AP Statistics
Ch. 11 Tests about Means

One-Sample t Test for Means

1. Abby and Raquel like to eat sub sandwiches. However, they noticed that the lengths of the "6-inch sub" sandwiches they get at their favorite restaurant seemed shorter than the advertised length. To investigate, they randomly selected 24 different times during the next month and ordered a "6-inch" sub. Here are the actual lengths of each of the 24 sandwiches (in inches):

4.50	4.75	4.75	5.00	5.00	5.00	5.50	5.50
5.50	5.50	5.50	5.50	5.75	5.75	5.75	6.00
6.00	6.00	6.00	6.00	6.50	6.75	6.75	7.00

(a) The sample mean, $\bar{x} = 5.68$. What are the two explanations for why $\bar{x}$ is less than 6 inches?

(b) Do these data provide convincing evidence at the $\alpha = 0.10$ level that the sandwiches at this restaurant are shorter than advertised, on average? Summary information is given below.

$\bar{x} = 5.68$ $s = .657$ A dotplot of the data is symmetric with no outliers.

(c) Given your conclusion in part (a), which kind of mistake—a Type I or a Type II error—could you have made? Explain what this mistake would mean in context.

Two Sample t-Test for $\mu_1 - \mu_2$

2. 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 Starbucks with a labeled menu is less than at a Starbucks without labeled menus?

Difference Between Two Means vs. Mean Difference

3. In each of the following settings, decide whether you should use two-sample t procedures to perform inference about a difference in means or paired t procedures to perform inference about a mean difference. Explain your choice.

(a) Luke's taco shop is considering a switch to a new tortilla that supposedly has a larger diameter. To test this claim, Luke takes a random sample of 50 of the old tortillas and 50 of the new tortillas and records the diameter of each.

(b) Luke's taco shop wants to be sure that the new tortillas taste better than the old tortillas. Luke selects a random sample of 20 regular customers. Each customer is asked to try both tortillas and then record a "taste" score for each. The order in which the customers try the two tortillas is randomized.

(c) Luke's taco shop is not sure whether to cook the tortillas in the oven or on the grill. The chefs want tortillas to cook as quickly as possible. Luke sets up an experiment taking a batch of 50 tortillas and randomly assigning half of them to be cooked one at a time in the oven and half of them to be cooked one at a time on the grill. The time it takes until ready to serve is recorded for each tortilla

4. Does drying barley seeds in a kiln increase the yield of barley? A famous experiment by William S. Gosset (who discovered the t distributions) investigated this question. Eleven pairs of adjacent plots were marked out in a large field. For each pair, regular barley seeds were planted in one plot and kiln-dried seeds were planted in the other. A coin flip was used to determine which plot in each pair got the regular barley seed and which got the kiln-dried seed.

Do the data provide convincing evidence that drying seeds increases yield at the $\alpha = 0.05$ level? Assume the conditions for inference are met.

Plot	Regular	Kiln
1	1903	2009
2	1935	1915
3	1910	2011
4	2496	2463
5	2108	2180
6	1961	1925
7	2060	2122
8	1444	1482
9	1612	1542
10	1316	1443
11	1511	1535