My title*

My subtitle if needed

First author Another author

February 8, 2024

First sentence. Second sentence. Third sentence. Fourth sentence.

1 Introduction

You can and should cross-reference sections and sub-sections. We use R Core Team (2023) and Wickham et al. (2019).

The remainder of this paper is structured as follows. Section 2....

2 Data

Some of our data is of penguins (Figure 4), from Horst, Hill, and Gorman (2020).

We are interested in the height of Lake Huron (Figure 1)

We are interested in the height of 31 black cherry trees (Figure 2)

We are interested in the weight of chicks in grams, by how old they were (**?@fig-chicks**)

```
#| label: chicks
#| fig-cap: Weight versus age of chicks
#| echo: false


datasets::ChickWeight |>
  as_tibble() |>
  ggplot(aes(x = Time, y = weight, group = Chick)) +
```

*Code and data are available at: LINK.

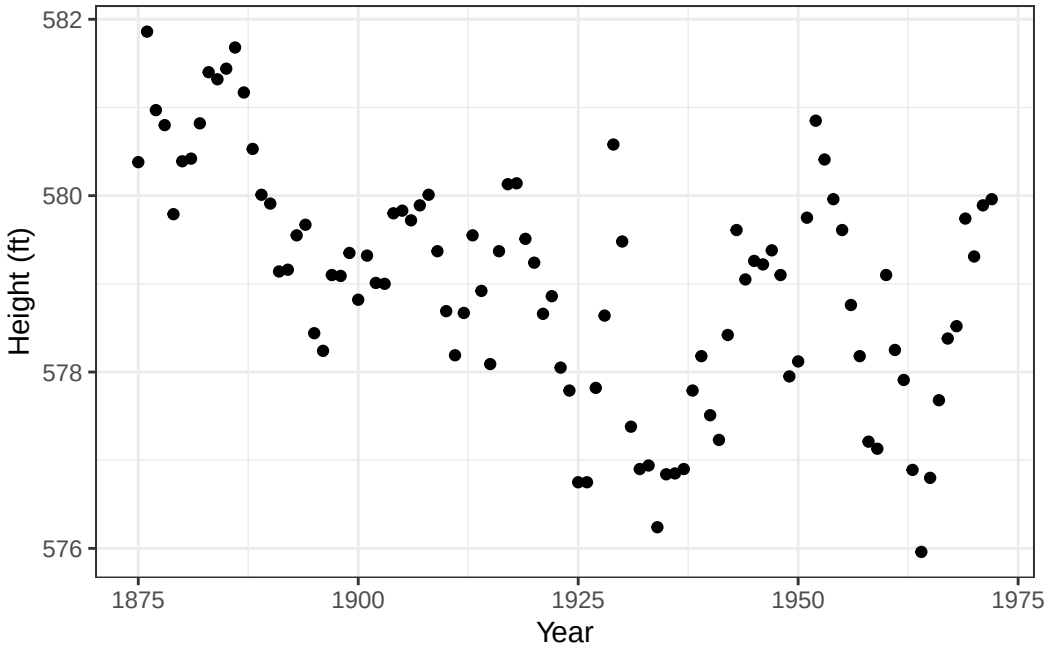


Figure 1: Annual measurements of the height, in feet, of Lake Huron 1875-1972

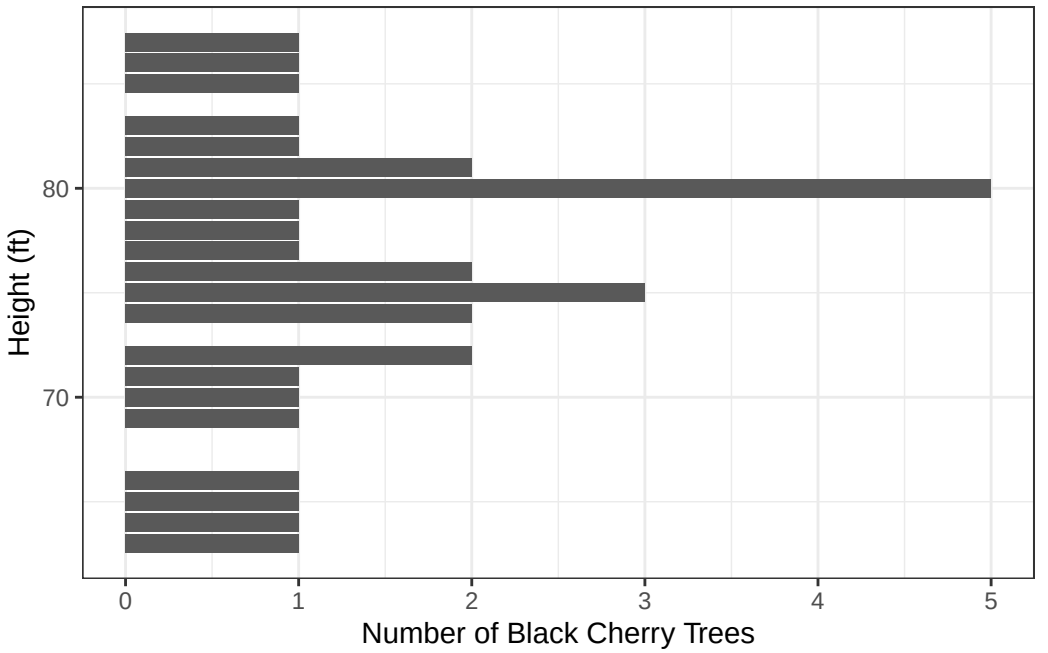
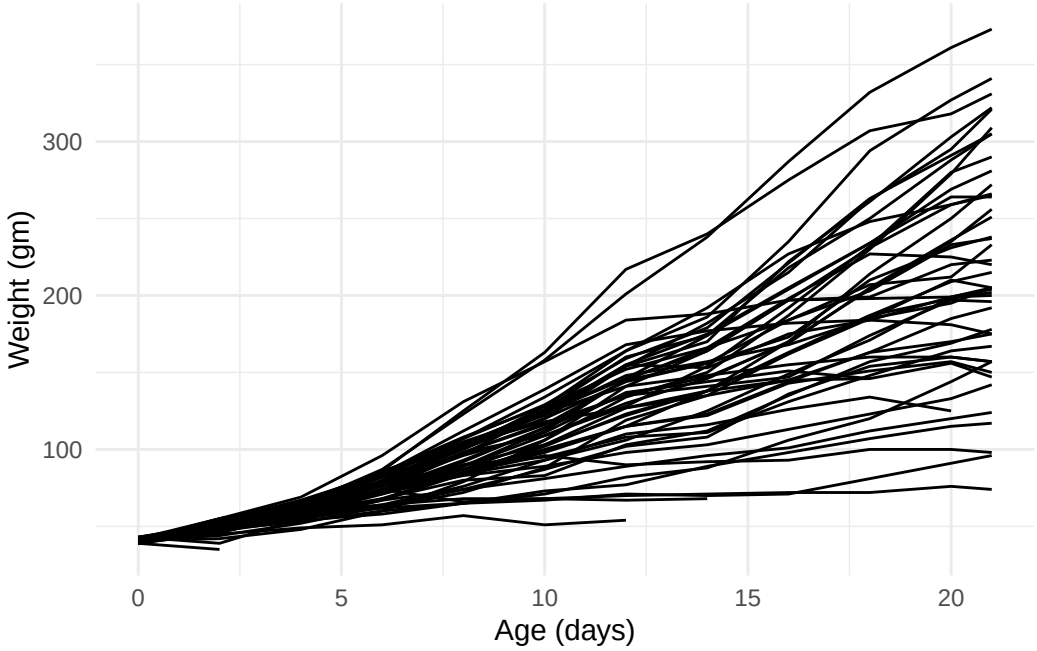


Figure 2: Height of 31 Black Cherry Trees

```
  geom_line() +
  labs(x = "Age (days)", y = "Weight (gm)") +
  theme_minimal()
```



We are interested in the number of sunspots from 1700 to 1988 (Figure 3)

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

Talk more about it.

And also planes (Figure 5). (You can change the height and width, but don't worry about doing that until you have finished every other aspect of the paper - Quarto will try to make it look nice and the defaults usually work well once you have enough text.)

Talk way more about it.

