Practice Manuscript - Data Analysis Project 2

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# 1. Summary/Abstract

Investigating which penguins have more complete clutches (observed as having 2 eggs in their nest).

# 2. Introduction

## 2.1 General Background Information

I assume having a complete clutch means that indiviual has higher reproductive fitness. We can see which variables (mass, species) are associated with this fitness.

## 2.2 Description of data and data source

Here we describe an analysis of the Palmer Penguins dataset (Horst et al. 2020), which contains data on three species of penguins from the Palmer Archipelago, Antarctica. 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 (Gorman 2014).

## 2.3 Questions/Hypotheses to be addressed

Our research questions are:

1. Is body mass (g) associated with clutch completion?
2. Is species associated with clutch completion?
3. Is body mass(g) associated with species?
4. Within species, how is body mass (g) associated with clutch completion?

# 3. Methods

We cleaned the dataset which had typos, made exploratory plots, and made a summary table. Then I made figures for each of our questions and tested patterns with ttest and ANOVA.

## 3.1 Data acquisition

Data came from the preloaded palmerpenguins dataset on base R (Horst et al. 2020). It was cleaned using this script <https://github.com/arfisher/Allison-Rclass-Project/blob/065fc1b7823d1bc0150e8751f6a50cc06f3550ef/Code/Processing_code/project1.qmd>.

## 3.2 Statistical analysis

Welch two sample t-test was used to compare body mass (g) between individuals with completed or non completed clutches. Two one-way ANOVAs were used to see if 1) clutch completion differs between species and 2) body mass differs between species.

# 4. Results

## 4.1 Exploratory/Descriptive analysis

[Table 1](#tbl-summary_table) shows a summary of the data.

Table 1: Data summary table.

| Variable | N | Mean | SE | Counts |
| --- | --- | --- | --- | --- |
| Region | 339 |  |  |  |
| Individual ID | 339 |  |  |  |
| Clutch Completion | 339 |  |  |  |
| Date Egg | 339 |  |  |  |
| Comments | 52 |  |  |  |
| Species | 339 |  |  | Ade: 151, Gen: 120, Chi: 68 |
| Island | 339 |  |  | Bis: 164, Dre: 124, Tor: 51 |
| Sex | 330 |  |  | MAL: 168, FEM: 162 |
| Sample Number | 339 | 63.13 | 2.19 |  |
| Culmen Length (mm) | 339 | 43.90 | 0.30 |  |
| Culmen Depth (mm) | 339 | 17.17 | 0.11 |  |
| Flipper Length (mm) | 339 | 200.79 | 0.76 |  |
| Body Mass (g) | 339 | 4196.17 | 43.62 |  |
| Delta 15 N (o/oo) | 327 | 8.74 | 0.03 |  |
| Delta 13 C (o/oo) | 328 | -25.68 | 0.04 |  |

## 4.2 Size on Clutch Completion

Analysis of size by clutch completion and species.

We found that those with complete clutches substantially larger than those without ([Figure 1](#fig-mass_clutch_bars), t-test P-value < 0.05 ).

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| Figure 1: Body mass distributions of Clutch Completion categories. |

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| Figure 2: Body mass distributions of Clutch Completion categories. |

We found that Gentoos have the highest number of complete clutches, followed by Adelie and Chinstrap with the lowest ([Figure 3](#fig-species_clutch_bars), ANOVA P-value < 0.005 ).

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| Figure 3: Proportion of clutch completion of the three species of penguin. |

Table 2: Differences in clutch completion by species.

|  | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
| --- | --- | --- | --- | --- | --- |
| Species | 2 | 0.98 | 0.49 | 5.39 | 0 |
| Residuals | 336 | 30.41 | 0.09 |  |  |

We found that Gentoos have the largest body size, followed by Adelie and Chinstrap at about the same size. ([Figure 4](#fig-mass_species_bars), ANOVA P-value < 0.0001 ).

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| Figure 4: Body mass distributions of the three species of penguin. |

Table 3: Differences in mass (g) by species.

|  | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
| --- | --- | --- | --- | --- | --- |
| Species | 2 | 145838050 | 72919025.2 | 339.27 | 0 |
| Residuals | 336 | 72215714 | 214927.7 |  |  |

We found that among Chinstrap and Gentoos, those with complete clutches fall on the higher end of the body size distribution. In Adelies, those with complete clutches fall in the middle of the range with larger and smaller indiviuals having fewer complete clutches.

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| Figure 5: Density of Clutch Completion across body mass within species. |

# 5. Discussion

## 5.1 Summary and Interpretation

We found that penguins with complete clutches tend to be larger. We also found Gentoos have more clutch completion than other species. Further investigation shows these findings may be confounded as Gentoos have larger body size in general. When looking at the species separately, we found that the actual range of body size for successful clutch completion is different across species.

## 5.2 Strengths and Limitations

There are surely other factors which influence clutch completion like age, resource availability, and life history traits.

## 5.3 Conclusions

We showed that we cannot generalize likelihood to have a complete clutch by body size or species alone because there are interactions between these traits.

# 6. References

Gorman, T. D. A. F., Kristen B. AND Williams. 2014. [Ecological sexual dimorphism and environmental variability within a community of antarctic penguins (genus pygoscelis)](https://doi.org/10.1371/journal.pone.0090081). PLOS ONE 9:1–14. Public Library of Science.

Horst, A. M., A. P. Hill, and K. B. Gorman. 2020. [Palmerpenguins: Palmer archipelago (antarctica) penguin data](https://doi.org/10.5281/zenodo.3960218).