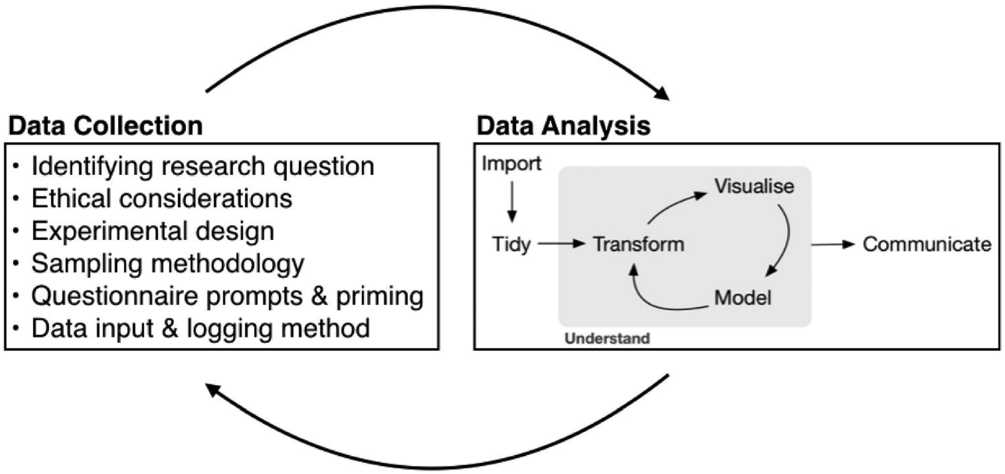
Exploratory Data Analysis in R

Ciaran Evans

Agenda

- Overview of exploratory data analysis
- Introduction to R and RStudio
- Class activity: penguins!

The data analysis process



Data Collection

- Identifying research question
- Ethical considerations
- Experimental design
- Sampling methodology
- Questionnaire prompts & priming
- Data input & logging method

Data Analysis

Import

Tidy

Transform

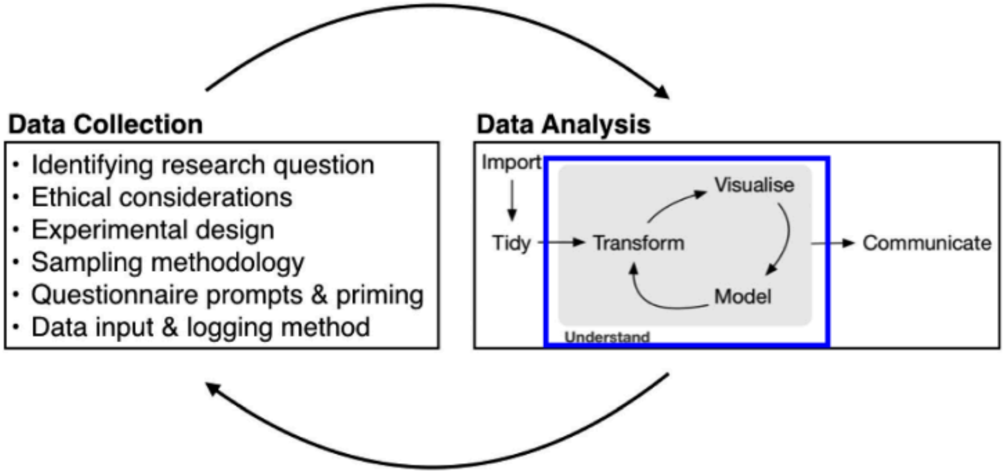
Visualise

Model

Understand

Communicate

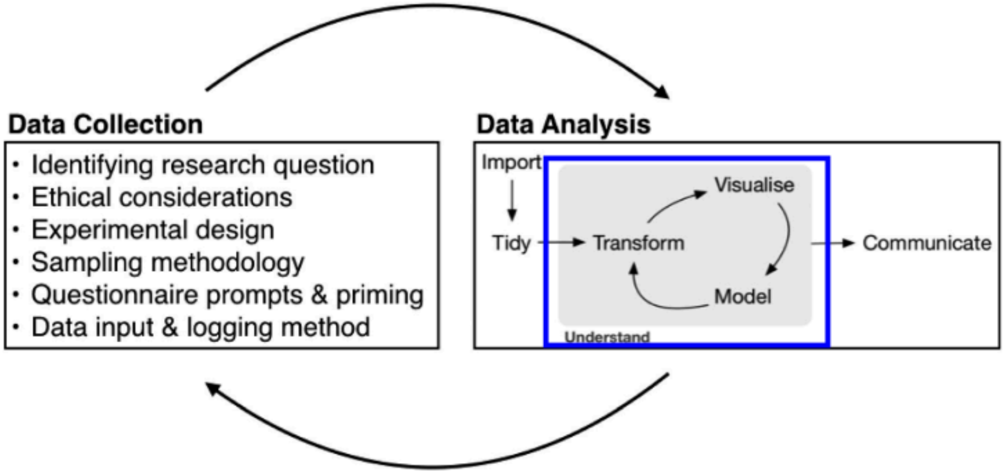
The data analysis process



Understanding:

- Not a linear process
- Begins with *exploratory data analysis*

Exploratory data analysis (EDA)



