**Question 3.**

**1. Calculate an estimate of the preference for humans turning their heads to the right when kissing using the above data, and provide an 95% confidence interval for this estimate. Summarise/describe your results appropriately.**

***Answer:***

95% confidence interval: [0.4967, 0.7937].

***Interpretation:***

The estimated proportion of people turning their heads to the right when kissing is approximately 0.6452, which corresponds to about 64.52% of observed pairs.

The 95% confidence interval for this estimate is approximately [0.4967, 0.7937]. This means we can be reasonably confident that the true proportion of people turning their heads to the right when kissing lies within this interval.

***Approach:***

We observed 124 kissing pairs, where 80 turned their heads to the right and 44 turned their heads to the left. To estimate the preference for turning heads to the right when kissing, so we can calculate the sample proportion.

Sample Proportion

To calculate a confidence interval for the proportion, you can use the formula for the confidence interval of a proportion, assuming that the conditions for constructing this interval are met (e.g., random sampling, independence, and a sufficiently large sample size).

The formula for the confidence interval of a proportion p with a confidence level of 95% is given by:

* is the sample proportion we calculated earlier 0.6452
* Z is the critical value for a 95% confidence interval. For a standard normal distribution, Z is approximately 1.96
* n is the sample size (number of kissing pairs, which is 124).

Now, plug these values into the formula:

Calculate the values within the square root first:

Now, calculate the confidence interval:

Confidence Interval = 0.6452 1.96 0.0757

Calculate the lower and upper bounds of the confidence interval:

- Lower Bound: 0.6452 1.96 0.0757 0.4967

- Upper Bound: 0.6452 1.96 0.0757 0.7937

**Question 3.**

**2. Test the hypothesis that there is no preference in humans for tilting their head to one particular side when kissing. Write down explicitly the hypothesis you are testing, and then calculate a *p*-value using the approach for testing a Bernoulli population. What does this *p*-value suggest?**

***Answer:***

z **2.3271**

p value **0.0202**

***Interpretation:***

* If you use a significance level (α) of, for example, (0.05), you would compare the p-value (0.0202) to alpha.
* Since (0.0202 < 0.05), you would reject the null hypothesis .
* Therefore, we have evidence to conclude that there is a statistically significant preference for head tilting when kissing.

In other words, based on Our data, it appears that people do not equally favour turning their heads to the right and to the left when kissing; there seems to be a preference.

***Approach:***

In hypothesis testing, we want to determine whether there is a statistically significant preference for head tilting when kissing. Let (P) represent the population proportion of people who turn their heads to the right when kissing. The null and alternative hypotheses are:

Null Hypothesis (): There is no preference;(p = 0.5) (i.e., an equal proportion of people turn their heads to the right

Alternative Hypothesis (): There is a preference; (p 0.5) (i.e., the proportion of people turning their heads to the right when kissing is not equal to the proportion turning to the left).

To test this hypothesis, We can calculate a z-score using the sample proportion and the null hypothesis value :

Where:

- is the sample proportion (0.6452).

- is the null hypothesis value ((0.5), as stated in the null hypothesis).

- n is the sample size ((124), the number of kissing pairs).

Putting the values:

Calculate the z-score:

z 2.3271

Next, we will use the z-score to calculate the p-value. The p-value is the probability of observing a z-score as extreme as the one calculated, assuming the null hypothesis is true.

Using a standard normal distribution table or calculator, we can find the probability associated with the z-score (z 2.3271). Specifically, we're interested in the two-tailed probability because the alternative hypothesis is two-sided.

The p-value is approximately (0.0202).

The p-value represents the probability of observing the sample results (or something more extreme) if there is truly no preference for head tilting when kissing (according to the null hypothesis).

With a p-value of approximately (0.0202), it is relatively small. In hypothesis testing, a small p-value suggests that the observed data is unlikely to have occurred by random chance alone under the null hypothesis.

