Single Sample Hypothesis Tests for Means

Note #3: H_0 ALWAYS gets an = ...even if the wording in the problem sounds like it shouldn't

$$H_0 : \mu = \#$$

Note #1: Use colons

$$H_a : \mu \; \begin{matrix} \neq \\ < \\ > \end{matrix} \; \#$$

Note #2: Use only PARAMETERS in your hypothesis...although there will be some problems where we'll use words/sentences

Note #4: The symbol used in the alternate will come from the context of the problem

$\neq$ - two-sided test, equivalent to a Confidence Interval (CI)

$<$, $>$ } - one-sided test

Steps in Hypothesis Testing

1. Define the population characteristic (i.e. parameter) about which hypotheses are to be tested.

2. State the null hypothesis H_0.

3. State the alternative hypothesis H_a.

4. State the significance level for the test α.

5. Check all assumptions and state name of test.

6. State the name of the test.

7. State df if applicable (not applicable in proportion land).

8. Display the test statistic to be used without any computation at this point.

9. Compute the value of the test statistic, showing specific numbers used.

10. Calculate the *P* – value.

11. Sketch a picture of the situation.

12. State the conclusion in two sentences -
    1. Summarize in theory discussing H_0.
    2. Summarize in context discussing H_a.

Single Sample Hypothesis Tests for Mean

Steps in Mean Hypothesis Testing

1. $\mu =$ ....

2. $H_0 : \mu = \#$

3. $H_a :\ \mu$ $\neq$ / $<$ / $>$ $\#$

4. State the significance level for the test α .

5. <u>Assumptions:</u>

   1. Random Sample

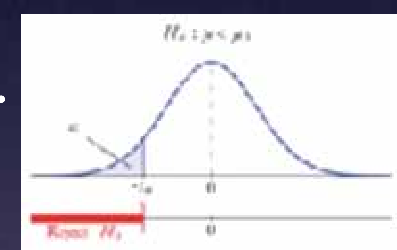
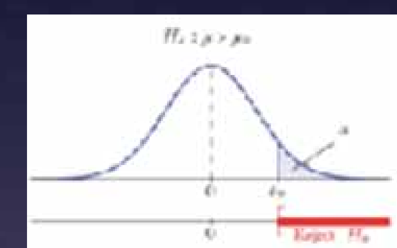
   2. Normality stated
      $n \geq 30$
      Boxplot of raw data shows roughly symmetric shape

   3. σ known

6. 1 Sample Mean z Test

7. df = N/A

8/9. $z = \dfrac{\overline{x} - \mu}{\sigma / \sqrt{n}} = \#$

11.  

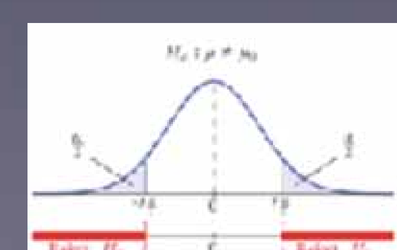
10. $P - value =$

$$P(z > \#) = normalcdf(\#,\ 1E99,\ 0,\ 1)$$
$$P(z < \#) = normalcdf(-1E99,\ \#,\ 0,\ 1)$$

} one-sided tests

$$2P(z > \#) = 2 * normalcdf(\#,\ 1E99,\ 0,\ 1)$$
$$2P(z < \#) = 2 * normalcdf(-1E99,\ \#,\ 0,\ 1)$$

} two-sided tests



12. State the conclusion in two sentences -
    1. Summarize in theory discussing H_0 .
    2. Summarize in context discussing H_a .

Single Sample Hypothesis Tests for Mean

Steps in Mean Hypothesis Testing

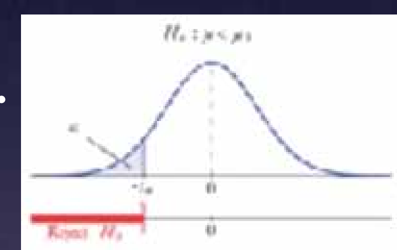
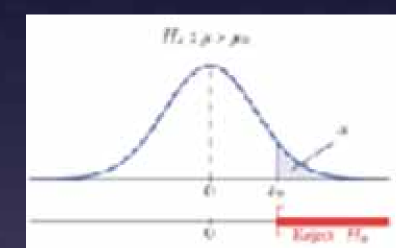
1. $\mu =$ ....
2. $H_0 : \mu = \#$
3. $H_a : \mu \; \neq, <, > \; \#$
4. State the significance level for the test α .

