Analysis on Physical Characteristics of Penguins in the Palmer Archipelago

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Introduction

Goal:

- To explore the Palmer Penguins dataset to better understand the differences in physical traits between penguin species.
  - To identify patterns between penguins
  - Species differences
  - Relationships between body size variables

- Understanding these traits can help explain how environmental conditions and biological factors may influence species variation and survival.

Research Questions

1. How do body size measurements vary between penguin species? Are certain species consistently larger in one or more measurements such as body mass or flipper length?

2. How do bill length and bill depth interact to help differentiate penguin species? Can these measurements be used to identify species differences effectively?

3. Is there a relationship between flipper length and body mass across species? Do larger flippers indicate heavier penguins, and does this relationship differ by species?

4. How does sex influence body size? Are male penguins consistently larger than female penguins across all species, and does this vary in strength across different species?

5. Does the island a penguins inhabits affect its body measurements? Are physical differences across islands still present even after accounting for species?

6. Which variable (bill length, bill depth, flipper length, or body mass) provides the strongest prediction of species classification? How do combines variables compare to single-variable predication?

Data

https://allisonhorst.github.io/palmerpenguins/

- The Palmer Penguins dataset used in this project comes from the {palmerpenguins} R package,
  - Cleaned and publicly accessible ecological data collected by Dr. Kristen Gorman at the Palmer Station, Antarctica.
  - The package includes two CSV-style data frames:
    - penguins
    - penguins_raw.
  - The dataset contains 344 rows and 8 variables, covering a range of physical traits and demographic attributes for each sampled penguin.
  - This dataset includes measurements collected on three penguins species in the Palmer Archipelago in Antarctica sampled across three islands (Biscoe, Dream, and Torgersen) during the 2007-2009 field seasons
    - Adelie
    - Gentoo
    - Chinstrap

```
penguins_clean <- penguins |>
  drop_na()

# Check dimensions before/after
dim(penguins)
```

```
## [1] 344   8
```

```
dim(penguins_clean)
```

```
## [1] 333   8
```

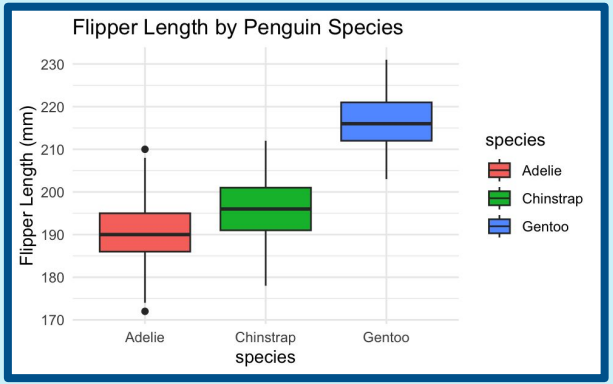
Cleaning data

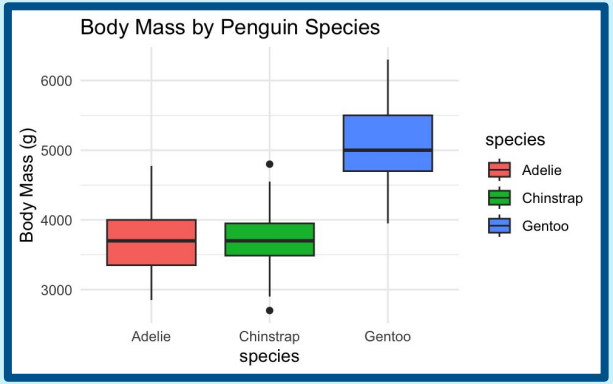
Variables

https://allisonhorst.github.io/palmerpenguins/

- ***species:*** the biological species of each penguin (Adelie, Gentoo, and Chinstrap)
- ***island:*** The island within the Palmer Archipelago where the penguin was observed (Biscoe, Dream, and Torgersen)
- ***bill_length_mm:*** The length of the penguin's bill (from tip to base) measured in millimeters
- ***bill_depth_mm:*** Thickness (depth) fo the penguin's bill measured at the base in millimeters
- ***flipper_length_mm:*** Length of the penguin's flipper from shoulder to tip measured in millimeters
- ***body_mass_g:*** Body weight of the penguin measured in grams
- ***sex:*** Sex of the penguin (male or female)
- ***year:*** The year the penguin was sampled during the Palmer Station field seasons (2007, 2008, 2009)

