

# Respiration Related Death Cause show Significant Relation to Increasing\*

My subtitle if needed

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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).

Talk more about it.

And also planes (**?@fig-planes**). (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.

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\*Code and data are available at: <https://github.com/shivankgoel003/Mortality-in-Alberta>.

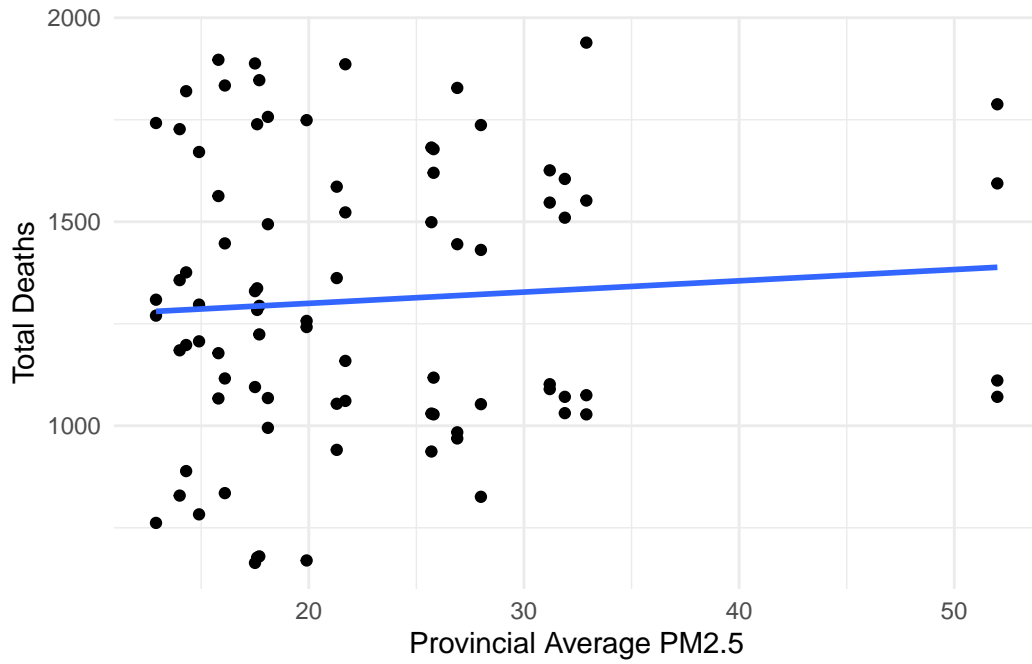