Data Collection

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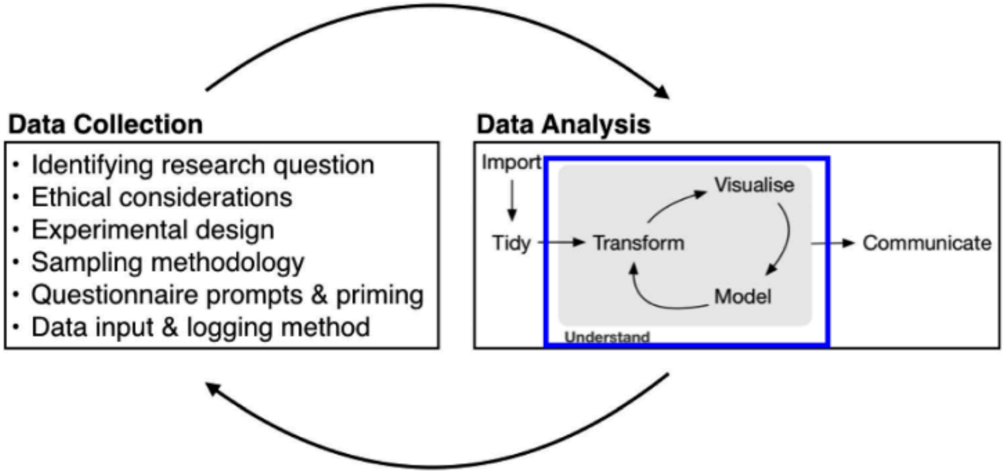
Data Analysis

Goal: get familiar with the data

- What does the data represent?
  - How big is the data?
  - What are the rows and columns?
  - Where and when was it collected?
  - Who collected it, and what choices did they make?
  - Etc.

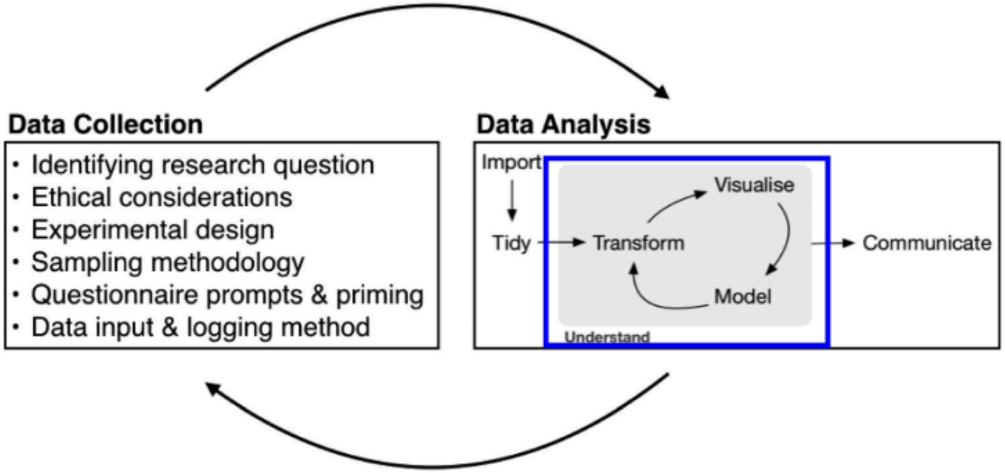
Exploratory data analysis (EDA)



Goal: get familiar with the data

- What do the variables look like? (univariate EDA)
  - histograms, frequency tables, summary statistics, etc.
  - any outliers?

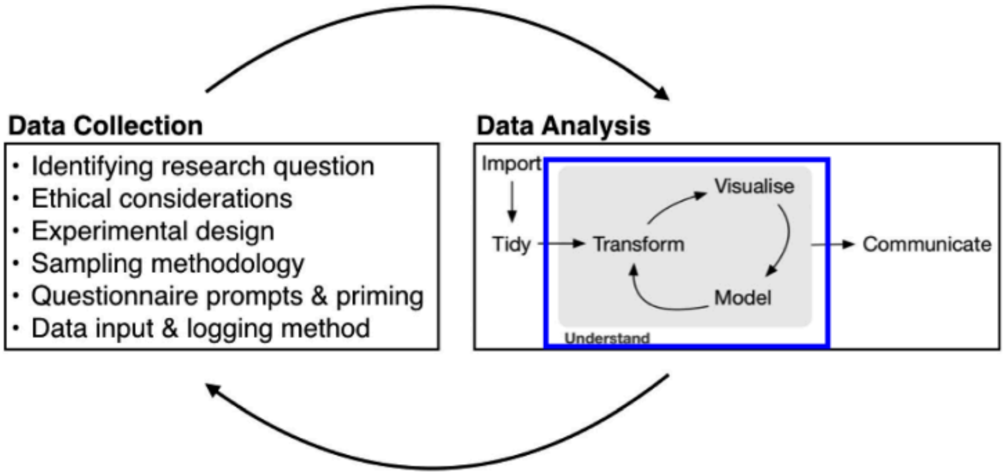
Exploratory data analysis (EDA)



Goal: get familiar with the data

- How are the variables related? (multivariate EDA)
  - two-way tables, scatterplots, boxplots, etc.

