

Graphing*

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This paper illustrates various types of graphs and themes using `ggplot2`.

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

We are interested in the height of Lake Huron (Figure [1](#)).

2.0.1 Activity 2

2.0.2 Activity 3

Some of our data is of penguins ([?@fig-bills](#)), from Horst, Hill, and Gorman (2020).

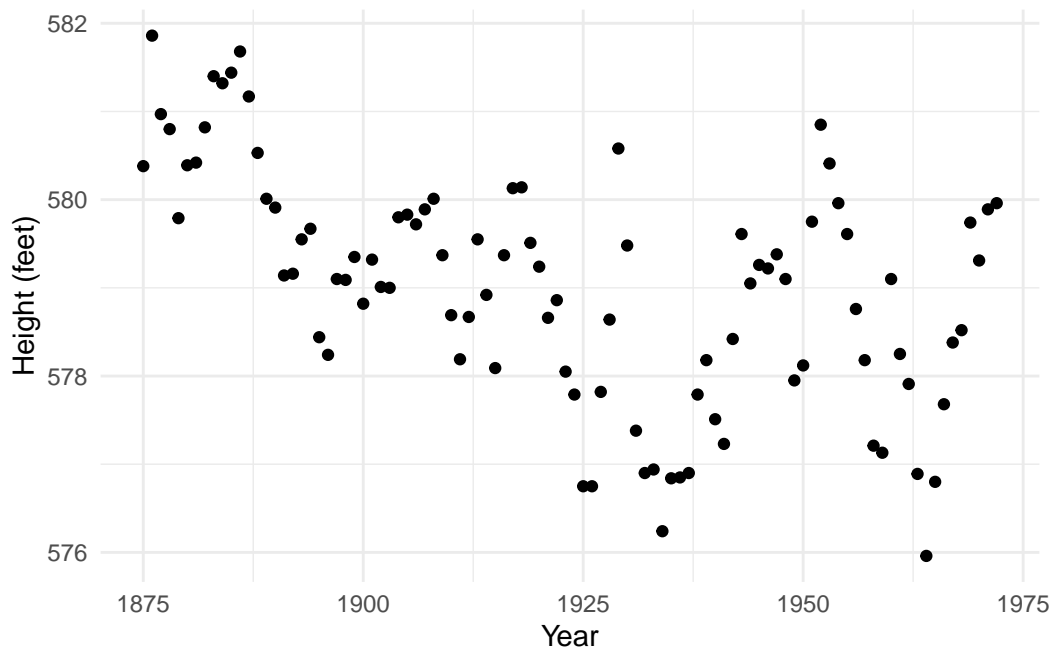


Figure 1: Annual measurements of the level, in feet, of Lake Huron 1875–1972.

