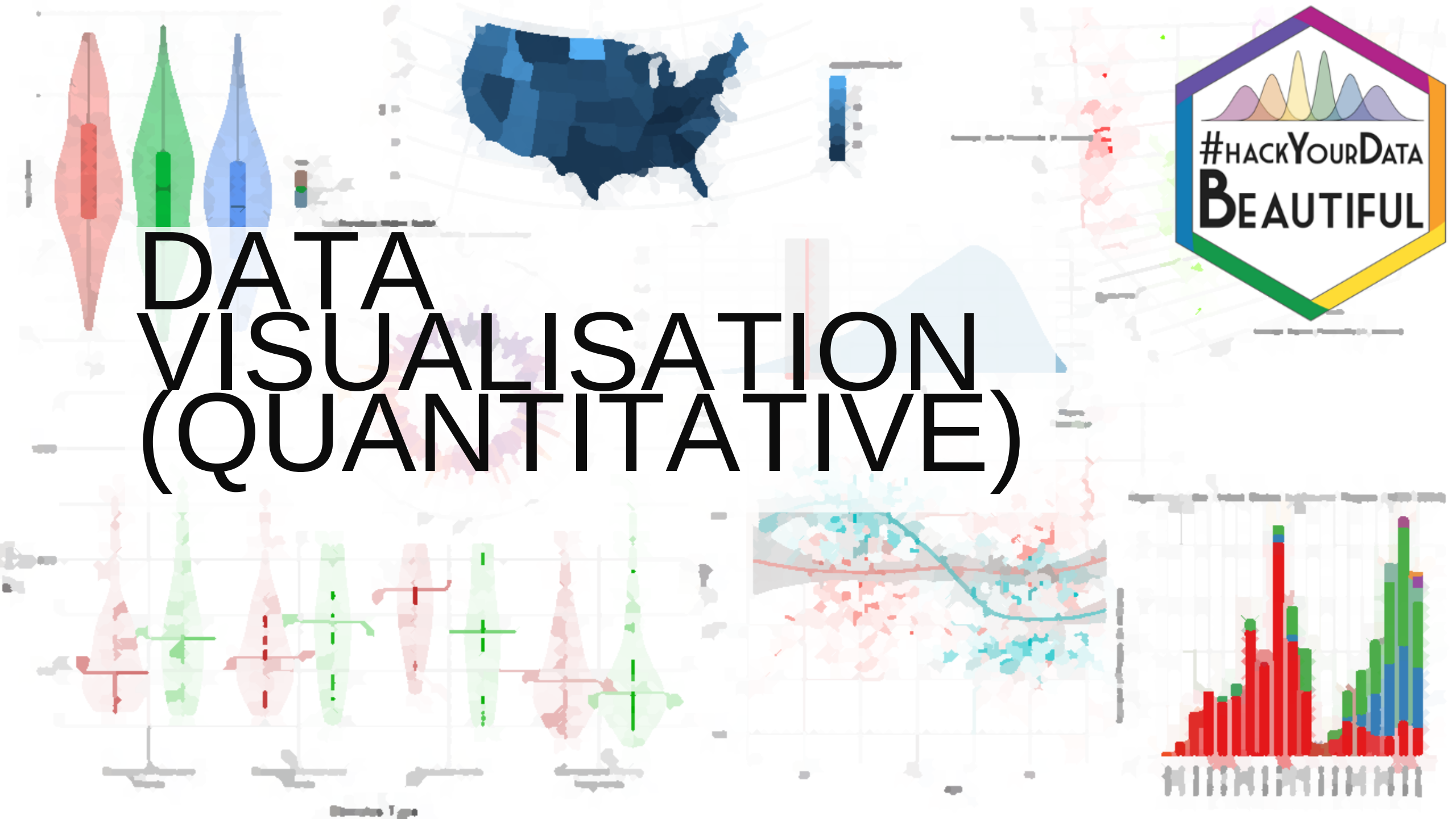


DATA VISUALISATION (QUANTITATIVE)

Visualising Data

- More important than statistical tests!(?)
- Telling a story in a graph
- R has some great packages for visualising your data, especially **ggplot**

ggplot2

- Part of (and complementary to) the tidyverse collection
- Beautiful and informative code, for beautiful and informative graphs
- Expects tidy data; one observation per row
  - (See tidyverse introduction from this morning)

Plan for the Session

- Introduce ggplot2
- Explain how it works, and show some example output
- Practice on some data we're interested in

ggplot2 Syntax


```
library(tidyverse)

iris %>%
  ggplot(aes(x=Sepal.Length, y=Petal.Length)) +
  geom_point()
```

Load in packages

Data

Pipe data into the plot

Build ggplot object

Add feature to ggplot object

Plot feature

ggplot2 Syntax - Pipes


```
library(tidyverse)


iris %>%
  ggplot(aes(x=Sepal.Length, y=Petal.Length)) +
  geom_point()
```

Remember, this is equivalent to…

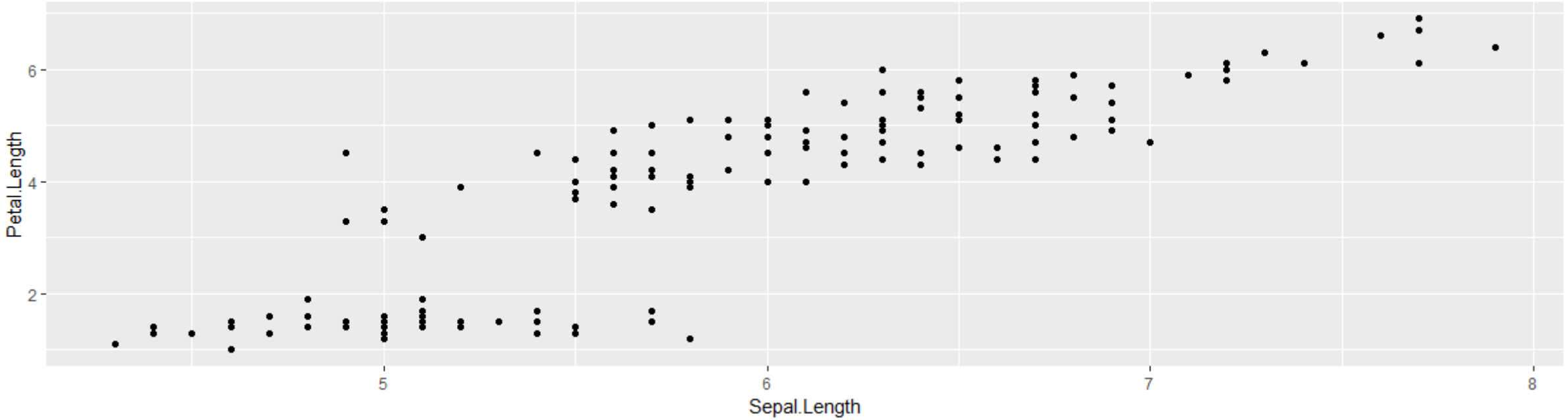
ggplot2 Syntax - Pipes


```
library(tidyverse)

ggplot(iris, aes(x=Sepal.Length, y=Petal.Length)) +
  geom_point()
```

ggplot2 syntax

```
iris %>%
  ggplot(aes(x = Sepal.Length, y = Petal.Length)) +
  geom_point()
```



