Can domestic dogs understand human body cues such as leaning? The experimenter leaned toward one of two objects and recorded whether or not the dog being tested correctly chose the object indicated. A four-year-old male beagle named Augie participated in this study. He chose the correct object 42 out of 70 times when the experimenter leaned towards the correct object.

(a) Let the parameter of interest, π, represent the probability that the long-run probability that Augie chooses correctly. Researches are interested to see if Augie understands human body cues (better than gussing).

The proportion of population is 42/70 = 0.60

The null and alternative hypotheses will be as follows:

H0: p = 0.60

Ha: p ≠ 0.60

(b) Based on the above context, conduct a test of significance to determine the p-value to investigate if domestic dogs understand human body cues. What conclusion will you draw with significance level of 10%? (If you use an applet, please specify which applet you use, and the inputs.)

If the p value of the test is less than the level of significance, the null hypothesis is rejected.

Given a significance level of 10%, we can say that the confidence level for the test statistic is 90% which is equivalent to 0.9. We can therefore say that the population proportion is 0.9 while the sample proportion has been shown to be 0.6

The test statistic is calculated as follows:

z = $\frac{p^s - p}{\sqrt{\frac{p(1-p)}{n}}} = \frac{0.9 - 0.6}{\sqrt{\frac{0.6(1-0.6)}{70}}}$ **= 5.123**

The p value is computed from the z table for 2 tails which is .00001.

Therefore, the null hypothesis that p = .6 is rejected.

(c) Based on the above context, conduct a test of significance to determine the p-value to investigate if domestic dogs understand human body cues. What conclusion will you draw with significance level of 5%? (If you use an applet, please specify which applet you use, and the inputs.)

Given a significance level of 5%, we can say that the confidence level for the test statistic is 95% which is equivalent to 0.95. We can therefore say that the population proportion is 0.95 while the sample proportion has been shown to be 0.6

The test statistic is calculated as follows:

z = $\frac{p^s - p}{\sqrt{\frac{p(1-p)}{n}}} == \frac{0.95 - 0.6}{\sqrt{\frac{0.6(1-0.6)}{70}}}$ **= 5.98**

The p value is computed from the z table for 2 tails which is .00001.

Therefore, the null hypothesis that p = .6 is rejected.

(d) Are your conclusions from part (b) and (c) the same? If they are different, please provide an explanation.

The conclusions from part b and c are the same.

(e) Shown below is a dot plot from a simulation of 100 sample proportions under the assumption that the long-run probability that Augie chooses correct is 0.50. Based on this dot plot, would a 90% confidence interval for π contain the value 0.5? Explain your answer.

Yes, the dot plot shows that most of the sample proportions are at the center hence increasing the probability of finding the value 0.5 when in the samples.

(f) Compute the standard error of the sample proportion of times that Augie chose the object correctly.

Standard error = $\sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{0.6(1-0.6)}{70}}$ **= 0.059**

(g) Construct an approximate 95% confidence interval for π using the 2SD method

A 95% confidence interval = 0.5 ± margin of error

= 0.6 ± 0.12

(h) What is the margin of error of the confidence interval that you found in the previous question?

z value for a 95% confidence level is 1.96

margin of error = z * $\sqrt{\frac{p(1-p)}{n}}$ **= 1.96 *** $\sqrt{\frac{0.6(1-0.6)}{70}}$ **= 0.12**

(i) How would you interpret the confidence interval that you found in part (g)?

Therefore, we can be 95% confident that the p value lies between 0.48 and 0.72

(j) Which of the following is a correct interpretation of the 95% confidence level?

a) If Augie repeats this process many times, then about 95% of the intervals produced will capture the true proportion of times of choosing the correct objective.

b) About 95% times Augie chooses the correct objective.

c) If Augie repeats this process and constructs 20 intervals from separate independent samples, we can expect about 19 of those intervals to contain the true proportion Augie chooses the correct objective.

(h) Suppose that we repeated the same study with auggie, and this time he chose the correct object 21 out of 35 times. Conjecture how, if at all, the center and the width of a 99% confidence interval would change with these data, compared to the original 2SD 95% confidence interval.