**Question 3.**

**3. Using R, calculate an exact *p*-value to test the above hypothesis. What does this *p*-value suggest? please provide the appropriate R command that you used to calculate your *p*-value.**

***Answer:***

p-value = 0.001565

***Interpretation:***

The p-value of 0.001565 is quite small. It suggests that the observed number of successes (heads) is significantly different from what would be expected by chance if the true probability of success were 0.5. In other words, there is strong evidence to reject the null hypothesis.

***Approach:***

> # Define the observed number of "successes" (heads to the right)

> observed\_successes <- 80

>

> # Define the total number of trials (kissing pairs)

> total\_trials <- 124

>

> # Perform the binomial test

> binom.test(observed\_successes, total\_trials, p = 0.5, alternative = "two.sided")

***Exact binomial test***

***data: observed\_successes and total\_trials***

***number of successes = 80, number of trials = 124, p-value = 0.001565***

***alternative hypothesis: true probability of success is not equal to 0.5***

***95 percent confidence interval:***

***0.5542296 0.7289832***

***sample estimates:***

***probability of success***

***0.6451613***

**Question 3.**

**4. It is entirely possible that any preference for head turning to the right/left could be simply a product of right/left-handedness. To test this, we obtain handedness of a sample of different people. It was found that 83 people were right-handed and 17 were left handed. Using the hypothesis testing procedure for testing two Bernoulli populations, test the hypothesis that the rate of right-handedness in the population is the same as the preference for turning heads to the right when kissing this data. Summarise your findings. What does the *p*-value suggest?**

***Answer:***

p-value = **0.7157**

***Interpretation:***

Based on the p-value (0.7157), which is much greater than the typical significance level of 0.05, there is no significant difference between the rate of right-handedness and the preference for turning heads to the right when kissing. In other words, the data does not provide enough evidence to reject the null hypothesis***.***

***Approach:***

To test whether there is a relationship between handedness (right-handed or left-handed) and the preference for turning heads to the right when kissing, you can perform a hypothesis test. In this case, you are comparing two Bernoulli populations: the population of people who prefer turning their heads to the right when kissing and the population of people who are right-handed.

Hypothesis:

(H0): The rate of right-handedness is the same as the preference for turning heads to the right when kissing.

(Ha): The rate of right-handedness is different from the preference for turning heads to the right when kissing.

The Significance Level (α):

Choose a significance level (α), often set at 0.05, to determine the threshold for statistical significance.

Here we will perform a two-sample proportion hypothesis test using R. Here's how to do it:

**R-code:**

> n\_right\_handed <- 83 # Number of right-handed people

> n\_left\_handed <- 17 # Number of left-handed people

> n\_right\_head\_turn <- 80 # Number of people who turn their heads to the right

>

> # Calculate sample proportions

> p\_right\_handed <- n\_right\_handed / (n\_right\_handed + n\_left\_handed)

> p\_right\_head\_turn <- n\_right\_head\_turn / (n\_right\_handed + n\_left\_handed)

>

> # Perform the hypothesis test

> prop.test(x = c(n\_right\_head\_turn, n\_right\_handed), n = c(n\_right\_handed + n\_left\_handed, n\_right\_handed + n\_left\_handed), alternative = "two.sided")

***2-sample test for equality of proportions with continuity correction***

***data: c(n\_right\_head\_turn, n\_right\_handed) out of c(n\_right\_handed + n\_left\_handed, n\_right\_handed + n\_left\_handed)***

***X-squared = 0.13265, df = 1, p-value = 0.7157***

***alternative hypothesis: two.sided***

***95 percent confidence interval:***

***-0.14754828 0.08754828***

***sample estimates:***

***prop 1 prop 2***

***0.80 0.83***

The `prop.test` function in R will perform a two-sample proportion test and provide you with a p-value.

p-value = 0.7157

The p-value is greater than α, you fail to reject the null hypothesis, indicating no significant difference.