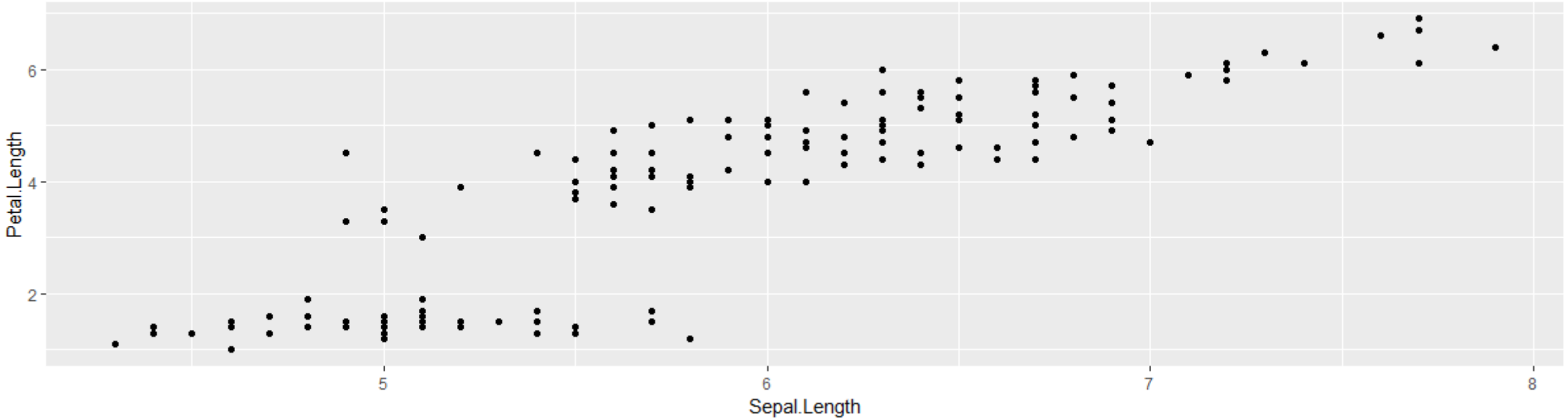
geom_x

- Multiple possible “geoms”
- Which geom you want will depend on what your variables are like:
  - How many?
  - Are they discrete (categorical) or continuous (numerical)?
- Most useful geoms can be found on the ggplot cheat sheat
- A full list of geoms is available on the ggplot reference page
- Google to find the geom you want, e.g.:

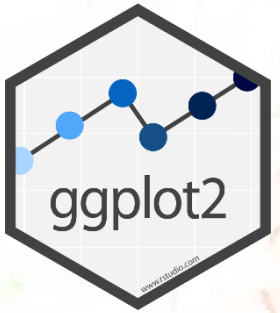
  “ggplot scatter graph” will return results showing that you want geom_point()

ggplot2 syntax

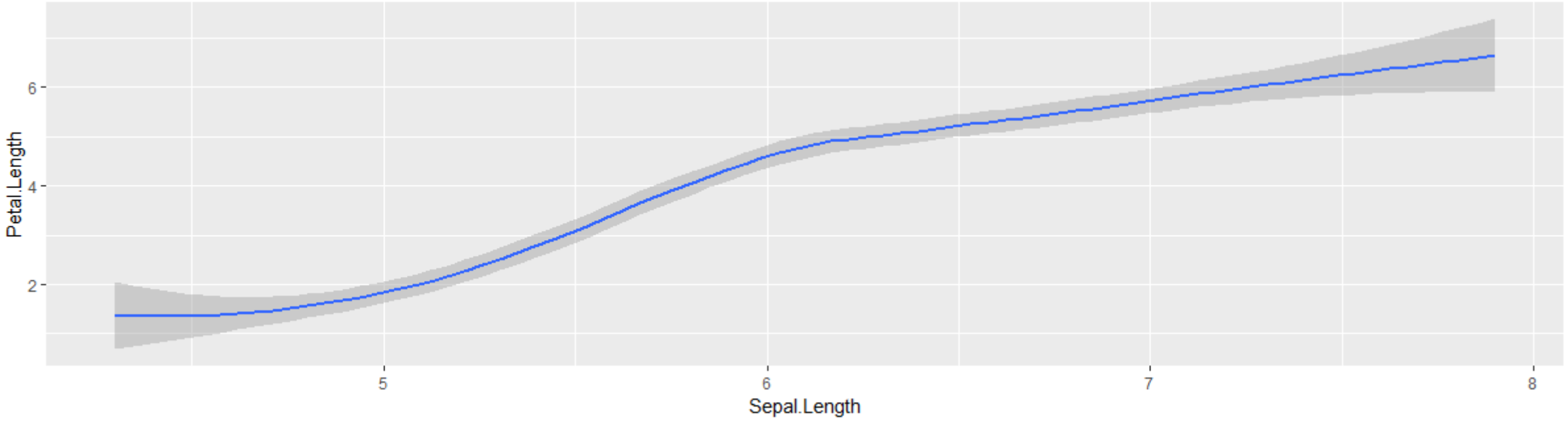
```
iris %>%
  ggplot(aes(x = Sepal.Length, y = Petal.Length)) +
  geom_point()
```



ggplot2 syntax

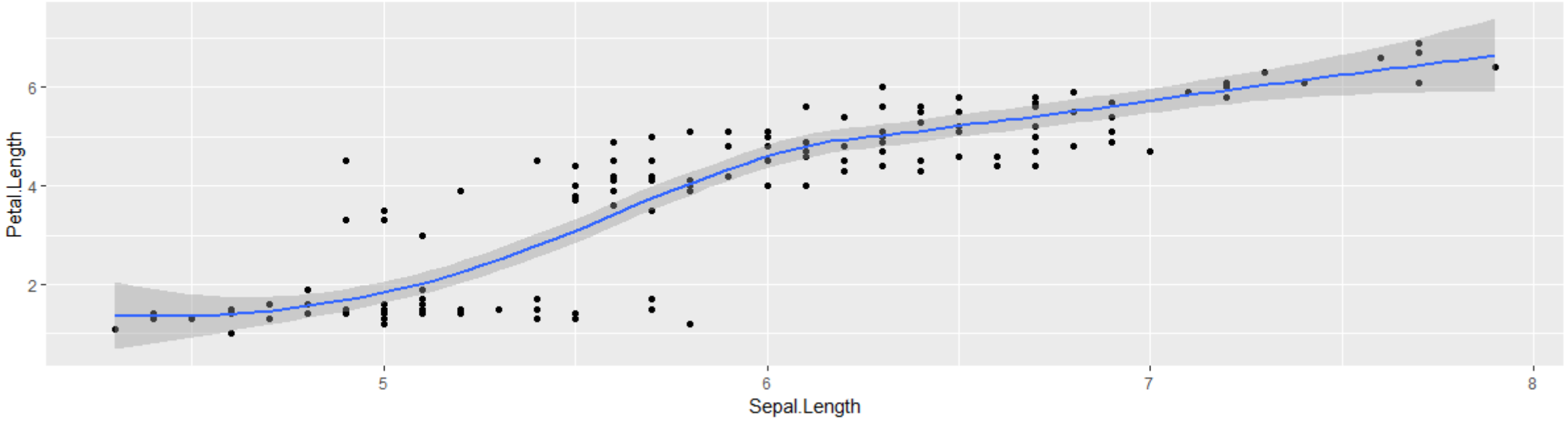



```
iris %>%
  ggplot(aes(x = Sepal.Length, y = Petal.Length)) +
  geom_smooth()
```