Figure 1: Provincial Average PM2.5 Quantity Vs Total Deaths

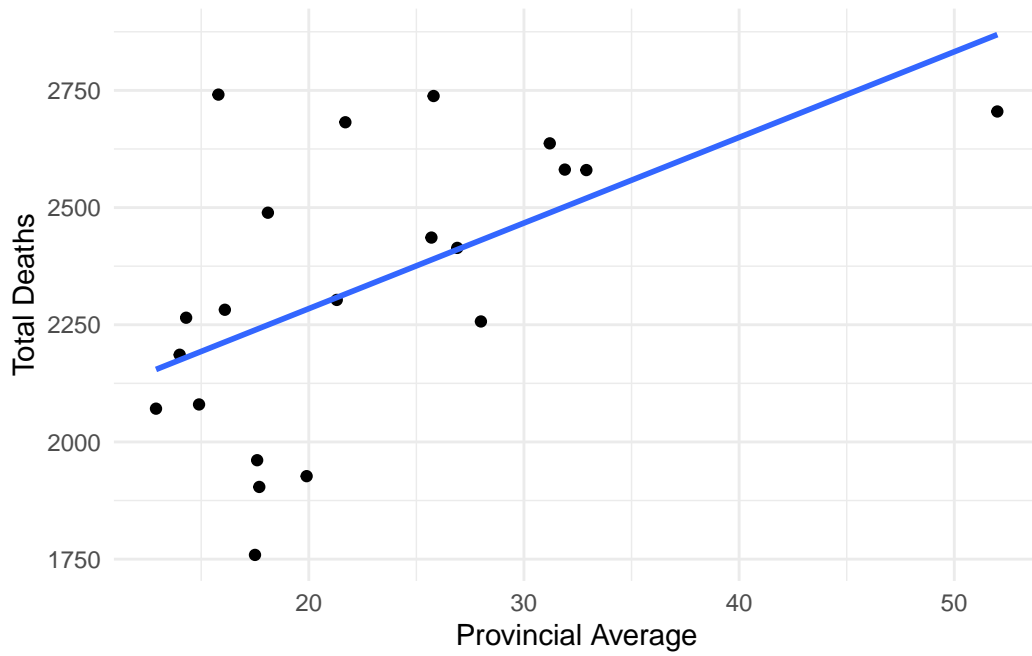


Figure 2: Lung Related Causes Mortality Rates vs Average PM2.5 Quantity

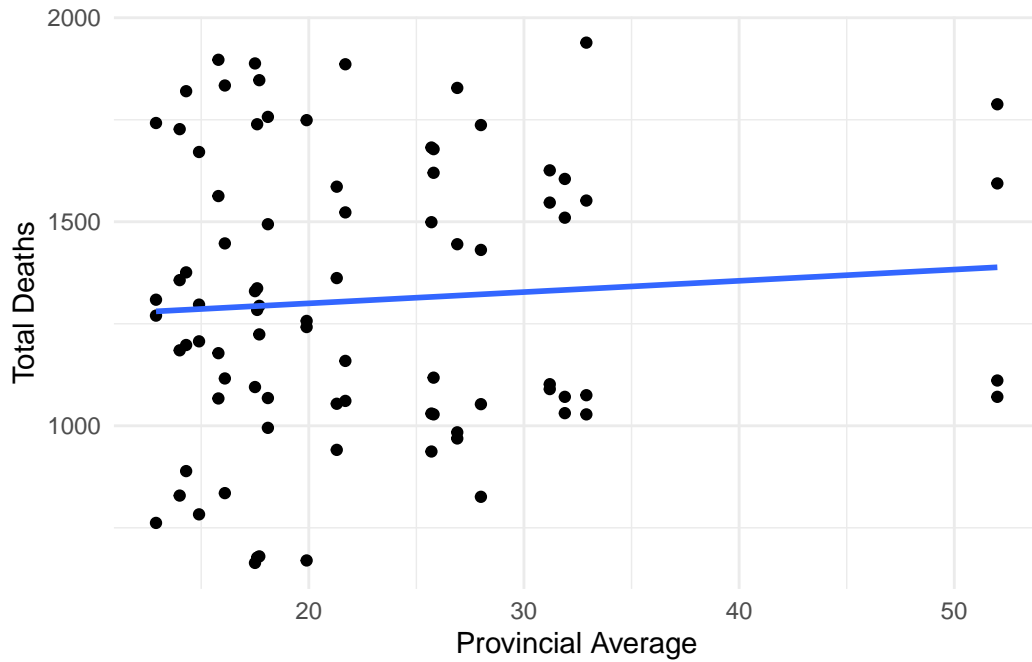


Figure 3: Heart Related Causes Mortality Rates vs Average PM2.5 Quantity

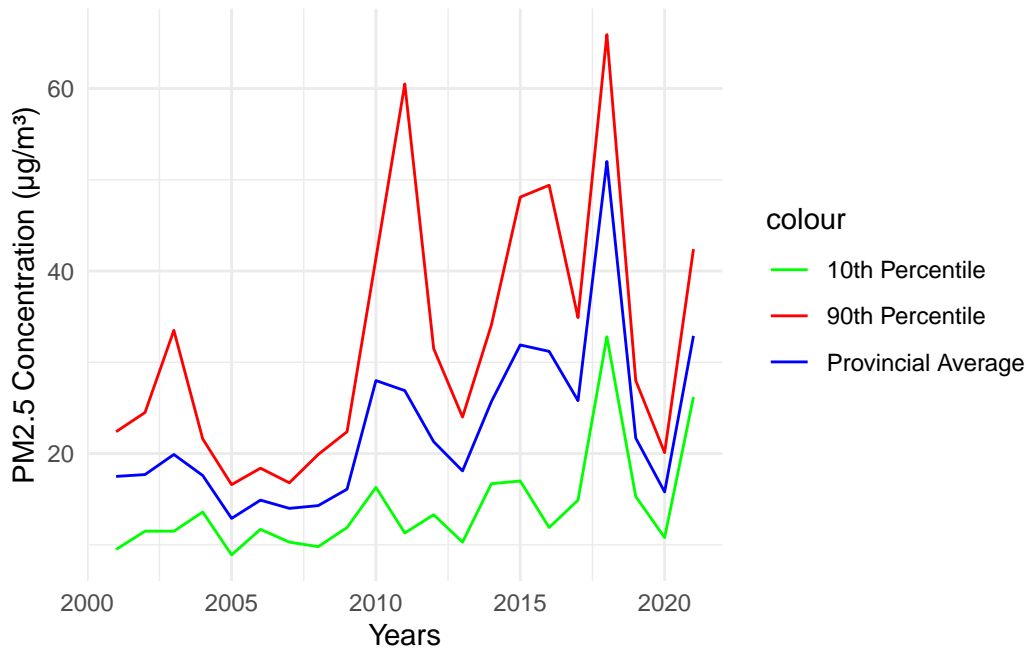


Figure 4: Annual Trends of PM2.5 Concentrations in Alberta

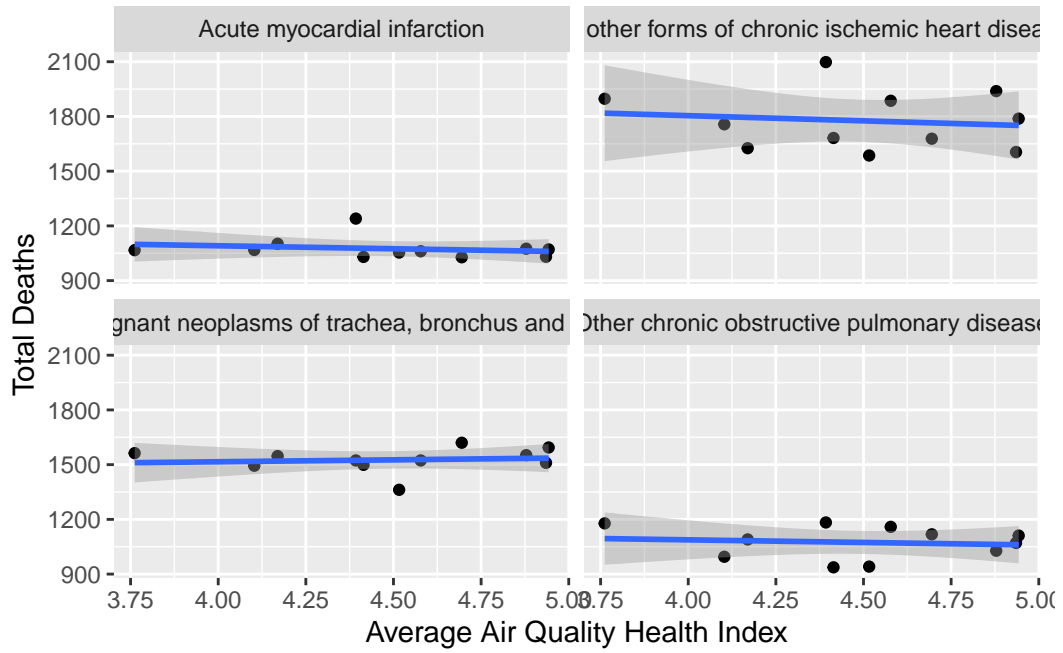


Figure 5: Mortality Rates vs. Air Quality Health Index