Exploratory data analysis (EDA)



Data Collection

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Data Analysis

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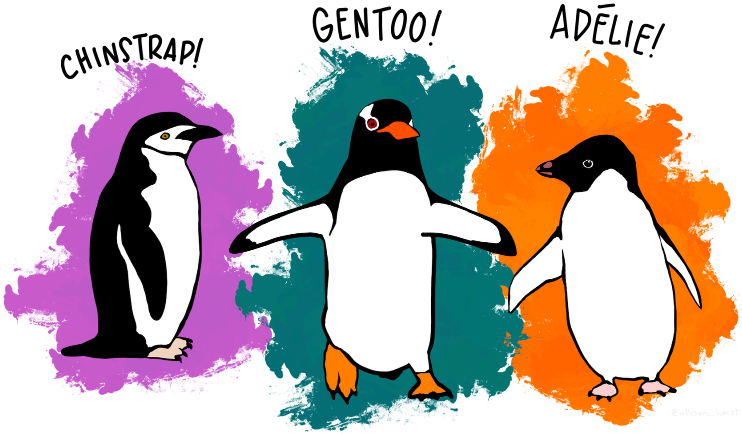
Goal: get familiar with the data

- What relationships might we want to model?
  - generally informed by *why* we're looking at the data

Data: Penguins!

Data on 344 penguins from 3 species (Adelie, Chinstrap, Gentoo). Variables include

- Species
- Bill length
- Bill depth
- ...



Artwork by @allison_horst

Visualizations

Bill length is a quantitative variable. What plot could we use to visualize the distribution of bill length in the penguins dataset?

Answer: A histogram is a good choice for visualizing the distribution of a single quantitative variable.

Visualizations

Species is a categorical variable. What plot could we use to visualize the distribution of species in the penguins dataset?

Answer: A bar chart is a good choice for visualizing the distribution of a single categorical variable. Pie charts also work, but I find them harder to read.

Visualizations

Bill length and *bill depth* are both quantitative variables. What plot could we use to visualize the relationship between these two variables?

Answer: A scatterplot shows the relationship between two quantitative variables.

Tools for working with data

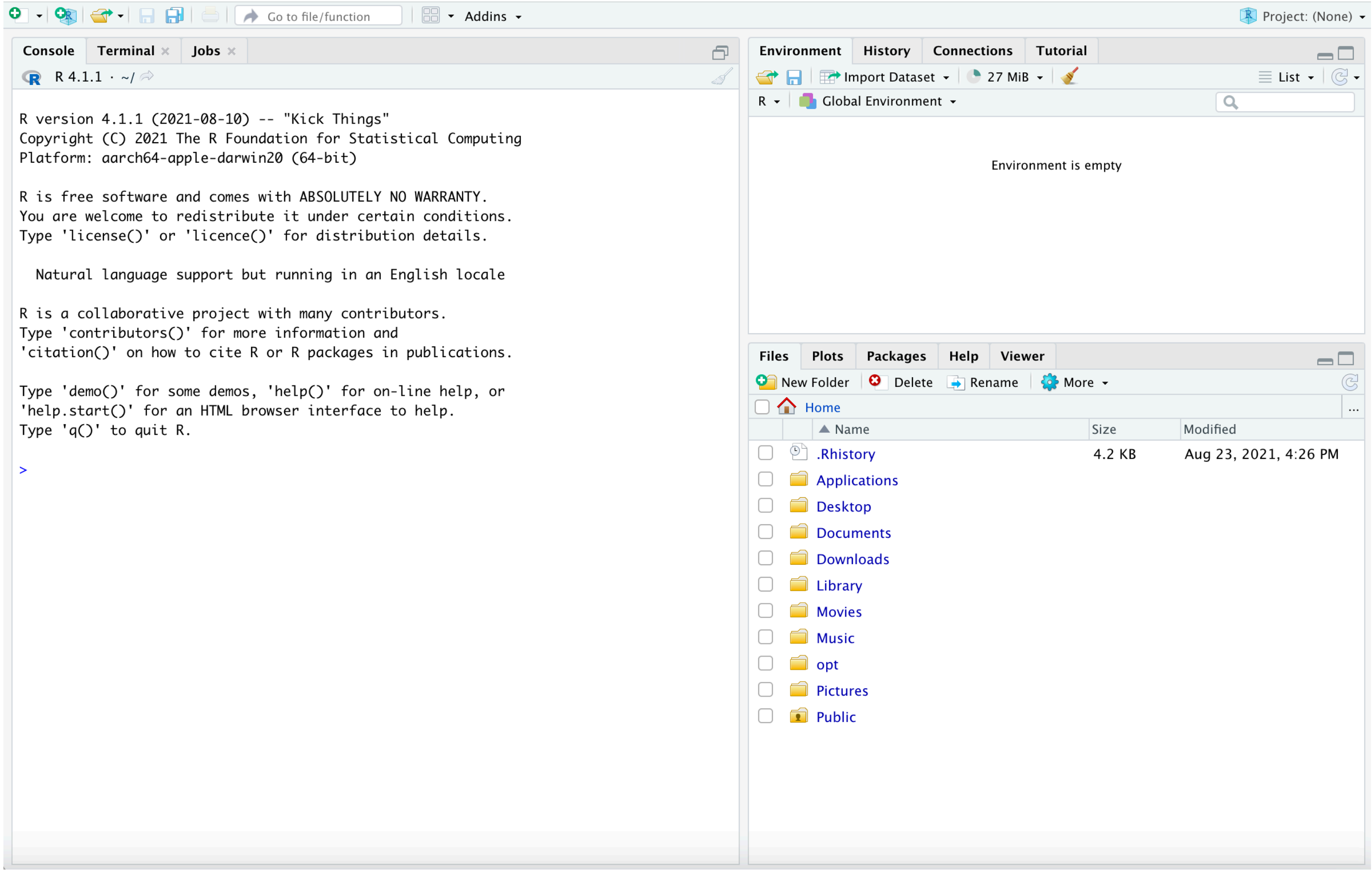
R: Statistical software for data manipulation, visualization, computing, modeling