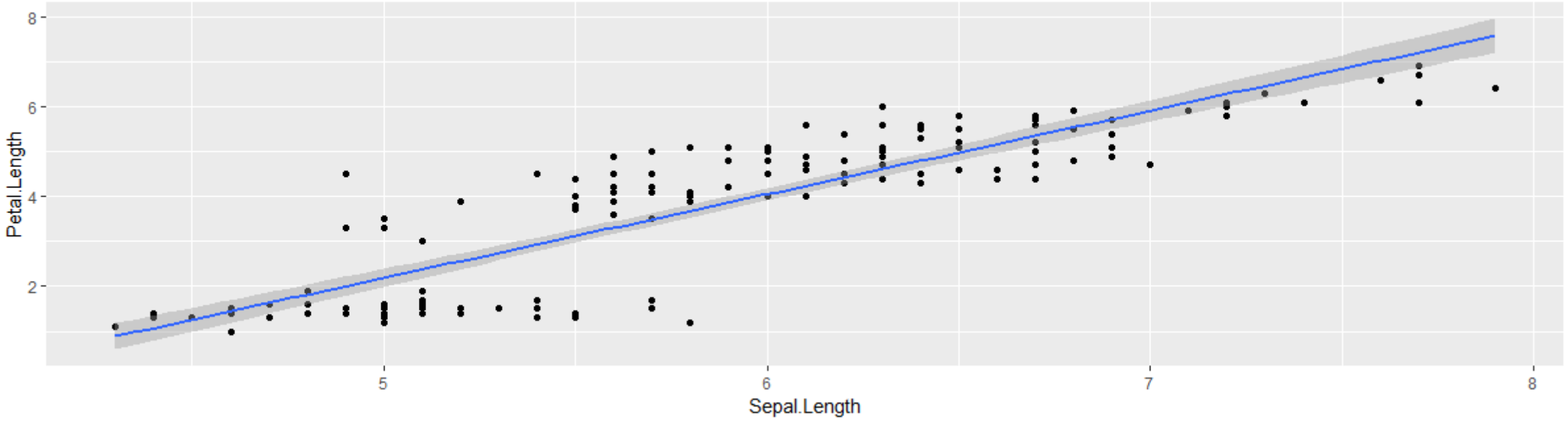
ggplot2 syntax

```
iris %>%
  ggplot(aes(x = Sepal.Length, y = Petal.Length)) +
  geom_point() +
  geom_smooth()
```



ggplot2 syntax

```
iris %>%
  ggplot(aes(x = Sepal.Length, y = Petal.Length)) +
  geom_point() +
  geom_smooth(method = "lm")
```



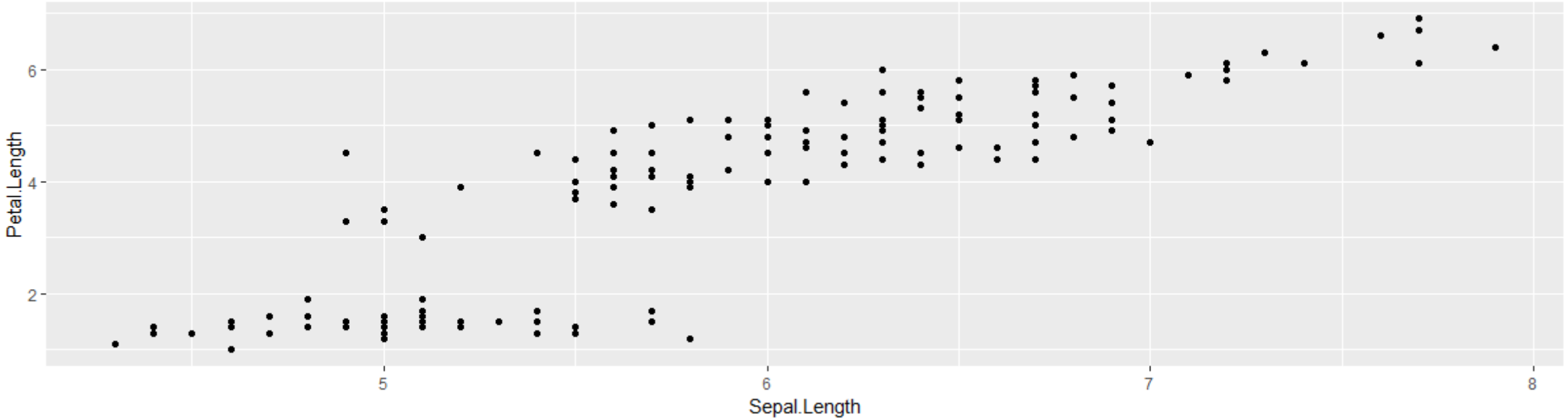
Aesthetics: aes()

- Tells ggplot what variables to plot, and which visual features should represent them

- Possible aesthetics include:
  - x
  - y
  - colour / color
  - fill
  - shape

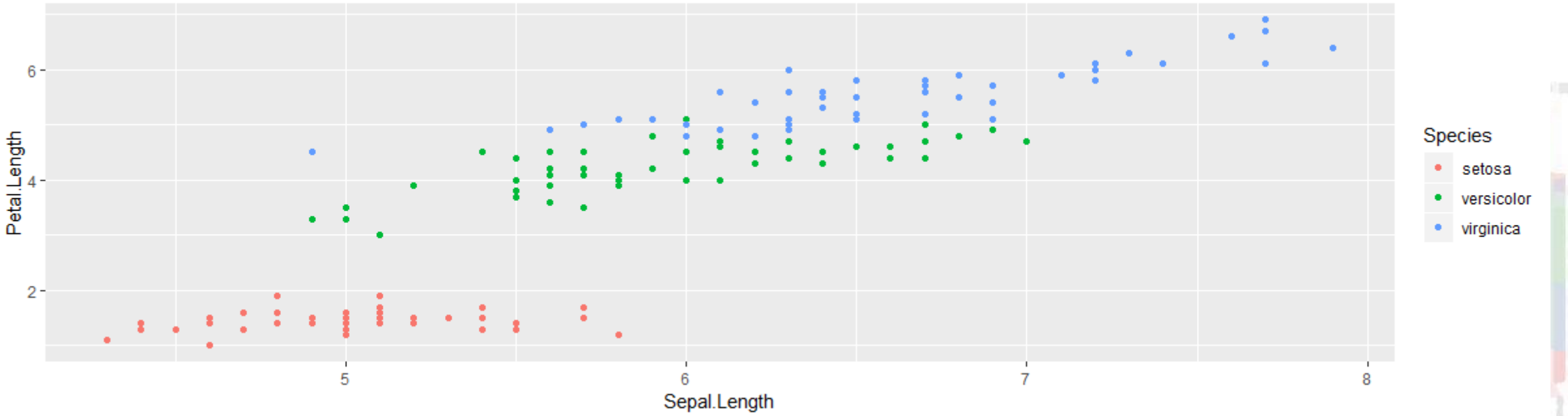
ggplot2 syntax

```
iris %>%
  ggplot(aes(x = Sepal.Length, y = Petal.Length)) +
  geom_point()
```



