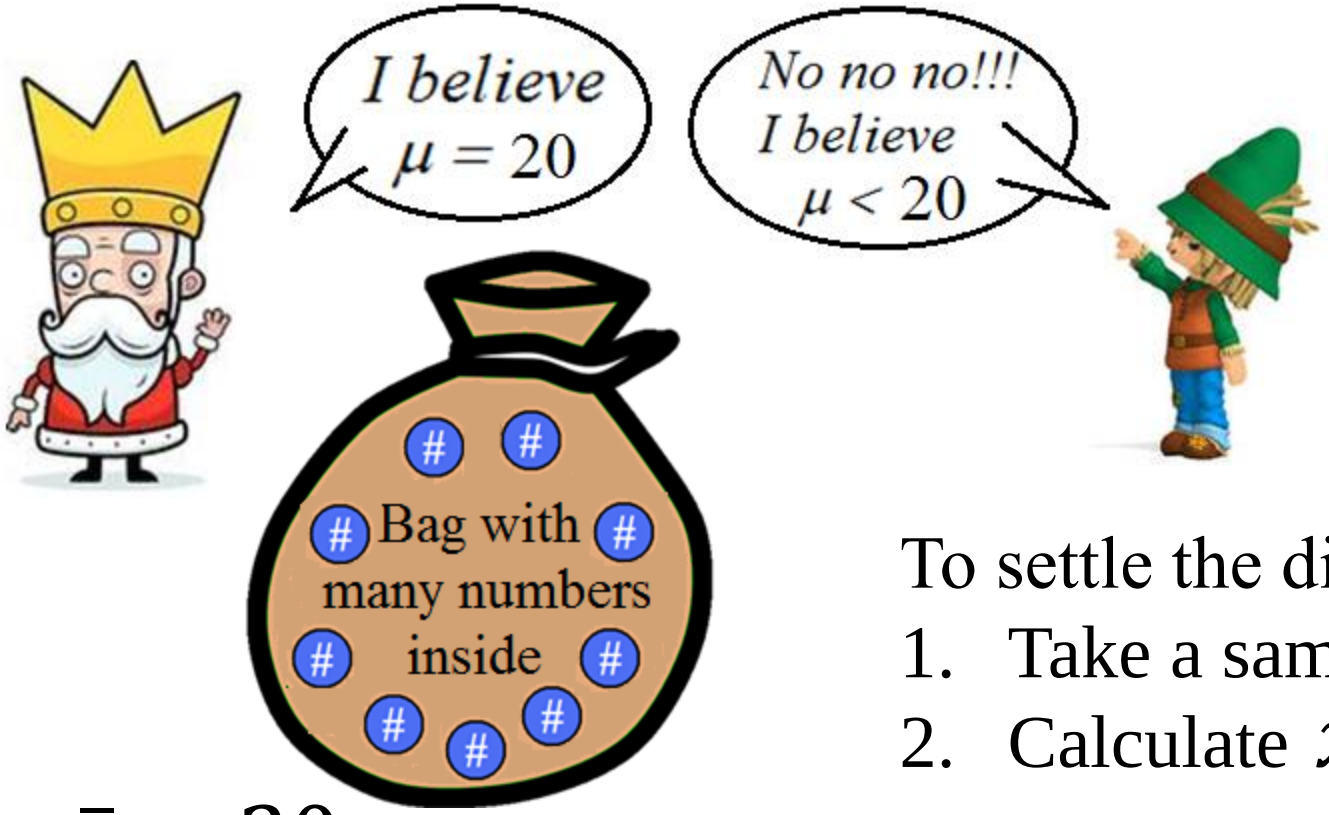
Sec. 10.1: Introduction to Hypothesis Tests

Sec. 10.3: Hypothesis Tests for a Population Mean μ

Idea Behind Hypothesis Tests (for μ)



To settle the dispute…

1. Take a sample (only one)
2. Calculate $\bar{x}$

If $\bar{x} = 20$, believe the king

If $\bar{x} > 20$, believe the king

If $\bar{x} < 20$, it depends!

- If $\bar{x} < 20$ but close to 20, still believe the king
- If $\bar{x} < 20$ but far from 20, then believe the peasant

How Do You Tell If 2 Numbers Are "Close Together" Or "Far Apart"?