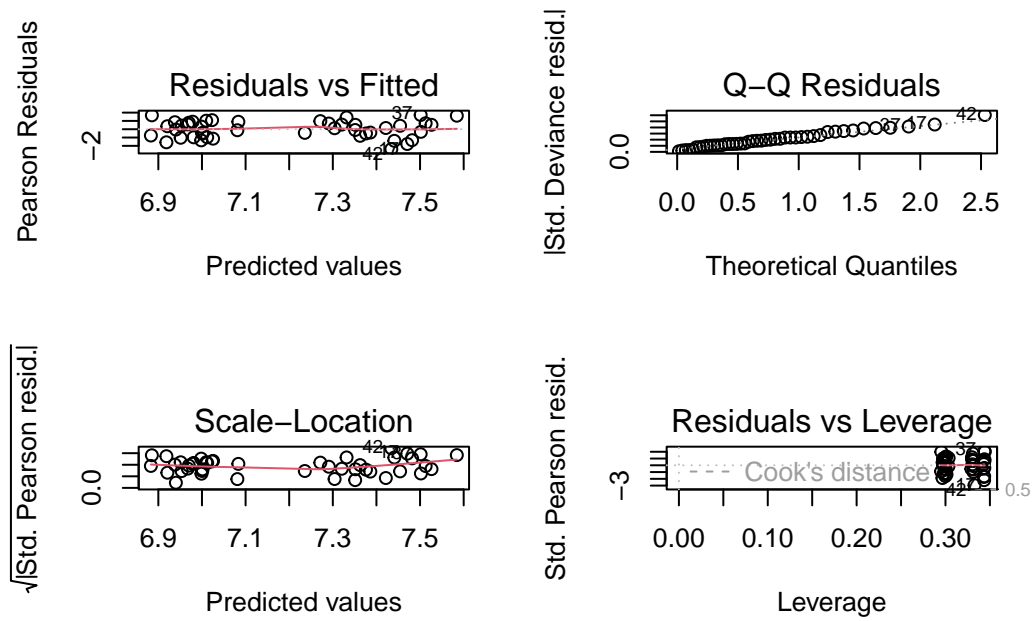


Figure 6: Model data

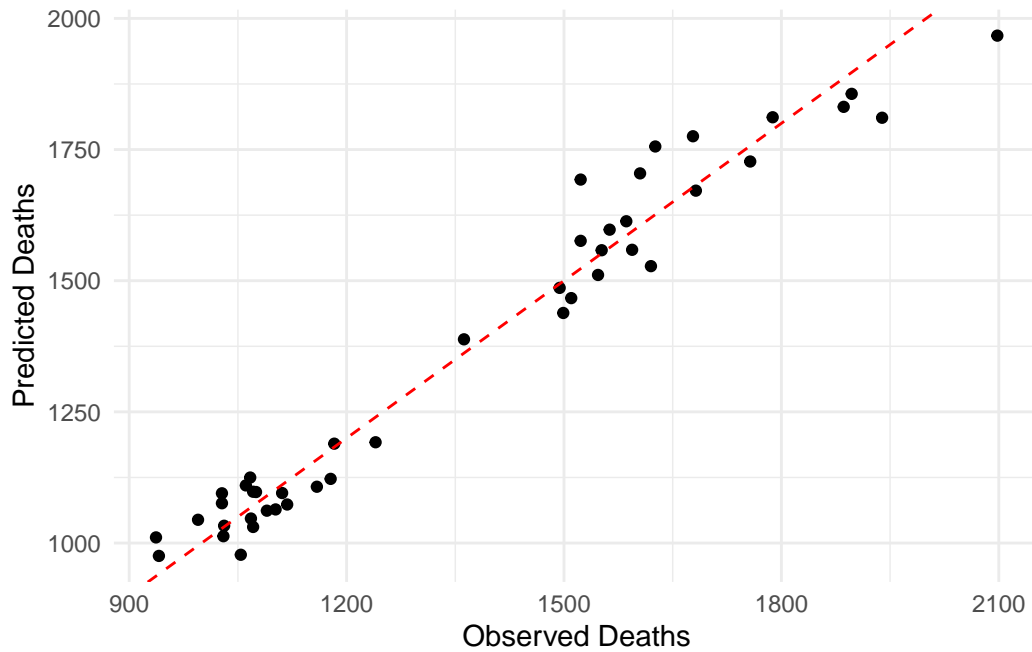


Figure 7: Prediction of deaths based on the model

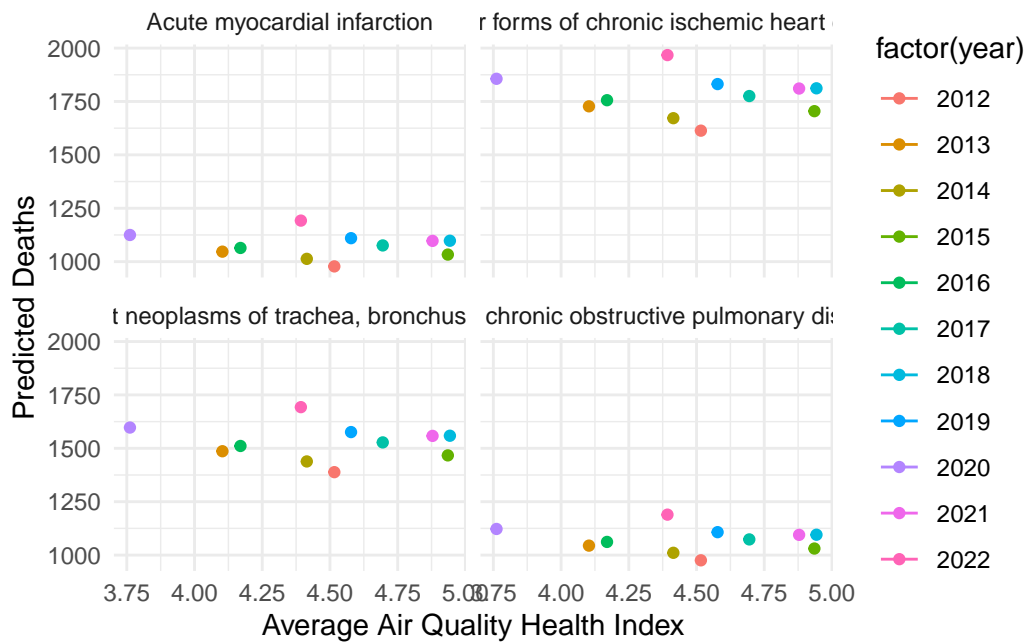


Figure 8: Relationship between wing length and width

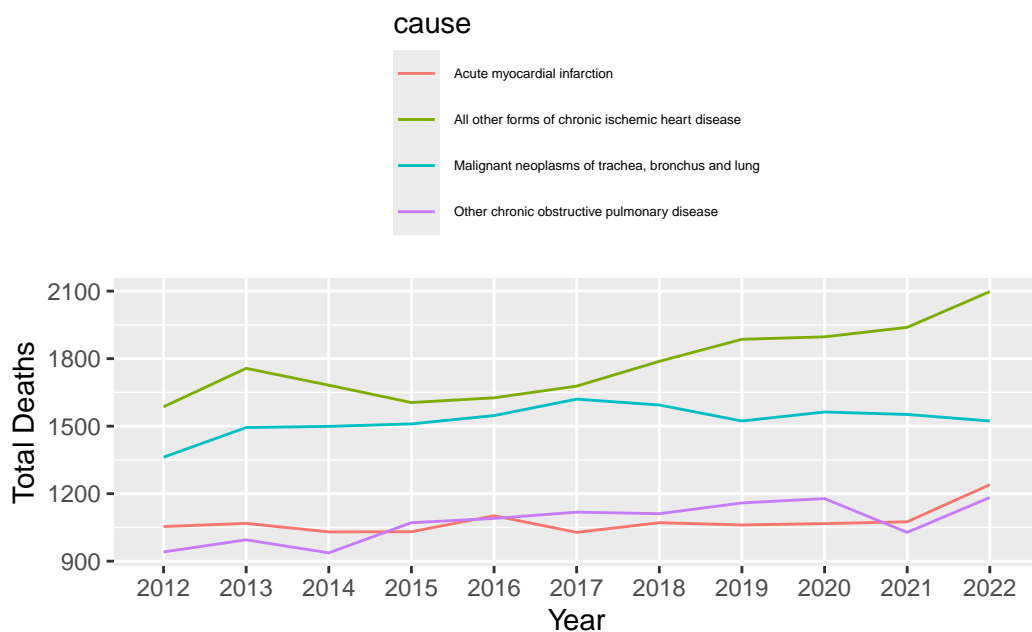


Figure 9: Total Deaths by Year for Each Cause

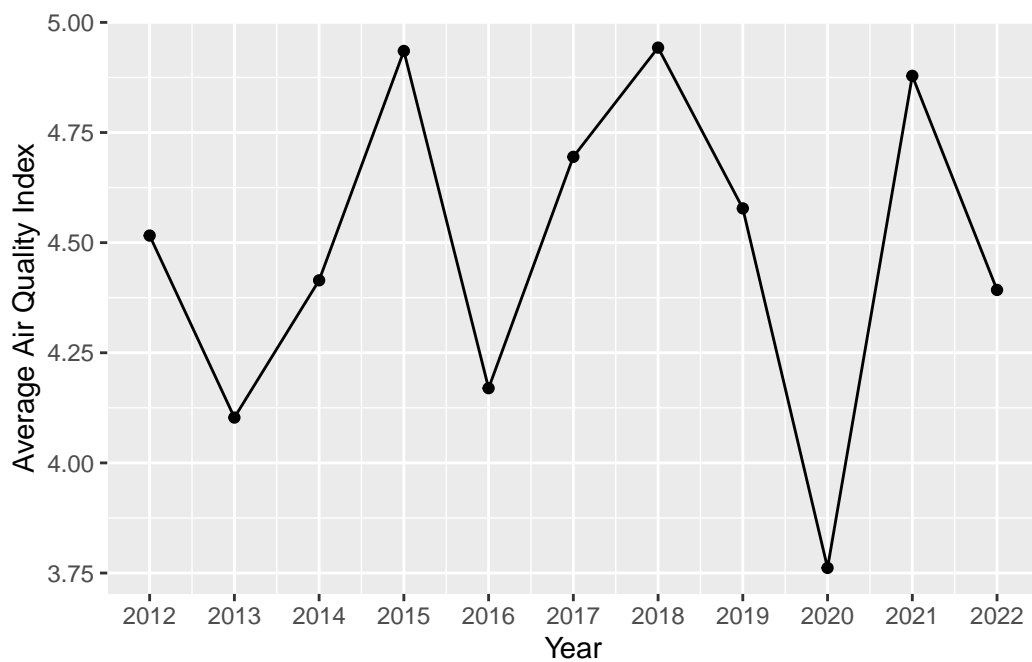


Figure 10: Average Air Quality Health Index by Year

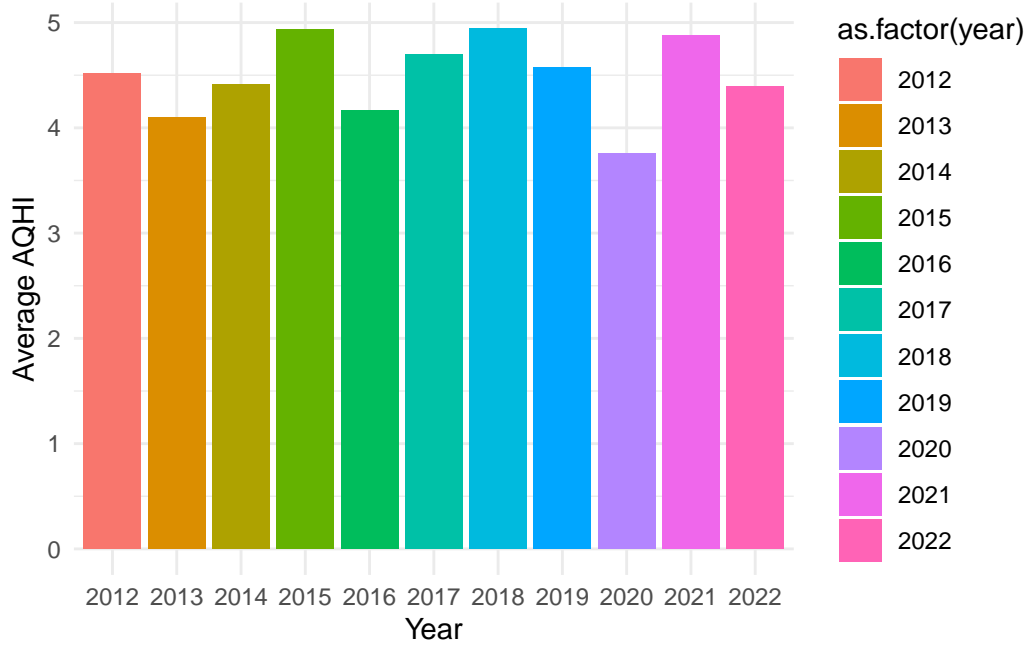