RStudio: Integrated development environment (IDE) that makes it easy to use R

R: Engine	RStudio: Dashboard

Source: Modern Dive

Overview of RStudio



```
R version 4.1.1 (2021-08-10) -- "Kick Things"
Copyright (C) 2021 The R Foundation for Statistical Computing
Platform: aarch64-apple-darwin20 (64-bit)

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  Natural language support but running in an English locale

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Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

>
```

Environment is empty

Name	Size	Modified
.Rhistory	4.2 KB	Aug 23, 2021, 4:26 PM
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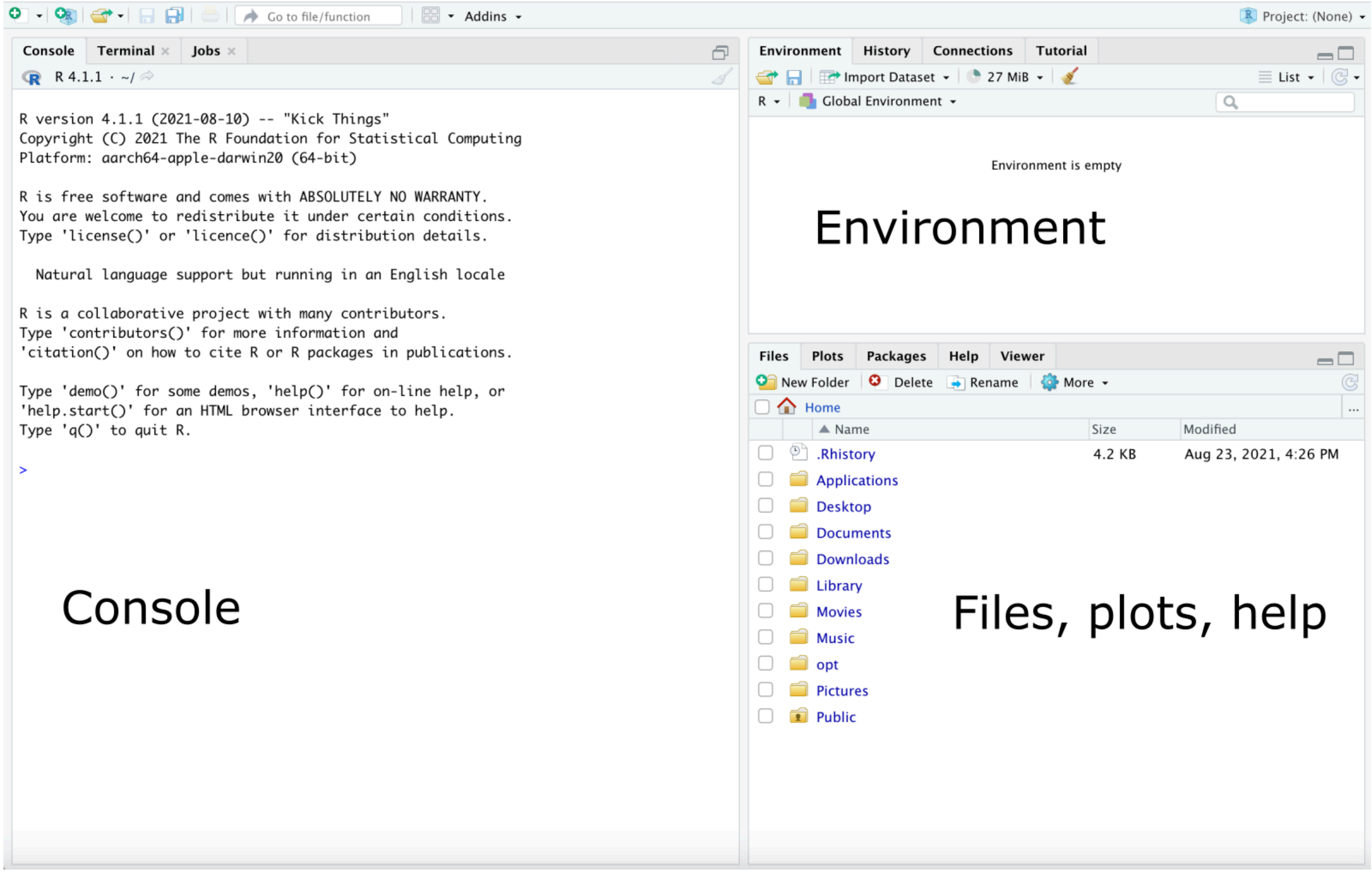
Public		

