My title*

My subtitle if needed

Ahnaf Alam

March 16, 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 (**?@fig-bills**), from Horst, Hill, and Gorman (2020).

Table 1: Description of cleaned data

Variable	Description
Date	Date of data collected
Durable goods	Real expenditure in durable goods
Non-durable goods	Real expenditure in non-durable goods
Food	Real food expenditure
Disposable income	Real disposable income
Healthcare	Real expenditure in healthcare
Services	Real expenditure in services

Talk more about it.

*Code and data are available at: LINK.

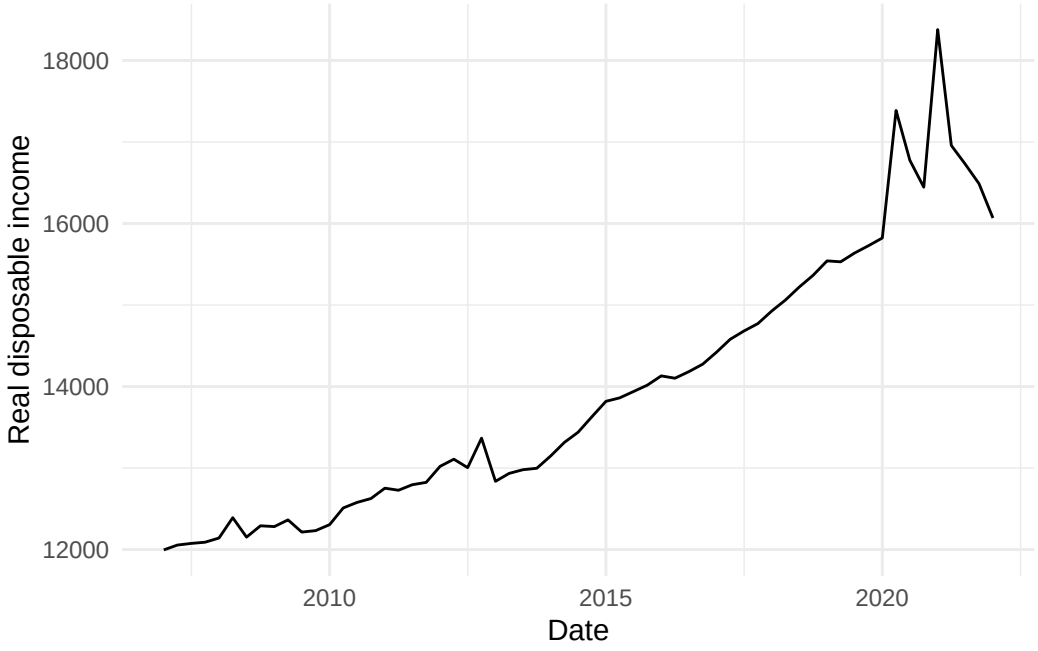


Figure 1: Relationship between wing length and width

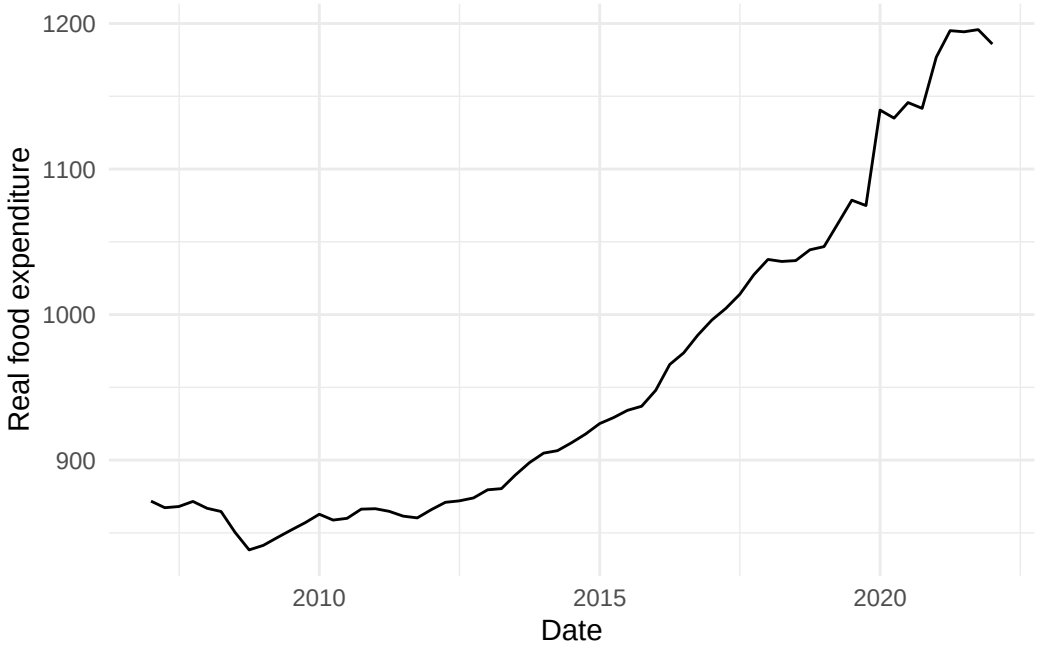


Figure 2: Relationship between wing length and width

Table 2: Cleaned data showing real expenditure by different categories

Date	Durable goods	Non-durable goods	Food	Disposable income	Healthcare	Services
2007-01-01	969.90	2435.00	871.80	11995.90	1736.72	25900.00
2007-04-01	980.10	2429.90	867.30	12055.30	1745.91	25913.00
2007-07-01	992.10	2437.50	868.10	12075.60	1762.55	26024.00
2007-10-01	999.50	2435.50	871.60	12090.30	1770.73	26088.00
2008-01-01	967.20	2416.60	866.90	12141.60	1788.97	26202.00
2008-04-01	960.30	2420.40	864.70	12391.20	1793.99	26273.00
2008-07-01	927.90	2385.10	850.40	12152.80	1800.01	26186.00
2008-10-01	859.60	2362.30	838.30	12291.70	1804.94	26167.00
2009-01-01	861.10	2361.40	841.40	12282.00	1817.91	26012.00
2009-04-01	854.90	2347.30	846.70	12364.40	1838.01	25848.00
2009-07-01	896.40	2354.70	851.90	12214.70	1849.31	25830.00
2009-10-01	875.30	2362.30	857.00	12232.60	1840.44	25795.00

And also planes (Figure 3). (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.

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.

