Analysis Steps and Results

1. Based on the graphical analysis, Gentoo penguins appear to be heavier than others. Also, penguins living on the island of Biscoe appear to be heavier than others. The objective of the analysis is to show whether these differences are statistically significant. In other words, we will attempt to see if the body mass of the penguins is a function of the type of their species, their habitat, or both.

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1. First, we tested how body mass changes among three species with the one-way ANOVA test. The null hypothesis is that there is no difference in body mass among the 3 penguin species. The alternative hypothesis is that there is a difference in body mass among the 3 penguin species.

With the p-value significantly low (p < 0.001), there appears to be a difference between group means.

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1. Second, we added another independent variable to the model to see if the body mass is influenced by the island where the penguins live.

The p-value for the variable island is high (p=0.995), which means that not a lot of variation in body mass can be explained by the island where penguins live.

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1. Next, we verified the assumptions of ANOVA.

There are 3 assumptions: observations are independent, errors are normally distributed, and all groups have equal error variances.

We assume a good data collection design, which ensures the independence of observations.

We test the assumption of normally distributed errors with the quantile-quantile plot. The data values stay close to the diagonal reference line and support the assumption. Another way to check the normality assumption is to draw a plot of residuals. It is approximately bell-shaped.

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We test the homogeneity of variances assumption with the Bartlett test. Since the p-value is higher than the 0.05 cut-off, we fail to reject the hypothesis that the variance is the same for all groups.

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1. We see that there appear to be differences in body mass among penguins of different species, but we don’t know what species. To answer that question, we conducted Tukey’s Honestly Significant Difference (Tukey’s HSD) posthoc test for pairwise comparisons.

There are statistically significant differences (p < 0.05) between Gentoo and Adelie and between Gentoo and Chinstrap, but the difference between Chinstrap and Adelie is not statistically significant. The same can be seen from the visual representation of the Tukey HSD test. There are significant groupwise differences where the 95% confidence interval doesn’t include zero.

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Results

We found a statistically significant difference in the average weight of penguins by species. Thus, Gentoo penguins are much heavier than Adelie or Chinstrap penguins.

There is no statistically significant difference in the average weight of penguins by the island where they live.