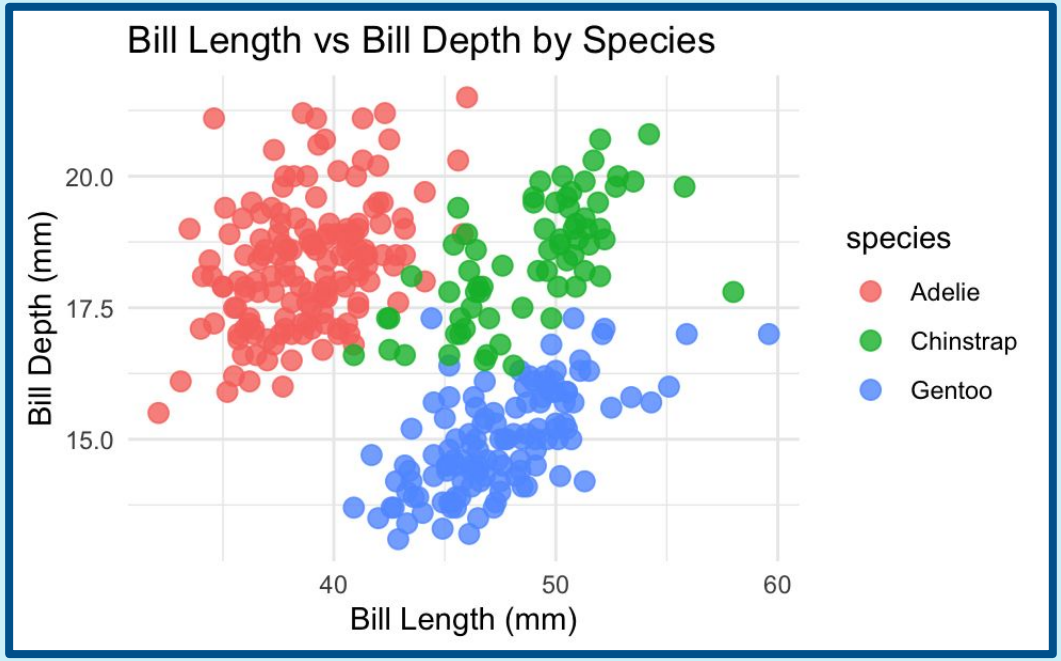
How do body size measurements vary between penguin species? Are certain species consistently larger in one or more measurements such as body mass or flipper length?



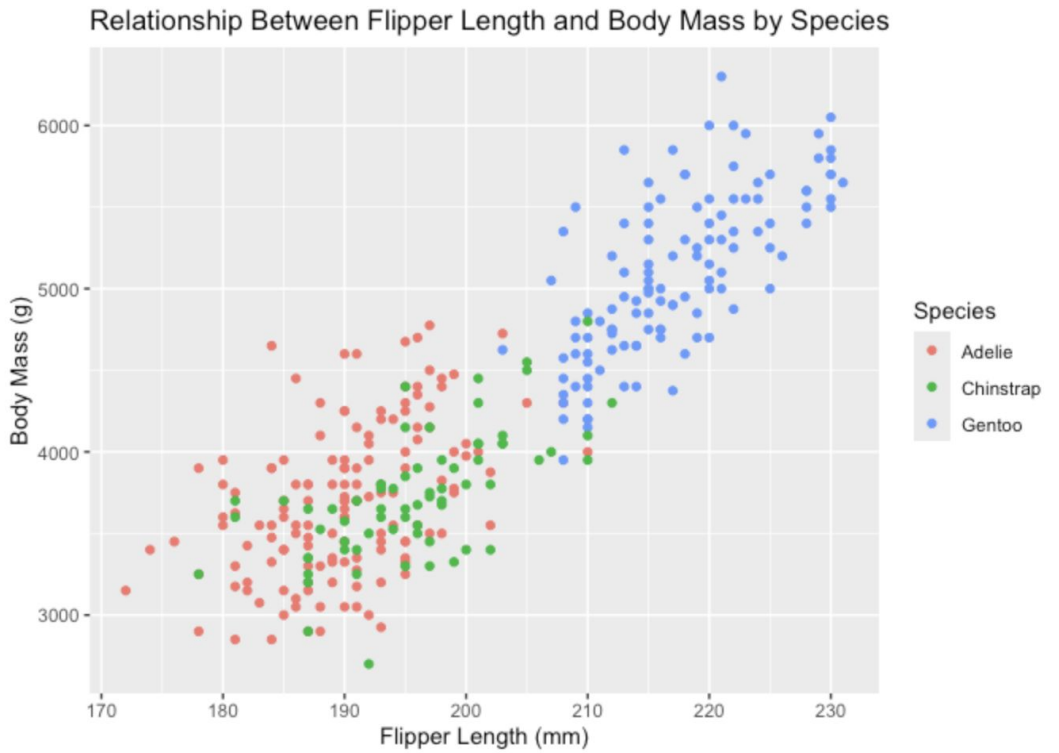


species <fctr>	mean_mass <dbl>	mean_flipper <dbl>
Adelie	3700.662	189.9536
Chinstrap	3733.088	195.8235
Gentoo	5076.016	217.1870

How do bill length and bill depth interact to help differentiate penguin species? Can these measurements be used to identify species differences effectively?



