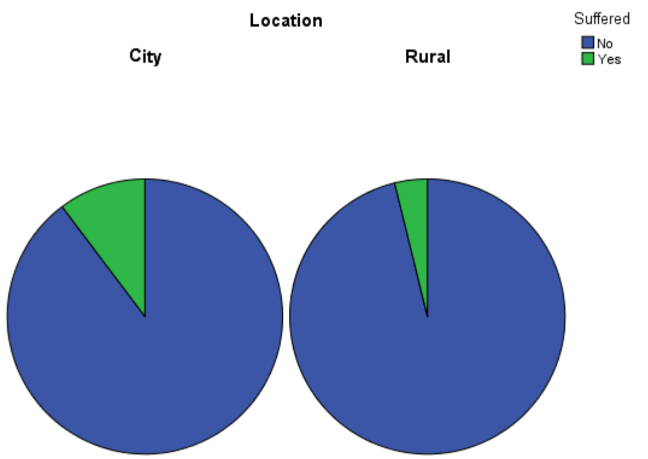
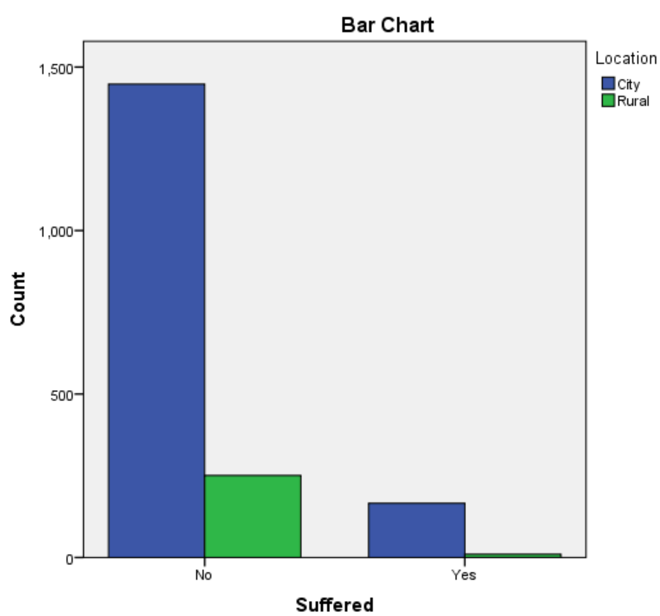
L18: Homework Answer Key

Instructions: You are encouraged to collaborate with other students on the homework, but it is important that you do your own work. Before working with someone else on the assignment, you should attempt each problem on your own.

A study was conducted in Austria to determine if the likelihood that a child will have hay fever (seasonal allergies) is different for children living in rural communities compared to children who live in a city. The researchers surveyed 261 children who lived in rural communities and found that 10 suffered from hay fever. Among the 1614 children who lived in the city, 166 reported that they had hay fever. Use this information to answer questions 1 through 4.

1. Create side-by-side pie charts to illustrate this data.





2. Verify that the requirements are met to create a confidence interval.
   Yes.
   $\boldsymbol{n_1 \cdot \hat{p}_1 \geq 10}$ and $\boldsymbol{n_1 \cdot (1 - \hat{p}_1) \geq 10}$
   $\mathbf{261(0.038) = 10 \geq 10}$ and $\mathbf{261(1 - 0.038) = 251 \geq 10}$
   and
   $\boldsymbol{n_2 \cdot \hat{p}_2 \geq 10}$ and $\boldsymbol{n_2 \cdot (1 - \hat{p}_2) \geq 10}$
   $\mathbf{1614(0.103) = 166 \geq 10}$ and $\mathbf{1614(1 - 0.103) = 1448 \geq 10}$

3. Construct and interpret a 95% confidence interval for the difference in the proportions of city children with hay fever and rural children with hay fever.

   (-0.092, -0.037) We are 95% confident that the true difference of the proportions of city children with hay fever and rural children with hay fever is between -0.092 and -0.037.

   If you swapped the definition of groups 1 and 2, then you would get the same values with opposite signs: (0.037, 0.092). This is also correct.

4. Is zero contained in the confidence interval? What does this mean?

   No. This means that it is plausible that the likelihood of a child contracting hay fever is different in the city than in rural areas.

On April 12, 1955, Dr. Jonas Salk released the results of clinical trials for his vaccine to prevent polio. In these clinical trials, 400,000 children were randomly divided into two groups. The subjects in Group 1 were given the vaccine, while the subjects in Group 2 were given the placebo. Of the 200,000 children in Group 1 (the vaccine group), 33 children developed polio. Of the 200,000 children in Group 2 (the placebo group), 115 children developed polio. Use this information to answer questions 5 and 6.