Figure 11: Average Air Quality Health Index by Year

### 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  $\beta_i$  is the wing width and  $\gamma_i$  is the wing length, both measured in millimeters.

$$y_i | \mu_i, \phi \sim \text{NegBin}(\mu_i, \phi) \quad (1)$$

$$\mu_i = \exp(\alpha + \beta x_i) \quad (2)$$

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

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

$$\phi \sim \text{Exponential}(1) \quad (5)$$

Table 1: Different causes of mortality and their death counts

|                              | Poisson     | Negative binomial |
|------------------------------|-------------|-------------------|
| Ischemic Heart Disease       | 0.510       | 0.510<br>(0.002)  |
| Trachea/Bronchus/Lung Cancer | 0.353       | 0.353<br>(0.002)  |
| COPD                         | 0.004       | 0.004<br>(0.002)  |
| Num.Obs.                     | 9048        | 9048              |
| Log.Lik.                     | −69 064.136 | −53 402.269       |
| ELPD                         | −69 078.6   | −53 405.5         |
| ELPD s.e.                    | 468.1       | 70.9              |
| LOOIC                        | 138 157.2   | 106 811.0         |
| LOOIC s.e.                   | 936.3       | 141.9             |
| WAIC                         | 138 157.2   | 106 811.0         |
| RMSE                         | 97.30       | 97.30             |

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 `?@tbl-modelresults`.