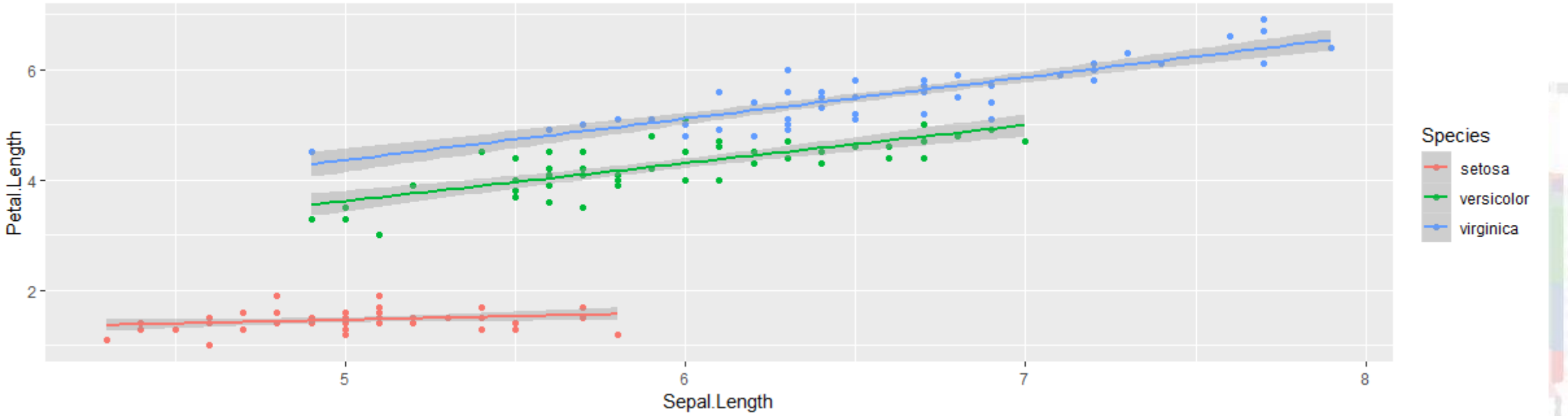
ggplot2 syntax

```
iris %>%
  ggplot(aes(x = Sepal.Length, y = Petal.Length, colour = Species)) +
  geom_point()
```



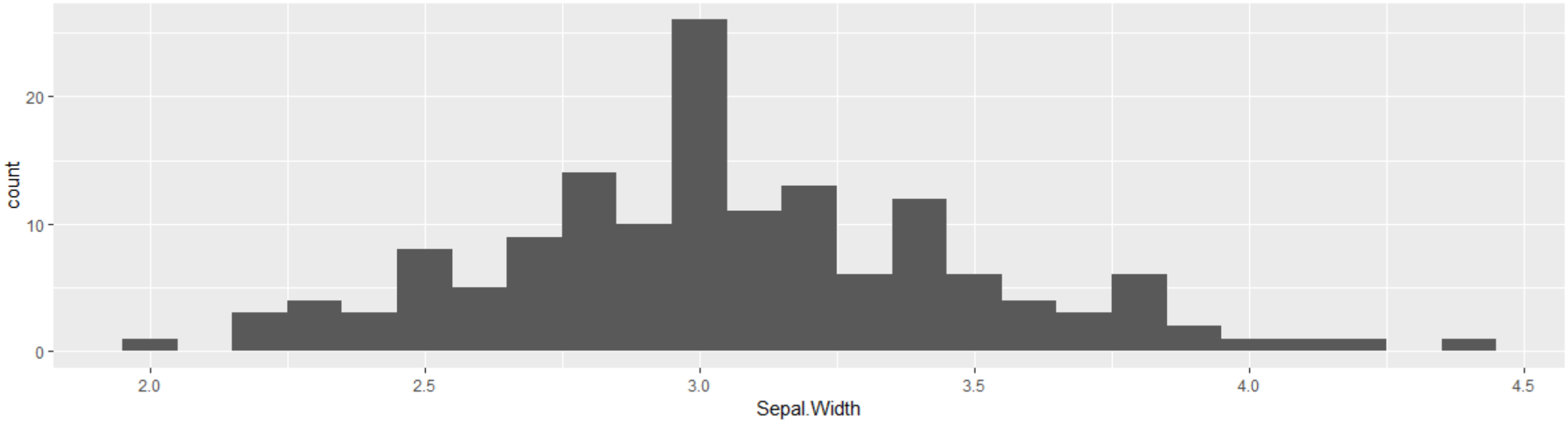
ggplot2 syntax

```
iris %>%
  ggplot(aes(x = Sepal.Length, y = Petal.Length, colour = Species)) +
  geom_point() +
  geom_smooth(method = "lm")
```



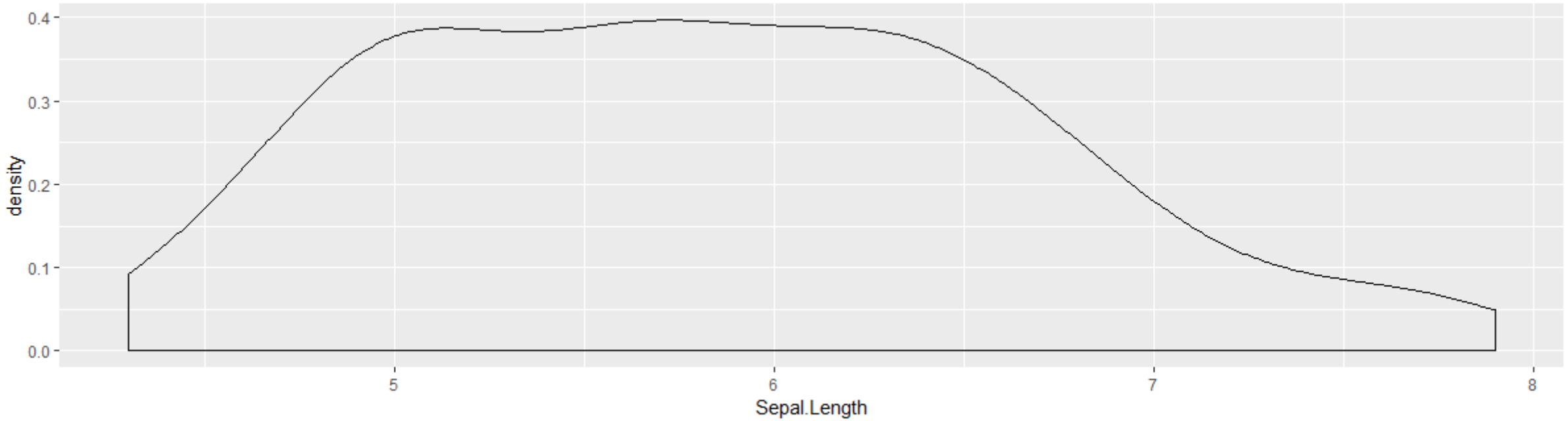
Visualising Distributions - Histograms


```
iris %>%
  ggplot(aes(x = Sepal.Width)) +
  geom_histogram(binwidth = 0.1)
```