We are interested in penguins and their silly business (Figure 6)

```
ggplot(data = penguins,
       aes(x = flipper_length_mm,
           y = body_mass_g)) +
  geom_point(aes(color = species, shape = sex),
```

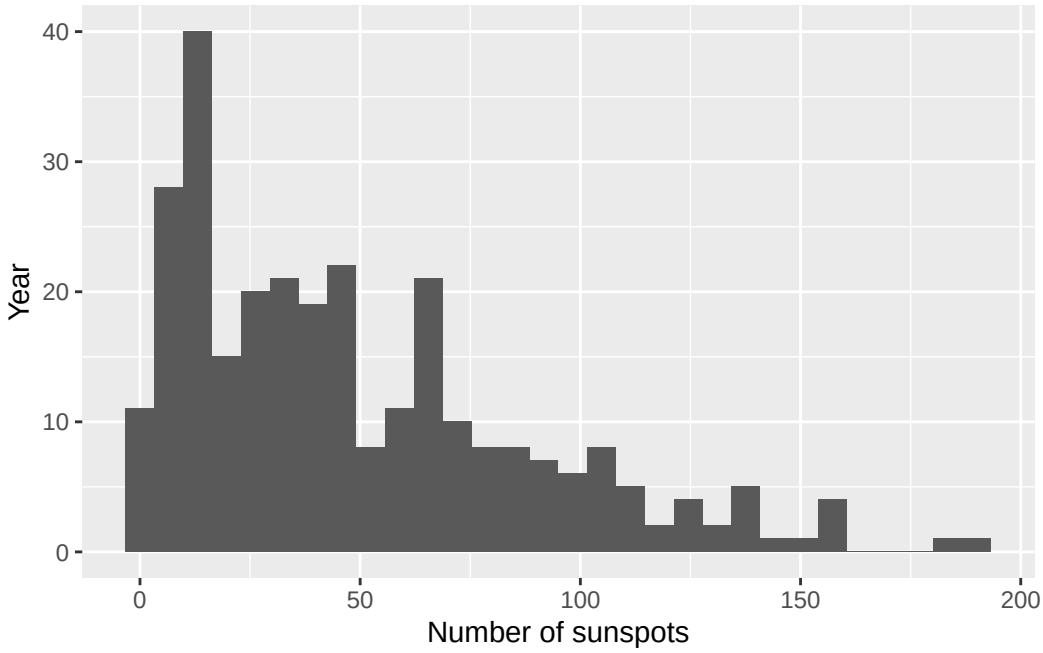


Figure 3: Number of sunspots from 1700 to 1988

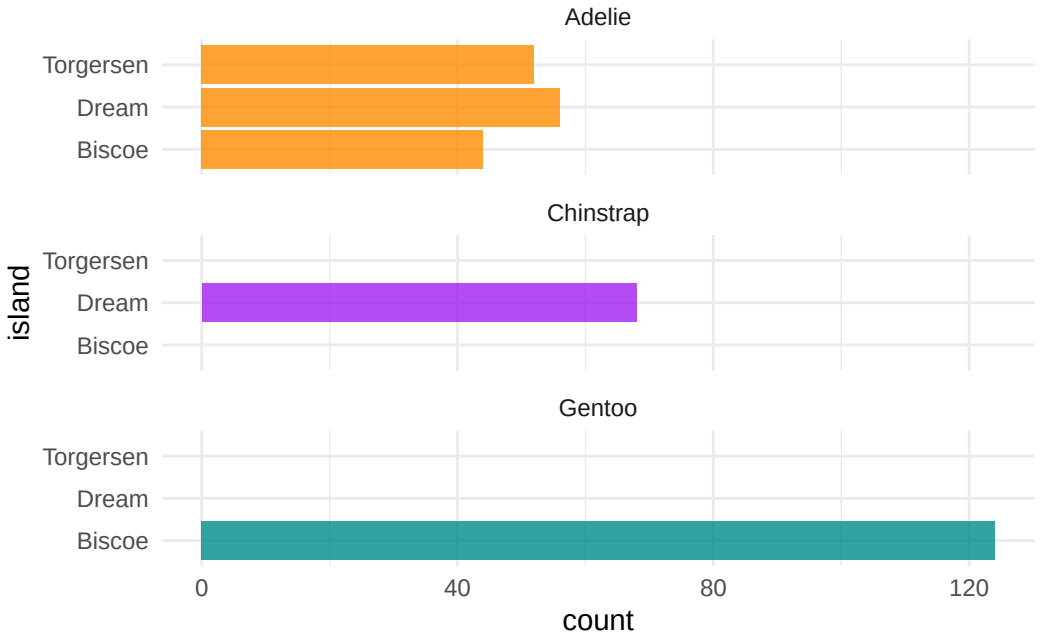


Figure 4: Bills of penguins

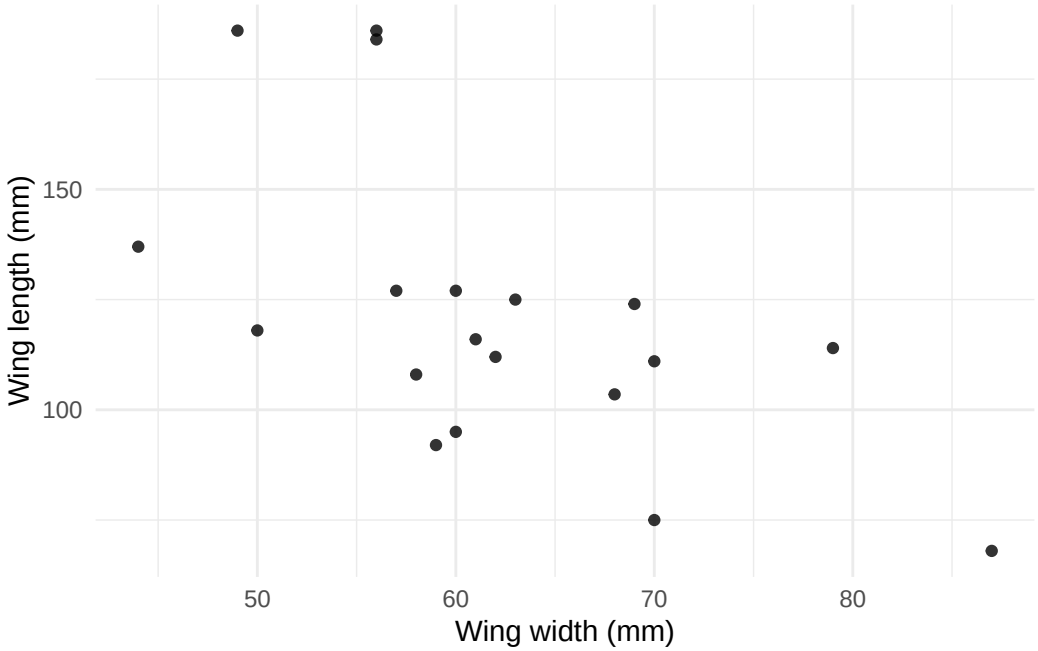


Figure 5: Relationship between wing length and width

```
            size = 20,
            alpha = .7) +
scale_color_manual(values = c("red", "pink", "red")) +
labs(
  title = "Penguins are mean, ur mom's house",
  subtitle = "Toe length and mass for ADeLIe, ChINSTRAP and gEnToo peNGuiNS",
  x = "Flipper length (houses)",
  y = "Body mass (bluberries)",
  color = "Penguin species"
) +
theme_minimal() +
theme(
  legend.position = c(0.7, 0.9),
  plot.title.position = "plot",
  title = element_text(size=24, face='bold'),
  plot.caption = element_text(hjust = 0, face = "italic"),
  plot.caption.position = "plot"
)
```

```
Warning: Removed 11 rows containing missing values (`geom_point()`).
```

Figure 6: **?(caption)**

3 Model

The goal of our modelling strategy is twofold. Firstly,...