The center of the confidence interval would **____remain the same**____________

The width of the confidence interval would **_____increase______________**

Suppose that we repeated the same study with auggie, and this time he chose the correct object 17 out of 35 times, and we also change the confidence level from 95% to 99%. Conjecture how, if at all, the center and the width of a 99% confidence interval would change with these data, compared to the original 2SD 95% confidence interval.

The center of the confidence interval would

_____shift to the right____

The width of the confidence interval would

____Increase______

2. Adult male polar bears are expected to weigh, on average, 370 kg. A polar bear's primary source of food are seals and other marine animals, which they hunt from a platform of sea ice.

Scientists are concerned that global warming is melting these platforms earlier in the year, reducing the time polar bears are able to hunt and forcing them inland without the necessary fat reserves built up to survive summer and fall. The US Geological Survey (USGS) conducted a study in the Southern Beaufort Sea to investigate whether climate change has appeared to negatively impact the weight of polar bears, on average. Eighty-three adult male polar bears were captured between March and May of the years 1990 and 2006 and their weights were recorded. The sample mean weight was 324.6 kg and the sample standard deviation was 88.3 kg. A histogram of the 83 polar bear weights in the sample is shown below.

(a) What are the observational units in this study?

Adult male polar bears of Southern Beaufort Sea

(b) What is the variable of interest? Is it quantitative or categorical?

Weight, it is quantitative.

(c) Are validity conditions met in order to use theory-based methods? Explain your answer.

Yes, the histogram indicates the population is normally distributed.

(d) What is the parameter of interest?

a. The proportion of adult male polar bears in the Southern Beaufort Sea that weigh less than 370 kg.

b. The number of adult male polar bears that have lost weight in the Southern Beaufort Sea.

c. The true mean weight of adult male polar bears in the Southern Beaufort Sea.

d. The mean weight of the 83 adult male polar bears in the sample.

(e) What are the appropriate null and alternative hypotheses to investigate whether climate change has appeared to negatively impact the weight of polar bears?

The expected mean is 370 kg while the sample mean is 324.6 kg. Therefore, the null and alternative hypotheses will be as follows:

H0: 324.6 kg = 370 kg

Ha : 324.6 kg ≠ 370 kg

(f) Use the sample results to estimate the standard error of the sampling distribution of sample mean weight.

Standard error = $\frac{SD}{\sqrt{n}} = \frac{88.3}{\sqrt{83}} = 9.69$

Standard error = 9.69

(g) Calculate the standardized statistic (z).

z = $\frac{x-u}{SD} = \frac{324.6-370}{83}$ = - 0.547

(h) Interpret the standardized statistic (z) you found in the previous part.

The standardized statistic is negative thereby indicating that the sample mean is below the population's mean.

(i) Based on this standardized statistic (z), does this result provide evidence that the true mean weight of polar bears is less than 370 kg?

Based on the negative z value, the result provides evidence that the true mean weight of polar bears is less than 370 kg.

(j) Use the 2SD method to find a 95% confidence interval for parameter of interest.

The 2sd method requires the use of 1.96 as the z value.

To get the margin of error the formula is

$$z^*\frac{SD}{\sqrt{n}} = 1.96 * \frac{88.3}{\sqrt{83}} = 19.0$$

A 95% confidence interval will be 324.6 ± 19.0

(k) How would you interpret the interval you found in part (j)?

We can be 95% sure that the parameter of interest is between 305.6 and 343.6

(l) Does the confidence interval in part (j) provide statistically significant evidence that the true mean weight of adult male polar bears in the Southern Beaufort Sea is less than 370 kg?

- **a.** No, since we only sampled 83 captured adult male polar bears and not the entire population.
- **b.** No, since the entire confidence interval lies above zero.
- **c.** Yes, since the sample mean of 324.6 kg is less than 370 kg.
- **d.** **Yes, since the entire confidence interval lies below 370 kg.**

(m) To which population can we generalize these results?

- **a.** All polar bears.
- **b.** All adult male polar bears.
- **c.** **All adult male polar bears in the Southern Beaufort Sea.**
- **d.** Adult male polar bears that are similar to those captured for the sample.