

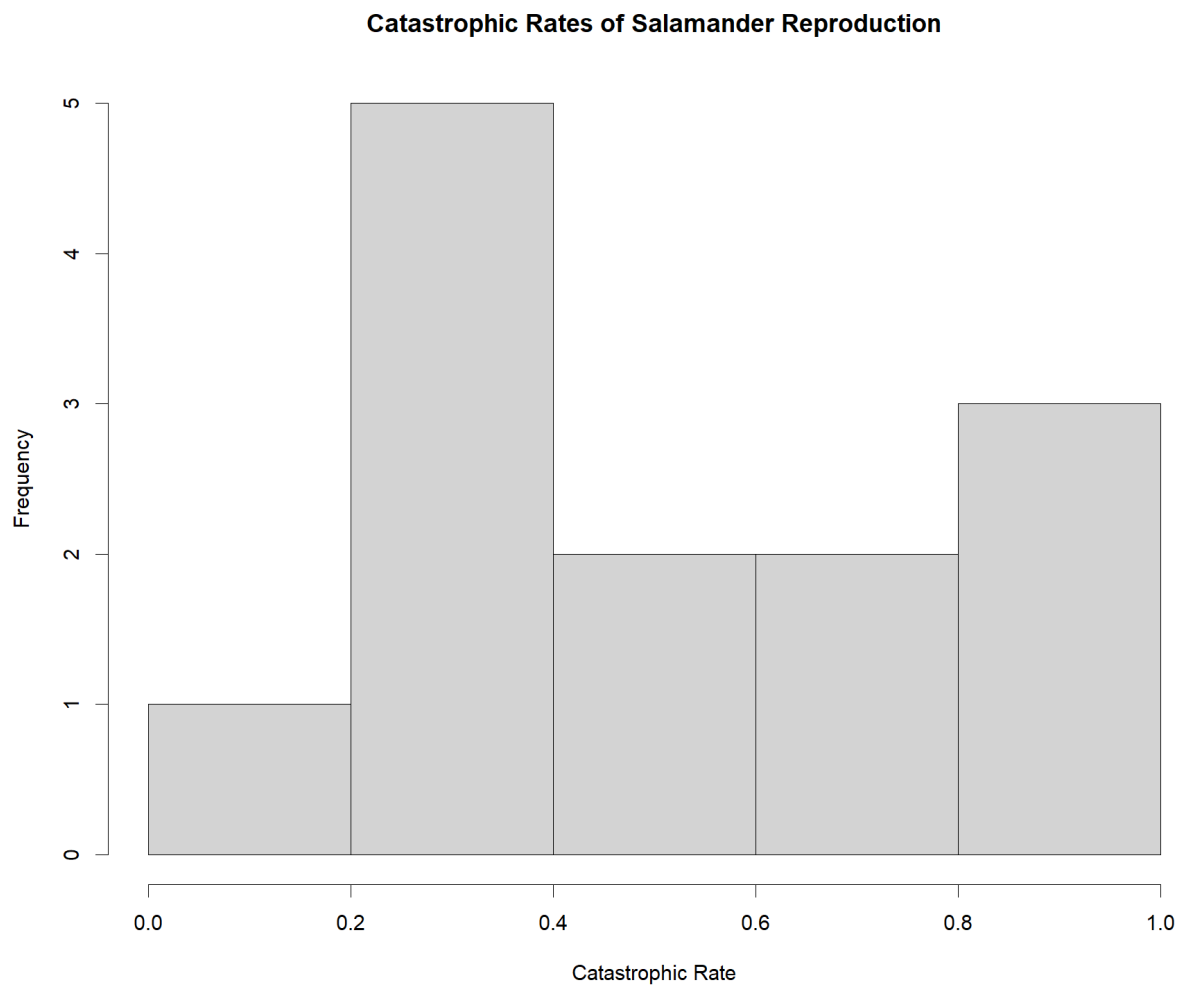
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ECo 602 : Using Models 1 (Individual Lecture Assignment)