Panes



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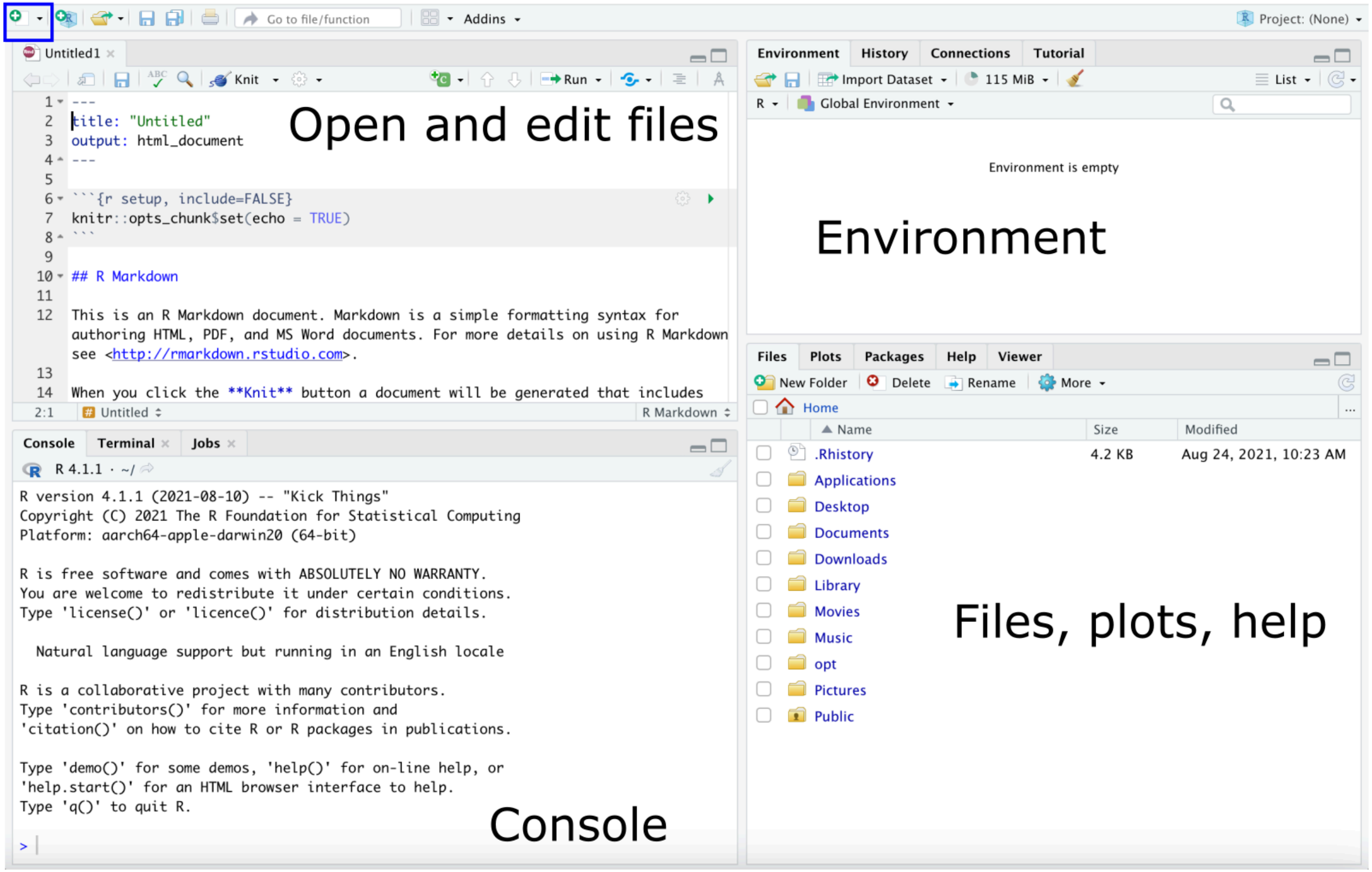
Environment

Console

Files, plots, help

Panes

Create a new file



Open and edit files

~~~
---
title: "Untitled"
output: html_document
---

```{r setup, include=FALSE}
knitr::opts_chunk$set(echo = TRUE)
```

## R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for
authoring HTML, PDF, and MS Word documents. For more details on using R Markdown
see <http://rmarkdown.rstudio.com>.

When you click the **Knit** button a document will be generated that includes
~~~

