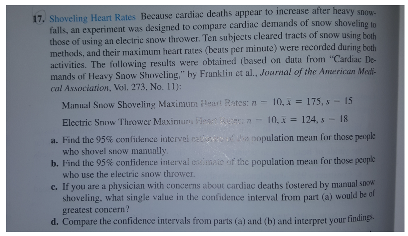
Example 4: This question asks to find the 95% confidence interval estimate of the population



17. Shoveling Heart Rates Because cardiac deaths appear to increase after heavy snowfalls, an experiment was designed to compare cardiac demands of snow shoveling to those of using an electric snow thrower. Ten subjects cleared tracts of snow using both methods, and their maximum heart rates (beats per minute) were recorded during both activities. The following results were obtained (based on data from "Cardiac Demands of Heavy Snow Shoveling," by Franklin et al., *Journal of the American Medical Association*, Vol. 273, No. 11):

Manual Snow Shoveling Maximum Heart Rates: $n = 10, \bar{x} = 175, s = 15$

Electric Snow Thrower Maximum Heart Rates: $n = 10, \bar{x} = 124, s = 18$

a. Find the 95% confidence interval estimate of the population mean for those people who shovel snow manually.
b. Find the 95% confidence interval estimate of the population mean for those people who use the electric snow thrower.
c. If you are a physician with concerns about cardiac deaths fostered by manual snow shoveling, what single value in the confidence interval from part (a) would be of greatest concern?
d. Compare the confidence intervals from parts (a) and (b) and interpret your findings.

mean for those people who shovel snow manually. $n = 10$, $\bar{=}175$, $s = 15$

1. $PE = 175$
2. $SE = 15/\sqrt{10} = 4.7434$
3. $1 - \alpha\% = 95$
4. $CV = 2.262$ from**t-table**using $\alpha/2 = 0.05/2 = 0.025$
5. $LB = PE - (CV)SE = 175 - 10.73 = 164.27$
6. $UB = PE + (CV)SE = 175 + 10.73 = 185.73$
7. **Interpretation:** We are 95% those people who shovel snow manually is within the $LB = 164.27$ and $UB = 185.73$.

pg.290 1st edition pg.308 in 2nd edition

8.4 Sample Size Determination for Sample Mean

We can also find the sample size required to illicit a certain amount of error, confidence, and variation based on the following equation.

$$n = \left[\frac{z_{\alpha/2}\sigma}{ME}\right]^2 \tag{28}$$

1. DETERMINE: Standard Deviation σ
2. DETERMINE: Margin of Error: (ME)
3. STATE Confidence Level: $1 - \alpha\%$
4. DETERMINE Critical Value (CV) from $\alpha/2$
5. CALCULATE Sample Size: $n = \left[\frac{z_{\alpha/2}\sigma}{ME}\right]^2$
6. NOTE: Always, I mean always round up to the nearest whole number
7. **Interpretation:** The sample size required to have a specific standard deviation and margin of error is n.

9 Lecture 10 Notes: Hypothesis Testing for Sample Mean and Proportion

I'm very versatile and there's nothing I really regret in my life. I'm excited with who I am and I'm just going to keep riding the wave. William Leonard Roberts II,

9.1 Theory Behind Hypothesis Testing

Again with a confidence interval, we are creating an interval of plausible values based on data.

Now a Hypothesis Testing is simply a test.

Purpose: We are testing if a parameter value is plausible based on the data.

The idea with a hypothesis testing is that we assume a parameter value to be **TRUE**.

Then we use data as evidence to determine if the data supports our hypothesis or if the data rejects the hypothesis.

We can never prove a hypothesis or be absolutely certain a hypothesis is correct in statistics.

In statistics, we use data to reject or support a hypothesis by defining the **null,** H_0 and **alternative,** H_1 hypotheses.

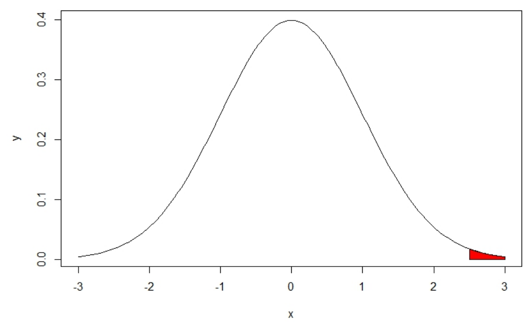
The H_0 is where we define what we are testing (only uses parameters, NOT STATISTICS)
For example:

- $H_0 : \mu = 3.25$ **OR** $H_0 : \mu \leq 3.25$ **OR** $H_0 : \mu \geq 3.25$
- $H_0 : p = 0.672$ **OR** $H_0 : p \leq 0.672$ **OR** $H_0 : p \geq 0.672$
- $H_0 : \sigma = 2.523$ **OR** $H_0 : \sigma \leq 2.523$ **OR** $H_0 : \sigma \geq 2.523$

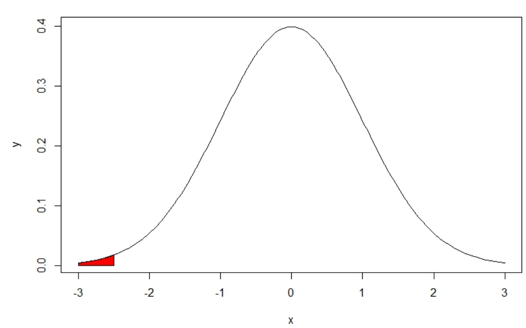
The H_1 is where we the null is not true (essentially the opposite of H_0)
For example:

- $H_1 : \mu \neq 3.25$ (Two-Tailed) **OR** $H_1 : \mu > 3.25$ (One-Tailed) **OR** $H_1 : \mu < 3.25$ (One-Tailed)
- $H_1 : p \neq 0.672$ (Two-Tailed) **OR** $H_1 : p > 0.672$ (One-Tailed) **OR** $H_1 : p < 0.672$ (One-Tailed)
- $H_1 : \sigma \neq 2.523$ (Two-Tailed) **OR** $H_1 : \sigma > 2.523$ (One-Tailed) **OR** $H_1 : \sigma < 2.523$ (One-Tailed)

What does One-Tailed mean graphically? More specifically what does it mean?

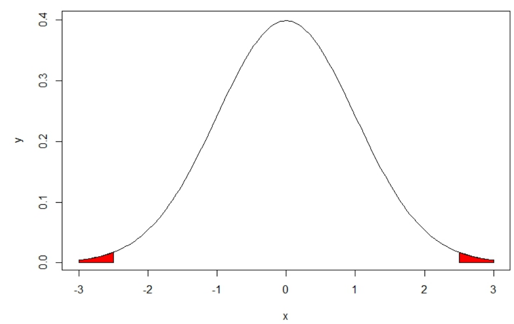


Right: is the reject H_0 region
Left: is the do not reject H_0 region



Left: is the reject H_0 region
Right: is the do not reject H_0 region

What does Two-Tailed mean graphically? More specifically what does it mean?



Left or Right: is the reject H_0 region
Middle: is the do not reject H_0 region

In the real world hypothesis testing is really works by:

- Defining the alternative hypothesis as the event that we are really interested in (in the book, the alternative is called the claim
- While creating our statistical question and hypotheses in such a manner that we want to reject the null hypothesis

If the data supports the null hypothesis **we fail to reject the null hypothesis**

If the data does not support the null hypothesis **we reject the null hypothesis**

NOTICE the statements are center around the null hypothesis

We can make mistakes ... it is totally possible. But what are the consequences?

	True State of Nature	
Decision	H_0 is true	H_0 is false
$Reject H_0$	Type I Error	Correct
Don't Reject H_0	Correct	Type II Error

Probability of a **Type I Error** is called Significance level, symbolically α, is rejecting the H_0 when the H_0 is true, as a researcher you get to define this

Probability of a **Type II Error** is called Power, symbolically $1 - \beta$, is failing to reject the H_0 when the H_0 is false

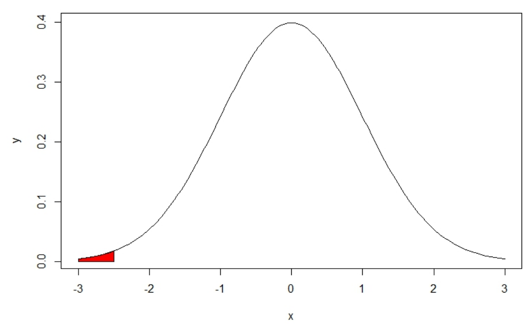
STATISTICAL PROCESS

Most generic process of implementing hypothesis testing to answer a statistical question (used in research and in class):

