Name: _____ Hour: _____ Date: _____

Lesson 10.2: Day 3: Does labeling menus reduce calories?

According to a Stanford Business article, Americans may eat fewer calories at restaurants if the calories of the food items are labeled on the menu. To investigate this, researchers compared Starbucks receipts from locations where the menus were labeled to receipts from stores where the menus were not labeled. A random sample of 30 receipts from stores with the menus labeled had an average number of calories of 225 calories with a standard deviation of 100 calories. A random sample of 40 receipts from stores without menus labeled showed an average of 265 calories per receipt with a standard deviation of 75 calories. Does this provide convincing evidence that the average calories per receipt at a store with a labeled menu is less than at a store without labeled menus?

STATE: Parameter: $\mu_1 - \mu_2$ = true difference in mean calorie intake Statistic: $\bar{x}_1 - \bar{x}_2 = 225 - 265 = -40$

Hypotheses:

$H_0: \mu_1 - \mu_2 = 0$

$H_a: \mu_1 - \mu_2 < 0$

Significance level: .05

PLAN: Name of procedure: Two sample t interval for $\mu_1 - \mu_2$

Check conditions:

Random — "Random sample of 30 & 40"

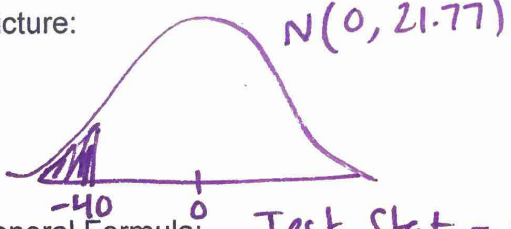
10% — $30 < \frac{1}{10}$ all receipts; $40 < \frac{1}{10}$ all receipts

Normal — $30 \geq 30$, $40 \geq 30$ CLT.

DO: Mean: $\mu_1 - \mu_2 = 0$

Standard deviation: $SE_{\bar{x}_1 - \bar{x}_2} = \sqrt{\frac{100^2}{30} + \frac{75^2}{40}} = 21.77$

Picture:



General Formula: $\text{Test Stat} = \frac{\text{Stat} - \text{Null}}{SD}$

Specific Formula: $t = \frac{\bar{x}_1 - \bar{x}_2 - 0}{SE_{\bar{x}_1 - \bar{x}_2}}$

Work: $t = \frac{-40 - 0}{21.77} = -1.84$

Test statistic: $t = -1.84$

P-value: .038

CONCLUDE: Assuming there is no difference in the average number of calories between the stores, there is a .038 prob. of getting a difference of -40 calories or less purely by chance.

Because 0.038 < 0.05, we reject Ho and have convincing evidence that the average calories per receipt at a store with a labeled menu is less than at a store without labeled menus.

Name: _____ Hour: _____ Date: _____

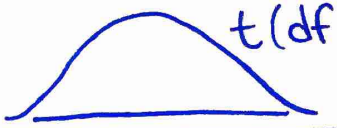
Lesson 10.2 Day 3– Significance Test for a Difference in Means

Important ideas:

LT #1

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

P-value → tcdf(lower t, upper t, df)



Check Your Understanding

How quickly do synthetic fabrics such as polyester decay in landfills? A researcher buried polyester strips in the soil for different lengths of time, then dug up the strips and measured the force required to break them. Breaking strength is easy to measure and is a good indicator of decay. Lower strength means the fabric has decayed more. For one part of the study, the researcher buried 10 strips of polyester fabric in well-drained soil in the summer. The strips were randomly assigned to two groups: 5 of them were buried for 2 weeks and the other 5 were buried for 16 weeks. Here are the breaking strengths in pounds:

Group 1 (2 weeks)	118	126	126	120	129
Group 2 (16 weeks)	124	98	110	140	110

Do the data give convincing evidence that polyester decays more in 16 weeks than in 2 weeks, on average

State: $\mu_1 - \mu_2$ → true diff. in means

$H_0: \mu_1 - \mu_2 = 0$

$H_a: \mu_1 - \mu_2 > 0$

$\bar{x}_1 - \bar{x}_2 = 123.8 - 116.4 = 7.4$

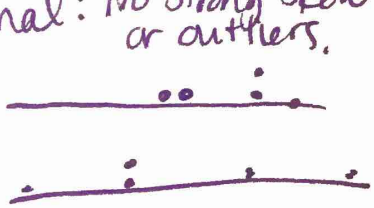
$\alpha = .05$

Plan: Two sample t test for $\mu_1 - \mu_2$

Random: "Randomly Assigned"

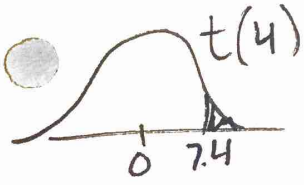
10%: Not needed, Independent

Normal: No strong skew or outliers.



Do:

$$\text{test stat} = \frac{\text{Stat} - \text{Null}}{SD} = \frac{\bar{x}_1 - \bar{x}_2 - 0}{SE_{\bar{x}_1 - \bar{x}_2}}$$



$$= \frac{7.4 - 0}{\sqrt{\frac{4.60^2}{5} + \frac{16.09^2}{5}}} = .99 \rightarrow p\text{-value} = .189$$

Conclude: Assuming there is no difference in means, there is a .189 probability of getting a difference of sample means of 7.4 or more purely by chance. This is not statistically significant (.189 > .05). We fail to reject the null and can't conclude polyester decays more in 16 weeks than in 2 weeks.