Environment is empty

Environment

Console

```
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```

Files, plots, help

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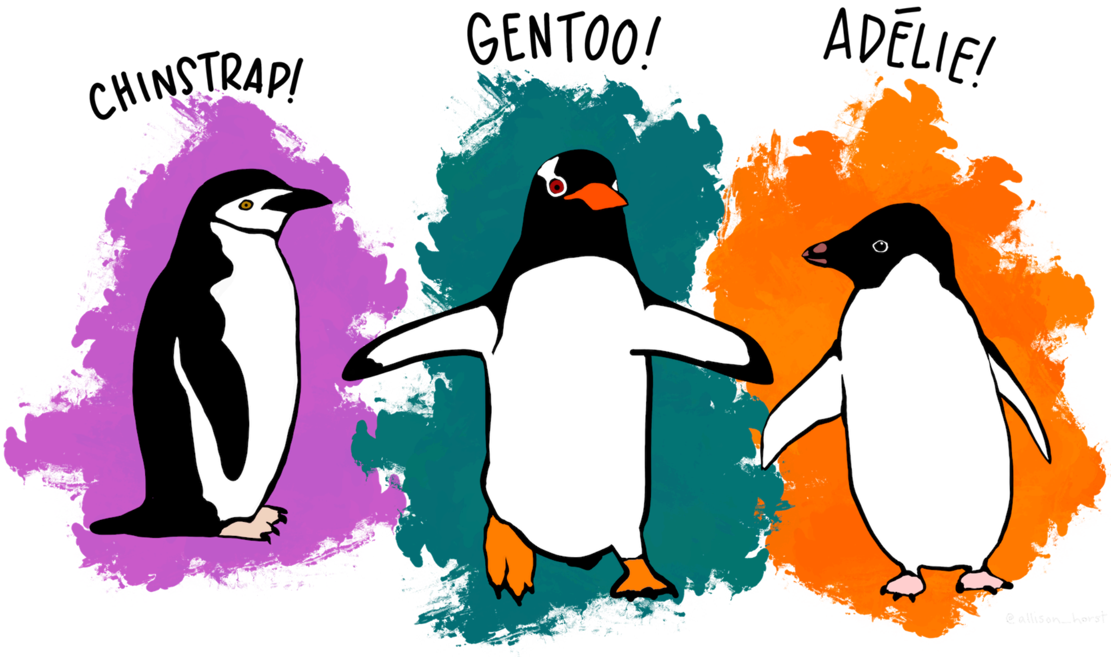
□	Public		

Class activity: EDA with penguins

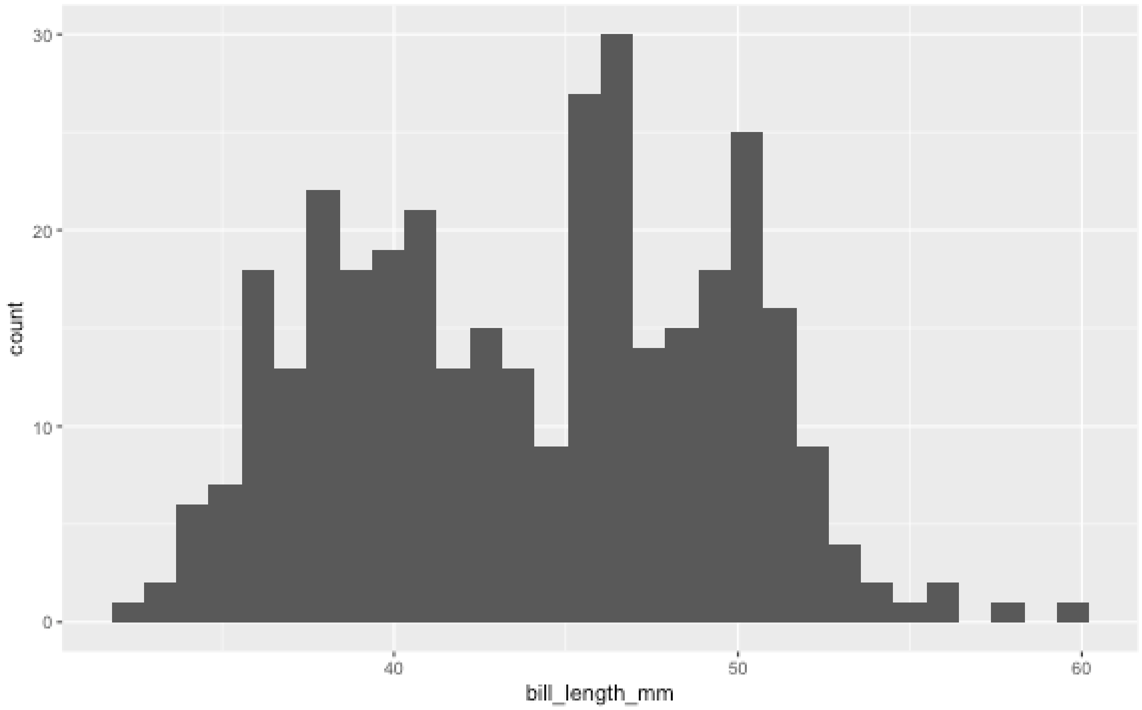
https://sta112-f25.github.io/class_activities/ca_02.html



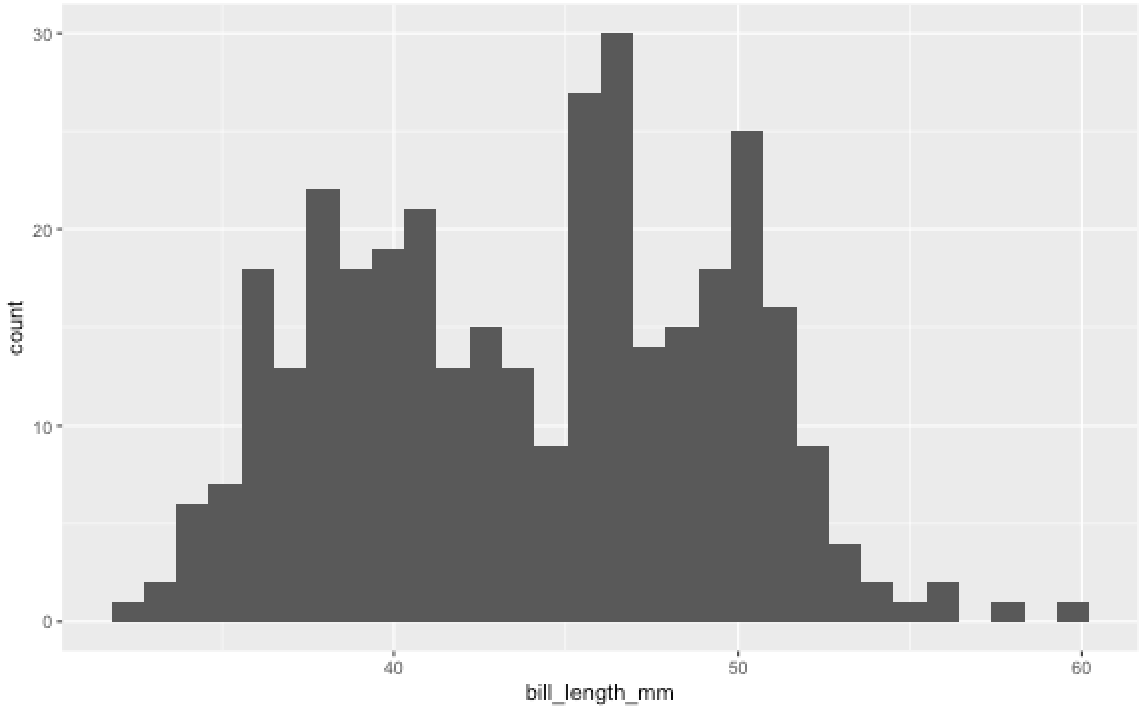
Artwork by @allison_horst

Distribution of bill length

