Chapter 10: Hypothesis Tests Regarding a Parameter

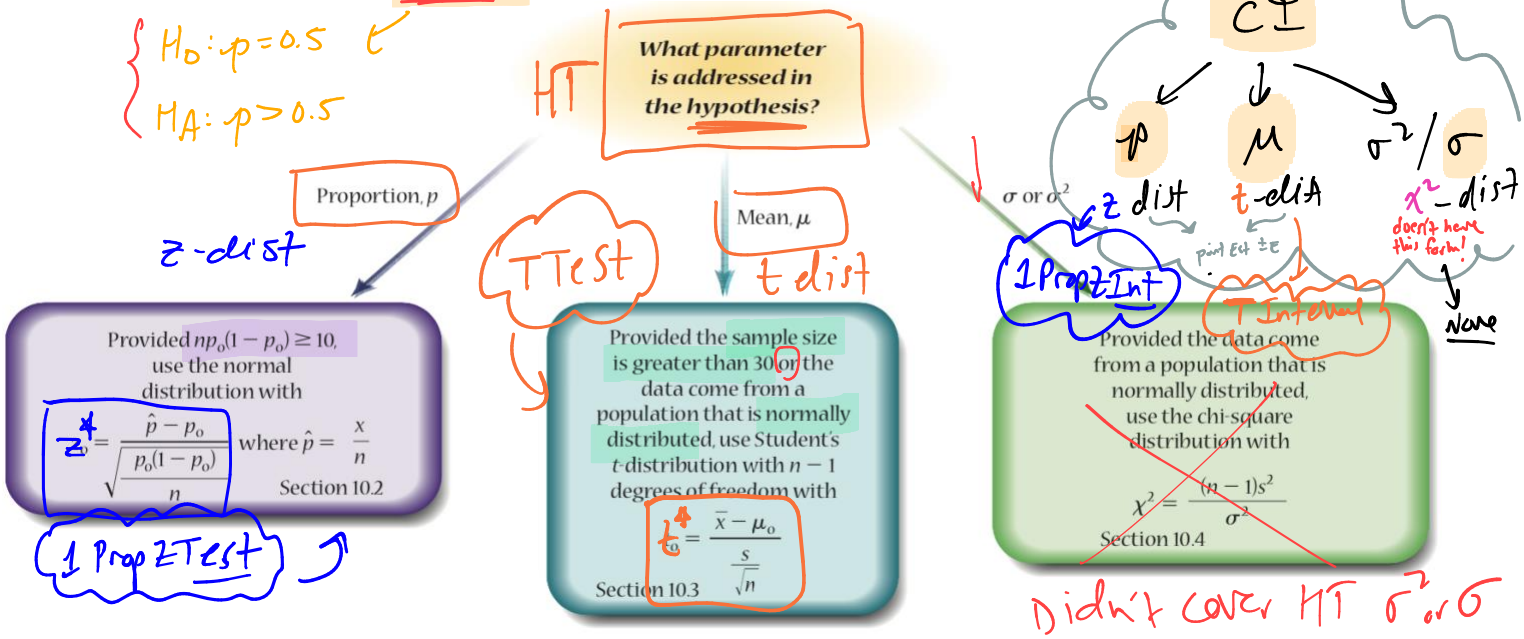
Section 10.5: Which method do I use?

GOAL: Help determine which method to use when reading word problems.

To determine which kind of statistical inference you need to do, be on the look-out for specific phrasing:

Two types of inference:

1. Confidence Intervals (CI):
   - "find the CL% **confidence interval** for (parameter)"
   - "**estimate** the value of (fill-in parameter)… with a confidence level of…."
2. Hypothesis tests (HT):
   - "**test the claim** about (fill-in parameter)…"
   - "do we think the (parameter) **has gotten smaller/has changed/has gotten bigger**?"
   - "determine if a **majority** of …. believe ….." This is specific to proportions.