5. Verify that the requirements are met to create a confidence interval.
   Yes.
   $\boldsymbol{n_1 \cdot \hat{p}_1 \geq 10}$ and $\boldsymbol{n_1 \cdot (1 - \hat{p}_1) \geq 10}$
   $\mathbf{200000(0.0002) = 33 \geq 10}$ and $\mathbf{200000(1 - 0.0002) = 199967 \geq 10}$
   and
   $\boldsymbol{n_2 \cdot \hat{p}_2 \geq 10}$ and $\boldsymbol{n_2 \cdot (1 - \hat{p}_2) \geq 10}$
   $\mathbf{200000(0.0006) = 115 \geq 10}$ and $\mathbf{200000(1 - 0.0006) = 199885 \geq 10}$

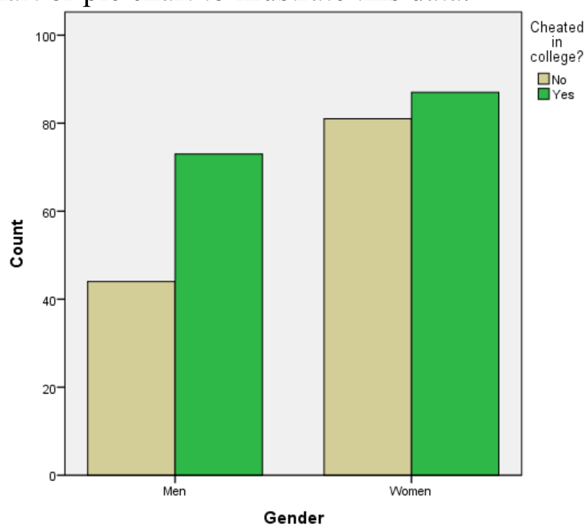
6. Construct and interpret a 95% confidence interval for the difference in the proportions of children who received the vaccine and contracted polio and children who received the placebo and contracted polio.

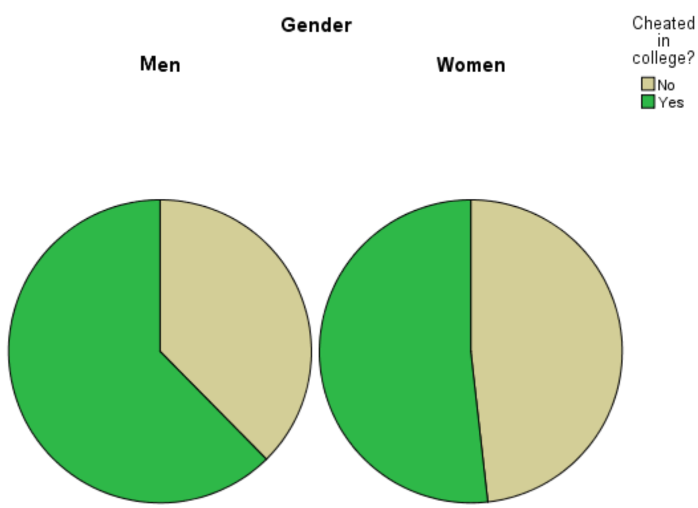
   (-0.00053, -0.00029) We are 95% confident that the true difference of the proportions of vaccinated children who developed polio and non-vaccinated children who developed polio is between -0.00053 and 0.00029.

   If you swapped the definition of groups 1 and 2, then you would get the same values with opposite signs: (-0.00029, -0.00053). This is also correct.

Historically, studies have shown that men are more likely to cheat in school than women. A study was conducted at four public universities to determine the accuracy of this claim. In an anonymous survey, a group of students was asked if they had ever cheated in college. Among the men, 73 out of 117 reported that they had cheated at least once in college. Among the women, 87 out of 168 females reported that they had cheated at least once. Use this information to test the hypothesis that men are more likely to cheat in college than women. Use a level of significance of $\alpha = 0.05$. For this hypothesis test, let group 1 represent men and group 2 represent women. Use this information to answer questions 7 through 15.

7. Create a bar chart or pie chart to illustrate this data.





8. Verify that the requirements are met to perform a hypothesis test.

   Yes.

   $\boldsymbol{n_1 \cdot \hat{p}_1 \geq 10}$ and $\boldsymbol{n_1 \cdot (1 - \hat{p}_1) \geq 10}$

   $\boldsymbol{117(0.624) = 73 \geq 10}$ and $\boldsymbol{117(1 - 0.624) = 44 \geq 10}$

   and

$\boldsymbol{n_2 \cdot \hat{p}_2 \geq 10}$ and $\boldsymbol{n_2 \cdot (1 - \hat{p}_2) \geq 10}$
$\boldsymbol{168(0.518) = 87 \geq 10}$ and $\boldsymbol{168(1 - 0.518) = 81 \geq 10}$