Is there a relationship between flipper length and body mass across species? Do larger flippers indicate heavier penguins, and does this relationship differ by species?




```
## # A tibble: 3 × 2
##   species   correlation
##   <fct>           <dbl>
## 1 Adelie          0.465
## 2 Chinstrap       0.642
## 3 Gentoo          0.711
```

Correlation Analysis

Is there a relationship between flipper length and body mass across species? Do larger flippers indicate heavier penguins, and does this relationship differ by species? *(CONT.)*

The average body mass for groups of flipper lengths

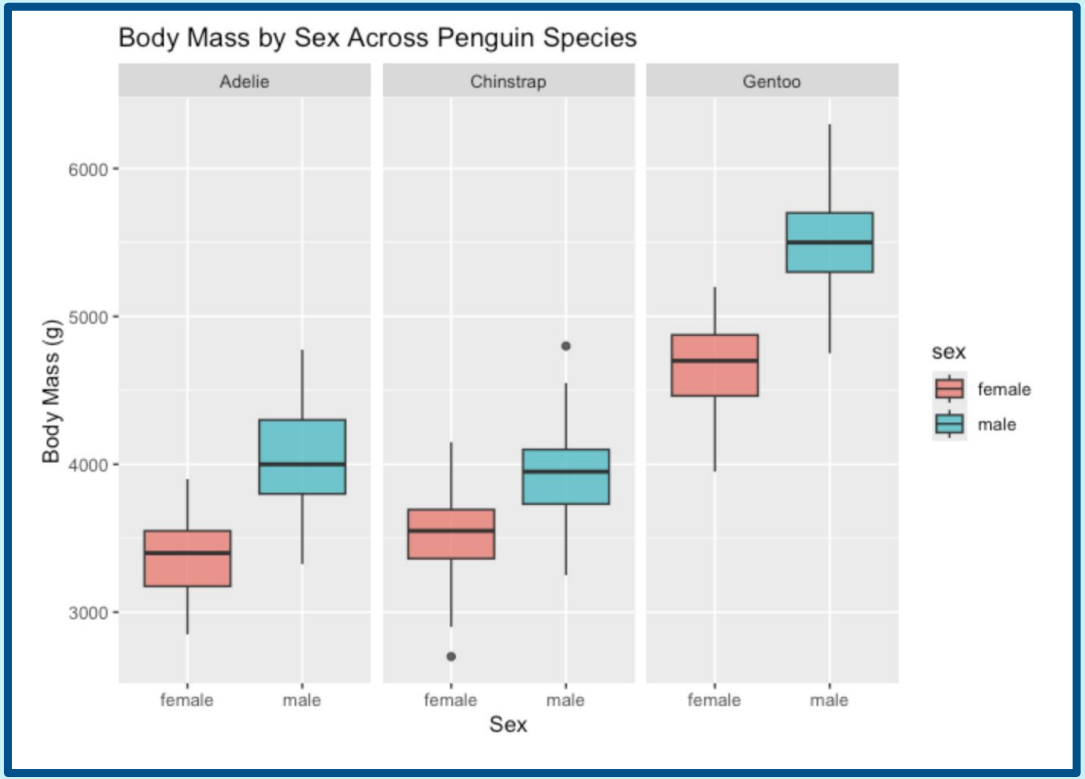
```
##           (172,187] (187,202] (202,216] (216,231]
## Adelie     3487.805  3771.212  4125.000        NA
## Chinstrap  3562.500  3648.039  4119.231        NA
## Gentoo           NA        NA  4798.361  5401.724
```

```
## $Adelie
## [1] 2850 4775
##
## $Chinstrap
## [1] 2700 4800
##
## $Gentoo
## [1] 3950 6300
```

Maximum & Minimum body mass

```
## $Adelie
## [1] 172 210
##
## $Chinstrap
## [1] 178 212
##
## $Gentoo
## [1] 203 231
```

How does sex influence body size? Are male penguins consistently larger than female penguins across all species, and does this vary in strength across different species?



