## 7-1 Overview

### Definition

- **Hypothesis**

in statistics, is a claim or statement about a property of a population

### Rare Event Rule for Inferential Statistics

If, under a given assumption, the probability of a particular observed event is exceptionally small, we conclude that the assumption is probably not correct.

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## 7-2 Fundamentals of Hypothesis Testing

### Null Hypothesis: $H_0$

- Statement about value of population parameter
- Must contain condition of equality
- $=$, $\geq$, or $\leq$
- Test the Null Hypothesis directly
- Reject $H_0$ or fail to reject $H_0$

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### Alternative Hypothesis: $H_1$

- Must be true if $H_0$ is false
- $\neq$, $<$, $>$
- 'opposite' of Null

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Determine the null and alternative hypothesis for the following statements:

Ex1a) The average women heights is 63.5 inches.
$H_0$:
$H_1$:

Ex1b) Todd scores an average of at least 20 or more points per game.
$H_0$:
$H_1$:

Ex1c) The mean age of a college student is less than 25 years old.
$H_0$:
$H_1$:

Ex1d) The mean age of a antique car in the museum is greater than 35 years old.
$H_0$:
$H_1$:

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### Significance Level

- denoted by $\alpha$
- the probability that the test statistic will fall in the critical region when the null hypothesis is actually true.
- common choices are 0.05, 0.01, and 0.10

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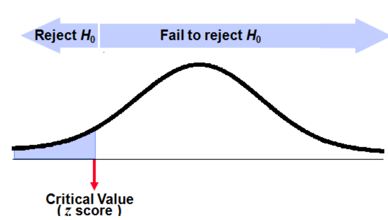
### Critical Value

Value or values that separate the critical region (where we reject the null hypothesis) from the values of the test statistics that do not lead to a rejection of the null hypothesis

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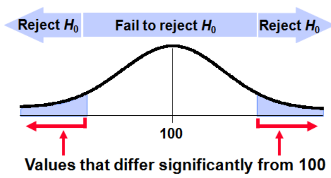
## Two-tailed Test

$H_0$: μ = 100

$H_1$: μ ≠ 100

α is divided equally between the two tails of the critical region

Means less than or greater than

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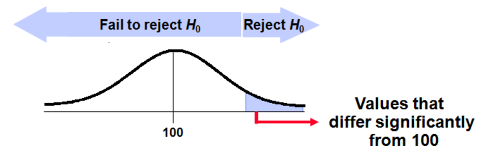
## Right-tailed Test

$H_0$: μ ≤ 100

$H_1$: μ > 100

Points Right

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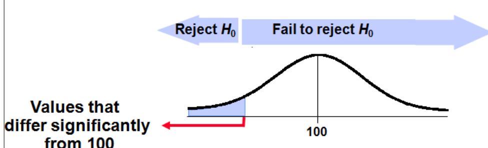
## Left-tailed Test

$H_0$: μ ≥ 100

$H_1$: μ < 100

Points Left

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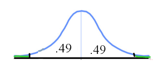
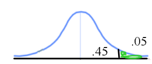
Shaded region is where we would reject, which is $H_1$.

Ex2) Determine the critical value(s).

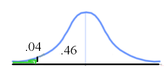
a) 2 tailed test α = .01



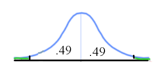

b) right tail and α = 0.5



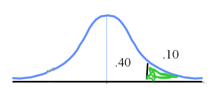

c) α = .04 and $H_o \geq 576$




d) α = .02 and $H_1 \neq 250$




e) α = .10 and $H_1 > 68$

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## Test Statistic

a value computed from the sample data that is used in making the decision about the rejection of the null hypothesis

For large samples, testing claims about population means

$$z = \frac{\bar{x} - \mu_{\bar{x}}}{\frac{\sigma}{\sqrt{n}}}$$

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Ex3) Find the test statistic: $z = \frac{\bar{x} - \mu_{\bar{x}}}{\frac{\sigma}{\sqrt{n}}}$

a)You wish to test the claim that μ > 10 at a level of significance of α = .05 and given n =50, $\bar{x}$ = 10.3, and s = 1.2.

