The penguins of Antarctica

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Contents

1 Introduction

There are three main penguin species in Antarctica (*Chinstrap*, *Gentoo*, *Adelie*). You can see them in the following figure:

```
# with this code chunk, you can include images from a file and have more control
# over the size of it
knitr::include_graphics("img/lter_penguins.png")
```

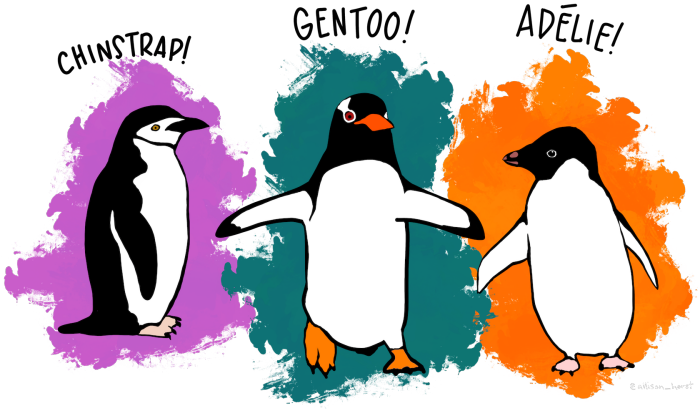

Figure 1: Illustration of the three penguin species by Allison Horst

In this paper we want to answer the following questions

1. How bill depth depends on bill length?
2. Which penguin species has the highest body mass?

2 Methods

All analysis was done using R version 4.1.3 (R Core Team 2022) and the R markdown package (Allaire et al. 2021).

2.1 The data

The data was collected on islands in Antarctica and published by Gorman, Williams, and Fraser (2014). You can find the original paper with the title "Ecological sexual dimorphism and environmental variability within a community of Antarctic penguins (genus *Pygoscelis*)" (Gorman, Williams, and Fraser 2014) in PLoS ONE[1]

The data is published via the `palmerpenguins` R package (Horst, Hill, and Gorman 2020) which you can find on this website.

The data contains (among others) the following measurements:

- bill length
- bill depth
- body mass
- sex
  - male
  - female

2.2 The analysis

We did some plots, calculated some summary statistics and a linear model of the form $y = ax + b$

3 Results

The mean weight of all penguin species is 4201.754386. *Gentoo* penguins have an average weight of 5076 g, *Adelie* penguins of 3701 g and *Chinstrap* penguins of 3733 g.

The figure below shows that *Gentoo* penguins have the highest body mass.

```
ggplot(penguins, aes(x = body_mass_g, fill = species)) +
  geom_histogram(alpha = 0.6) +
   scale_fill_manual(values = c("darkorange", "purple", "cyan4")) +
  theme_minimal()
```

There is a positive relationship between bill length and bill depth for all 3 species, as the figure below shows.

```
ggplot(
  data = penguins,
  aes(
    x = bill_length_mm,
    y = bill_depth_mm,
    color = species,
    shape = species
  )
) +
  geom_point(size = 3, alpha = 0.8) +
  geom_smooth(method = "lm", se = FALSE) +
  scale_color_manual(values = c("darkorange", "purple", "cyan4")) +
  theme_minimal()
```

[1] paper available here.

