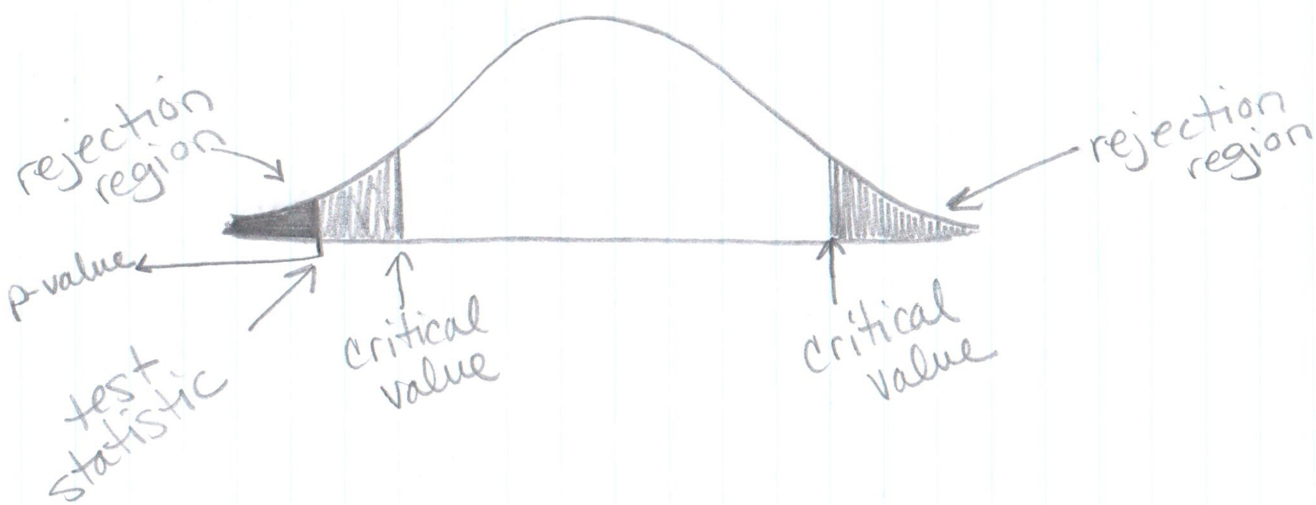
Distribution under the null hypothesis



Select the null and alternative hypotheses for the following tests:

a. Test if the mean weight of cereal differs from 18 ounces.

$H_0: \mu = 18 \quad H_A: \mu \neq 18$

b. Test if the stock price increases on more than 60% of the trading days.

$H_0: p \leq 0.6 \quad H_A: p > 0.6$

c. Test if Americans get an average of less than 7 hours of sleep.

$H_0: \mu \geq 7 \quad H_A: \mu < 7$

Which set of hypotheses are valid?

a. $H_0: \bar{x} \leq 210 \quad H_A: \bar{x} > 210$ — invalid $\bar{x}$
b. $H_0: \mu = 120 \quad H_A: \mu \neq 120$ — valid
c. $H_0: p \leq 0.24 \quad H_A: p > 0.24$ — valid
d. $H_0: \mu < 252 \quad H_A: \mu > 252$ — invalid $H_0 \leq$
e. $H_0: p = 0.12 \quad H_A: p > 0.2$ — invalid must be complements

Select the null and alternative hypotheses for the following claims.

a. "I am going to get the majority of the votes to win this election."

$H_0: p \leq 0.50 \quad H_A: p > .50$

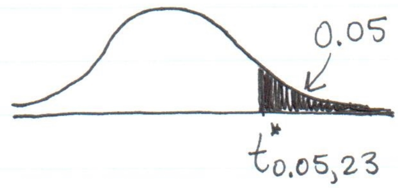
b. I suspect that your 10" pizzas are, on average, less than 10" in size.

$H_0: \mu \geq 10 \quad H_A: \mu < 10$

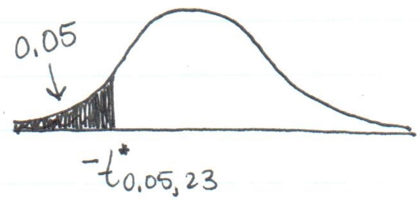
Find the critical values / areas for the following hypothesis tests:

$\alpha = 0.05 \quad n = 24$

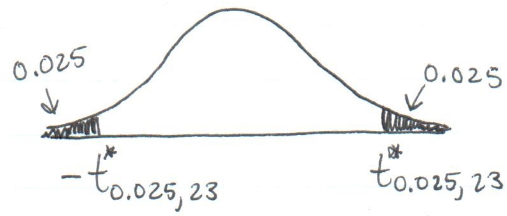
1.714 a. $H_0: \mu \leq 4.5 \quad H_A: \mu > 4.5$



-1.714 b. $H_0: \mu \geq 4.5 \quad H_A: \mu < 4.5$

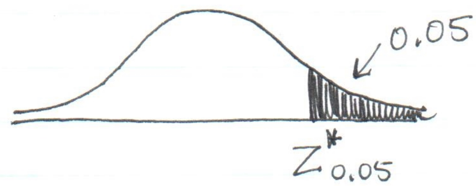


2.069
-2.069 c. $H_0: \mu = 4.5 \quad H_A: \mu \neq 4.5$

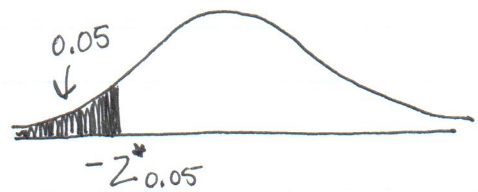


$\alpha = 0.05$

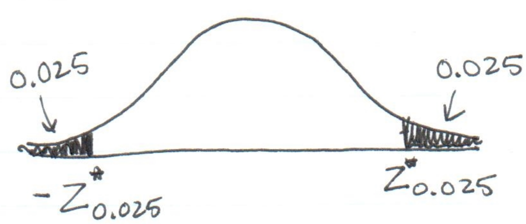
1.645 d. $H_0: p \leq 0.2 \quad H_A: p > 0.2$



