HW

4.3, 4.10, 4.17, 4.19, 4.25, 4.27, 4.31

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4.3

Removing the zeros from the dataset would completely alter the data and therefore change the results (especially when there are so many zeros). Either a small value should be added to all the observations if a log transformation is still desired, or a different method should be used.

4.10

The cutoff of $p = 0.05$ is essentially arbitrary; there's no intrinsic reason that a 5% chance of something happening is significant while a 6% chance is not. In this case, the two *p*-values are so similar that they tell the same story: there is around a 5% chance that these results would occur due to pure randomness if the null hypothesis were true. As such, it's better to report and discuss the *p*-value itself rather than a simple "yes/no" of significance.

4.17

The number of O-ring incidents based on temperature is given as follows:

Launch temperature	Number of incidents
Below 65F	1 1 1 2
Above 65F	1 1 3 0 (x17)

A *t*-test of these values (assuming equal variance) yields a *t*-statistic of 2.643. According to the following table:

# of arrangements	t-statistic
2380	-1.188
3400	-0.463
2040	0.231
1530	0.939
855	1.716
316	2.643
95	3.888
10	5.952

there are $316 + 95 + 10 = 421$ arrangements with *t*-statistics of 2.643 or greater, out of a total $10,626$ arrangements. This gives a one-sided *p*-value of $\frac{421}{10,626} = 0.04$.

4.19

I will answer parts **(b)** and **(c)** first. The `wilcox.test` function in R allows for computing either an exact *p*-value or one based on the normal approximation. If using the approximate value, continuity correction is optional. In my case, I will compute the approximate *p*-value with continuity correction.

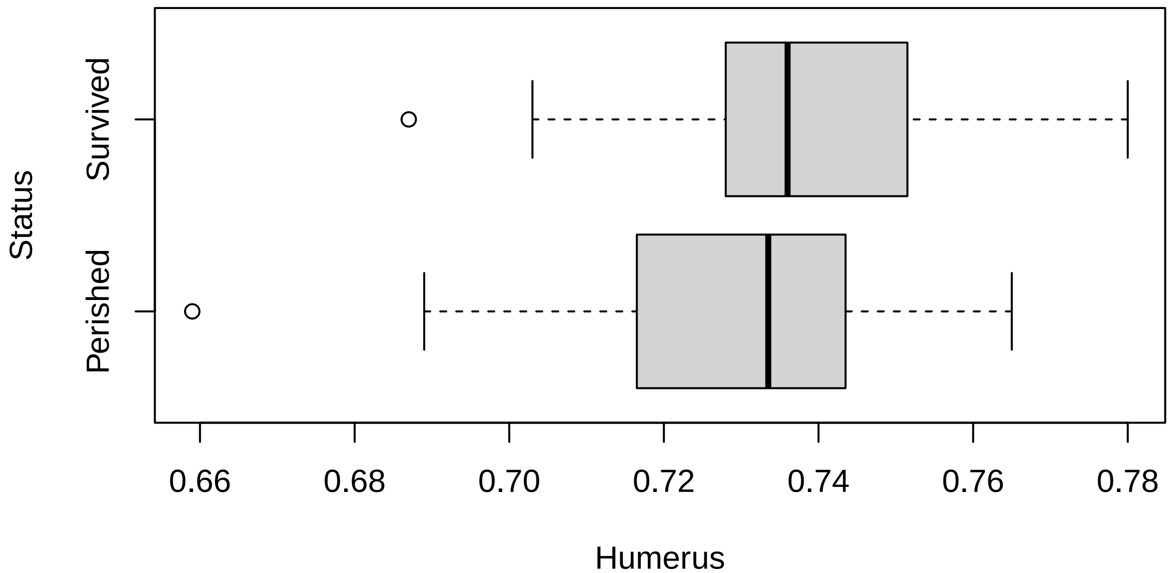


Figure 1: Humerus length of sparrows.

