

## 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  $\sigma = 5$  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  $n=97$   
 $\pm 1.96(5/\sqrt{97}) = \pm .995$

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

- Pond's Age-Defying Complex is a crème 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 =  $[(.554)(.446)/83]^{.5} = .05456$**
- $.554 \pm 1.96(.055)$
- $.554 \pm .107$
- **.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.**

- $\bar{x} = 10.54$      $s = 1.61$      $n = 27$

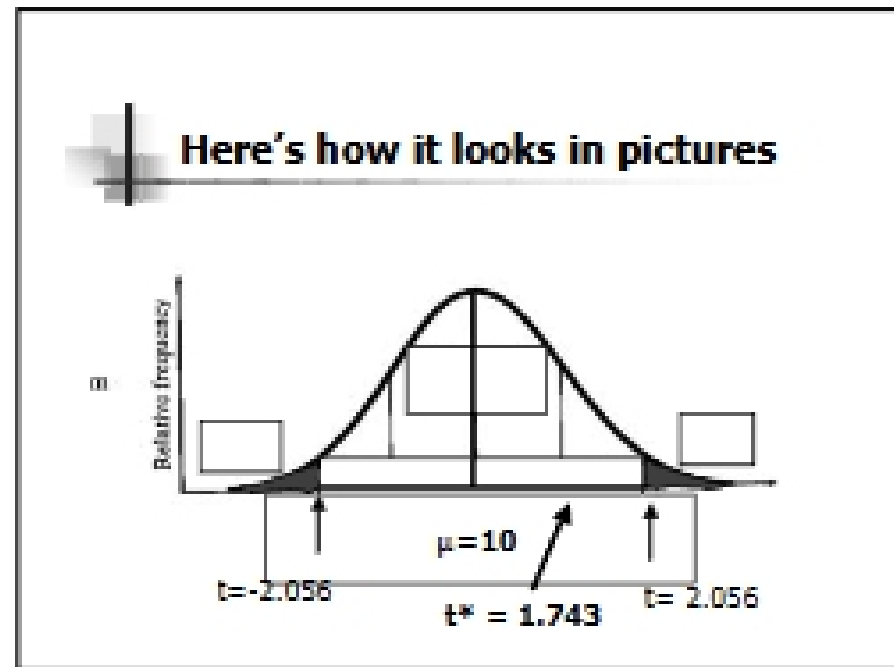
Calculate a 95% confidence interval for this sample estimate.

- **Standard Error =**
  - $1.61/(27)^{.5} = .3098$
- $t_{.05/2, 26 \text{ d.f.}} = 2.056$
- $10.54 \pm 2.056(.3098)$
- $10.54 \pm .637$
- **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  $\alpha = .05$ . Note: use the t-distribution for the rejection region.**

HYPOTHESIS TEST	
Null Hypothesis	$H_0: \mu = 10$
Alternative Hypothesis	$H_a: \mu \neq 10$ Two-tailed Test
Assumptions of test	$n$ (27) is a small sample, so I use the $t$ -distribution, with $\alpha = .05/2$ and $27-1=26$ d.f. We assume the distribution in the population is approximately normal
Test Statistic ( $z^*$ or $t^*$ )	$t^* = (10.64 - 10.0)/1.3088$
Rejection Region	$t_{\alpha/2, df} = 2.056$
Calculation of Test Statistic	$t^* = 1.743$
Comparison of Test Statistic with Rejection Region	$-2.056 < t^* < 2.056$ $-2.056 < 1.743 < 2.056$
<b>Cannot reject <math>H_0: \mu = 10</math></b>	



- Even though our sample of 27 observations generated a mean level above the manufacturer's 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  $\alpha = .05$

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