5. <u>Assumptions:</u>
   1. Random Sample
   2. Normality stated
      $n \geq 30$
      Boxplot of raw data shows roughly symmetric shape
   3. σ unknown

6. 1 Sample Mean t Test

7. $df = n - 1$

8/9. $t = \dfrac{\overline{x} - \mu}{s/\sqrt{n}} = \#$

11.  

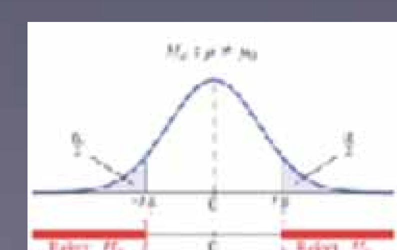
10. $P - value =$

$$P(t > \#) = tcdf(\#, 1E99, df)$$
$$P(t < \#) = tcdf(-1E99, \#, df)$$

one-sided tests

$$2P(t > \#) = 2 * tcdf(\#, 1E99, df)$$
$$2P(t < \#) = 2 * tcdf(-1E99, \#, df)$$

two-sided tests



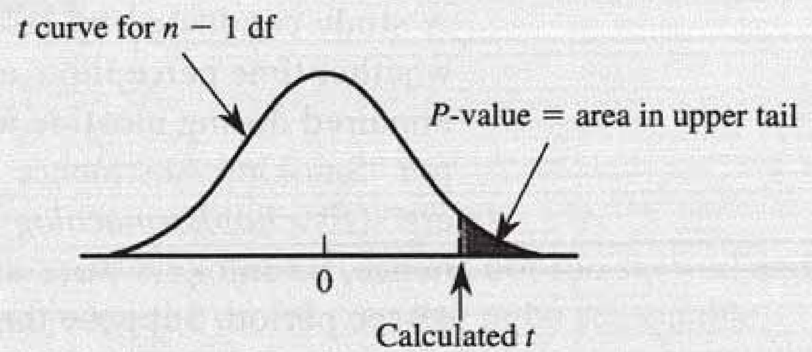
12. State the conclusion in two sentences -
    1. Summarize in theory discussing H_0 .
    2. Summarize in context discussing H_a .

10. $$P-value = \begin{cases} P(t > \#) = tcdf(\#, 1E99, df) \\ P(t < \#) = tcdf(-1E99, \#, df) \end{cases} \text{one-sided tests}$$

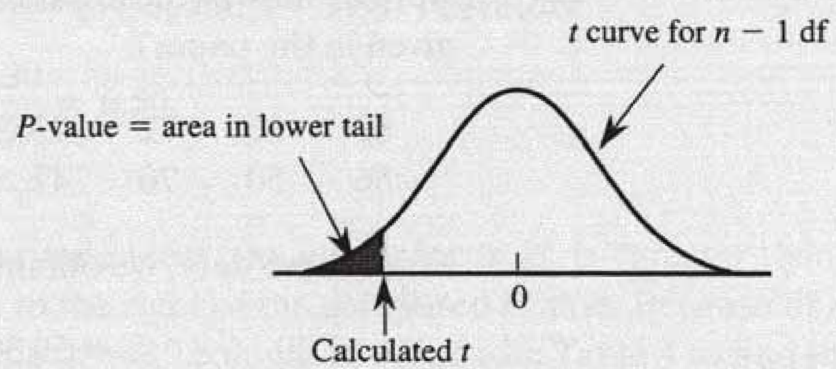
$$\begin{cases} 2P(t > \#) = 2 * tcdf(\#, 1E99, df) \\ 2P(t < \#) = 2 * tcdf(-1E99, \#, df) \end{cases} \text{two-sided tests}$$

■ Finding *P*-Values for a *t* Test

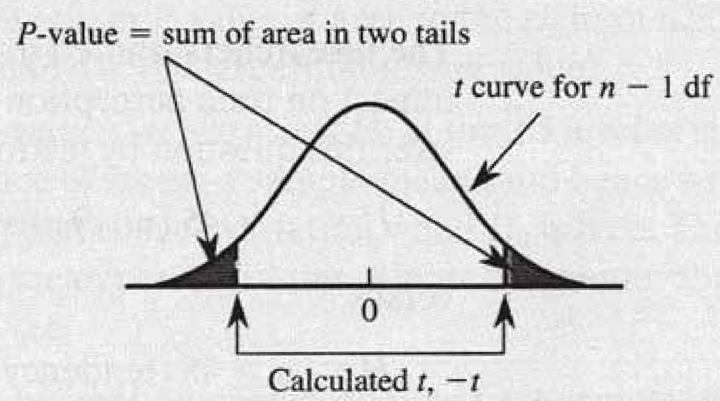
1. **Upper-tailed test:**
   H_a: $\mu >$ hypothesized value.
   P-value computed as illustrated:



2. **Lower-tailed test:**
   H_a: $\mu <$ hypothesized value.
   P-value computed as illustrated:



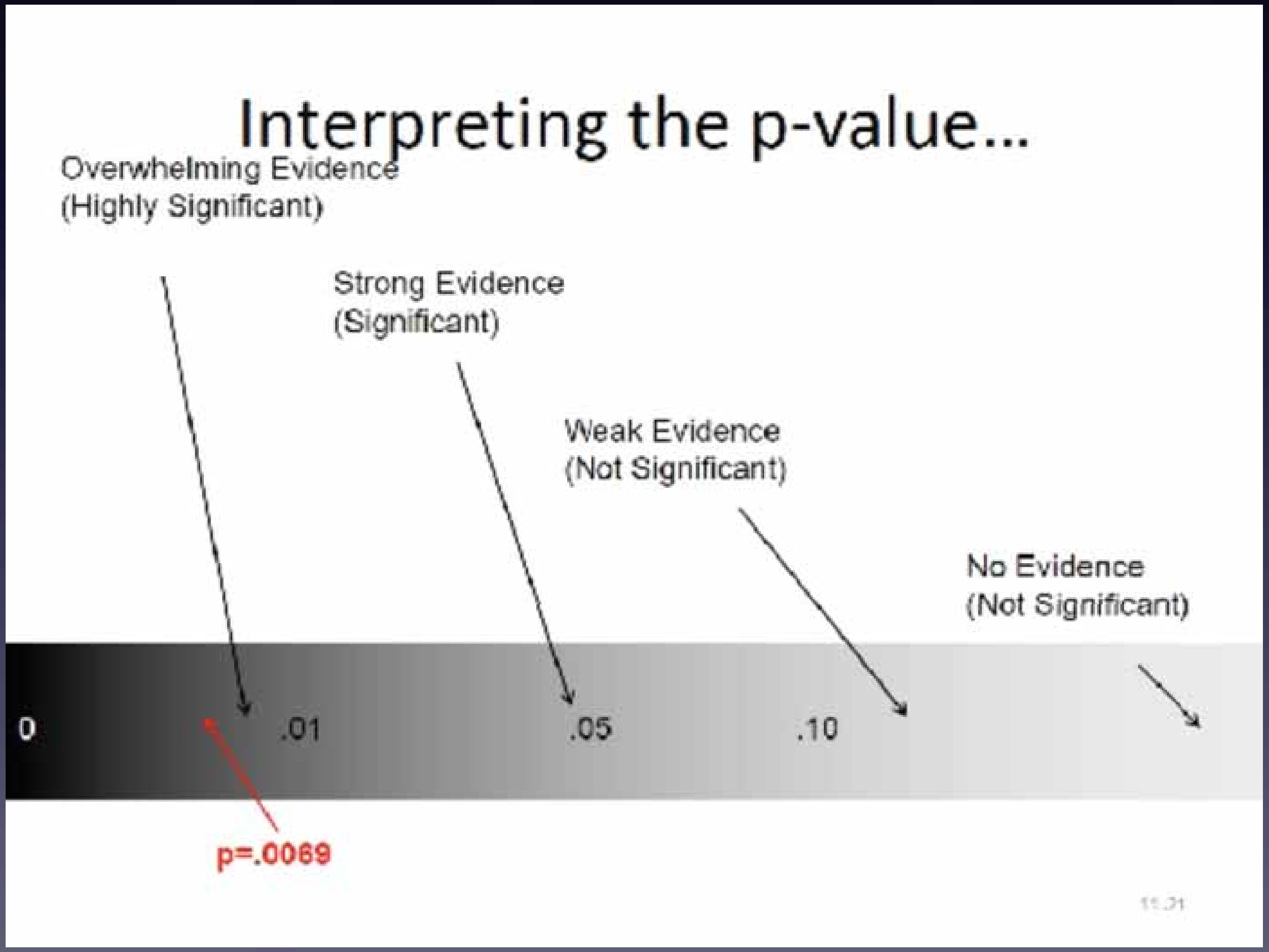
3. **Two-tailed test:**
   H_a: $\mu \neq$ hypothesized value.
   P-value computed as illustrated:



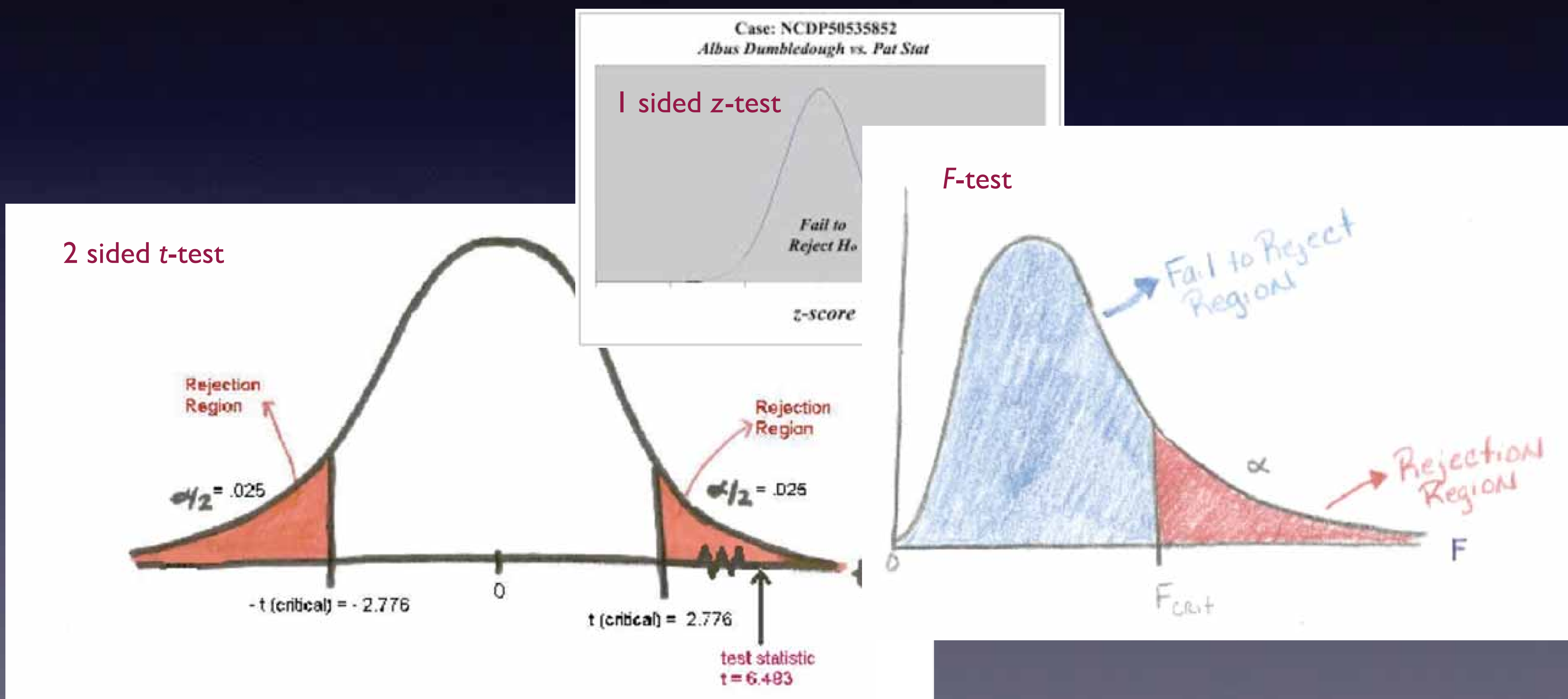
P-Value < $\alpha \Rightarrow$ Reject H_o, Evidence for H_a

P-Value > $\alpha \Rightarrow$ Fail to Reject H_o, No Evidence for H_a

$\alpha \rightarrow$



P-Value is the probability of obtaining a test statistic at least as extreme as the one that was actually observed, assuming that the null hypothesis is true



Errors - We make them, even though we're awesome

	Fail to reject H_0	Reject H_0
H_0 true	Hooray!	Type I error
H_a true	Type II error	Hooray!

Type I error - reject H_0 when H_0 is true

Type II error - fail to reject H_0 when H_0 is false

OR

Type I error - 1st equation correct and you pick the 2nd equation

Type II error - 2nd equation correct and you pick the 1st equation

α vs β

$P(\text{Type I error}) = \alpha$

$P(\text{Type II error}) = \beta$

Also called 'level of significance' or 'significance level'.

If α goes up, then β goes down.

If α goes down, then β goes up.

Game plan - determine which error is worse, then choose the appropriate α and β.

Some common terminology -

“Justify” = Run a hypothesis test

“Estimate” = Construct a Confidence Interval

“Statistically significant” = The null hypothesis is rejected