Question: Are the numbers 10 and 14 "close together" or "far apart"?

Answer: It depends on the standard deviation σ !!!

If $\sigma = 2$, then 10 and 14 are 2 steps away and so they are close together.

If $\sigma = 0.5$, then 10 and 14 are 8 steps away and so they are far apart.

How Can You Tell How Many "Steps" Apart 2 Numbers Are?

Answer: That's what the *z* –transformation formula

$$Z = \frac{X - \mu}{\sigma}$$ tells you!!

Ex: If the mean of a bunch of numbers is $\mu = 14$ and the standard deviation of those numbers is $\sigma = 0.5$,

a) How many steps away is the data point $X = 10$ from the mean?

b) What does the sign of the answer in part (a) mean?

How Can You Tell How Many "Steps" Apart 2 Numbers Are?

Answer: That's what the *z* –transformation formula

$$Z = \frac{X - \mu}{\sigma}$$ tells you!!

Ex: If the mean of a bunch of numbers is $\mu = 29$ and the standard deviation of those numbers is $\sigma = 0.7$,

a) How many steps away is the data point $X = 33$ from the mean?

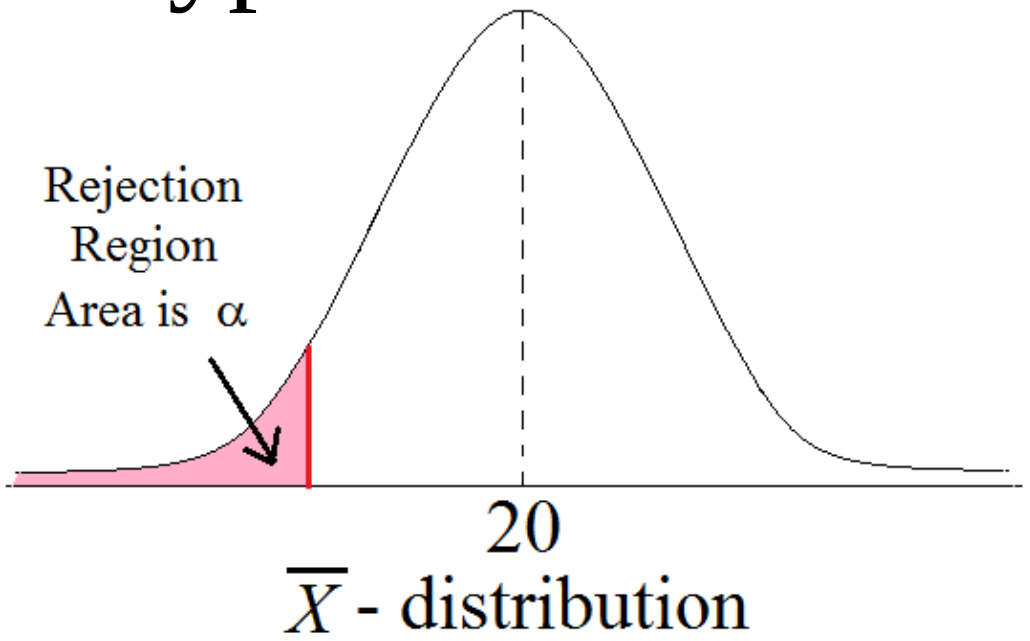
b) What does the sign of the answer in part (a) mean?

