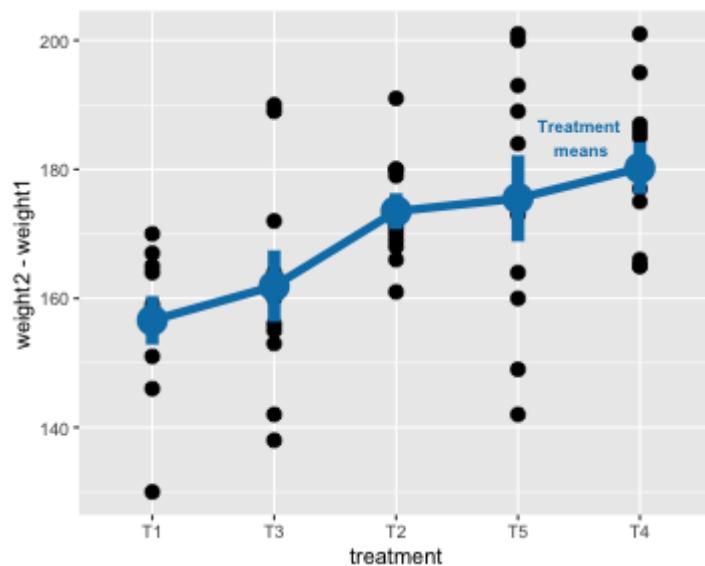


One way to do this:

```
fig <- ggplot(crampton.pig2,
               aes(treatment,
                    weight2 - weight1)) +
  geom_point(size = 3) +
  stat_summary(fun.data = mean_se,
              geom = "pointrange", fatten = 2,
              color = "#027EB6", size = 3) +
  stat_summary(fun = mean, geom = "line",
              group = 1, color = "#027EB6",
              size = 2)
```

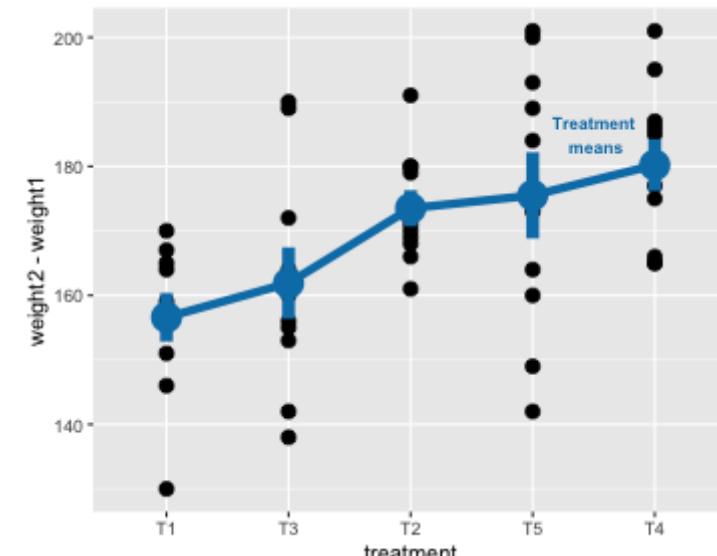
# Plotting annotations

```
fig +  
  geom_text(data = data.frame(treatment = 4.5,  
                               weight2 = 185,  
                               weight1 = 0),  
            label = "Treatment\n means",  
            size = 3,  
            color = "#027EB6",  
            fontface = "bold")
```



But it might be just easier to:

```
fig +  
  annotate("text",  
          x = 4.5, y = 185,  
          label = "Treatment\n means",  
          size = 3,  
          color = "#027EB6",  
          fontface = "bold")
```





`</> Open part1-exercise-02.Rmd`

15 : 00

# Session Information

```
devtools::session_info()
```

```
## - Session info 🎅️ ⚪️ 🎳  
## hash: Santa Claus: dark skin tone, oncoming fist: medium skin tone, bowling  
##  
## setting value  
## version R version 4.1.2 (2021-11-01)  
## os      macOS Big Sur 10.16  
## system x86_64, darwin17.0  
## ui      X11  
## language (EN)  
## collate en_AU.UTF-8  
## ctype   en_AU.UTF-8  
## tz      Australia/Melbourne  
## date   2022-02-20
```

These slides are licensed under