Here we briefly describe the Bayesian analysis model used to investigate... Background details and diagnostics are included in Appendix B.

3.1 Model set-up

Define y_i as the number of seconds that the plane remained aloft. Then β_i is the wing width and γ_i is the wing length, both measured in millimeters.

$$y_i|\mu_i, \sigma \sim \text{Normal}(\mu_i, \sigma) \tag{1}$$
$$\mu_i = \alpha + \beta_i + \gamma_i \tag{2}$$
$$\alpha \sim \text{Normal}(0, 2.5) \tag{3}$$
$$\beta \sim \text{Normal}(0, 2.5) \tag{4}$$
$$\gamma \sim \text{Normal}(0, 2.5) \tag{5}$$
$$\sigma \sim \text{Exponential}(1) \tag{6}$$

We run the model in R (R Core Team 2023) using the `rstanarm` package of Goodrich et al. (2022). We use the default priors from `rstanarm`.

3.1.1 Model justification

We expect a positive relationship between the size of the wings and time spent aloft. In particular...

We can use maths by including latex between dollar signs, for instance θ.

4 Results

Our results are summarized in Table 1.

5 Discussion

5.1 First discussion point

If my paper were 10 pages, then should be be at least 2.5 pages. The discussion is a chance to show off what you know and what you learnt from all this.

5.2 Second discussion point

5.3 Third discussion point

5.4 Weaknesses and next steps

Weaknesses and next steps should also be included.