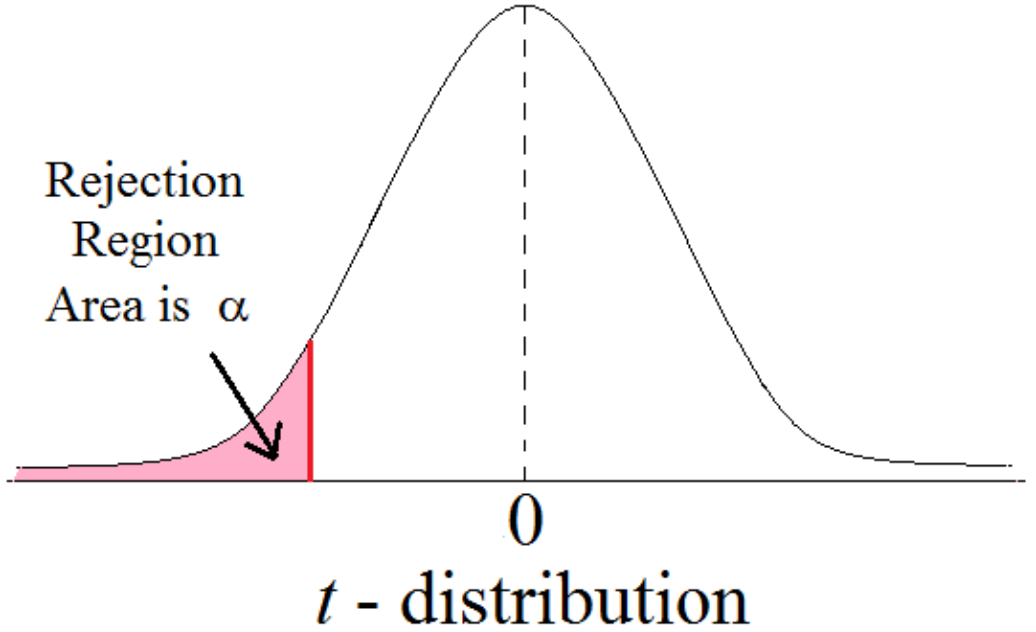
3 Types Of Hypothesis Tests

Left Tailed Test

$H_0: \ \mu = 20$

$H_1: \ \mu < 20$





3 Types Of Hypothesis Tests

Right Tailed Test

$H_0: \ \mu = 20$

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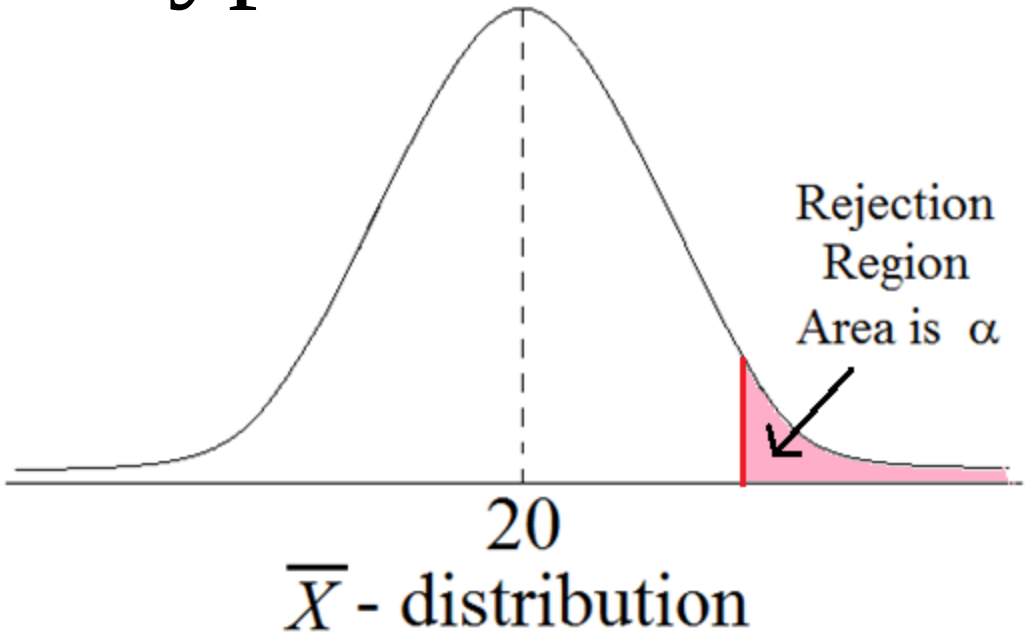
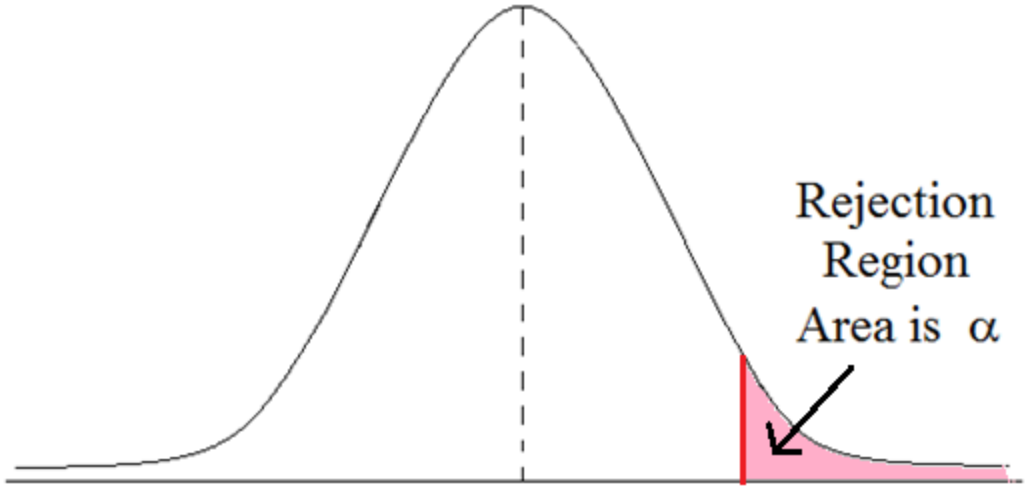