## 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.



Table 2: Heart related causes death count and the air quality

|                    | heart causes model |
|--------------------|--------------------|
| (Intercept)        | 8.02<br>(0.18)     |
| provincial_average | 0.00<br>(0.01)     |
| Num.Obs.           | 21                 |
| Log.Lik.           | −163.733           |
| ELPD               | −164.5             |
| ELPD s.e.          | 0.5                |
| LOOIC              | 329.0              |
| LOOIC s.e.         | 1.0                |
| WAIC               | 328.9              |
| RMSE               | 142.90             |

Table 3: Lung related causes death count and the air quality

|                    | Lung Causes model |
|--------------------|-------------------|
| (Intercept)        | 7.57<br>(0.20)    |
| provincial_average | 0.01<br>(0.01)    |
| Num.Obs.           | 21                |
| Log.Lik.           | −160.858          |
| ELPD               | −161.6            |
| ELPD s.e.          | 0.8               |
| LOOIC              | 323.3             |
| LOOIC s.e.         | 1.6               |
| WAIC               | 323.2             |
| RMSE               | 248.30            |

## **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

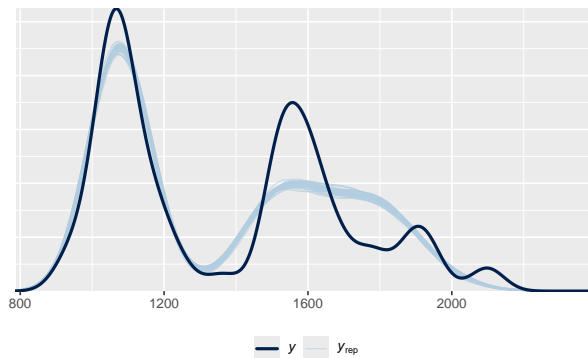
### A Additional data details

### B Model details

#### B.1 Posterior predictive check

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

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



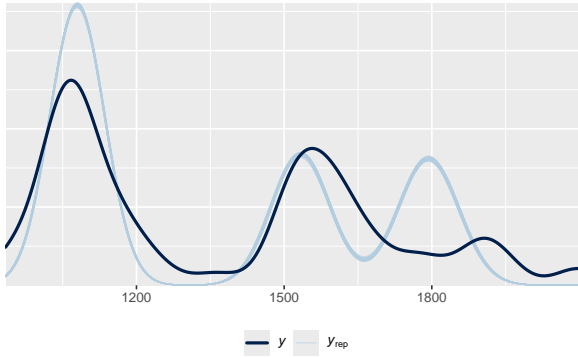
(a) Posterior prediction check

Figure 12: Examining how the model fits, and is affected by, the data

#### B.2 Diagnostics

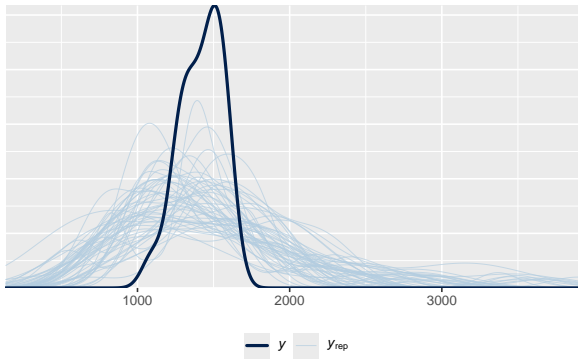
Figure 18a is a trace plot. It shows... This suggests...

Figure 18b is a Rhat plot. It shows... This suggests...