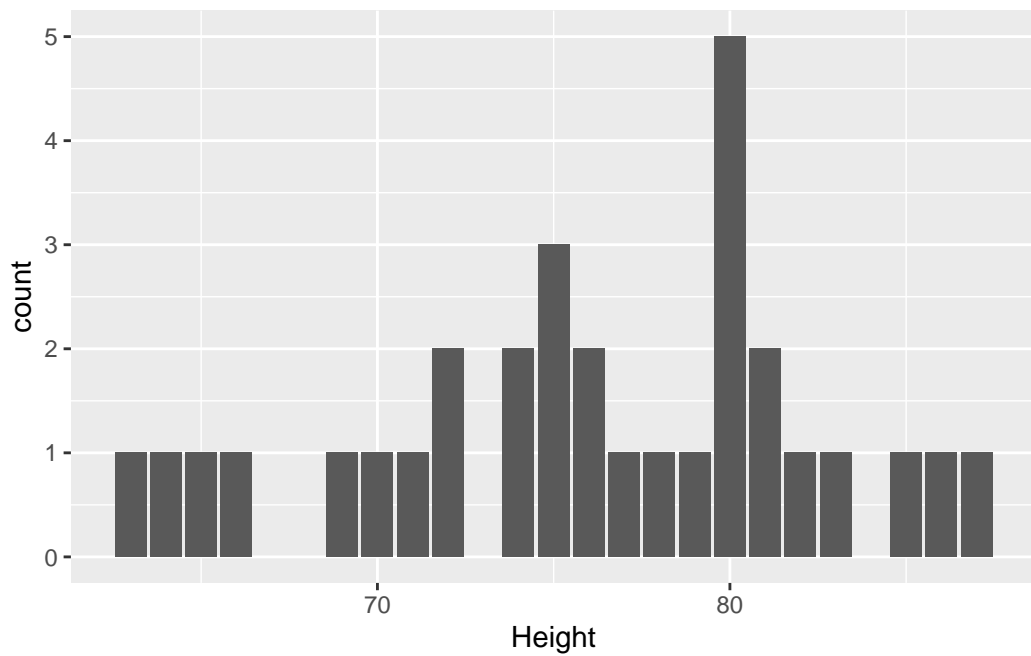


Figure 2: Annual measurements of the level, in feet, of Lake Huron 1875–1972.