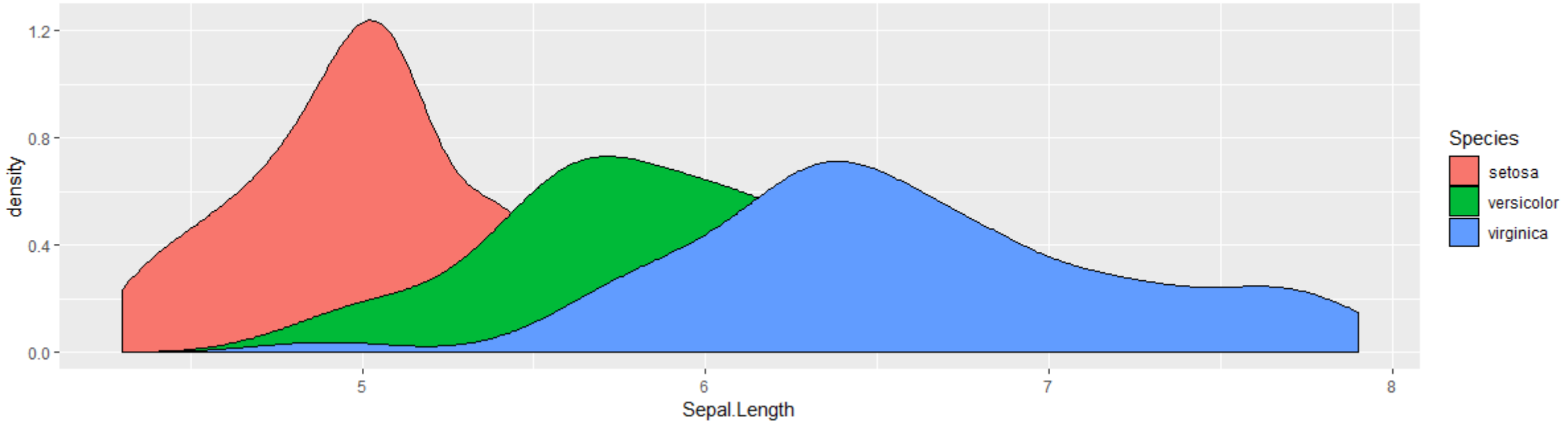
Visualising Distributions – Density Plots


```
iris %>%
  ggplot(aes(x = Sepal.Length)) +
  geom_density()
```



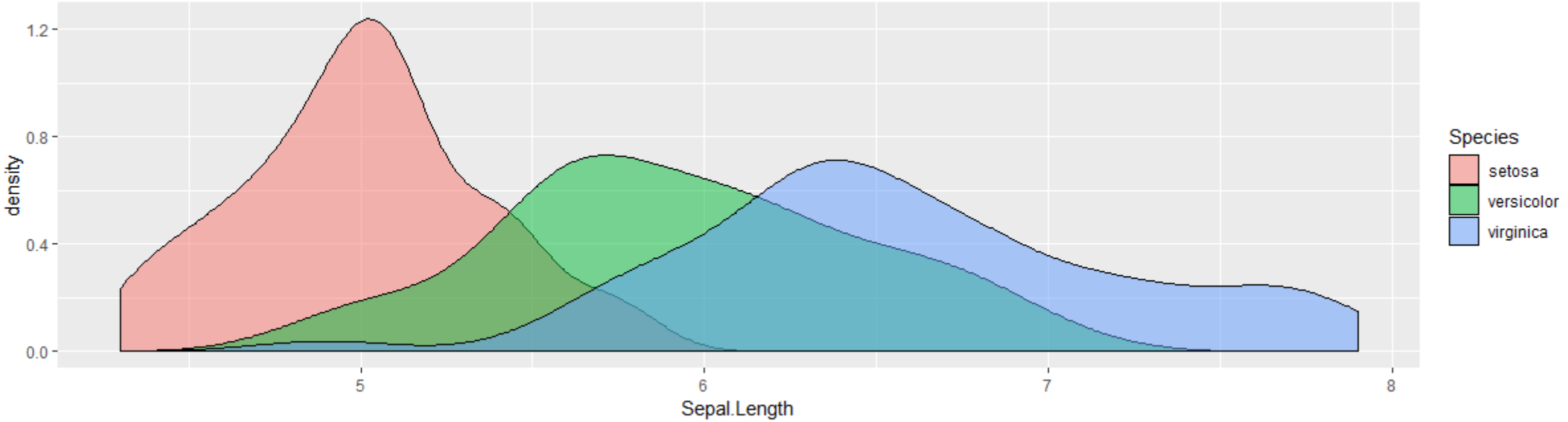
Visualising Distributions – Density Plots


```
iris %>%
  ggplot(aes(x = Sepal.Length, fill = Species)) +
  geom_density()
```



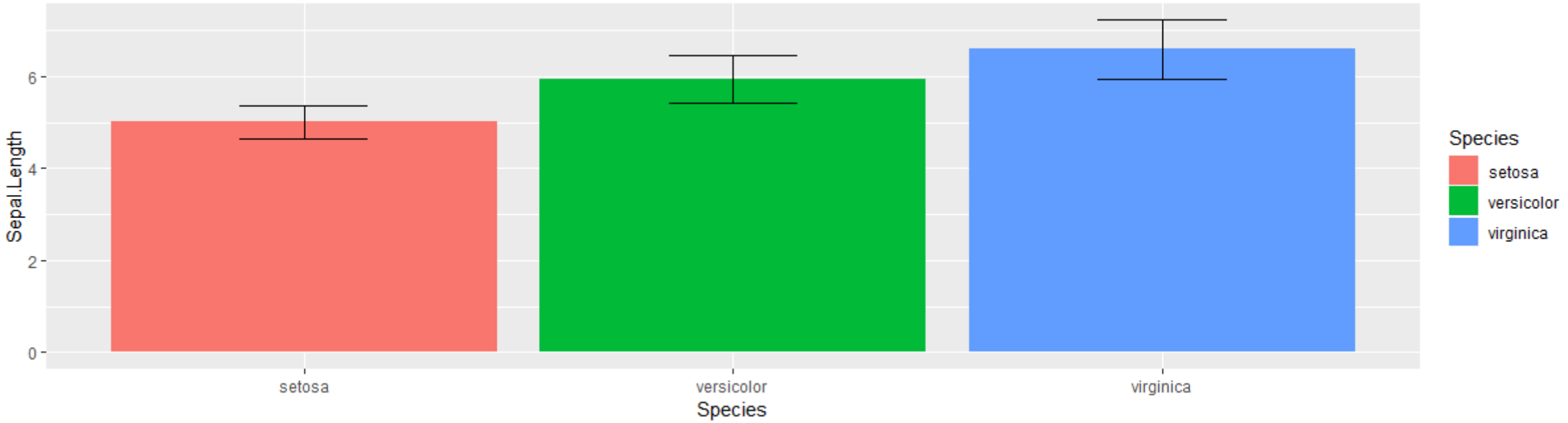
Visualising Distributions – Density Plots


```
iris %>%
  ggplot(aes(x = Sepal.Length, fill = Species)) +
  geom_density(alpha = 0.5)
```