Important Note on Notation: I use z^* or t^* to denote the test statistics for proportions and means, respectively.

Practice Problems

Instructions: For each of the following problems:

(i) state the parameter;
(ii) determine the type of inference (CI or HT);
   - if CI, state the point estimate
   - if HT, state both hypotheses

(iii) which calculator functions do you need to use?
(iv) Use your calculator to answer the problem; either state the conclusion of a hypothesis test or give the confidence interval (no work necessary)

1. **The Atomic Bomb** In October 1945, the Gallup organization asked 1487 randomly sampled Americans, "Do you think we can develop a way to protect ourselves from atomic bombs in case other countries tried to use them against us?" with 788 responding yes. Did a majority of Americans feel the United States could develop a way to protect itself from atomic bombs in 1945? Use the $\alpha = 0.05$ level of significance.

i) parameter? proportion

ii) CI or HT? Hyp Test!

past proportion $p_0 = \frac{788}{1487} = 0.530$

$\begin{cases} H_0: p = 0.5 \\ H_A: p > 0.5 \end{cases}$ (Right Tailed Test)

iii) 1 Prop Z Test

iv) Calc side:

$z^* = 2.3$

$P = 0.0105$

$\alpha = 0.05$

$P < \alpha \rightarrow$ Plow, Null so Reject H_0

2. **Click It** Based on a poll conducted by the Centers for Disease Control, 862 of 1013 randomly selected adults said that they always wear seat belts. Construct and interpret a 95% confidence interval for the proportion of adults who always wear seat belts.

i) • parameter? proportion

ii) • CI or HT? CI $\Rightarrow (\hat{p} - E, \hat{p} + E)$ → z-dist / ~~T-MEAN~~

point est: $\hat{p} = \frac{862}{1013} = 0.851$

iii) 1 Prop Z Int

iv) CI: $(0.829, 0.873)$

3. A simple random sample of size $n = 19$ is drawn from a population that is normally distributed. The sample mean is found to be 0.8, and the sample standard deviation is found to be 0.4. Test whether the population mean is less than 1.0 at the $\alpha = 0.01$ level of significance.

i) • parameter? mean μ

ii) • CI or HT? Hyp Test

μ_0

$\begin{cases} H_0: \mu = 0.1 \\ H_A: \mu < 0.1 \end{cases}$ (Left Tailed Test)

iii) T Test

iv) calc: $t^* = 7.63$

$P = 2.38 \times 10^{-7} = 0.000\,000\,238$

$\alpha = 0.01$

$P < \alpha \rightarrow$ Plow, Null so Reject H_0

4. **Course Redesign** Pass rates for Intermediate Algebra at a community college are 52.6%. In an effort to improve pass rates in the course, faculty of a community college develop a mastery-based learning model where course content is delivered in a lab through a computer program. The instructor serves as a learning mentor for the students. Of the 480 students who enroll in the mastery-based course, 267 pass. $\hat{p} = 267/480 = 0.556$

$p_0 = 0.526$ "past proportion"

(a) What is the variable of interest in this study? What type of variable is it?

(b) At the 0.01 level of significance, decide whether the sample evidence suggests the mastery-based learning model improved pass rates. } HT

(c) Explain why a 0.01 level of significance might be used to test this hypothesis. Relive

i) • parameter? proportion p

ii) • CI or HT? Hyp Test

$\begin{cases} H_0: p = 0.526 \\ H_A: p > 0.526 \end{cases}$ (Right Tailed Test)

iii) 1-Prop Z Test

iv) Calc: $z^* = 1.33$

$P = 0.0922$

$\alpha = 0.01$

$P > \alpha \rightarrow$ Phigh, Null fly

Fail to Reject H_0

5. **Theme Park Spending** In a random sample of 40 visitors to a certain theme park, it was determined that the mean amount of money spent per person at the park (including ticket price) was $93.43 per day with a standard deviation of $15. Construct and interpret a 99% confidence interval for the mean amount spent daily per person at the theme park.

iii)

i) • parameter? mean μ

ii) • CI or HT? Confidence Int.

point est: $\bar{x} = \$93.43$ per day

6. **Annoying Behavior** In March 2014, Harris Interactive conducted a poll of a random sample of 2234 adult Americans 18 years of age or older and asked, "Which is more annoying to you, tailgaters or slow drivers who stay in the passing lane?" Among those surveyed, 1184 were more annoyed by tailgaters.