```
penguins |>
  ggplot(aes(x = bill_length_mm)) +
  geom_histogram()
```



Distribution of bill length



- Most bill lengths between 35mm and 55mm
- Multimodal, with peaks around 40mm, 45mm, and 50mm
- Fairly symmetric, no clear outliers

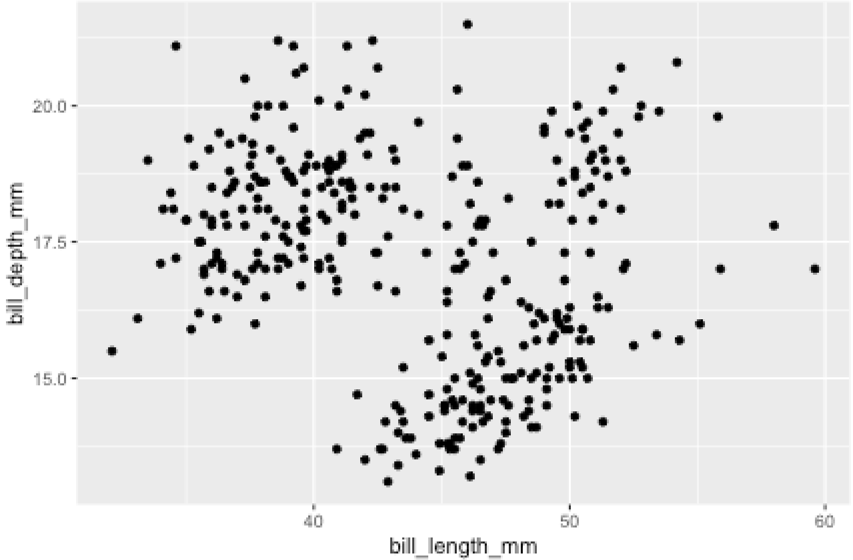
Aside: changing the number of bins

```r
penguins |>
  ggplot(aes(x = bill_length_mm)) +
  geom_histogram(bins = 20)
```

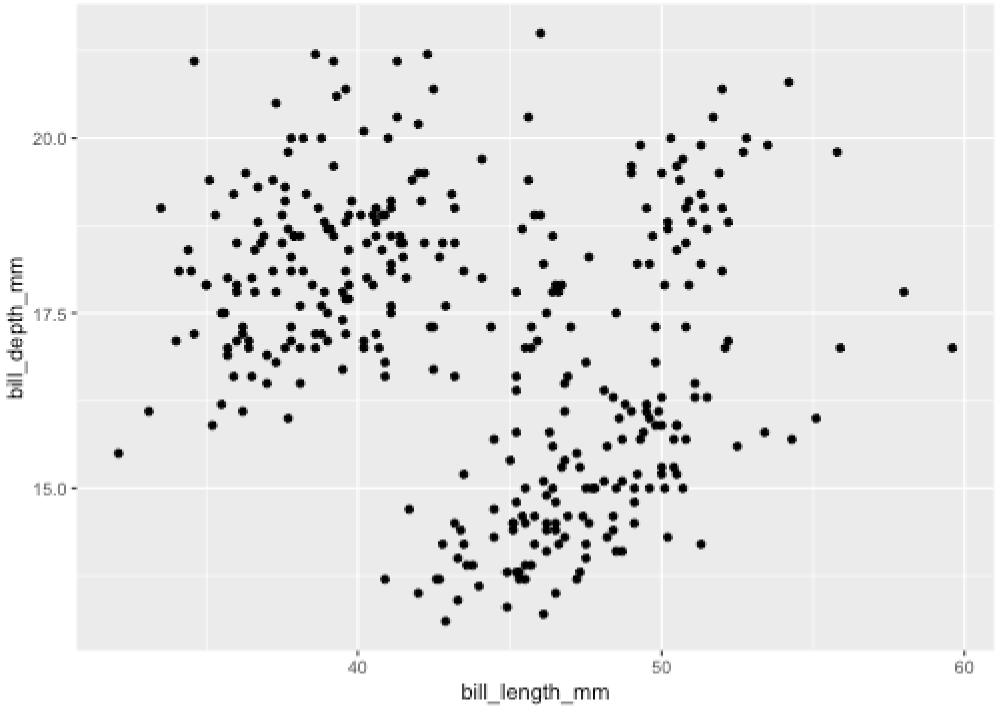
When making histograms, it is good to try different numbers of bins. The default in `geom_histogram` is 30, but can be changed with `bins = ...`

Bill depth vs. bill length