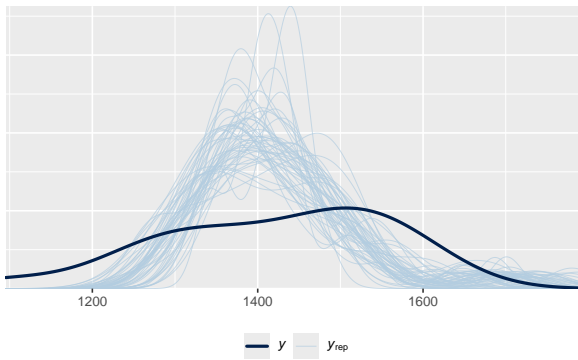
(a) Posterior prediction check

Figure 13: Examining how the model fits, and is affected by, the data



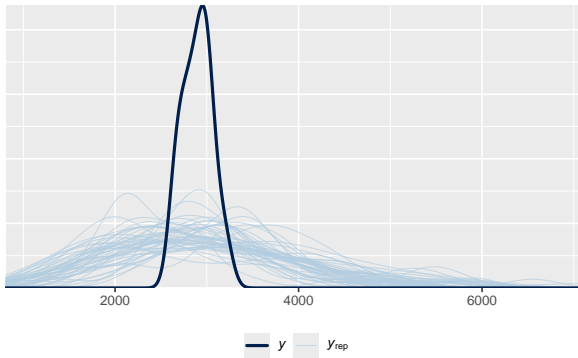
(a) Posterior prediction check

Figure 14: Examining how the model fits, and is affected by, the data



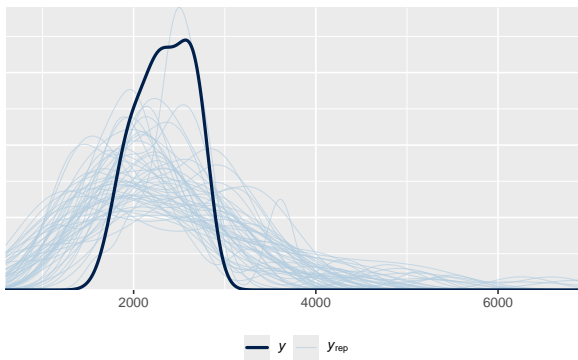
(a) Posterior prediction check

Figure 15: Examining how the model fits, and is affected by, the data



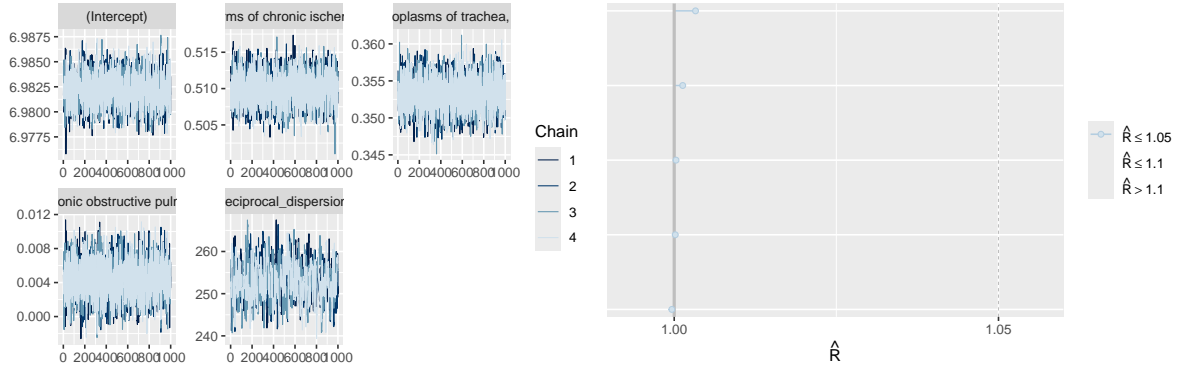
(a) Posterior prediction check

Figure 16: Examining how the model fits, and is affected by, the data



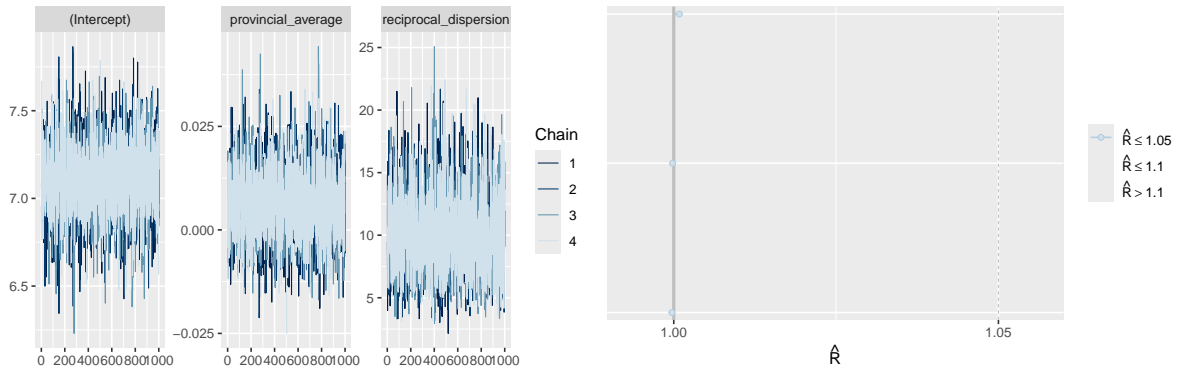
(a) Posterior prediction check

Figure 17: Examining how the model fits, and is affected by, the data



(a) Trace plot

(b) Rhat plot



(c) Trace plot

(d) Rhat plot

Figure 18: 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>.