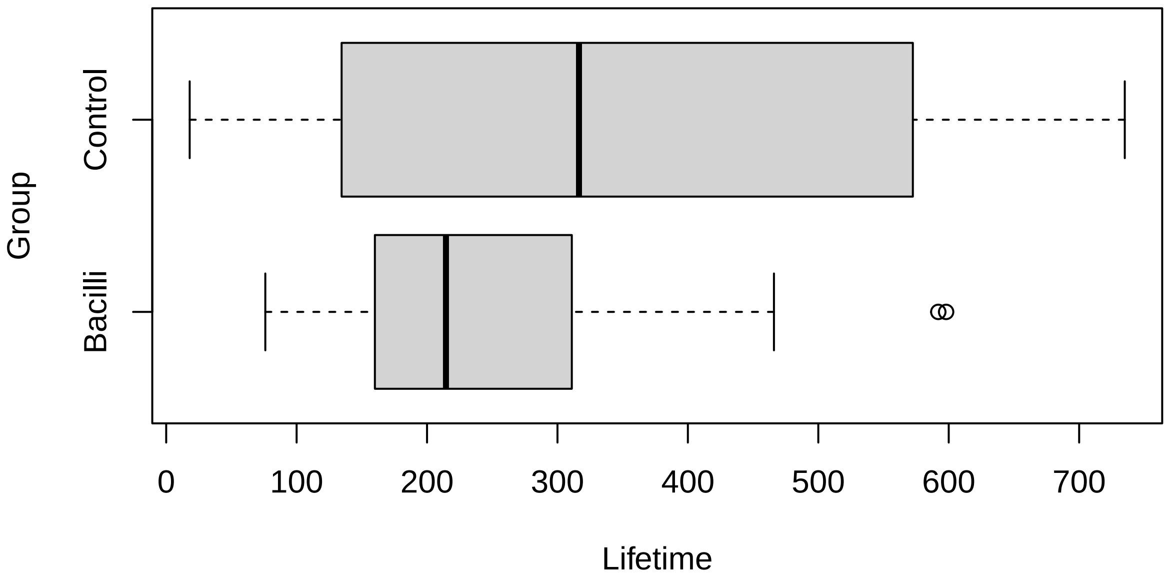
A boxplot of the data is given in Figure 1. A table comparing the *p*-values of the rank-sum test, the two-sample *t*-test, and the *t*-test with the smallest observation removed is shown below:

	Rank-sum	t-test	t-test (w/o smallest observation)
p-value	0.172	0.081	0.18

The *p*-value of the rank-sum test is nearly identical to that of the *t*-test with the smallest outlier removed. When there are outliers such as this, the rank-sum test deals with them handily, and the *t*-test requires a decision regarding any outliers. Both can give helpful results, but the *t*-test requires more verification of the data.

4.25

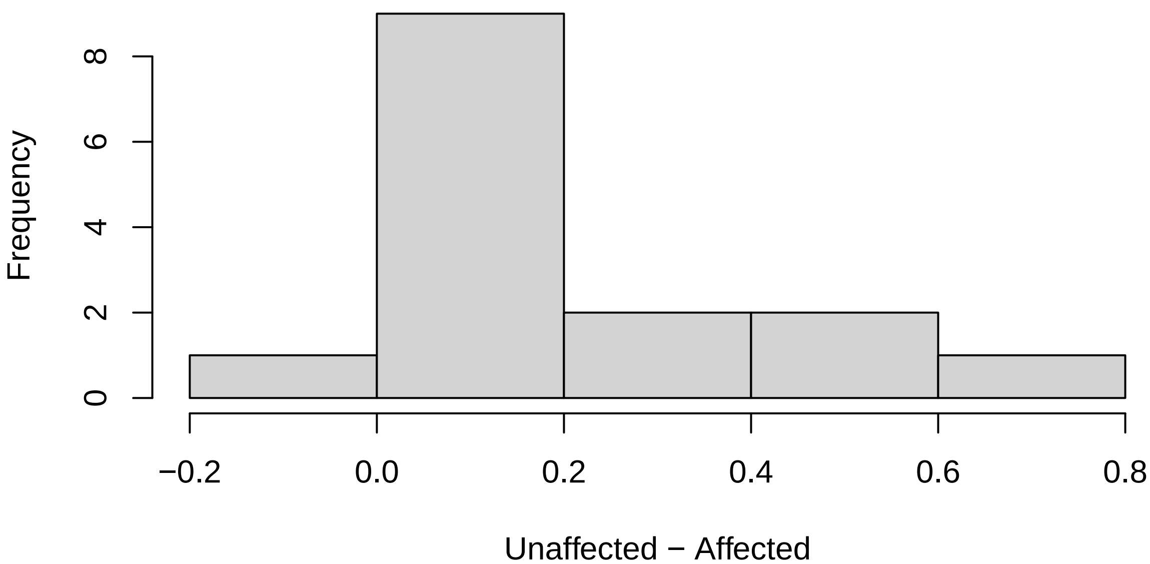
A boxplot of the data:



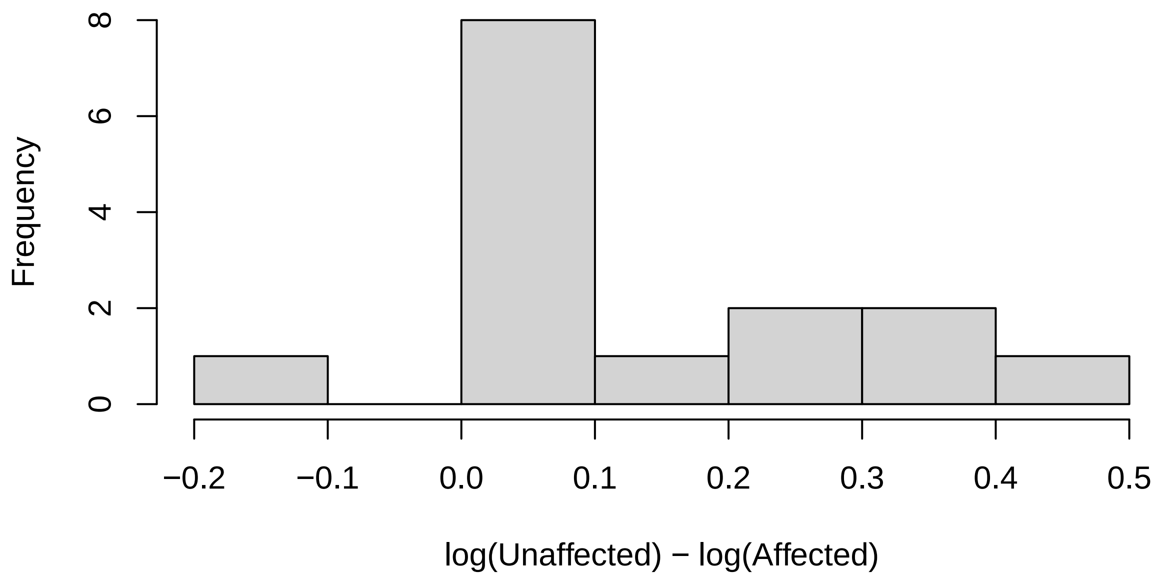
The Welch t-test gives a two-sided p-value of 0.002, and a confidence interval of $-165.807 < \mu_{\text{bacilli}} - \mu_{\text{control}} < -39.593$. The additive model is not ideal, as there is only one treatment, and the groups are delineated based on whether or not they received the treatment.

4.27

A histogram of the differences in hippocampus volumes:



And of the differences of the log-transformed data:



The signed-rank test of the difference in log values gives a p-value of 0.002, and the untransformed data gives 0.002.

Based on the histograms, neither distribution is particularly normal, though the log-transformed data has a less normal distribution than the untransformed data. The rank test would therefore be more useful on the log-transformed data.