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

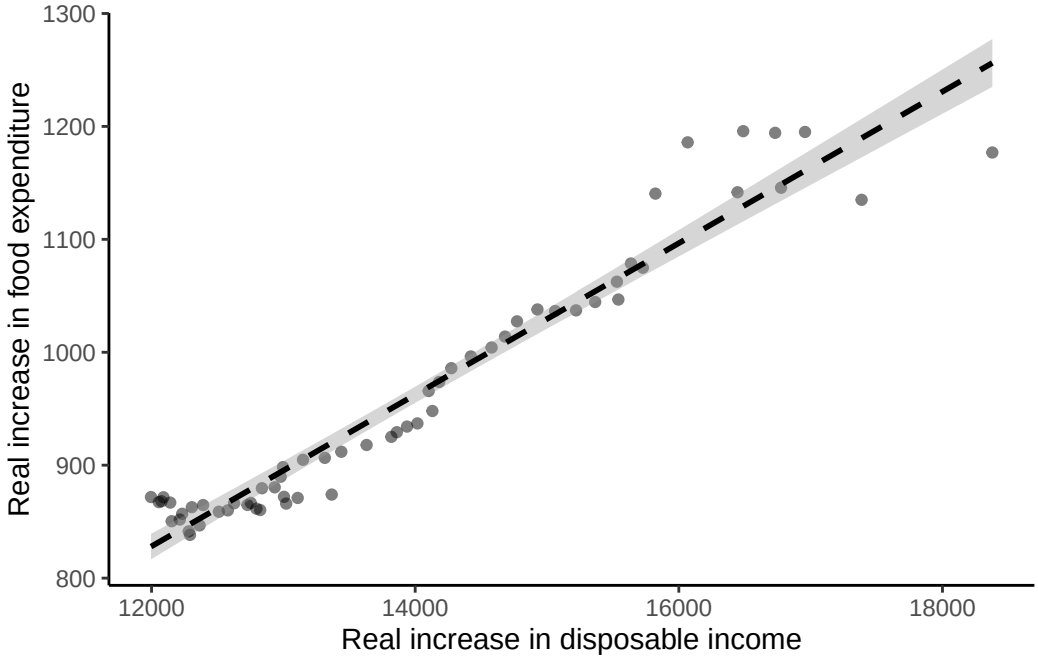


Figure 3: Relationship between wing length and width

	First Model
(Intercept)	24.07
	(30.88)
income_expenditure	0.07
	(0.00)
Num.Obs.	61
R2	0.936
R2 Adj.	0.933
Log.Lik.	−289.419
ELPD	−292.9
ELPD s.e.	8.0
LOOIC	585.7
LOOIC s.e.	16.0
WAIC	585.6
RMSE	27.49

Table 3: Explanatory models of flight time based on wing width and wing length

	First model
(Intercept)	24.07
	(30.88)
income_expenditure	0.07
	(0.00)
Num.Obs.	61
R2	0.936
R2 Adj.	0.933
Log.Lik.	−289.419
ELPD	−292.9
ELPD s.e.	8.0
LOOIC	585.7
LOOIC s.e.	16.0
WAIC	585.6
RMSE	27.49

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 3.

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.

Appendix

We are at the back end of covid-19 pandemic yet risks of another widespread epidemic is still rather underestimated. At the beginning of this pandemic, public health officials were rather caught off-guard with the emergence and virulence of this disease. As such, public were relayed lots of mixed messages regarding what they can do to mitigate the risk of infection and this confusion only added to public panic. Measures like Spain banning smoking in public were, or mandatory gloves Russia and Ukraine were implemented, which may sound absurd right now, although at the time seemed reasonable. However, public health experts soon realized effectiveness of masks in slowing transmission rate. A meta-analysis, consisting of 6 studies from 4 different countries show that masks significantly reduce transmission risks (OR = 0.38, 95% CI: 0.21-0.69, I2 = 54.1%) , and among health care workers, masks reduce transmission by as much as 70%.

A Additional data details

B Model details

B.1 Posterior predictive check

In **?@fig-ppcheckandposteriorvsprior-1** we implement a posterior predictive check. This shows…

In **?@fig-ppcheckandposteriorvsprior-2** we compare the posterior with the prior. This shows…

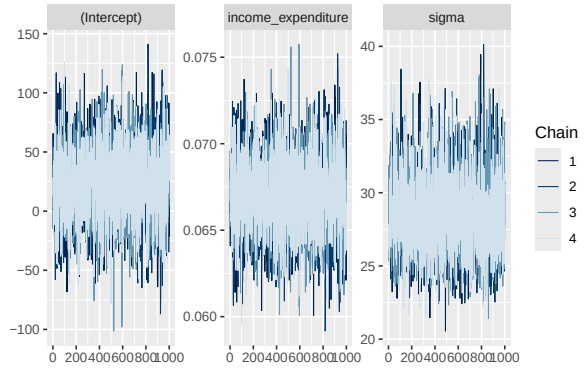
Examining how the model fits, and is affected
by, the data

Figure 4: **?(caption)**

B.2 Diagnostics

?@fig-stanareyouokay-1 is a trace plot. It shows… This suggests…

?@fig-stanareyouokay-2 is a Rhat plot. It shows… This suggests…



(a) Trace plot

Figure 5: 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.