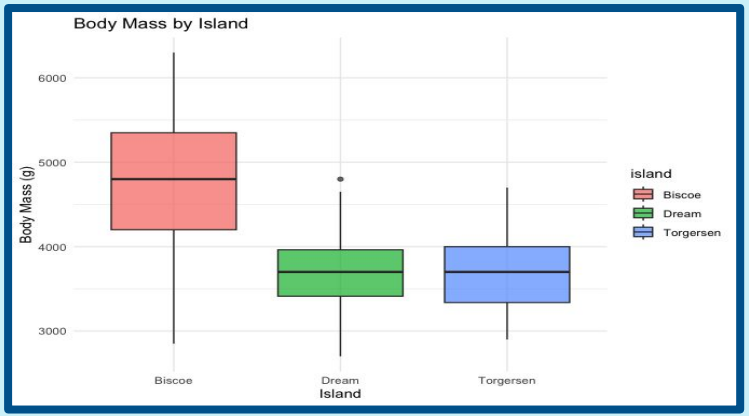
species <fctr>	sex <fctr>	mean_mass <dbl>
Adelie	female	3368.836
Adelie	male	4043.493
Chinstrap	female	3527.206
Chinstrap	male	3938.971
Gentoo	female	4679.741
Gentoo	male	5484.836

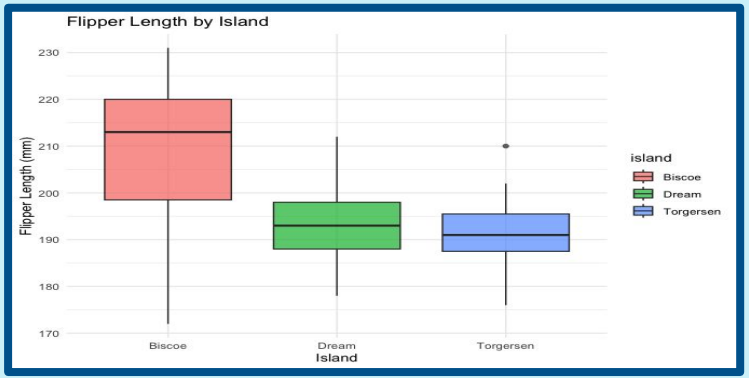
Summary Table

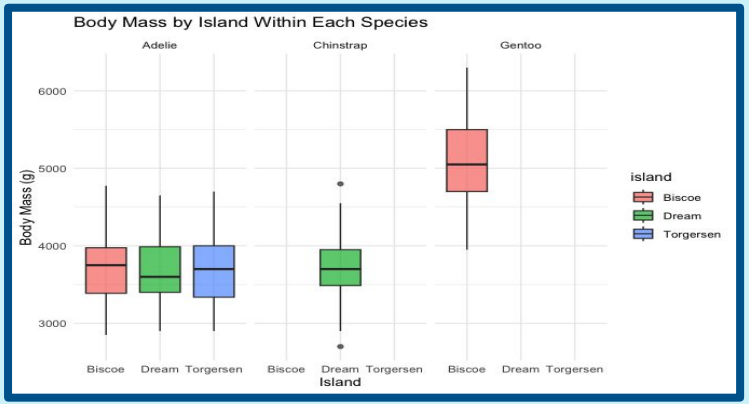
	female	male
Adelie	269.3801	346.8116
Chinstrap	285.3339	362.1376
Gentoo	281.5783	313.1586

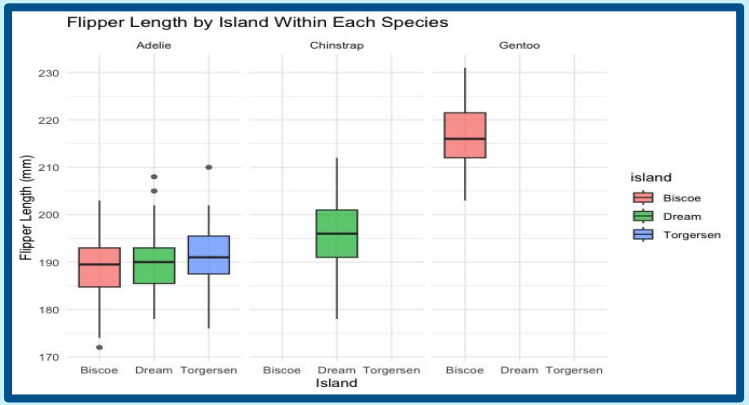
Standard Deviations

Does the island a penguins inhabits affect its body measurements? Are physical differences across islands still present even after accounting for species?