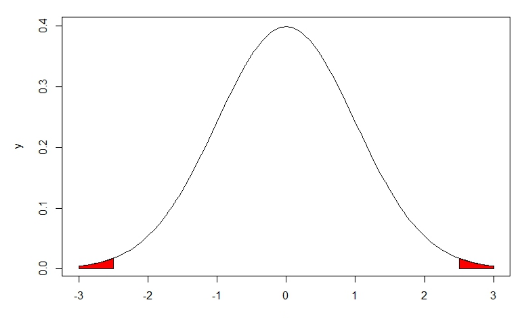
1. **State/Identify the Statistical Question**
   - **Determine the variable(s) of interest**
   - **Determine the type variable(s) (i.e., quantitative or qualitative)**
   - **State/Identify the Hypotheses based on the question at hand (Null and Alternative Hypotheses)**
2. Collect and Manipulate data
3. Extract Information from data
   - Summarize variable(s) (data) visually and numerically
   - Determine Central Tendency, Dispersion and Shape
4. **Perform Statistical Test and Interpret Results**
5. Make inferences/conclusions about Population based results

Process for Hypothesis Testing for this class:

1. Identify and State the Statistical Question
   - Determine the variable(s) of interest
   - Determine the type variable(s) (i.e., quantitative or qualitative)
   - Identify and state the hypotheses (Null and Alternative Hypotheses) based on the question at hand
2. Identify and state level of significance α (the probability of rejecting the H_0 when H_0 is true)



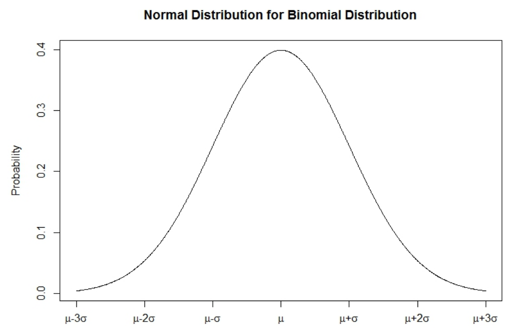
Really IMPORTANT:
- Critical Value:
- α:



Really IMPORTANT:
- Critical Value:
- α:

3. Perform Statistical Test and Interpret Results

Parameter	Test Statistic
Population Proportion (p)	$z = \frac{\hat{p}-p}{\sqrt{\frac{pq}{n}}}$
Population Mean (μ): σ known or unknown	$z = \frac{\bar{x}-\mu}{\frac{\sigma}{\sqrt{n}}}$ or $t = \frac{\bar{x}-\mu}{\frac{s}{\sqrt{n}}}$
Population Standard Deviation	$\chi^2 = \frac{(n-1)s^2}{\sigma^2}$



- Test Statistic:
- p-value:

4. State the sample, null hypothesis, test that was used, and conclusion with non-statistical terms

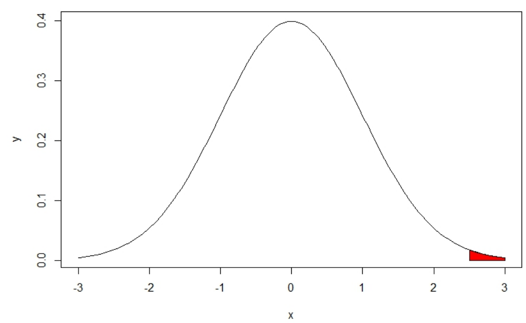
9.2 Hypothesis Testing: Sample Mean

Example 1: Right Tailed

- $n = 40$
- $\bar{x} = 3$
- $s = 4.9$
- $\alpha = 0.01$
- Claim H_1: Mean weight is greater than 0.

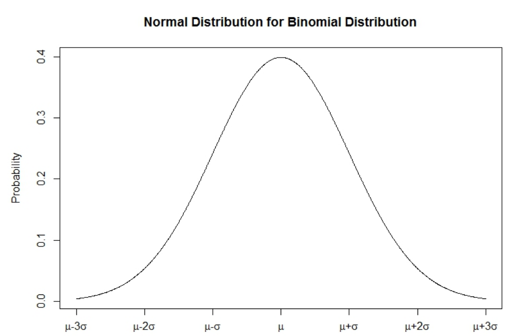
Process for Hypothesis Testing for this class:

1. Identify and State the Statistical Question: **Do weight watchers loss 0 pounds on average?**
   - Determine the variable(s) of interest: **Weight**
   - Determine the type variable(s) (i.e., quantitative or qualitative): Quantitative
   - Identify and state the hypotheses (Null and Alternative Hypotheses) based on the question at hand $H_0 : \mu = 0$ **and** $H_0 : \mu > 0$
2. Identify and state level of significance α (the probability of rejecting the H_0 when H_0 is true): $\alpha = 0.01$



Really IMPORTANT:
   - Critical Value: 2.426
   - α: 0.01
3. Perform Statistical Test and Interpret Results

$$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}} = \frac{3 - 0}{\frac{4.9}{\sqrt{40}}} =$$



   - Test Statistic: 3.872177
   - p-value: ¡0.01
4. State the sample, null hypothesis, test that was used, and conclusion with non-statistical terms