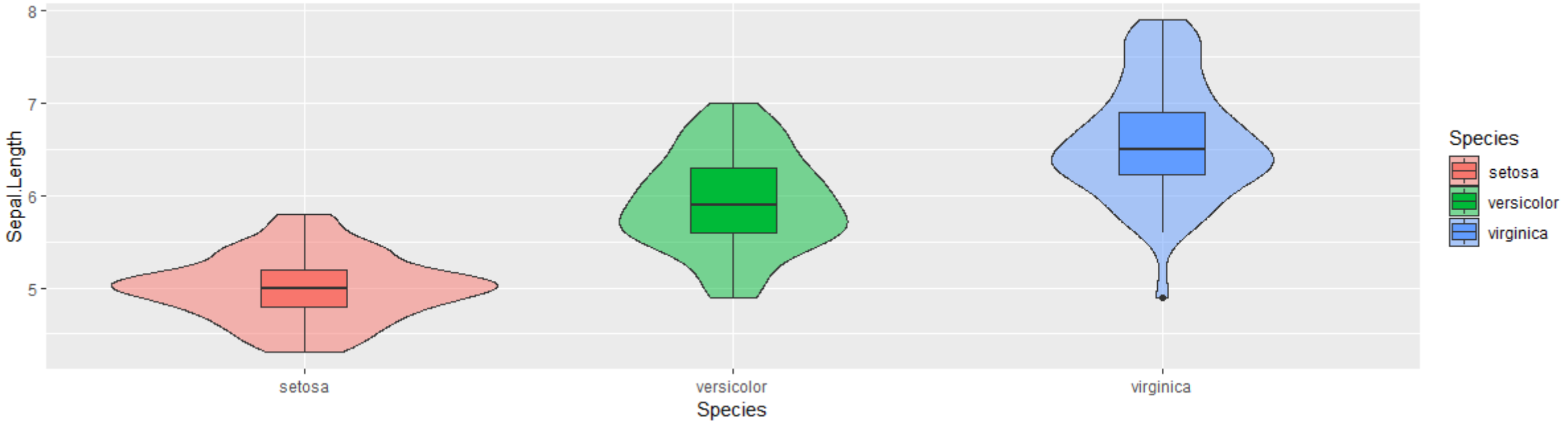
Ban the Bar Graph!

- Bar graphs can show us summaries about our data, but don't tell us much about the underlying distributions.



One Alternative – Violinbox Plots


```
iris %>%
  ggplot(aes(x = Species, y = Sepal.Length, fill = Species)) +
  geom_violin(alpha = 0.5) +
  geom_boxplot(width = 0.2)
```

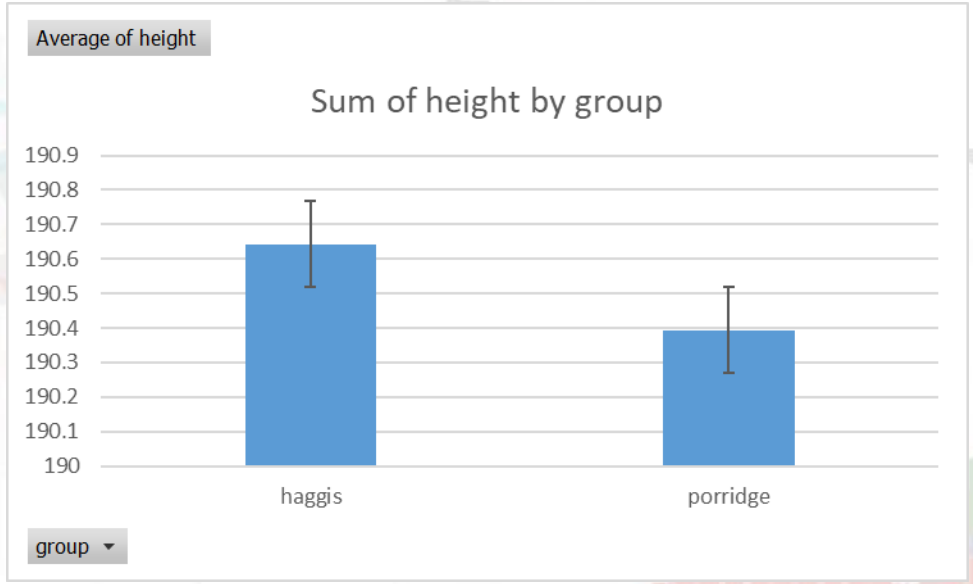


Time to Practice!

Example data

- Available in the .zip folder: haggis.csv
- Heights for two groups, based on lifetime breakfast habits:
  - Porridge eaters
  - Haggis eaters
- 64 Participants in each group (128 participants in total)
- Who will be taller?

SPSS and Microsoft Excel – Bar Graphs (Yuck!)



*Error bars show SEM

So Haggis Eaters are Taller than Porridge Eaters, right?

- Well, let's load the data and have a gander!

TASK 1:

- Create a new (or use an existing) .Rmd file to make notes in
- Load in the tidyverse packages
- Load in the dataset *hint:* read_csv()

Have a go, and then we'll go through it together

So Haggis Eaters are Taller than Porridge Eaters, right?

- Well, let's load the data and have a gander!

TASK 1:

- Create a new (or use an existing) .Rmd file to make notes in
- Load in the tidyverse packages
- Load in the dataset *hint:* `read_csv()`

Have a go, and then we'll go through it together

Task 1 – Solution

```
haggis <- read_csv("haggis.csv")
```

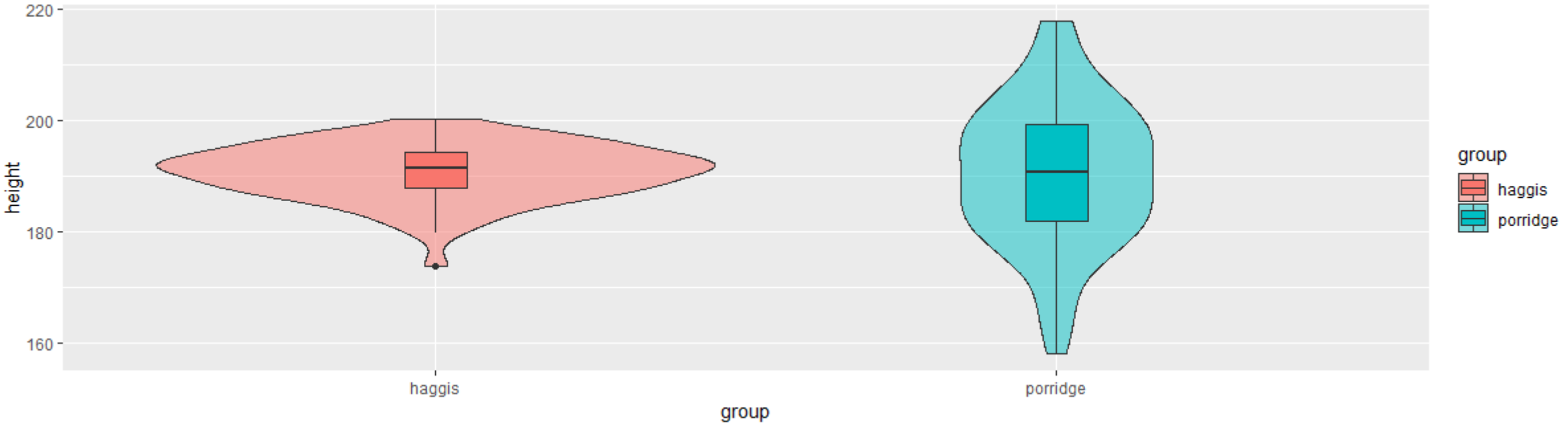
Task 2 – Visualise Height by Breakfast Group

- Create a violinbox plot, showing how height differs between haggis and porridge eaters.