$\overline{X}$ - distribution



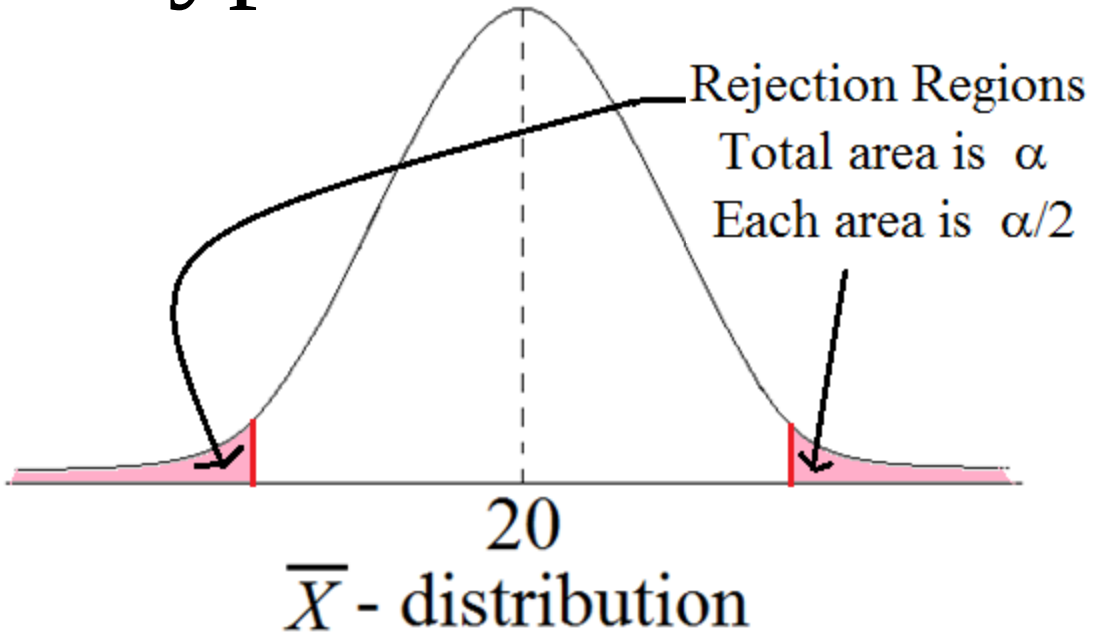
t - distribution

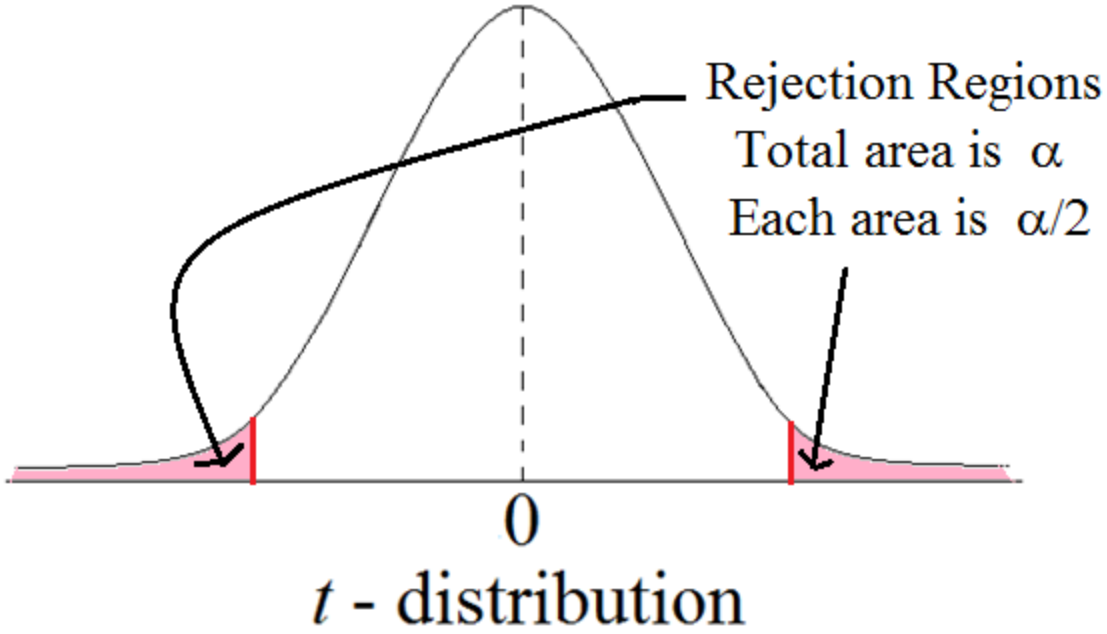
3 Types Of Hypothesis Tests

Two Tailed Test

$H_0: \ \mu = 20$

$H_1: \ \mu \neq 20$