```
penguins |>
  ggplot(aes(x = bill_length_mm,
             y = bill_depth_mm)) +
  geom_point()
```



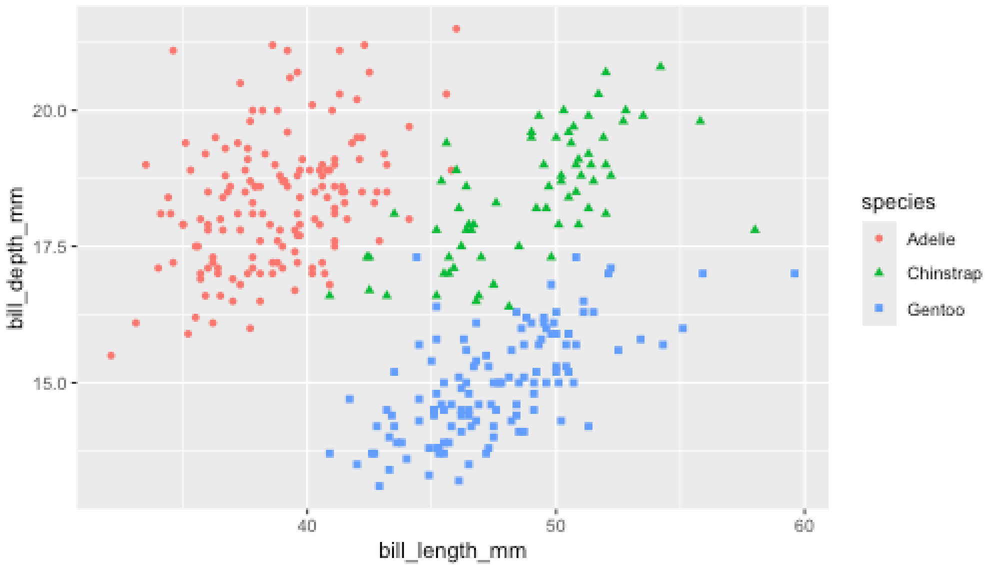
Bill depth vs. bill length



- There does not appear to be a relationship between bill length and bill depth

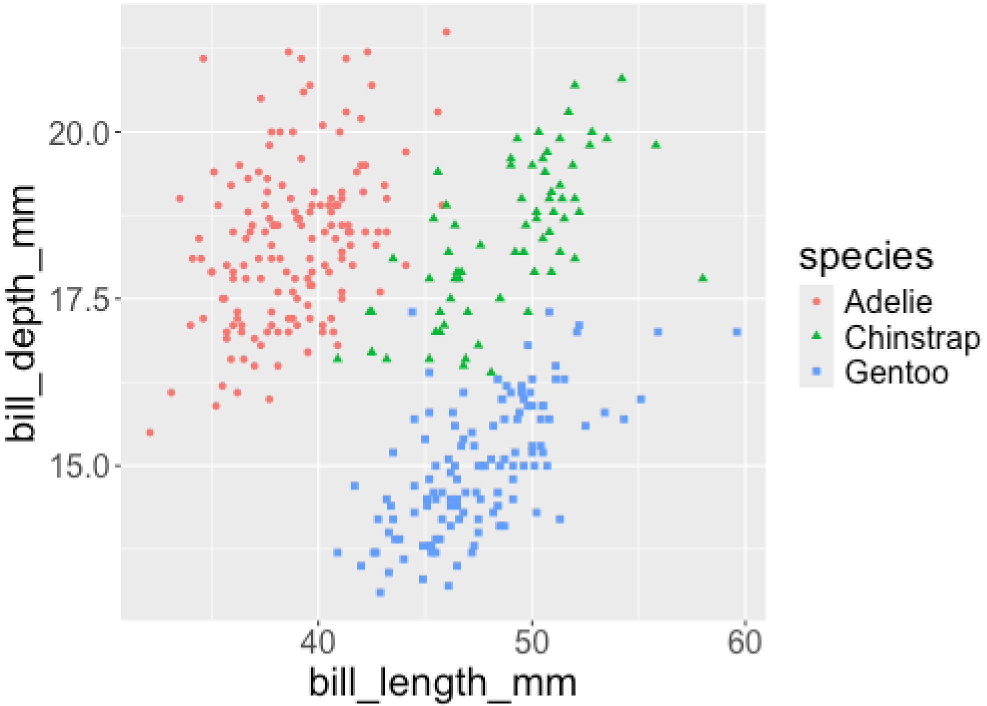
Coloring by species

```
penguins |>
  ggplot(aes(x = bill_length_mm,
             y = bill_depth_mm,
             color = species, shape=species)) +
  geom_point()
```



Within each species, there appears to be a positive, linear relationship between bill length and bill depth.

Predicting species



New penguin 🐧:

- Bill length = 50mm, bill depth = 15mm
- Predicted species = ?