Lesson 10.2.2

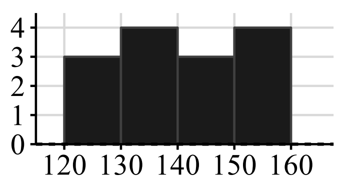
10-31. a. Random is met, as is the large sample size condition, but the independent trials condition is not; because her population is so small relative to her sample size, Summer's calculations are not reliable. She could rectify this by drawing with replacement, even though that would potentially mean counting some students twice!

b. Random sampling is met, and "huge display" seems to satisfy the independent trials condition, but $n = 14$ is too small to satisfy large sample size, and without more information about the population you cannot continue.

c. This works! Random condition is satisfied by "mixed up bag," independent trials is satisfied by "very large," and the sample size > 30, satisfying large sample size. Anna can use the normal approximation to the sampling distribution of the average year.

d. This is not really a quantitative variable, so there is no mean to do inference on! It satisfies all of the conditions for *proportion* inference, however.

10-32. a. 140.93 g

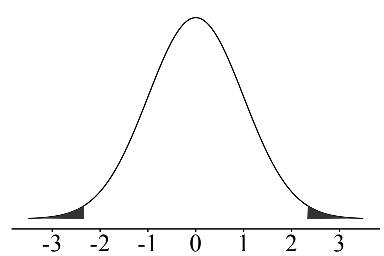
b. 

c. Yes. No outliers, any skew is very minimal.

d. H_0: $\mu = 131$ g and $\sigma = 18$ g (μ and σ being the mean and SD of the Fresh Food oranges). H_A: $\mu \neq 131$ g and/or $\sigma \neq 18$ g.

e. $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{18}{\sqrt{14}} \approx 4.81$ g. So Latavia's average of 140.93 has a z-score of $\frac{140.93-131}{4.81} \approx 2.06$.

f. This is a two-tailed test. The p-value about 0.04, so Latavia can reject the null hypothesis. See diagram at right.



g. Since the p-value < α, Latavia can reject the null hypothesis. The Fresh Foods oranges do not follow the same distribution as the numbers she found online. However, she cannot be sure if the mean, standard deviation, or both are the incorrect values at this point!

h. Latavia could have made a Type I error, since she rejected the null hypothesis. If she did, then she will think Fresh Foods does not follow the published distribution, even though it does.

10-33. The confidence interval is (131.5, 150.36) or 140.93 ± 9.43 g.

10-34. a. It is likely left-skewed, as evidenced by the fact that the median of this sample is higher than the mean. It also makes sense that it would be so, since there are probably more newer pennies than older pennies, but older pennies can trail off for many years to the left.

b. The Central Limit Theorem says that as long as the sample size is large enough the shape of the sampling distribution is approximately normal. 100 is a very large sample size.

c. $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{16.2}{\sqrt{100}} = 1.62$ years. The confidence interval is therefore $1992.32 \pm 1.96 \cdot 1.62 = 1992.32 \pm 3.18$ years or (1989.15, 1995.50).

10-35. a. Identify: One sample z-interval. Given: $\bar{x} = 147$, $\sigma = 32$, $n = 12$.
Check conditions: Random selection, to avoid bias—given in problem. Independent trials, for an accurate σ—assumed thousands of liters are discharged daily. Large sample, so the sampling distribution is ≈ normal—normality given in problem.
Calculate: $147 \pm 1.96(\frac{32}{\sqrt{12}}) = (129 < \mu < 165)$ cfu/100 mL.

Conclude: With 95% confidence the mean *E. coli* discharge was between 129 and 165 cfu/100 mL.

b. The claim ($x > 175$) is completely outside of the confidence interval so it can be rejected with at least 95% certainty.

10-36. a. standard deviation of mean $= \frac{\sigma}{\sqrt{n}} = \frac{50}{10} \approx 5$ g. For a 95% confidence interval the critical value is 1.96, so the margin of error will be about 9.8 g.

b. Margin of error inequality is $1.96 \cdot \frac{50}{\sqrt{n}} < 5$. Solving for n yields $n > 384.16$, so she will need a sample of at least 385 apples.

c. Random selection, to avoid bias—condition is met. Independent trials, for an accurate σ—condition is likely met, assuming it is a large orchard. And the large sample size, so the sampling distribution is ≈ normal—condition is met. Therefore the confidence interval is $185.2 \pm 1.96 \cdot \frac{50}{\sqrt{400}} = 185.2 \pm 4.9$ g.
$(180.3 < \mu < 190.1)$ g

d. 190 g is in the confidence interval, barely, so the apples *could* reasonably be the same size, on average.

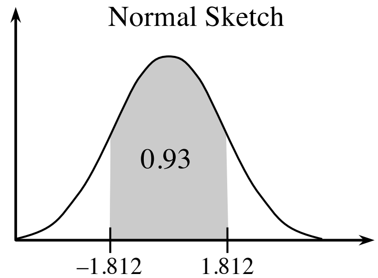
10-37. a. If the point of the study were to establish cause and effect, an experiment would be most appropriate.

b. Explanatory variable: using a calculator or not; response variable: score on an arithmetic test.

c. Randomly assign subjects to one of two treatment groups. One group will take an arithmetic test using a calculator; the other group will not use a calculator on the test. Researchers will compare average test scores from each treatment group. This could also be done as a matched pairs test by then switching the test and control groups and measuring the difference of the scores for each person.

10-38. Identify: One proportion confidence interval.

Given: $n = 684$, $x = 497$, $\hat{p} = 0.727$. See sketch at right.



Check conditions: Random selection, to avoid bias—"randomly" was mentioned in the problem description with regards to sampling technique. Independent trials, for an accurate σ—it must be assumed that the population of interest is larger than ten times the sample size of 684. Large counts, so the sampling distribution is ≈ normal— $n\hat{p} = 497$ and $n(1 - \hat{p}) = 187$, which are both at least 10.

Calculate: $\text{SE} = \sqrt{0.7266\left(\frac{1-0.7266}{684}\right)} = 0.0170$, $z^* = \text{invnorm}(0.965, 0, 1) = 1.812$,

$\text{CI} = \hat{p} \pm (z^*)(\text{SE}) = 0.727 \pm (1.812)(0.0170) = (0.6957 < p < 0.7575)$.

Conclude: Students are 93% confident the interval from 0.6957 to 0.7575 contains the population proportion of people who have the ability to curl their tongue.