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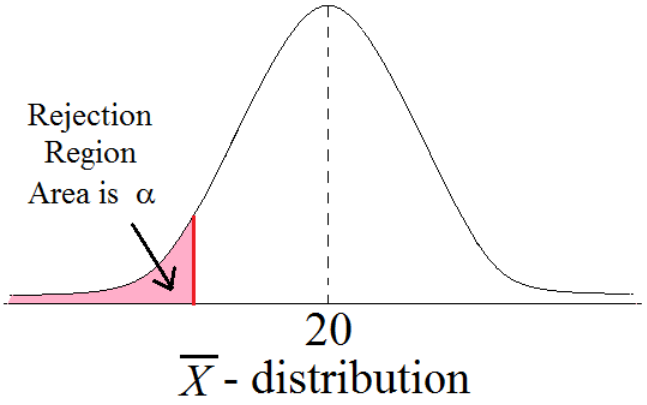

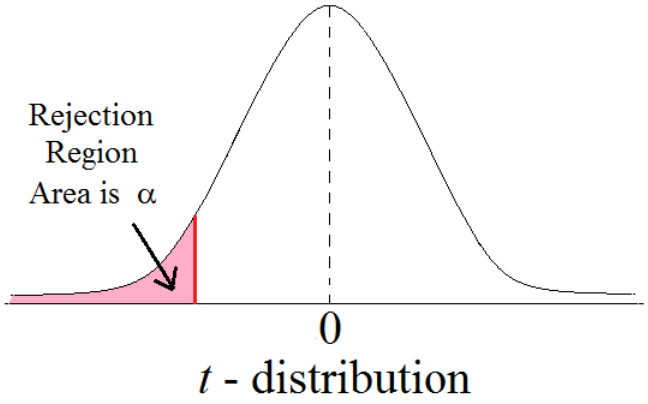

Right Tailed Test

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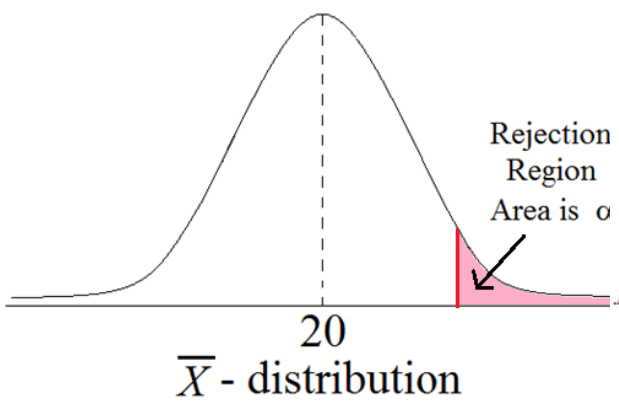