$$z = \frac{10.3 - 10}{\frac{1.2}{\sqrt{50}}}$$

$$= 1.77$$

b) You wish to test the claim that μ ≤ 25 at a level of significance of α = .01 and n = 40, $\bar{x}$ = 26.8 and s = 4.3 .

$$z = \frac{26.8 - 25}{\frac{4.3}{\sqrt{40}}}$$

$$=2.65$$

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## Conclusions in Hypothesis Testing

- always test the null hypothesis
  1. Reject the $H_0$
  2. Fail to reject the $H_0$
- need to formulate correct wording of final conclusion

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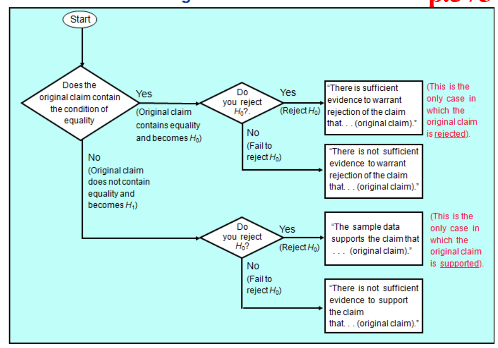
FIGURE 7-4 **Wording of Final Conclusion** **p.375**

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Ex4) Write a statement to reject the $H_0$ and a statement that fails to reject the $H_0$.

Determine the $H_0$ and $H_1$ before determining your statement.

***The final statement should always include the original claim.***

a) The Dean of a major university claims that the mean times for students to earn a Bachelor's degree is at most 5 years.

$H_0$: $H_1$:

reject $H_0$:

☆

fail to reject $H_0$:

☆

b) The mean score for NBA games during a particular season was less than 100 points.

$H_0$: $H_1$:

reject $H_0$:

☆

fail to reject $H_0$:

☆

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c) The mean grade point average of a stats students is greater than 2.9.

$H_0$: $H_1$:

reject $H_0$:

fail to reject $H_0$:

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## Type I Error

- The mistake of rejecting the null hypothesis when it is true.
- $\alpha$ (alpha) is used to represent the probability of a type I error
- Example: Rejecting a claim that the mean body temperature is 98.6 degrees when the mean really does equal 98.6

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## Type II Error

- the mistake of failing to reject the null hypothesis when it is false.
- $\beta$ (beta) is used to represent the probability of a type II error
- Example: Failing to reject the claim that the mean body temperature is 98.6 degrees when the mean is really different from 98.6

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Ex5) Give the type I and II errors for the following examples. It is helpful to identify the $H_0$ and $H_1$ first.

a) The average age for a U.S. president is 54.8 years.

$H_0$: $\mu = 54.8$ $H_1$: $\mu \neq 54.8$

Type I error:

rejecting the $H_0$: $\mu=54.8$, when $\mu = 54.8$

Type II error:

fail to reject $H_o$: $\mu = 54.8$ when $\mu \neq 54.8$

b) The mean score of an NBA basketball game is less than 100 points per game.

$H_0$: $\mu \geq 100$ $H_1$: $\mu < 100$

Type I error:

rejecting $H_0$: $\mu \geq 100$ when $\mu \geq 100$

Type II error:

rejecting $H_0$: $\mu \geq 100$ when $\mu < 100$

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c) Average salary for an engineer is greater than $66,000.

$H_o$: $\mu \leq 66{,}000$ $H_1$: $\mu > 66{,}000$

Type I error:

reject $H_0$: $\mu \leq 66{,}000$, when $\mu \leq 66{,}000$

Type II error:

failure to reject $H_0$: $\mu \leq 66{,}000$, when $\mu > 66{,}000$

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