11/2/2021

Q1. Catastrophic Rate Histogram

```
hist(catrate$cat.rate,  
     main = "Catastrophic Rates of Salamander Reproduction",  
     xlab = "Catastrophic Rate")
```



Q2. Conduct a Shapiro-Wilk test of normality of the salamander catastrophic rates. Report the p-value and show the R-code you used to conduct the test.

```
shapiro.test(catrate$cat.rate)
```

```
>Shapiro-Wilk normality test:
```

```
>data: catrate$cat.rate
```

```
>W = 0.86202, p-value = 0.04097
```

Q3. What is the null hypothesis for the Shapiro test?

The null hypothesis for the Shapiro test is that the data follows a normal distribution. The Shapiro test outputs a p-value that signifies whether or not this null hypothesis can be supported, and that the data are normally distributed.

Q4. Based on the Shapiro test results, is there strong evidence that the sample came from a non-normally-distributed population?

The output of the Shapiro test on cat.rate provides strong evidence that the cat.rate does NOT follow a normal distribution. Therefore, yes, it provides strong evidence that the sample came from a non-normally distributed population. If the value of p from a Shapiro test is equal to or less than 0.05 (which it is), then we can reject the hypothesis of normality. The cat.rate data likely does NOT follow a normal distribution.

T-test 1

Conduct a one-sample t-test of the alternative hypothesis that the catastrophic rate is different from the pond late-filling rate. Review the assignment walkthrough if needed.

Q5. Show the code you used to conduct the t-test.

```
t.test(catrate$cat.rate, mu = 2/7)
```

```
>One Sample t-test
```

```
data: catrate$cat.rate
```

```
t = 2.9595, df = 12, p-value = 0.01193
```

```
alternative hypothesis: true mean is not equal to 0.2857143
```

```
95 percent confidence interval:
```

```
0.3526250      0.7261295
```

```
sample estimates:
```

mean of x

0.5393773

Q6. State the null hypothesis of the test, in plain nontechnical English.

The null hypothesis is that the mean of population from which the data were collected is not different from $\mu = 2/7$ or 0.28 in this case. We get that μ value from the late-filling rate. The default value of μ is 0 for the null hypothesis.

Q7. Is this a one or two-tailed test?

Two-tailed (but one sample) – because we are not specifying the cat.rate be greater than or less than a particular value, the $\mu = 2/7$ (0.28), just that the mean cat.rate is different than $2/7$ late-filling rate.

T-test 2

Interpret the results of your one-sample t-test of the alternative hypothesis that the catastrophic rate is different from the pond late-filling rate.

Q8. What is the p-value from your t-test? Interpret the p-value as a *false-positive rate* using nontechnical English that a non-scientist would understand.

P-value = 0.01193. This p-value is less than the cut-off value, normally 0.05. A false positive is when you get a significant difference in your cat.rate sample where, in reality in the population, none exists. Basically, the p-value represents the chance that your data could occur given no difference in the cat.rate sample compared to the pond late-filling rate actually exists.

Q9. What is the confidence interval for the difference between the null hypothesis and alternative hypothesis means? Did it include zero?

95 percent confidence interval: **0.3526250 - 0.7261295**. No, it does not include 0.

The sample mean is estimated at 0.5393773, which is NOT equal to the $2/7$ (0.28) pond late-filling rate.

Q10. Considering the results from your t-test, did you conclude that there was strong evidence to reject the null hypothesis? Make sure you justify your answer using the output of the t-test.

I concluded that there is strong evidence to reject the null hypothesis, based on the p-value of 0.01 resulting from the T-test of cat.rate compared to the pond late-filling rate. The null hypothesis would be that there is no difference in the observed sample cat.rate and the pond late-filling rate. In this case, the low p-value allows us to reject that null hypothesis. The estimated mean of cat.rate is also 0.54, which is definitely different than the 0.28 late-filling rate. However, given the small sample size, I would say it is possible that we are falsely rejecting the null hypothesis.