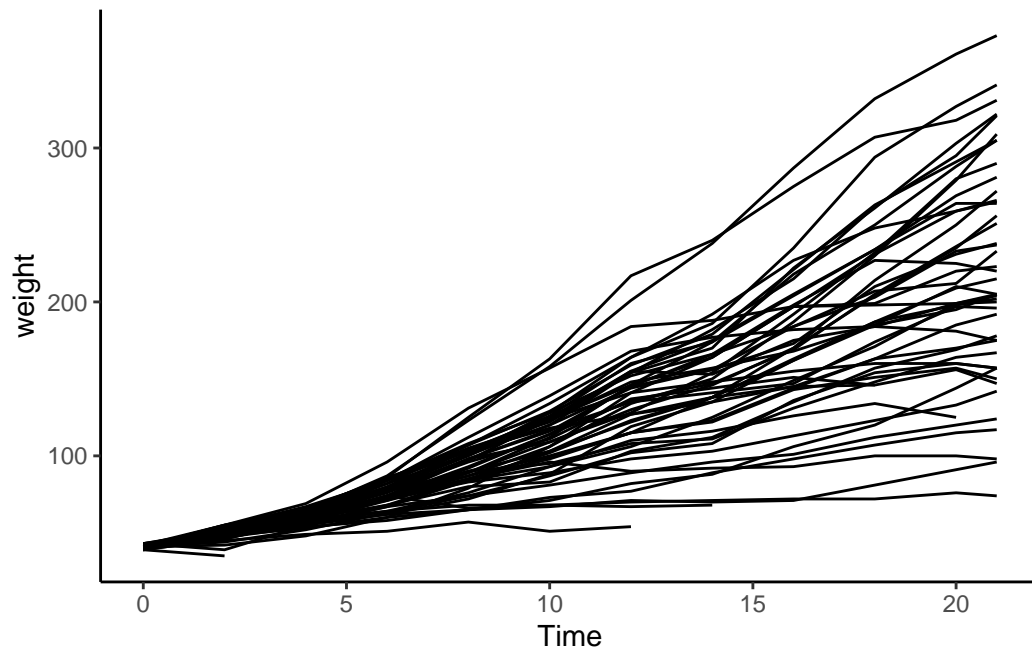


Figure 3: Weight of chicks after birth

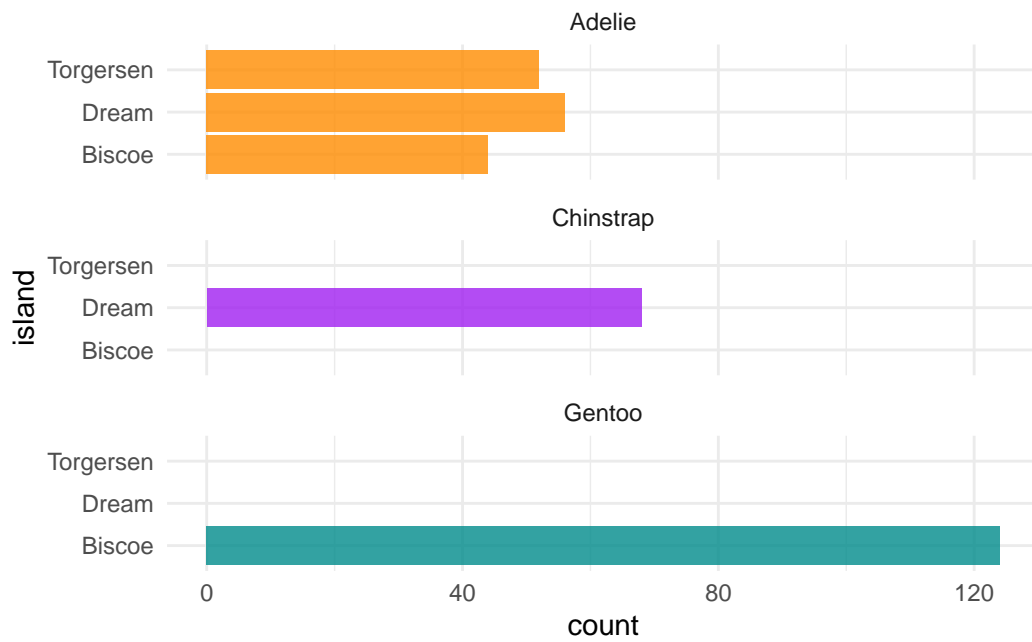


Figure 4: Bills of penguins

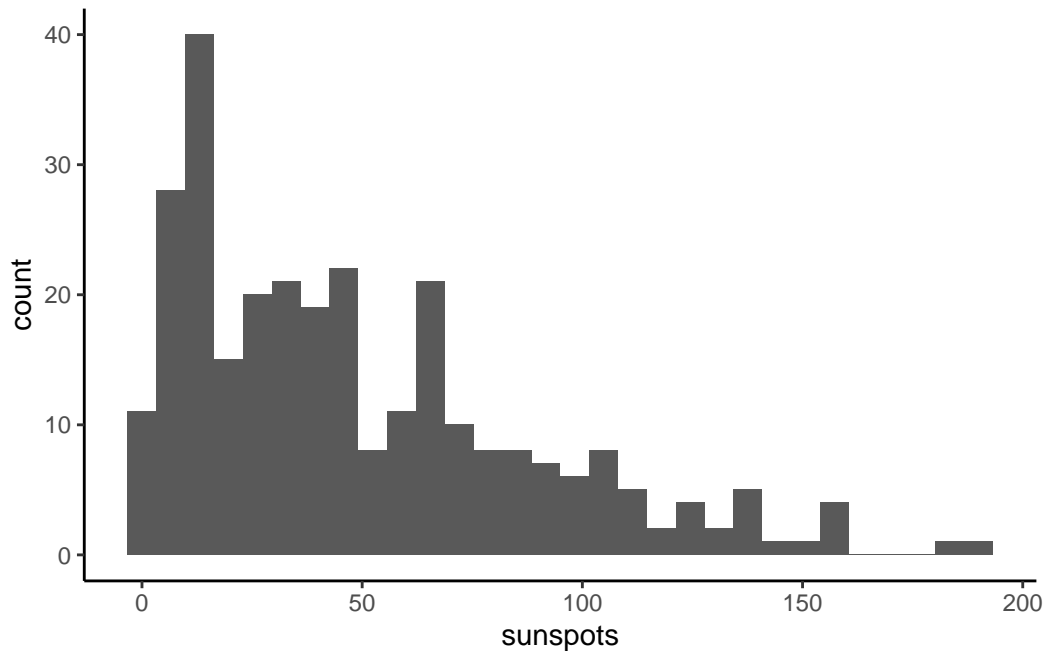


Figure 5: Bills of penguins

2.0.3 Activity 4

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

Talk more about it.

And also planes (Figure 6). (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.