Table 1: Explanatory models of flight time based on wing width and wing length

	First model
(Intercept)	1.12
	(1.70)
length	0.01
	(0.01)
width	−0.01
	(0.02)
Num.Obs.	19
R2	0.320
R2 Adj.	0.019
Log.Lik.	−18.128
ELPD	−21.6
ELPD s.e.	2.1
LOOIC	43.2
LOOIC s.e.	4.3
WAIC	42.7
RMSE	0.60

Appendix

A Additional data details

B Model details

B.1 Posterior predictive check

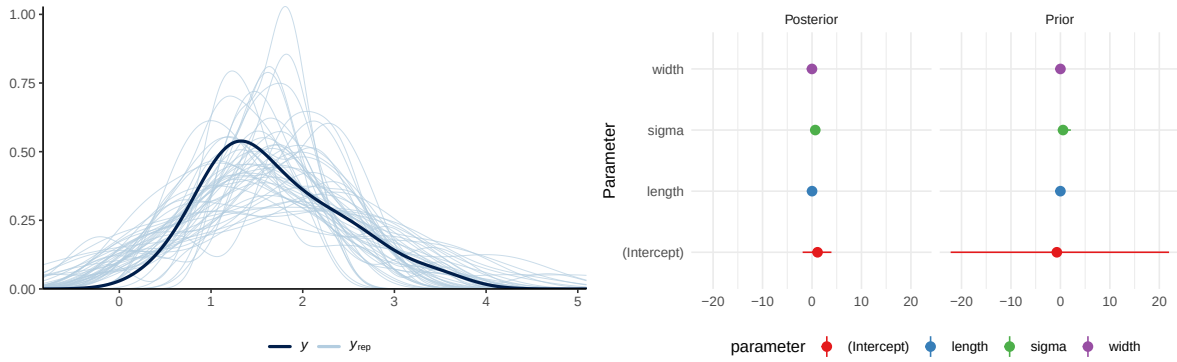
In Figure 7a we implement a posterior predictive check. This shows...

In Figure 7b we compare the posterior with the prior. This shows...

B.2 Diagnostics

Figure 8a is a trace plot. It shows... This suggests...

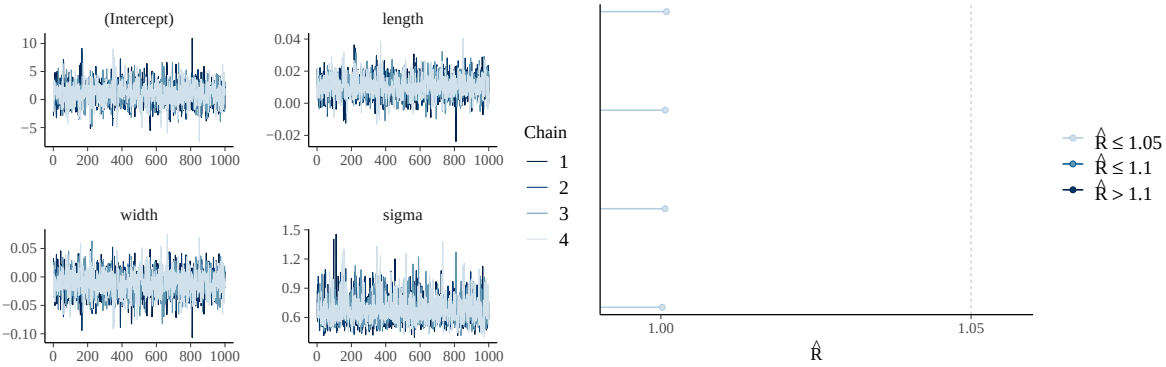
Figure 8b is a Rhat plot. It shows... This suggests...



(a) Posterior prediction check

(b) Comparing the posterior with the prior

Figure 7: Examining how the model fits, and is affected by, the data



(a) Trace plot

(b) Rhat plot

Figure 8: Checking the convergence of the MCMC algorithm

References

Goodrich, Ben, Jonah Gabry, Imad Ali, and Sam Brilleman. 2022. "Rstanarm: Bayesian Applied Regression Modeling via Stan." https://mc-stan.org/rstanarm/.

Horst, Allison Marie, Alison Presmanes Hill, and Kristen B Gorman. 2020. *Palmerpenguins: Palmer Archipelago (Antarctica) Penguin Data*. https://doi.org/10.5281/zenodo.3960218.

R Core Team. 2023. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.

Wickham, Hadley, Mara Averick, Jennifer Bryan, Winston Chang, Lucy D'Agostino McGowan, Romain François, Garrett Grolemund, et al. 2019. "Welcome to the tidyverse." *Journal of Open Source Software* 4 (43): 1686. https://doi.org/10.21105/joss.01686.