Wilcoxon Test 1

Conduct a one-sample Wilcoxon rank sum test of the alternative hypothesis that the catastrophic rate is different from the pond late-filling rate.

Q11. Show the code you used to conduct the test.

```
wilcox.test(catrate$cat.rate, mu = 2 / 7)
```

Q12. Compare the p-value with the p-value you got from the t-test.

Wilcoxon signed rank test with continuity correction

data: catrate\$cat.rate

V = 85, p-value = 0.006275

alternative hypothesis: true location is not equal to 0.2857143

As compared to the t-test results, the Wilcoxon test has a lower p-value of 0.006, whereas the t-test p-value was slightly higher at 0.01. Because of this, the lower p-value gives us stronger evidence to reject the null hypothesis that the observed catastrophic rate is the same as the pond late-filling rate.

Q13. Considering the results from your rank sum test, did you conclude that there was strong evidence to reject the null hypothesis?

Yes the very low p-value of 0.006 gives us very strong evidence to reject the null hypothesis that observed catastrophic salamander reproduction rate is the same as the pond late-filling rate. The p-value is lower than the cut-off value of 0.05. In this case, we could actually assume based on the test results that it is fair to say there is significant difference in the observed catastrophic rate and the late-filling rate of 0.28.

Test Comparison

Consider the one-sample t-test and Wilcoxon rank sum tests that you performed on the catastrophic rate data. Explain your reasoning.

Q14. Compare the overall conclusions you could draw from the results of the two tests.

The conclusions for both tests are the same – that we can reject the null that the catastrophic rates observed are the same as the late-filling rate. The p-values resulting from each test were different however. The p-value of the Wilcoxon test was smaller, giving stronger evidence against the null. Both tests allow us to say that there is significant difference in the rates.

Q15. Considering the numerical and graphical data exploration, which test do you think was more appropriate for these data?

I think in this case, the Wilcoxon test would be more appropriate for this data, since it follows a non-normal distribution. We observe this non-normal distribution based on the Shapiro test conducted prior, as well as just looking at the histogram.

Flippers Normality Tests

Q16. Show the R-code you used to conduct tests of normality for the flipper lengths of Chinstrap and Adelie penguins.

```
# Extract the Adelie and Chinstrap penguin data
dat_adelie = subset(penguin_dat, species == "Adelie")
dat_chinstrap = subset(penguin_dat, species == "Chinstrap")
#conduct normality tests
shapiro.test(dat_adelie$flipper_length_mm)
shapiro.test(dat_chinstrap$flipper_length_mm)
```

Q17. Interpret the test results. Do you conclude that the flipper lengths are normally-distributed for each species? Make sure your answers make reference to the test output.

Shapiro-Wilk normality test

data: dat_adelie\$flipper_length_mm

W = 0.99339, **p-value = 0.72**

Shapiro-Wilk normality test

data: dat_chinstrap\$flipper_length_mm

W = 0.98891, **p-value = 0.8106**

Based on the results of the normality tests, I do conclude that the flipper lengths for both species, Adelie and Chinstrap, are normally-distributed. The Shapiro test null hypothesis is that the data follow a normal distribution. Since we do not have a low p-value that is below the 0.05 significance threshold, then we cannot reject the null. The p-values are relatively much higher than the 0.05 criteria – as Adelie had $p = 0.72$ and Chinstrap had $p = 0.81$. There is strong evidence in favor of the null hypothesis that the data of both species follow a normal distribution.

