# Chapter 7.2 Day ~~1~~ 2

# Hypothesis Testing for the Mean ($\sigma$ known)

$n=100$ $\bar{x}=36$ $\sigma=4$ $\alpha=.05$

**Hypothesis Testing using P-values**

**Example 1:** $\mu > 35$ mph

Homeowners claim that the mean speed of automobiles traveling on their street is greater than the speed limit of 35 miles per hour. A random sample of 100 automobiles has a mean speed of 36 miles per hour. Assume the population standard deviation is 4 miles per hour. Is there enough evidence to support the claim at $\alpha = 0.05$?

$$\text{test statistic} = z = \frac{\bar{x}-\mu}{\sigma/\sqrt{n}}$$

**a. Step 1: Identify the claim and state $H_0$ and $H_a$.**

Claim: $\mu > 35$mph

$H_0: \mu \leq 35$ mph

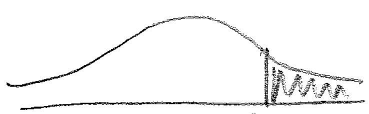
$H_a: \mu > 35$ mph (claim)

**b. Step 2: Find the standardized test statistic z.**

$$z = \frac{36-35}{\frac{4}{\sqrt{100}}} = 2.5$$

$z = 2.5$

**c. Step 3: Find the corresponding P-value.**



2.5

Left-tailed test

p-value $= 1 - .9938$
$= .0062$

**d. Step 4: Decide whether to reject or fail to reject $H_0$.**

$.0062 \leq .05$
reject $H_0$

Reject $H_0$

**e. Step 5: Interpretation**

There is (is/is not) enough evidence at the 5 ($\alpha$) % level of significance to support (reject/support) the claim that

the mean speed of automobiles traveling on their street is greater than the 35mph speed limit.

**Example 2:** $\mu = 3.5$ days $n = 25$ $\bar{x} = 4$ $\sigma = 1.5$

According to a study of employed U.S. adults ages 18 and over, the mean number of workdays missed due to illness or injury in the past 12 months is 3.5 days. You randomly select 25 employed U.S. adults ages 18 and over and find the mean number of workdays missed is 4 days. Assume the population standard deviation is 1.5 days and the population is normally distributed. Is there enough evidence to doubt the study's claim at $\alpha = 0.01$?

$$\text{test statistic} = z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$$

**a. Step 1: Identify the claim and state $H_0$ and $H_a$.**

Claim: $\mu = 3.5$

$H_0: \mu = 3.5$ (claim)

$H_a: \mu \neq 3.5$

**b. Step 2: Find the standardized test statistic z.**

$$z = \frac{4 - 3.5}{\frac{1.5}{\sqrt{25}}} = 1.67$$

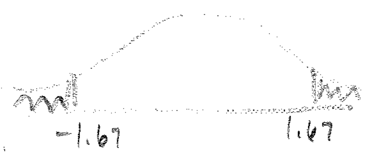
**c. Step 3: Find the corresponding P-value.**

two-tailed test

p-value $= 2(.0475)$

$= .095$

$.095 > .01$




**d. Step 4: Decide whether to reject or fail to reject $H_0$.**

Fail to reject $H_0$

**e. Step 5: Interpretation**

There is not enough evidence at the 1% level of significance to reject the claim that the mean number of workdays missed due to illness or injury in the past 12 months is 3.5 days.

**Hypothesis Testing using Rejection Region(s):** $n = 20$ $\bar{x} = 85900$ $\sigma = 9500$

**Example 3**:

Employees at a construction and mining company claim that the mean salary of the company's mechanical engineers is less than that of one of its competitors, which is $88,200. A Random sample of 20 of the company's mechanical engineers has a mean salary of $85,900. Assume the population standard deviation is $9500 and the population is normally distributed. At $\alpha = 0.05$, test the employees' claim.

$$\boxed{\text{test statistic} = z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}}$$

**a. Step 1: Identify the claim and state $H_0$ and $H_a$.**

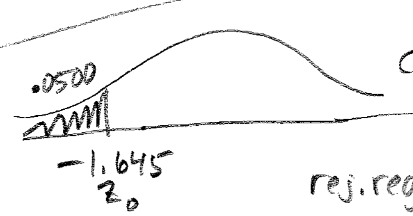
$\mu < 88200$

$H_0: \mu \geq 88200$

$H_a: \mu < 88200$ (claim)

**b. Step 2: Find the critical value(s) and identify the rejection region(s)**

$\alpha = .05$ left-tailed




C.V. $z_0 = -1.645$

rej. reg.: $z < -1.645$

**c. Step 3: Find the standardized test statistic z.**

$$z = \frac{85900 - 88200}{\frac{9500}{\sqrt{20}}} = -1.08$$

**d. Step 4: Decide whether to reject or fail to reject $H_0$.**

Fail to reject $H_0$

$-1.08 > -1.645$

**e. Step 5: Interpretation**

There is not enough evidence at the 5% level of significance to support the claim that the employees at this construction and mining company have a lower mean salary than their competitor.

$n = 32 \quad \bar{x} = 12.9 \quad \sigma = .19$

**Example 4**:

In auto racing, a pit stop is where a racing vehicle stops for new tires, fuel, repairs, and other mechanical adjustments. The efficiency of a pit crew that makes these adjustments can affect the outcome of a race. A pit crew claims that its mean pit stop time (for 4 new tires and fuel) is ~~less than~~ at most 13 seconds. A random sample of 32 pit stop times has a sample mean of ~~12.9~~ 13.1 seconds. Assume the population standard deviation is 0.19 second. Is there enough evidence to support the claim at $\alpha = 0.01$, test the employees' claim.

$$\text{test statistic} = z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$$

**a. Step 1: Identify the claim and state $H_0$ and $H_a$.**

$\mu \leq 13$

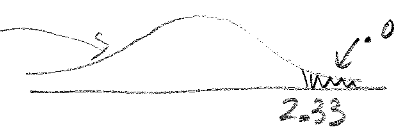
$H_0: \mu \leq 13$ (claim)

$H_a: \mu > 13$

**b. Step 2: Find the critical value(s) and identify the rejection region(s)**

$\alpha = .01$ right-tailed test

$1 - .01 = .9900$




C.V.: $z_0 = 2.33$

rej. reg.: $z > 2.33$

**c. Step 3: Find the standardized test statistic z.**

$$z = \frac{13.1 - 13}{\frac{.19}{\sqrt{32}}} = 2.98$$

$2.98 > 2.33$

**d. Step 4: Decide whether to reject or fail to reject $H_0$.**

Reject $H_0$

**e. Step 5: Interpretation**

There is enough evidence at the 1% level of significance to reject the claim that the mean pit stop time is at most 13 seconds.