-1.645 e. $H_0: p \geq 0.2 \quad H_A: p < 0.2$



± 1.96 f. $H_0: p = 0.2 \quad H_A: p \neq 0.2$



$$t_{df} = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} \qquad z = \frac{\bar{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$$

Calculate the value of the test statistic.

a. $H_0: \mu \le 4.5 \quad H_A: \mu > 4.5$

$\bar{x} = 4.8 \quad s = 0.8 \quad n = 24$

$$t = \frac{4.8 - 4.5}{\frac{0.8}{\sqrt{24}}} = 1.84$$

b. $H_0: p = 0.2 \quad H_A: p \ne 0.2 \qquad \bar{p} = 0.23 \quad n = 30$

$$z = \frac{0.23 - 0.2}{\sqrt{\frac{(0.2)(0.8)}{30}}} = \frac{0.03}{0.073} = 0.411$$

c. $H_0: \mu \ge 200 \quad H_A < 200$

$\bar{x} = 196 \quad s = 0.98 \quad n = 26$

$$t = \frac{196 - 200}{0.98/\sqrt{26}} = \frac{-4}{0.1922} = -20.8$$

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Hypothesis Testing Introductory Exercises

6. Consider the following hypotheses: Compare p-value to α.

   H_0: $\mu \le 210$; H_A: $\mu > 210$

   Approximate the p-value for this test based on the following sample information.

   a. $\bar{x} = 216$; $s = 26$; $n = 40$ $\quad t_{39} = \frac{216-210}{26/\sqrt{40}} = 1.46$ =T.DIST.RT(1.46, 39)
      p-value = 0.0761
   b. $\bar{x} = 216$; $s = 26$; $n = 80$ $\quad t_{79} = \frac{216-210}{26/\sqrt{80}} = 2.06$ =T.DIST.RT(2.06, 79)
      p-value = 0.0213
   c. $\bar{x} = 216$; $s = 16$; $n = 40$ $\quad t_{39} = \frac{216-210}{16/\sqrt{40}} = 2.37$ =T.DIST.RT(2.37, 39)
      p-value = 0.0114

7. Consider the following hypotheses:

   $H_0: \mu = 12$; $H_A: \mu \neq 12$

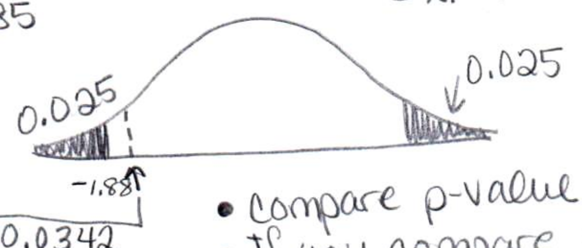
   Approximate the p-value for this test based on the following sample information.

   $t_{35} = \frac{11-12}{3.2/\sqrt{36}} = -1.88$
   a. $\bar{x} = 11$; $s = 3.2$; $n = 36$
      =T.DIST.2T(1.88, 35) = 0.0685

   $t_{35} = \frac{11-12}{2.8/\sqrt{36}} = -2.14$
   b. $\bar{x} = 11$; $s = 2.8$; $n = 36$
      =T.DIST.2T

   $t_{48} = \frac{11-12}{2.8/\sqrt{49}} = -2.5$
   c. $\bar{x} = 11$; $s = 2.8$; $n = 49$

ex. $\alpha = 0.05$



- compare p-value to α
- If you compare 0.0342 to 0.05, you will reject. But -1.88 is not in the critical region. You double the prob. of -1.88 (or less) and compare that to α.

8. Consider the following hypotheses:

   H_0: $p \le 0.5$; H_A: $p > 0.5$

   Approximate the p-value for this test based on the following sample information.

   a. $\bar{p} = 0.55$; $n = 50$
      $z = \frac{0.55-0.5}{\sqrt{\frac{(0.5)(0.5)}{50}}} = 0.71$ =1 - NORM.S.DIST(0.71, 1) = 0.2389
   b. $\bar{p} = 0.55$; $n = 200$
      $z = \frac{0.55-0.5}{\sqrt{\frac{(0.5)(0.5)}{200}}} = 1.41$ =1 - NORM.S.DIST(1.41, 1) = 0.0793

9. A polygraph (lie detector) is an instrument used to determine if the individual is telling the truth. These tests are considered to be 95% reliable. In other words, if an individual lies, there is a 0.95 probability that the test will detect a lie. Let there also be a 0.005 probability that the test erroneously detects a lie even when the individual is actually telling the truth. Consider the null hypothesis, "the individual is telling the truth," to answer the following questions.

   reject a true null →
   a. What is the probability of Type I error? 0.005
      Detect a lie when telling truth.

   fail to reject a false null
   b. What is the probability of Type II error?
      Does not detect a lie when lying 0.05

Reality

Test	Truth	Lie
Lie H_A	0.005 TYPE I	0.95
Truth H_0	0.995	0.05 TYPE II
	1	1