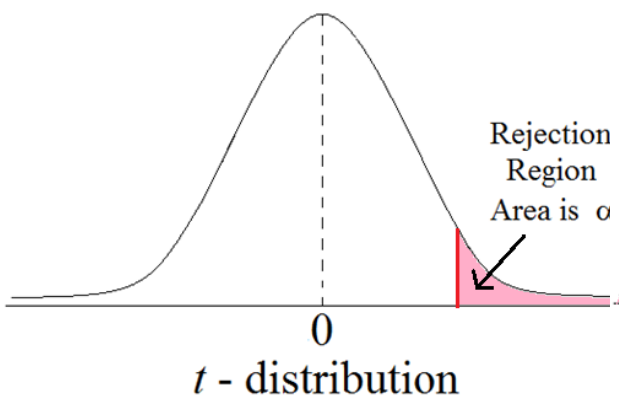

Two Tailed Test

$H_0: \ \mu = 20$

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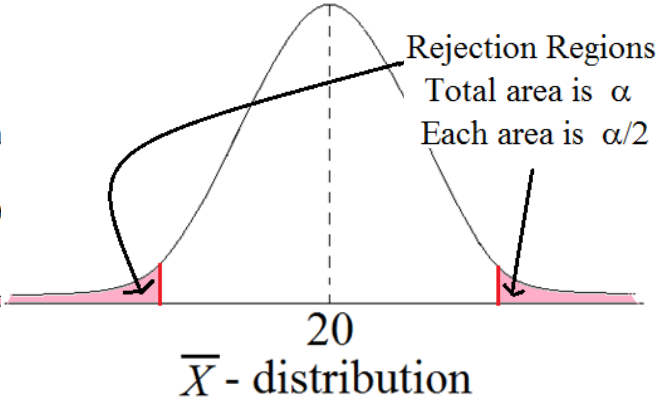
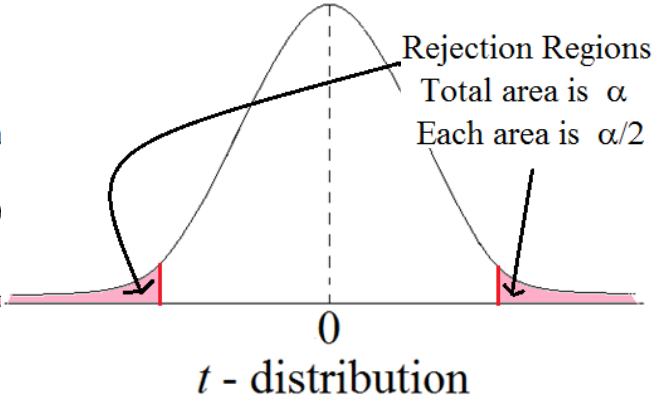




Hypothesis Tests for μ
Formulas and Info

Quantity you are performing a hypothesis test about: μ

Significance level: $\propto$ (helps you determine the cutoff of the rejection region)

Probability distribution: *t* - distribution

Degrees of freedom: $df = n - 1$

Test statistic formula: $t = \dfrac{\bar{X} - \mu}{\dfrac{s}{\sqrt{n}}}$

Condition: Population from which samples are drawn have a NORMAL distribution OR $n \geq 30$

Ex 1 (Sec. 10.3 Hw #18 pg. 504): **TVaholics** According to the American Time Use Survey, the typical American spends 154.8 minutes (2.58 hours) per day watching television. Do Internet users spend less time each day watching television? A survey of 50 Internet users results in a mean time watching television per day of 128.7 minutes, with a standard deviation of 46.5 minutes. Conduct the appropriate test to determine if Internet users spend less time watching television at the $\alpha = 0.05$ level of significance