2.0.4 Activity 6

```
datasets::morley |>
  tibble()
```

*Code and data are available at: <https://github.com/hadi-u/lecture-starter>

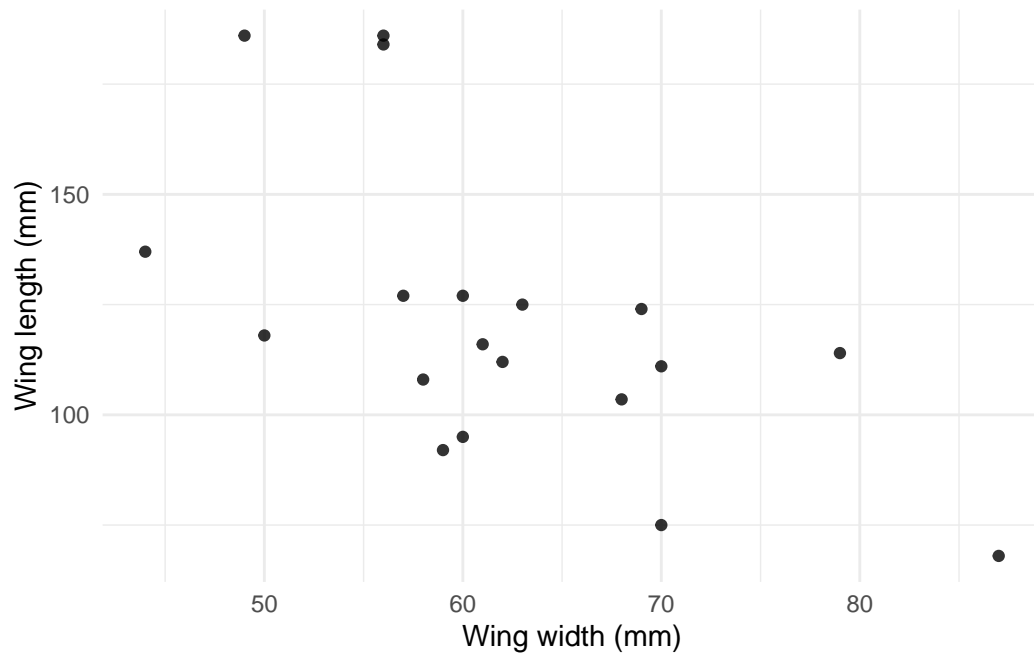


Figure 6: Relationship between wing length and width

According to all known laws of aviation, there is no way a penguin sh

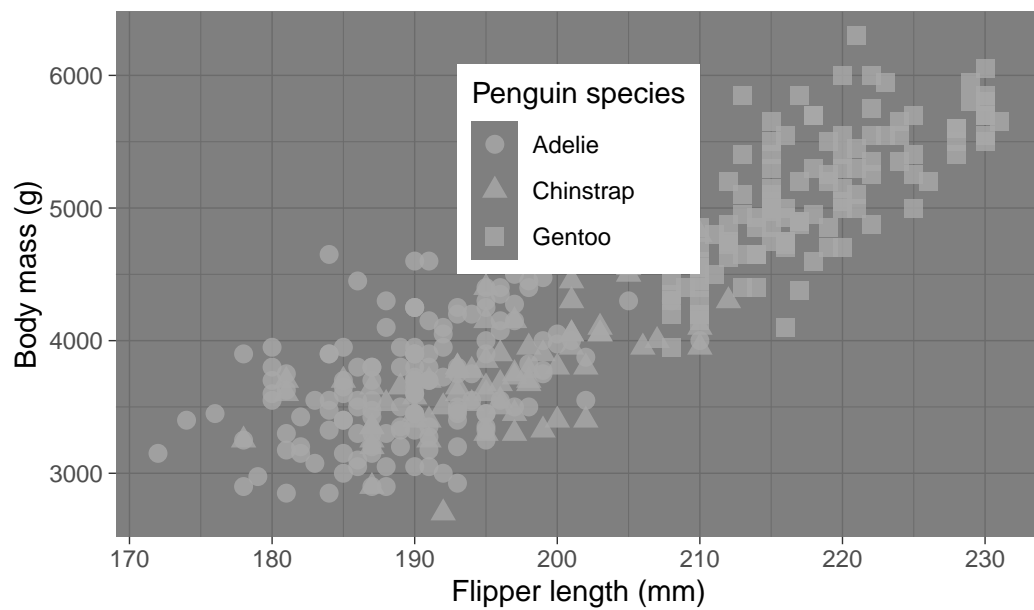


Figure 7: Relationship between wing length and width

```
# A tibble: 100 x 3
  Expt Run Speed
  <int> <int> <int>
1     1     1   850
2     1     2   740
3     1     3   900
4     1     4  1070
5     1     5   930
6     1     6   850
7     1     7   950
8     1     8   980
9     1     9   980
10    1    10   880
# i 90 more rows
```

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.

$$y_i | \mu_i, \sigma \sim \text{Normal}(\mu_i, \sigma) \quad (1)$$

$$\mu_i = \alpha + \beta_i + \gamma_i \quad (2)$$

$$\alpha \sim \text{Normal}(0, 2.5) \quad (3)$$

$$\beta \sim \text{Normal}(0, 2.5) \quad (4)$$

$$\gamma \sim \text{Normal}(0, 2.5) \quad (5)$$

$$\sigma \sim \text{Exponential}(1) \quad (6)$$

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`.

