# P-VALUES AND CAUTIONS ABOUT TESTS

MATH 2300 Sections 9.3, 9.4 and 9.5, Part 2

#### **P-Values**

- The probability of obtaining a test statistic at least as extreme as the test statistic we calculated from the sample.
  - Assuming  $H_o$  is true!!!
- The smaller the P-value, the stronger the evidence against  $\ensuremath{\mathsf{H}_{o}}\xspace.$
- Provide another method to determine whether the null hypothesis should be rejected.

### The Decision Rule

- If the P-Value is less than or equal to α, reject the **null** hypothesis in favor of the alternative.
- If the P-value is greater than α, do **not** reject the null hypothesis.

## Example

- P-Value = 0.1142
- Would you reject H<sub>0</sub> at the following significance levels?
  - α = 0.01
    α = 0.05
    α = 0.10
    α = 0.15





| P-Values for the Z-test:<br>Use Table II |                                      |
|--|--------------------------------------|
| Alternative Hypothe                      | esis P-Value                         |
| $\mu > \mu_o$                            | 1- (proportion less than z)          |
| $\mu < \mu_o$                            | Proportion less than z               |
| $\mu\neq\mu_o$                           | $2^*$ (proportion less than $- z $ ) |



# Formal Steps for a Hypothesis Test Using P-Values

- 1. State  $H_0$  and  $H_a$ .
- 2. Calculate the **test statistic**.
- 3. Calculate the P-value.
- 4. Reach conclusion about  $H_0$  using the decision rule.
- 5. State your conclusion in the context of your specific study.









| P-Values for the Z-test:<br>Use Table IV to Approximate |  |
|---|--|
| P-Value   |  |
| 1- (proportion less than t)                             |  |
| Proportion less than t                                  |  |
| 2*(proportion less than - t )                           |  |
|   |  |





#### **Statistical Significance**

- An event is said to be **statistically significant** if it is unlikely to occur by chance alone.
- If the P-Value < α, then our parameter of interest is significantly different than the value claimed in H<sub>0</sub>.

#### Cautions

- There is no sharp border between "significant" and "insignificant," only increasingly strong evidence as the P-Value decreases.
- Statistical significance is not the same as practical significance.
- Badly designed experiments will produce useless results.
  - $\boldsymbol{\cdot}$  It's important to know how the data was produced.
- As always, be aware of outliers.