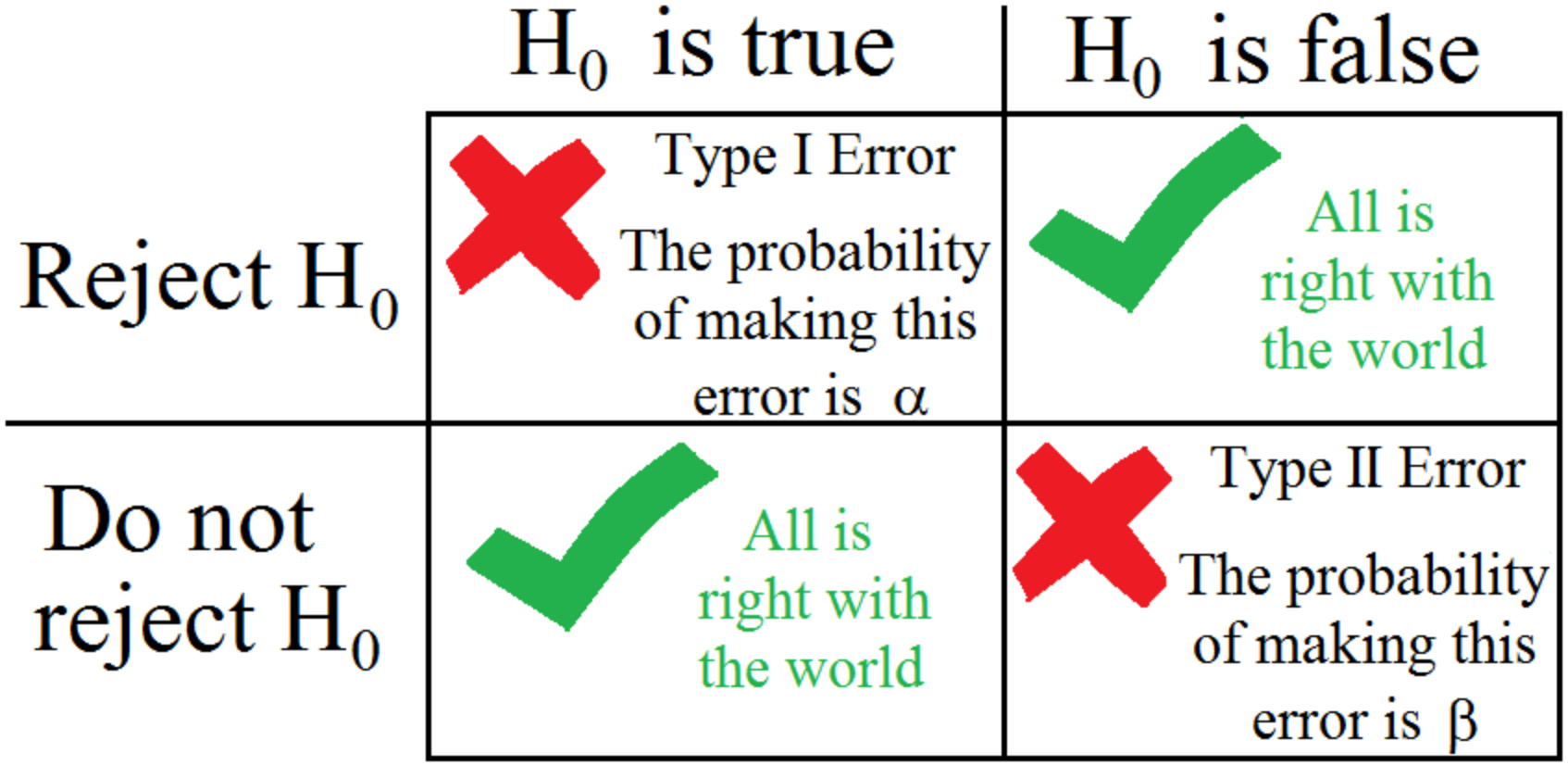
Ex 2 (Sec. 10.3 Hw #22 pg. 504): **Reading Rates** Michael Sullivan, son of the author, decided to enroll in a reading course that allegedly increases reading speed and comprehension. Prior to enrolling in the class, Michael read 198 words per minute (wpm). The following data represent the words per minute read for 10 different passages read after that course.

