

# Model Example\*

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## 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 [1](#)), from Horst, Hill, and Gorman (2020).

Talk more about it.

And also planes (Figure [2](#)). (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.

## 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](#).

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\*Code and data are available at: <https://github.com/NotSakura/MarathonExamination.git>



Figure 1: Bills of penguins



Figure 2: Relationship between wing length and width

### 3.1 Model set-up

Define  $y_i$  as the number of seconds that the plane remained aloft. Then  $\beta_i$  is the wing width and  $\gamma_i$  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`.

#### 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  $\theta$ .

## 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.

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

## 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

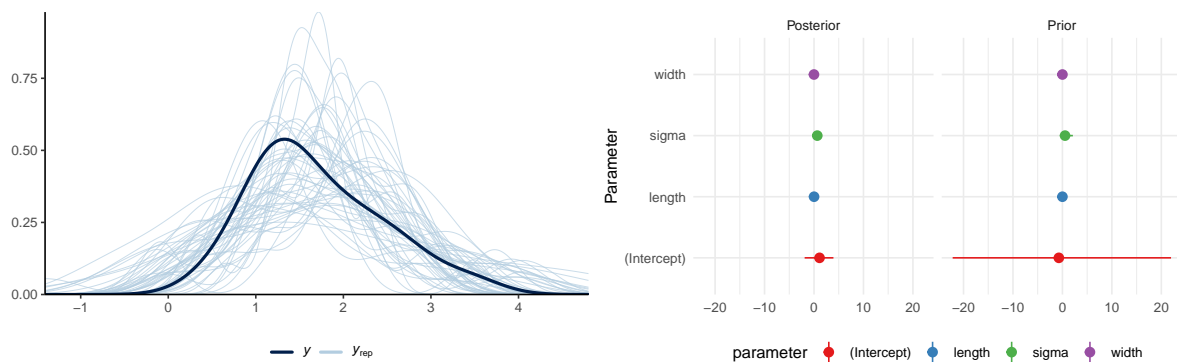
## A Additional data details

## B Model details

### B.1 Posterior predictive check

In Figure 3a we implement a posterior predictive check. This shows...

In Figure 3b we compare the posterior with the prior. This shows...



(a) Posterior prediction check

(b) Comparing the posterior with the prior

Figure 3: Examining how the model fits, and is affected by, the data

### B.2 Diagnostics

Figure 4a is a trace plot. It shows... This suggests...

Figure 4b is a Rhat plot. It shows... This suggests...

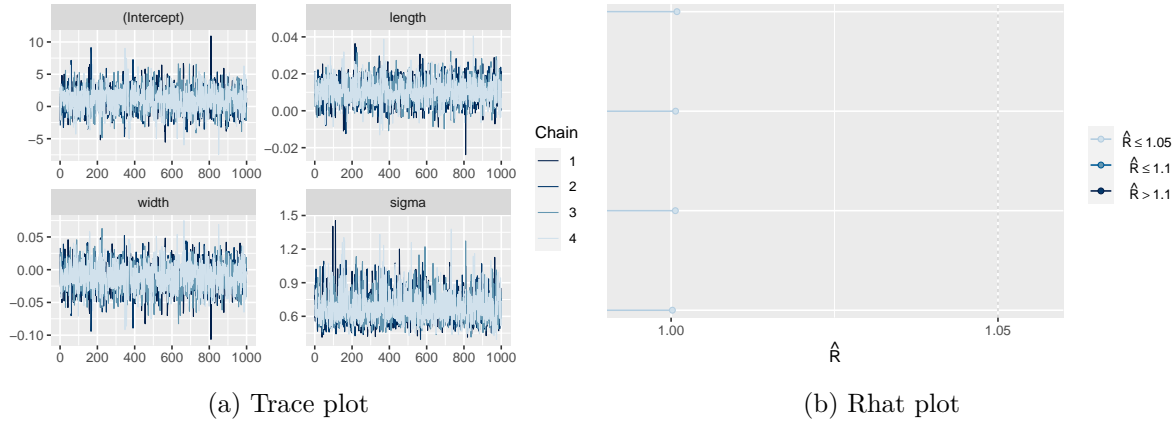


Figure 4: Checking the convergence of the MCMC algorithm

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