$\hat{p} = 1184/2234 = 0.530$ $\quad \hat{q} = 1-\hat{p} = 0.47$

outcomes: tailgating, slow pokes

(a) Explain why the variable of interest is qualitative with two possible outcomes. What are the two outcomes?

(b) Verify the requirements for constructing a 90% confidence interval for the population proportion of all adult Americans who are more annoyed by tailgaters than slow drivers in the passing lane.

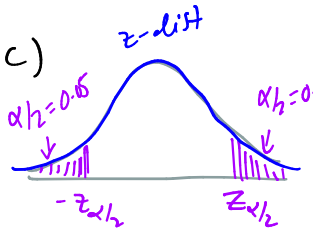
(c) Construct a 90% confidence interval for the population proportion of all adult Americans who are more annoyed by tailgaters than slow drivers in the passing lane.

a) variable: answer to poll Q.

b) Verify Req.

- SRS? ✓
- Independt? $n \le 0.05N$ $n = 2234$ ✓
- $n\hat{p}\hat{q} \ge 10$? ✓ $2234\left(\frac{1184}{2234}\right)\left(1-\frac{1184}{2234}\right)$ $= 556.5 \ge 10$

c)



Critical Value

$z_{\alpha/2} = z_{0.05} = \text{invNorm}(0.05, 0, 1, R) = 1.64$

CL = 0.9

$\alpha = 1 - CL = 0.1$

$\alpha/2 = 0.05$

Error $E = z_{\alpha/2}\sqrt{\frac{\hat{p}\hat{q}}{n}}$

$E = 1.64 * \sqrt{\frac{0.53 * 0.47}{2234}} = 0.0173$

CI $(\hat{p} - E, \hat{p} + E)$

- $\hat{p} = 0.53$
- $E = 0.0173$

$(0.5127, 0.5473)$

$(0.513, 0.547)$

• parameter: proportion

• CI or HT? HT

↳ majority

$H_0: p = 0.5$

$H_A: p > 0.5$

iii) 1PropZTest

7. A simple random sample of size $n = 200$ individuals with a valid driver's license is asked if they drive an American-made automobile. Of the 200 individuals surveyed, 115 responded that they drive an American-made automobile. Determine if a majority of those with a valid driver's license drive an American-made automobile at the $\alpha = 0.05$ level of significance.

Poll

8. A simple random sample of size $n = 65$ is drawn from a population. The sample mean is found to be 583.1, and the sample standard deviation is found to be 114.9. Is the population mean different from 600 at the $\alpha = 0.1$ level of significance?

μ_0

• parameter mean

• CI or HT? HT

$H_0: \mu = 600$

$H_A: \mu \neq 600$ (TwoTailedTest)

iii) TTest

9. A simple random sample of size $n = 320$ adults was asked their favorite ice cream flavor. Of the 320 individuals surveyed, 58 responded that they preferred mint chocolate chip. Do less than 25% of adults prefer mint chocolate chip ice cream? Use the $\alpha = 0.01$ level of significance.

poll

claim

p_0

i) parameter? proportion

ii) CI or HT? HT

iii) 1 PropZTest

iv) $z^a = -2.84$

$p = 0.00225$

$\alpha = 0.01$

$p < \alpha \rightarrow$ p low, will go

Reject H_0

$H_0: p = 0.25$

$H_A: p < 0.25$ (Left Tailed Test)