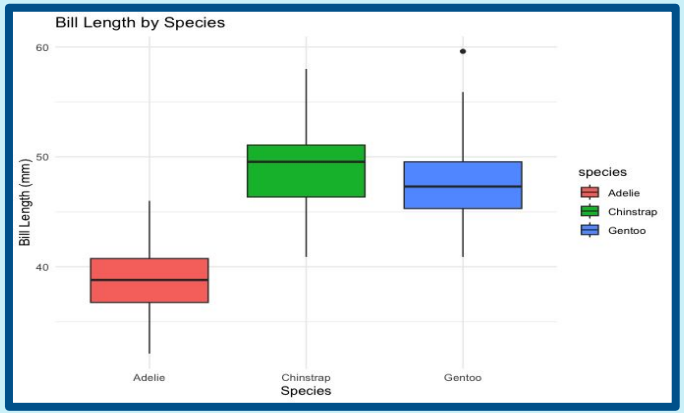


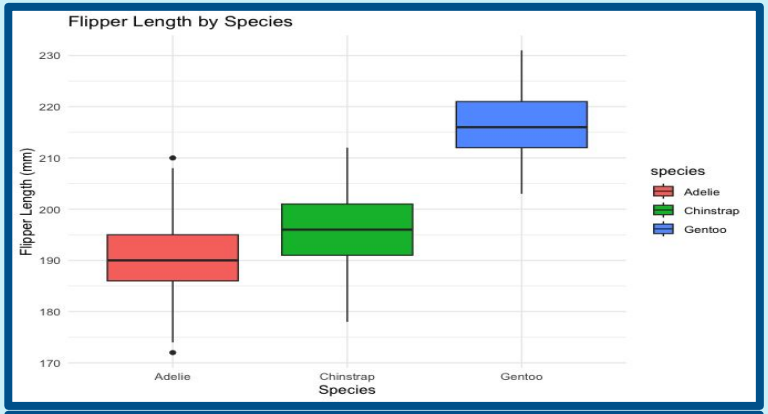


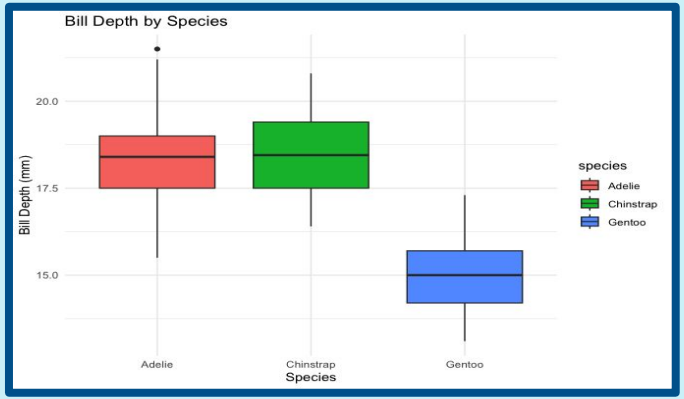


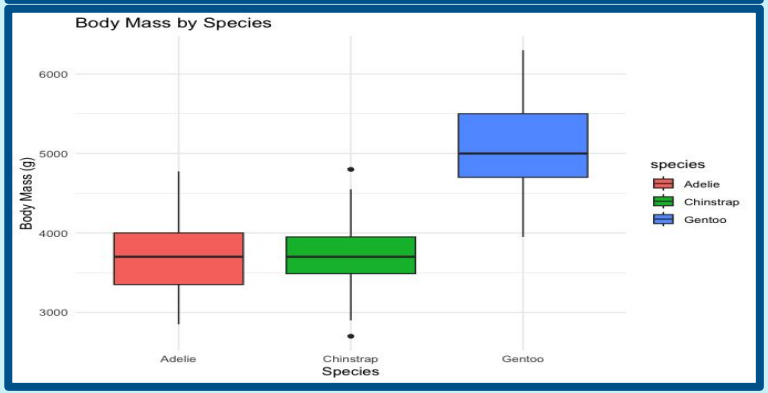


Which variable (bill length, bill depth, flipper length, or body mass) provides the strongest prediction of species classification? How do combined variables compare to single-variable prediction?









Conclusion

- Our analysis of the Palmer Penguins dataset successfully met the goals outlined in our introduction. Species differences emerged as the strongest influence on body size, while island location had only minor impact.

  - Gentoo penguins are generally the largest, Adelie and Chinstrap smaller
    Males tend to be slightly larger than females
  - Using multiple measurements improves species classification

- Further research could explore diet, temperature, or nesting conditions to understand physical differences and survival

Questions?