Have a go, and then we'll go through it together

Task 2 – Solution

```
haggis %>%
  ggplot(aes(x = group, y = height, fill = group)) +
  geom_violin(alpha = 0.5) +
  geom_boxplot(width = 0.1)
```



Task 3 – Check the Distributions

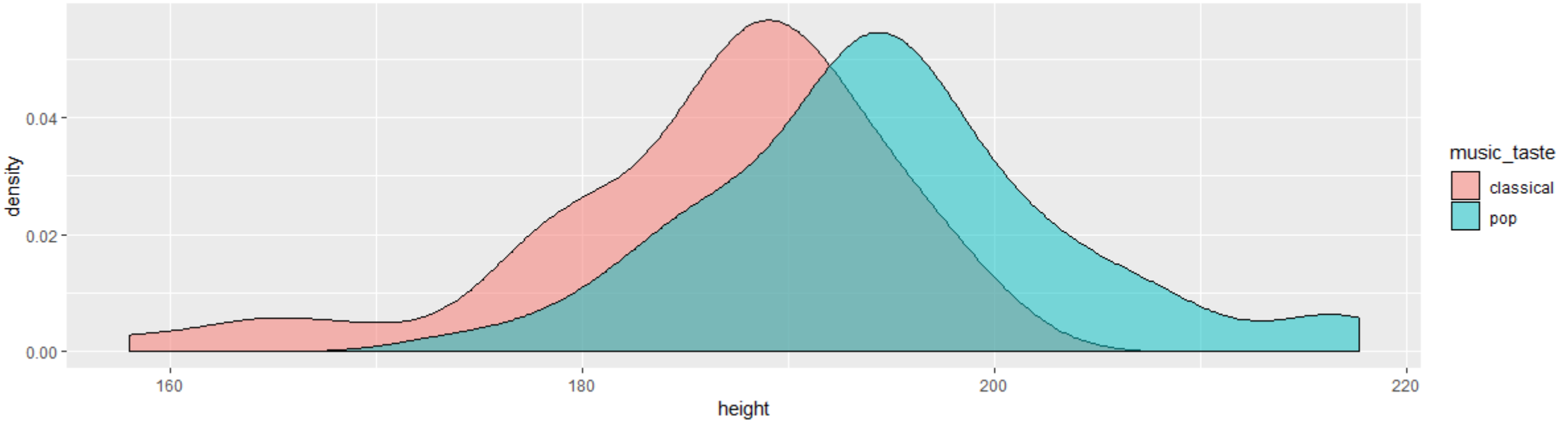
Create two density plots to see:

a) How the distribution of height differs between pop fans and classical fans
b) How the distribution of age differs between pop fans and classical fans

Have a go, and then we'll go through it together

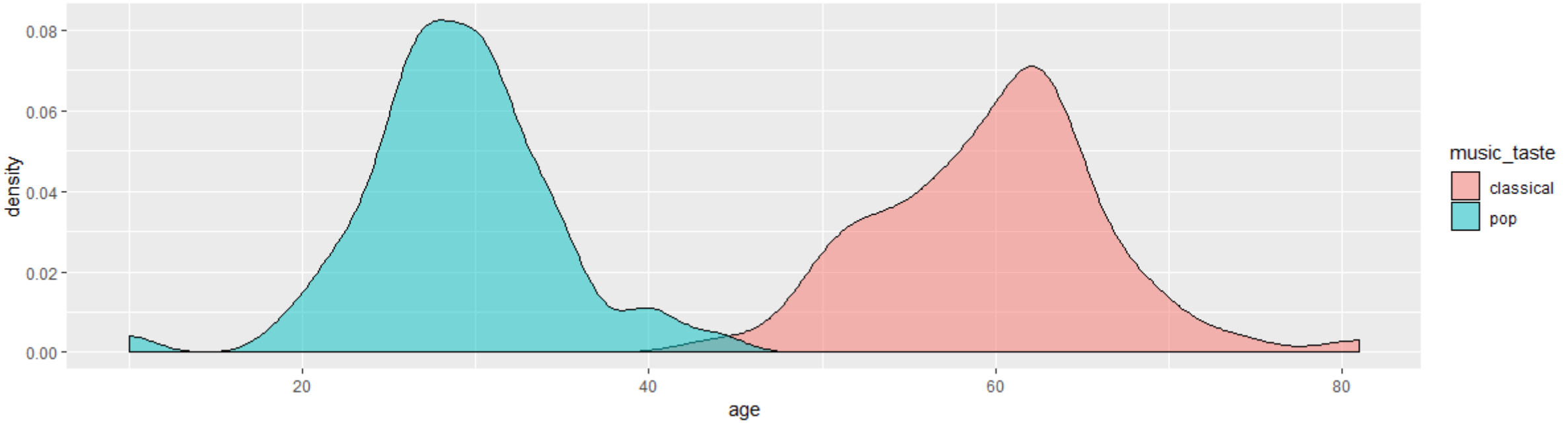
Task 3 – Solution a)

```
haggis %>%
  ggplot(aes(x = height, fill = music_taste)) +
  geom_density(alpha = 0.5)
```



Task 3 – Solution b)

```
haggis %>%
  ggplot(aes(x = age, fill = music_taste)) +
  geom_density(alpha = 0.5)
```



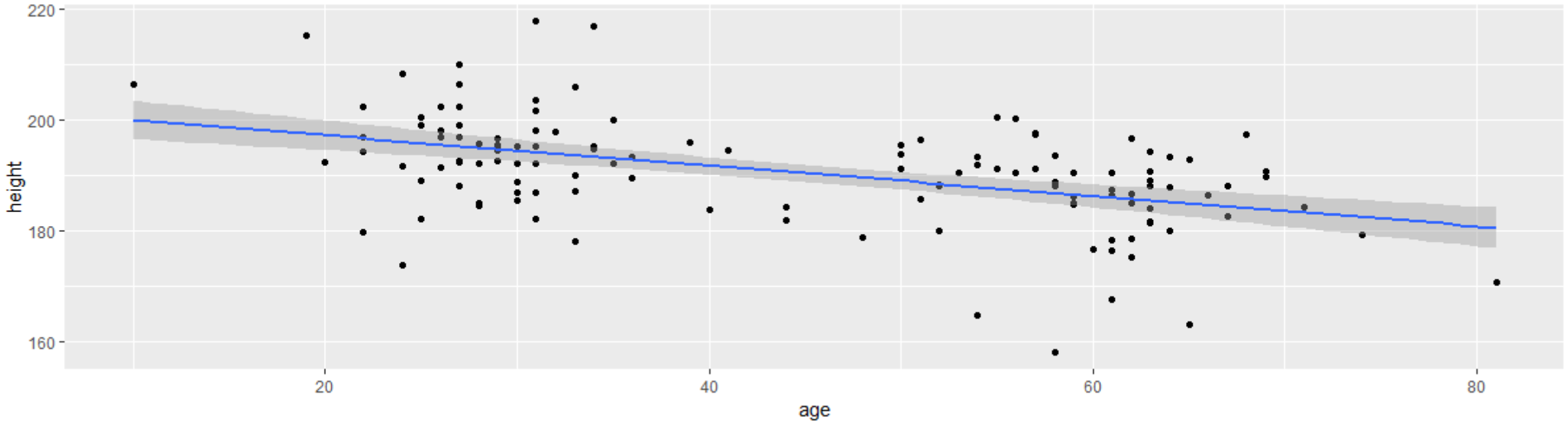
Task 4 – Does Age predict Height?