Flippers – Histograms

Q18. Create a single figure consisting of histograms of flipper lengths of Adelie and Chinstrap penguins. Your figure should have two histograms arranged in one row. Save your figure to a file and include it in your report. Your figure needs to have appropriate dimensions such that the two histograms are not vertically stretched.

```
image_file = "usingmodels1_peng_hist.png"

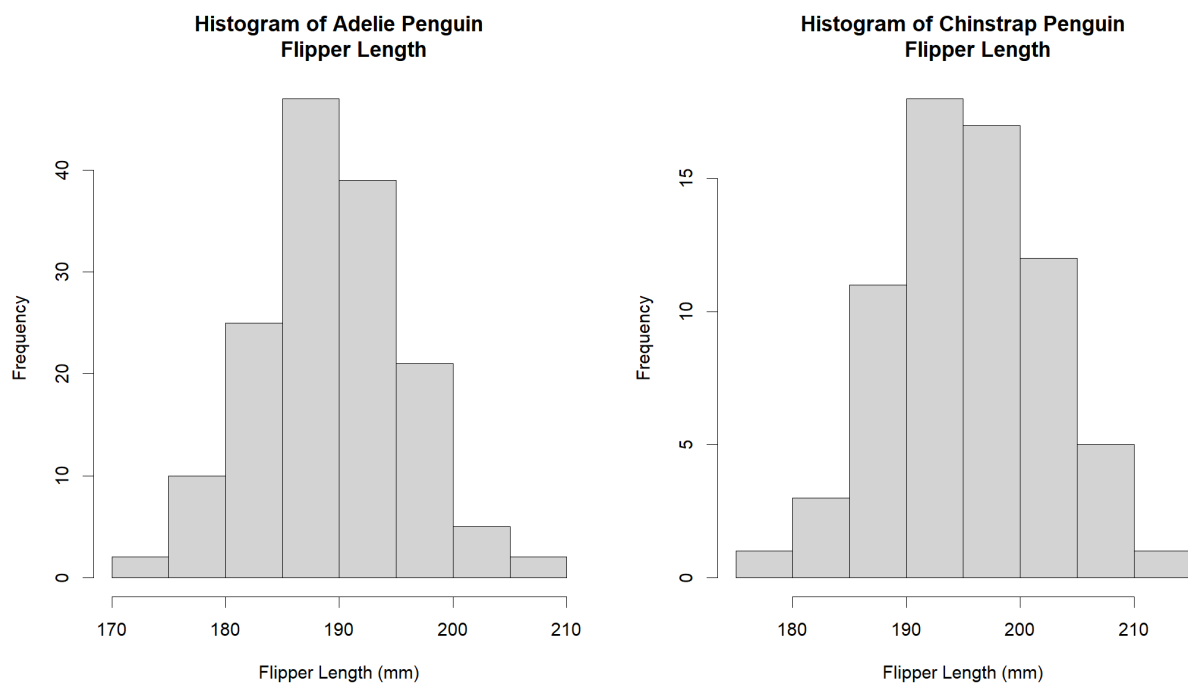
png(here("images", image_file), width = 1900, height = 1200, res = 180)

par(mfrow = c(1, 2))

hist(dat_adelie$flipper_length_mm, main = "Histogram of Adelie Penguin
  Flipper Length", xlab = "Flipper Length (mm)")

hist(dat_chinstrap$flipper_length_mm, main = "Histogram of Chinstrap Penguin
  Flipper Length", xlab = "Flipper Length (mm)")

dev.off()
```



Flippers – T-test

Conduct a two-sample t-test of the alternative hypothesis that the Adelie penguins have different flipper lengths than Chinstrap penguins.

Q19. State the alternative hypothesis of the test, in plain nontechnical English. Consider whether you used a one- or two- tailed test.

The alternative hypothesis of the two-sample t-test is that the Adelie and Chinstrap penguin species have different flipper lengths. We are not stating whether or not Adelie or Chinstrap have bigger flipper lengths, just that they differ. In that case, this is a two-tailed test.

If we wanted to do a one-tailed test, we would check if Adelie, the base level species, has the greater flipper lengths on average. We would have to change the below line of code.

Q20. Include the code you used to conduct the t-test. Hint: your answer should only be a single line of code.

```
t.test(flipper_length_mm ~ species, data = penguin_dat)
```

*I worked independently on this assignment