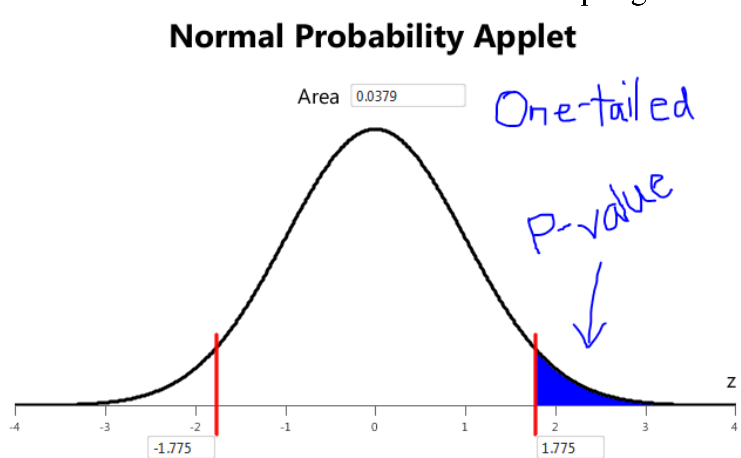
9. State the null and alternative hypotheses.
   $\boldsymbol{H_o:\ p_1 = p_2}$
   $\boldsymbol{H_a:\ p_1 > p_2}$

10. Give the value of $\boldsymbol{\hat{p}_1}$ and $\boldsymbol{\hat{p}_2}$.
   $\boldsymbol{\hat{p}_1 = 0.624}$
   $\boldsymbol{\hat{p}_2 = 0.518}$

11. Give the test statistic and its value.
   $\boldsymbol{z = 1.775}$

12. Calculate the P-value based on the test statistic.
   ***P*-value = 0.038**

13. Label the test statistic and shade the P-value on a sampling distribution curve.



14. What decision do you make based on the P-value and the level of significance (α)?
   Reject the null hypothesis.

15. State your conclusion in an English sentence.
   There is sufficient evidence to suggest that the proportion of men who cheat in college is greater than the proportion of women who cheat in college.

16. How would your answer change if the hypothesis test was a 2-sided test?
   The p-value would double and be equal to 0.076. This p-value is not significant and we would fail to reject the null hypothesis. With a two sided test we would not have sufficient evidence to conclude that there is a difference between the proportion of women and men who cheat in college.

In clinical trials of the allergy medicine Clarinex, it was reported that 50 out of 1655 individuals in the Clarinex group and 31 out of 1652 individuals in the placebo group experienced dry mouth as a side effect of their respective treatments. Is there a difference in the proportions of those who had dry mouth between the two groups? Use a level of significance of α = 0.05. For this hypothesis test, let group 1 represent the subjects on Clarinex and group 2 represent the subjects on placebo. Use this information to answer questions 16 through 23.

17. Verify that the requirements are met to perform a hypothesis test.

    Yes.

    $\boldsymbol{n_1 \cdot \hat{p}_1 \geq 10}$ and $\boldsymbol{n_1 \cdot (1-\hat{p}_1) \geq 10}$

    $\boldsymbol{1655(0.030) = 50 \geq 10}$ and $\boldsymbol{1655(1-0.030) = 1605 \geq 10}$

    and

    $\boldsymbol{n_2 \cdot \hat{p}_2 \geq 10}$ and $\boldsymbol{n_2 \cdot (1-\hat{p}_2) \geq 10}$

    $\boldsymbol{1652(0.019) = 31 \geq 10}$ and $\boldsymbol{1652(1-0.019) = 1621 \geq 10}$

18. State the null and alternative hypotheses.

    $\boldsymbol{H_o\colon\ p_1 = p_2}$

    $\boldsymbol{H_a\colon\ p_1 \neq p_2}$

19. Give the value of $\boldsymbol{\hat{p}_1}$ and $\boldsymbol{\hat{p}_2}$.

    $\boldsymbol{\hat{p}_1 = 0.030}$

    $\boldsymbol{\hat{p}_2 = 0.019}$

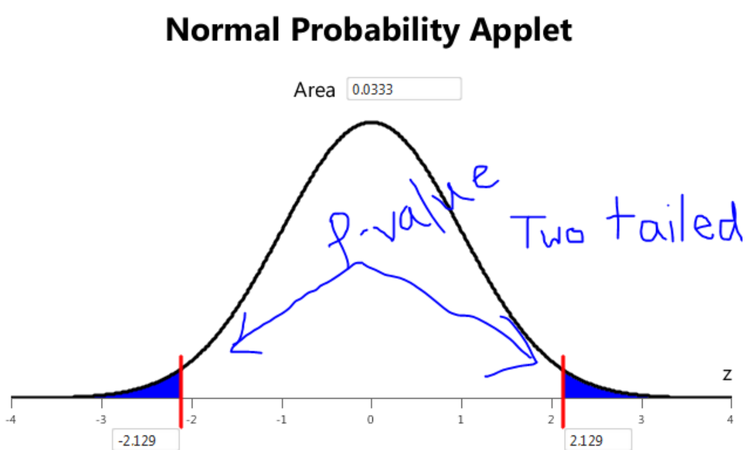
20. Give the test statistic and its value.

    $\boldsymbol{z = 2.129}$

21. Calculate the P-value based on the test statistic.

    P-value = **0.033**

22. Label the test statistic and shade the P-value on a sampling distribution curve.



23. What decision do you make based on the P-value and the level of significance (α)?

    Reject the null hypothesis.

24. State your conclusion in an English sentence.

There is sufficient evidence to suggest that the proportion of Clarinex subjects with dry mouth is different than the proportion of placebo subjects with dry mouth.