Reading Rates						
206	217	197	199	210	n =	
210	197	212	227	209	xbar =	
					s =	

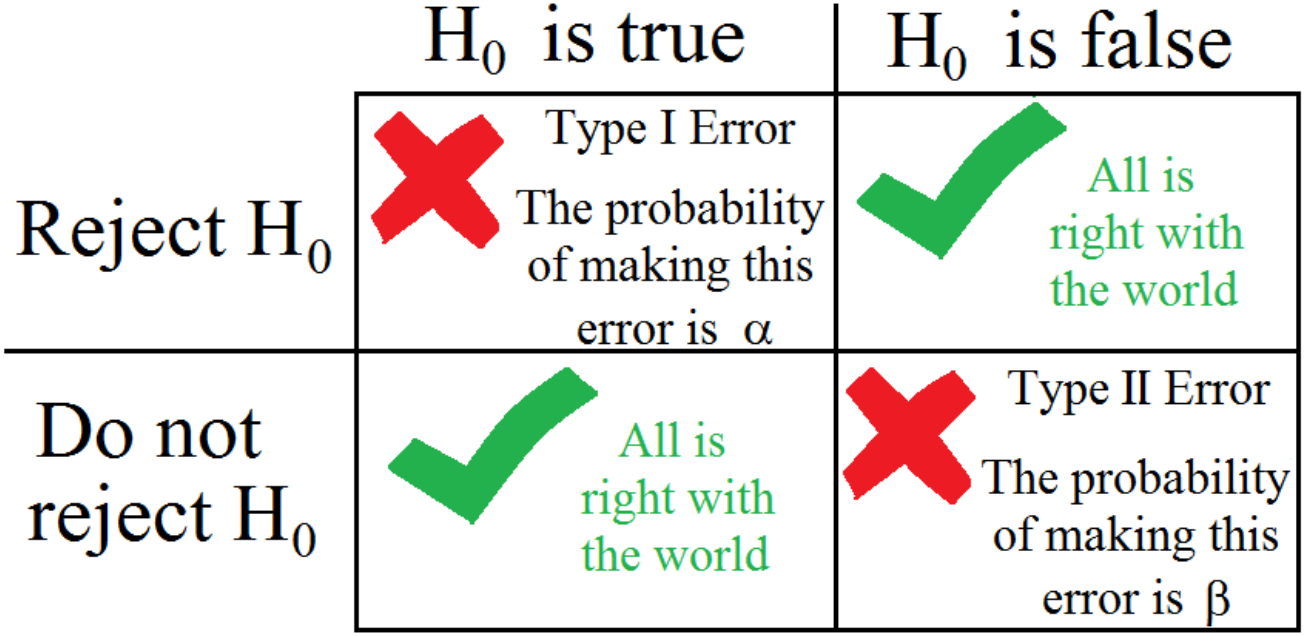
Was the class effective? Use the $\alpha = 0.10$ significance level.

Ex 3 (Sec. 10.3 Hw #19 pg. 504): **Age of Death-Row Inmates** In 2002, the mean age of an inmate on death row was 40.7 years, according to data obtained from the U.S. Department of Justice. A sociologist wondered whether the mean age of death-row inmates has changed since then. She randomly selects 32 death-row inmates and finds that their mean age is 38.9, with a standard deviation of 9.6. At the $\alpha = 0.05$ significance level, test the claim that the mean age of death-row inmates has changed since 2002.

Type I & Type II Errors / Meaning Of The Significance Level



Type I & Type II Errors / Meaning Of The Significance Level



Meaning of the significance level α

If you perform the same hypothesis test many times, each time drawing a new sample, you will reject H_0 when H_0 is true about 100α percent of the time.

P - Values

P – Values is a 2nd way of performing hypothesis tests, without needing to be given a significance level α (why?)

- A P-value is a probability (or an area)
- You always calculate a P-value for a test statistic
- If α is given, then
  - If P-value $\leq \alpha$, reject H_0
  - If P-value $> \alpha$, do not reject H_0
- If α is not given, then if the P-value is small enough (by your judgement), reject H_0
- The P-Value tells you how deep into the rejection region your test statistic is (the smaller the P-value, the further into the rejection region the test statistic is)