- Draw a scatter plot to see how age predicts height. Add a line showing the linear relationship between age and height.

Have a go, and then we'll go through it together

Task 4 – Solution

```
haggis %>%
  ggplot(aes(x = age, y = height)) +
  geom_point() +
  geom_smooth(method = "lm")
```



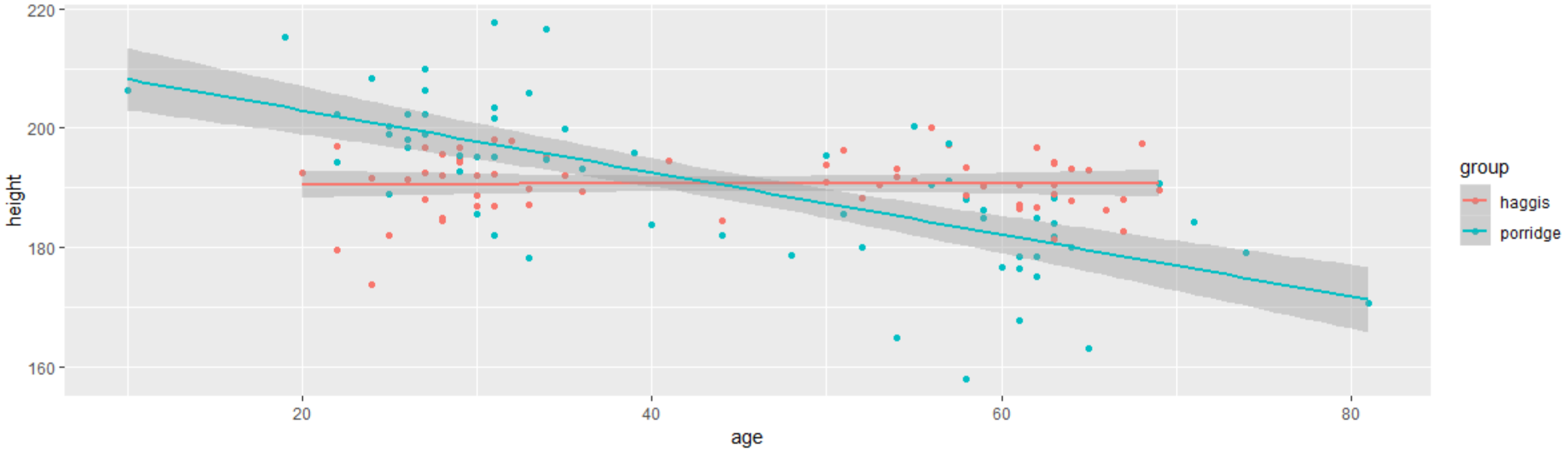
Task 5 – Does Age interact with Breakfast Habits?

- Recreate the previous graph, but colour the points and line by participants' breakfast habits.

Have a go, and then we'll go through it together

Task 5 – Solution

```
haggis %>%
  ggplot(aes(x = age, y = height, colour = group)) +
  geom_point() +
  geom_smooth(method = "lm")
```



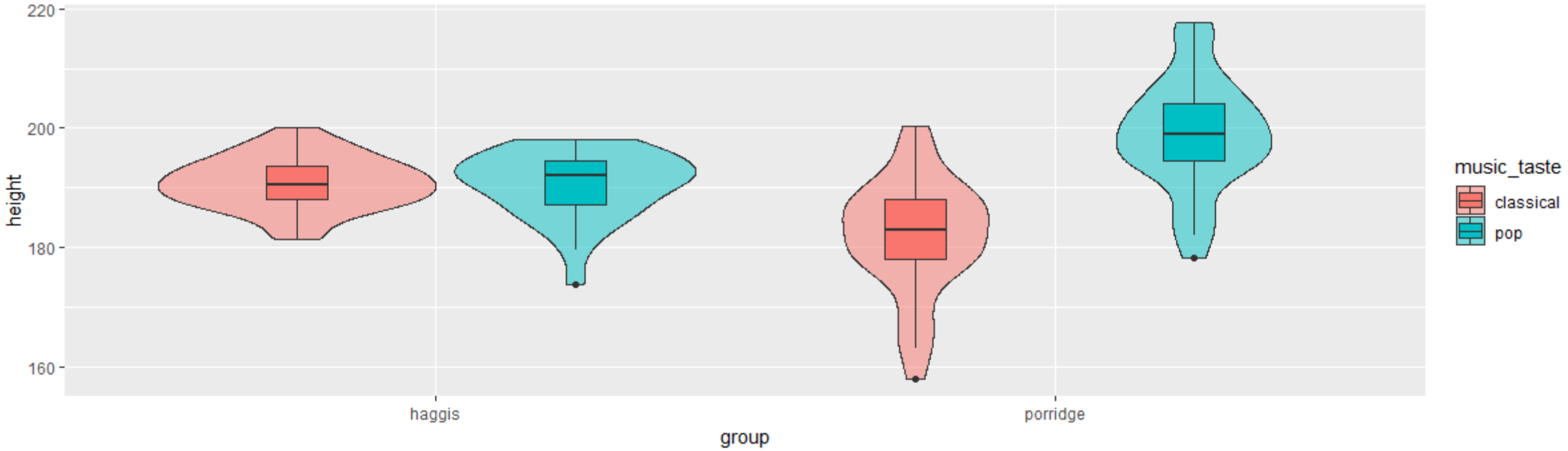
Task 6 – Does Music Taste interact with Breakfast Preference?

- Create a violinbox plot as you did in Practice Question 2, but split by music taste *as well as* breakfast group.

Have a go, and then we'll go through it together

Task 6 – Solution

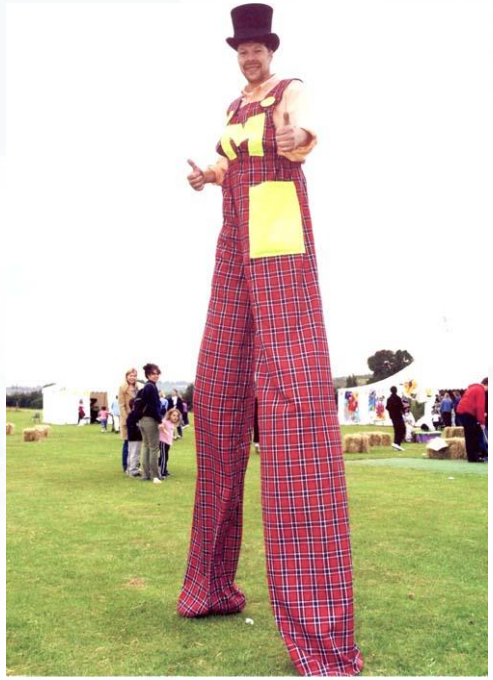
```
haggis %>%
  ggplot(aes(x = group, y = height, fill = music_taste)) +
  geom_violin(alpha = 0.5) +
  geom_boxplot(width = 0.2, position = position_dodge(width = 0.9))
```



Conclusion

+

=



?

Conclusion

Well… no.

- We don’t know anything about the possible causal relationships, and only looked at our data in an exploratory way

- Also, the data was kind of made up.

Real Conclusion

- Data Visualisation in R is fun, easy, and informative!
- If we're looking at differences between groups, it's important to not hide the distributions behind bar graphs and summary statistics.
- Googling for R solutions is a skill in itself.