FREC 408

Group Exercise 6

Suspended Solids

- EPA standard on the amount of suspended solids that can be discharged into a river is a maximum of 60mg per liter per day (mg/L).
- You want to test a randomly selected sample of n water specimens and estimate the mean daily rate of pollution produced by a mining operation.

Water quality problem

- You have been asked to submit a proposal to do this study.
- The granting agency wants to know about the precision of your estimate
- Suppose you want a 95% C.I. with a bound of error of 1 mg/l
- Assume the water readings are approximately normal with σ = 5 mg/L
- What is the minimum sample size you would need?

Answer

- $\alpha/2$ = .025 since (1-.95) =.05
- z= 1.96
- B = 1 mg/l

Answer

$$n = \frac{(1.96^2)5^2}{1^2}$$

$$n = \frac{(3.8416)25}{1}$$

$$n = 96.04$$

N = 97 as a minimum sample size

The check

- Calculate the Bound of Error for this particular problem, using n=97

$$\pm 1.96\left(5/\sqrt{97}\right) = \pm .995$$

Pond's Age-Defying Complex is a cream with alpha-hydroxy acid

- **Pond's Age-Defying Complex is a creme with alpha-hydroxy acid,** a product that is advertised to improve the skin. In a study, 83 women over age 40 used a cream with alpha-hydroxy acid, for 22 weeks. At the end of the study period the women were examined by dermatologists and 46 exhibited skin improvement.
- Calculate a 95% Confidence Interval for the proportion of women who exhibited improvement.

Calculate a 95% Confidence Interval for the proportion of women who exhibited improvement.

- p = 46/83 = .554 q = .446
- **Standard Error = $[(.554)(.446)/83]^{.5}$ = .05456**
- **.554 ± 1.96(.055)**
- **.554 ± .107**
- **.447 to .661**

Does there seem to be support from this study that the cream improved more than half of the women who use it?

- **No, we do not have sufficient evidence that more than half of the women using the cream would show improvement.**
- **Even though nearly 55% of the sample showed improvement, based on our confidence interval, .5 is within interval.**

Current technology uses X-rays and lasers for inspection of solder-joints

- **Current technology uses X-rays and lasers for inspection of** solder-joints on printed circuit boards. A current manufacturer claims its product can inspect on average at least 10 solder joints per second. A potential buyer tested the equipment on 27 different printed circuit boards (PCB). The sample mean and standard deviation are given below. **We will assume that this distribution is approximately normal.**
- $\bar{x}$ = 10.54 s = 1.61 n = 27

Calculate a 95% confidence interval for this sample estimate.

- **Standard Error =**
  - **$1.61/(27)^{.5}$ = .3098**
- **$t_{.05/2,\ 26\ d.f.}$ = 2.056**
- **10.54 ± 2.056(.3098)**
- **10.54 ± .637**
- **9.903 to 11.177**

inspection of solder-joints

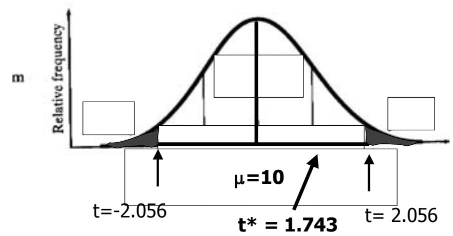
- Test to see if the sample data is different from the manufacturer's claim. You will need to determine the Null Hypothesis and your Alternative Hypothesis. Use α = .05. **Note: use the t-distribution for the rejection region.**

HYPOTHESIS TEST

Null Hypothesis	$H_0 : \mu = 10$
Alternative Hypothesis	$Ha : \mu \neq 10$ Two-tailed Test
Assumptions of Test	n (27) is a small sample, so I use the t-distribution, with α =.05/2 and 27-1=26 d.f. We assume the distribution in the population is approximately normal
Test Statistic (z* or t*)	t* = (10.54 - 10.0)/.3098
Rejection Region	$t_{.05/2, 26\ d.f.} = 2.056$
Calculation of Test Statistics	t* = 1.743
Comparison of Test Statistics with Rejection Region	-2.056 < t* < 2.056 -2.056 < 1.743 < 2.056

Cannot reject Ho: μ = 10

Here's how it looks in pictures



- **Even though our sample of 27 observations generated a mean level above the manufacturers claim, we still don't have enough information to say our sample was sufficiently different from the claim.**
- **Our sample mean was 1.743 standard deviations above the manufacturer's claim, but that is not such a rare occurrence to cause us to challenge the manufacturer's claim.**

Golf Course Problem

- **Golf course designers are worried that the new equipment is making old courses obsolete.**
- **One designer says that courses need to be built with the expectation that players will be able to drive the ball an average of 250 yards or more.**

Golf Course Problem

- **A sample of 135 golfers is taken and they measured their driving distance**
  - **$\bar{x}$ = 256.3 yards**
  - **s = 43.4 yards**
- **Does the sample provide enough evidence to suggest that golfers are already hitting it farther than the 250 mark? Use α=.05**

Golf Course Problem

Null hypothesis	**H_0: μ = 250**
Alternative	**H_a: μ > 250** one-tailed test,upper
Assumptions	**Large sample, normal**
Test Statistic	**z* = (256.3-250)/(43.4/√135)**
Rejection Region	**$z_{\alpha=.05}$ = 1.645**
Calculation	**z* = 1.69**
Conclusion	**$z^* > z_{\alpha=.05}$** **1.69 > 1.645** **Reject H_0: μ = 250**

P-values

- Take the test statistic that you calculated (i.e., z*) and find the probability associated with this z-value. The probability will be:
  - **.5 - p(associated with z*) this is known as a p-value for this problem**

- Compare this to the alpha level set for the problem.

P-values

- z* = 1.69
- P(0<x<z*) = .4545
- p= .5 - .4545 = <u>**.0455**</u>

- **Compare this to the alpha level set for the problem.**
  - α=.05
  - The p-value is less than .05, therefore I have a z* that is out in the rejection region
  - **When the p-value is less than α, I can reject the Null Hypothesis**