Analysing penguin data

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# 1. Introduction

## 1.1 The data set

As everyone always says, penguins are very cute, so let’s work with penguin data today.

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| Figure 1: Penguin species drawing by Allison Horst |

Note that the palmerpenguins dataset is meant as an alternative to the commonly used iris data and contains data on three species - see [Figure 1](#fig-penguins).

More information on this data set is available on [Allison Horst’s Github page.](https://allisonhorst.github.io/palmerpenguins/)

## 1.2 Data source

Data were collected and made available by Dr. Kristen Gorman and the Palmer Station, Antarctica LTER, a member of the Long Term Ecological Research Network.

This data can also be used via the {palmerpenguins} package ([Horst et al., 2020](#ref-Horst.2020)) and was originally introduced in Gorman et al. ([2014](#ref-Gorman.2014))

# 2. Descriptive statistics

We’ve removed missing values here, which means that the data has 333 rows[[1]](#footnote-28).

## 2.1 Overall statistics

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| Figure 2: Explaining bill dimensions |

Some descriptive statistics:

The data was collected between 2007 and 2009.

* bill lengths and depths
  + the average bill length is 43.99 mm
  + the average bill depth is 17.16 mm

Penguins on the island Torgersen have the smallest average bill length.

* body mass
  + the average weight is 4207.06 g

## 2.2 Separate per species

[Table 1](#tbl-bill) shows bill lengths for each of the three species of penguin in the data.

Table 1: Bill lengths (in mm) by species

| species | average bill length | variance | std. deviation |
| --- | --- | --- | --- |
| Adelie | 38.82397 | 7.089421 | 2.662597 |
| Gentoo | 47.56807 | 9.647955 | 3.106116 |
| Chinstrap | 48.83382 | 11.150630 | 3.339256 |

# 3. Graphs

**Hypotheses:**

1. Flipper length and body mass are *positively* associated.
2. This is true for ***all*** three species in the data.

## 3.1 Weight and flipper length

The following graphs are slightly simplified versions from the [vignette for the {palmerpenguins} package.](https://allisonhorst.github.io/palmerpenguins/articles/examples.html)

### 3.1.1 Entire data

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| Figure 3: Penguin flipper length and body mass |

Refer to [Figure 2](#fig-bill) for an explanation of the measurements.

### 3.1.2 Separated by species

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| Figure 4: Penguin flipper length and body mass, separately by species |

[Figure 3](#fig-entire) does not separate the data by species, while [Figure 4](#fig-species) does.

### 3.1.3 Separated by species and sex

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| Figure 5: Penguin flipper length and body mass, separately by species and sex |

# 4. Modeling

## 4.1 Model output

We’ve constructed a mixed-effects model that predicts bill length by bill depth, body mass, and their interaction, with island as a random intercept.

Table 2: Model output - Predicting penguin bill lengths

| term | estimate | standard error | t-value | p-value |
| --- | --- | --- | --- | --- |
| Intercept | -6.3638 | 19.2569 | -0.3305 | 0.7413 |
| Bill depth (in mm) | 1.7408 | 1.1334 | 1.5359 | 0.1255 |
| Body mass (in g) | 0.0121 | 0.0044 | 2.7584 | 0.0061 |
| Bill depth : Body mass | -0.0004 | 0.0003 | -1.6365 | 0.1027 |

The model output is shown in [Table 2](#tbl-penguinsMdl). Only the slope for body mass is significant at p < 0.05 (b = 0.0121, SE = 0.0044).

## 4.2 Model predictions

The model predictions are visualised in [Figure 6](#fig-MdlPred).

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| Figure 6: Model predictions for bill lengths for different body masses |

# 5. Bibliography

Gorman, K. B., Williams, T. D., & Fraser, W. R. (2014). Ecological sexual dimorphism and environmental variability within a community of antarctic penguins (genus pygoscelis). *PloS One*, *9*(3), e90081. <https://doi.org/10.1371/journal.pone.0090081>

Horst, A. M., Presmanes Hill, A., & Gorman, K. B. (2020). *Palmerpenguins: Palmer archipelago (antarctica) penguin data. R package version 0.1.0.* Zenodo. <https://doi.org/10.5281/zenodo.3960218>

1. Note that this removes any rows with missing values! [↑](#footnote-ref-28)