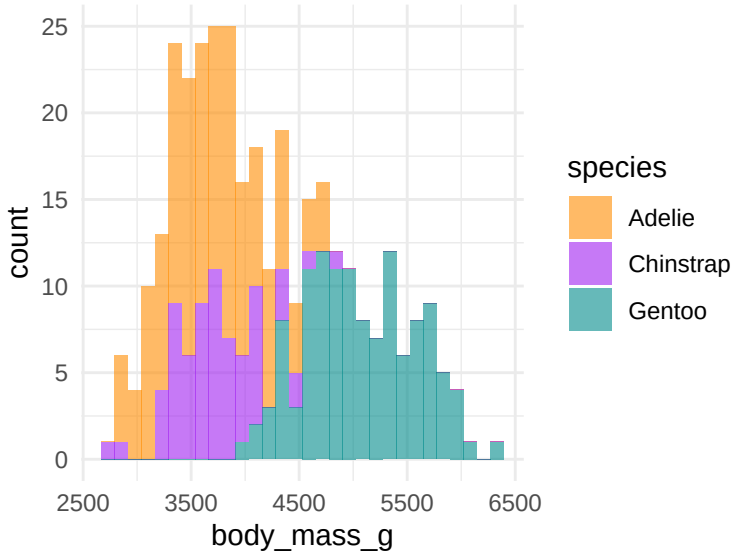

Figure 2: Histogram of weight of the three penguin species.

In general, it looks like the body characteristics differ between the sexes but also between the penguin species, as the table below illustrates:

```
penguins_sum <- penguins %>%
  filter(!(is.na(sex))) %>%
  group_by(species, sex) %>%
  summarize(
    bill_length = mean(bill_length_mm, na.rm = TRUE),
    bill_depth = mean(bill_depth_mm, na.rm = TRUE),
    flipper_length = mean(flipper_length_mm, na.rm = TRUE),
    body_mass = mean(body_mass_g, na.rm = TRUE)
  )
```

```
penguins_sum %>%
  kable(
    digits = 1,
    col.names = c("Species", "Sex", "Bill length", "Bill depth", "Flipper length", "Body mass"),
    caption = "Mean penguin variables with `kable` and `kableExtra`",
    align = "c",
    booktabs = TRUE
  ) %>%
  kable_styling(
    latex_options = c("striped", "hold_position"),
    bootstrap_options = c("striped", "hover"),
    full_width = FALSE,
    position = "center"
  )
```

Mean penguin variables with `kable` and `kableExtra`

Species

Sex

Bill length

Bill depth

Flipper length

Body mass

Adelie

female

37.3

17.6

187.8

3368.8

Adelie

male

40.4

19.1

192.4

4043.5

Chinstrap

female

46.6

17.6

191.7

3527.2

Chinstrap

male

51.1

19.3

199.9

3939.0

Gentoo

female

45.6

14.2

212.7

4679.7

Gentoo

male

49.5

15.7

221.5

5484.8

```
penguins_sum %>%
  arrange(sex) %>%
  select(-sex) %>%
  kable(
    digits = 1,
    col.names = c("Species", "Bill length", "Bill depth", "Flipper length", "Body mass"),
    caption = "Mean penguin variables with `kable` and `kableExtra` and packed rows",
    align = "c",
    booktabs = TRUE
  ) %>%
  pack_rows("female", 1, 3) %>%
  pack_rows("male", 4, 6) %>%
  kable_styling(
    latex_options = c("striped", "hold_position"),
    bootstrap_options = c("striped", "hover"),
    full_width = FALSE,
    position = "center"
  )
```

Mean penguin variables with `kable` and `kableExtra` and packed rows

Species

Bill length

Bill depth

Flipper length

Body mass

female

Adelie

37.3

17.6

187.8

3368.8

Chinstrap

46.6

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References

Allaire, JJ, Yihui Xie, Jonathan McPherson, Javier Luraschi, Kevin Ushey, Aron Atkins, Hadley Wickham, Joe Cheng, Winston Chang, and Richard Iannone. 2021. *Rmarkdown: Dynamic Documents for r*. https://github.com/rstudio/rmarkdown.

Gorman, Kristen B., Tony D. Williams, and William R. Fraser. 2014. "Ecological Sexual Dimorphism and Environmental Variability Within a Community of Antarctic Penguins (Genus Pygoscelis)." Edited by André Chiaradia. *PLoS ONE* 9 (3): e90081. https://doi.org/10.1371/journal.pone.0090081.

Horst, Allison Marie, Alison Presmanes Hill, and Kristen B Gorman. 2020. *Palmerpenguins: Palmer Archipelago (Antarctica) Penguin Data*. https://doi.org/10.5281/zenodo.3960218.

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