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

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 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.

Appendix

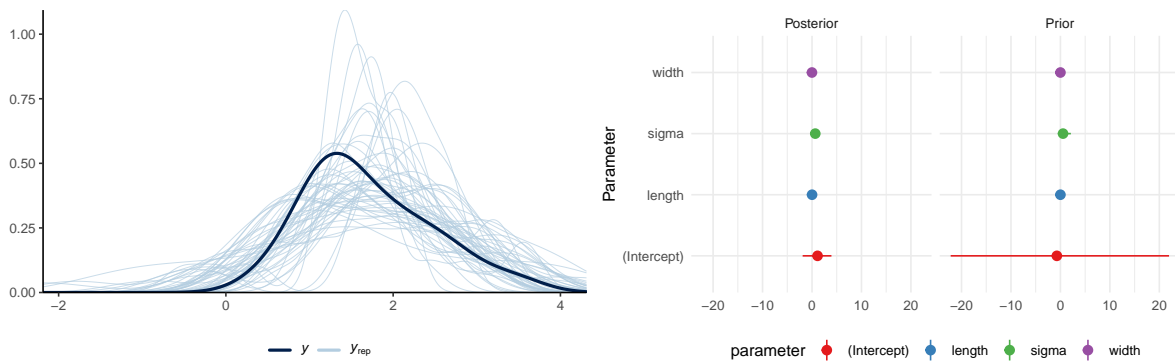
A Additional data details

B Model details

B.1 Posterior predictive check

In Figure 8a we implement a posterior predictive check. This shows...

In Figure 8b we compare the posterior with the prior. This shows...



(a) Posterior prediction check

(b) Comparing the posterior with the prior

Figure 8: Examining how the model fits, and is affected by, the data

B.2 Diagnostics

Figure 9a is a trace plot. It shows... This suggests...

Figure 9b is a Rhat plot. It shows... This suggests...

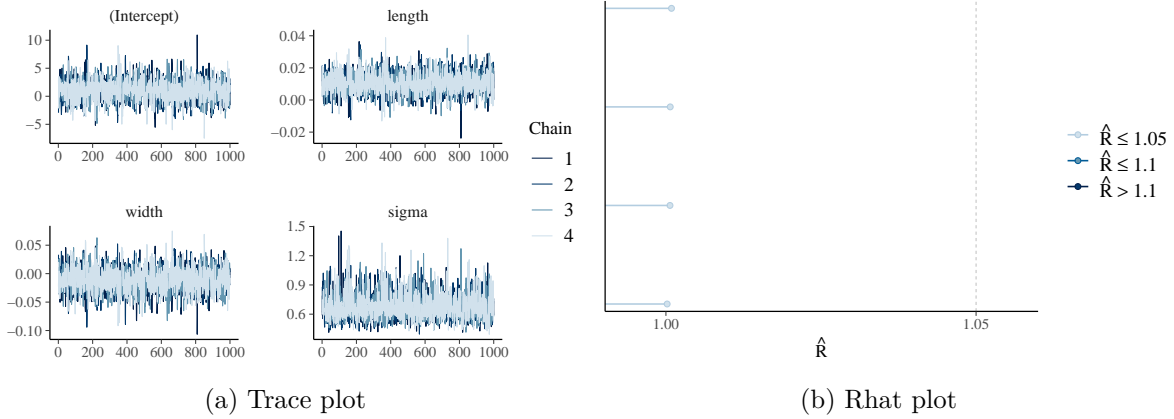


Figure 9: Checking the convergence of the MCMC algorithm

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 Golemund, et al. 2019. “Welcome to the tidyverse.” *Journal of Open Source Software* 4 (43): 1686. <https://doi.org/10.21105/joss.01686>.