9.1 TESTING A CLAIM - Significance Tests

Learning Objectives:

1. State the null and alternative hypotheses for a significance test about a population parameter.
2. Interpret a P-value in context.
3. Determine whether the results of a study are statistically significant and make an appropriate conclusion using a significance level.
4. Interpret a Type I and a Type II error in context and give a consequence of each.

Vocabulary: null hypothesis, alternative hypothesis, one-sided H_a, two sided H_a, P-value, statistically significant at level α, Type I error, Type II error

ACTIVITY: Flipping a coin – Probability of getting Tails.

CASE STUDY *Read 537*

What are the two explanations for why $\bar{x}$ = 98.25ºF instead of 98.6 ºF.

What are the two explanations for why $\hat{p}$ = 62.3% instead of 50%.

Example: A recent study on "The relative age effect and career success: Evidence from corporate CEOs" (Economics Letters 117 (2012)) suggests that people born in June and July are under-represented in the population of corporate CEOs. This "is consistent with the 'relative-age effect' due to school admissions grouping together children with age differences up to one year, with children born in June and July disadvantaged throughout life by being younger than their classmates born in other months." In their sample of 375 corporate CEOs, only 45 (12%) were born in June and July. Is this *convincing* evidence that the true proportion *p* of *all* corporate CEOs born in June and July is smaller than 2/12?

Give two explanations for why the sample proportion was below 2/12.

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How can we decide which of the two explanations is more plausible?

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Read 539-541
What is the difference between a null and an alternative hypothesis? What notation is used for each? What are some common mistakes when stating hypotheses?

For each scenario, define the parameter of interest and state appropriate hypotheses.

(a) A basketball player claims to make 80% of the free throws that he attempts. We think he might be exaggerating. To test this claim, we'll ask him to shoot some free throws many times and record the proportion of shots he makes.

(b) The CEO study from the previous page.

(c) Mike is an avid golfer who would like to improve his play. A friend suggests getting new clubs and lets Mike try out his 7-iron. Based on years of experience, Mike has established that the mean distance that balls travel when hit with his old 7-iron is $\mu = 175$ yards with a standard deviation of $\sigma = 15$ yards. He is hoping that his new club will make his shots with a 7-iron more consistent (less variable), and so he goes to the driving range and hits 50 shots with the new 7-iron.

What is the difference between and one-sided and a two-sided alternative hypothesis? How can you decide which to use?

HW page 551 (2–10 even)

9.1 *P*-values and Conclusions

Read 541–544
What is a *P*-value?

In the CEO example, the *P*-value = $P(\hat{p} \le 0.12 | p = 2/12) = 0.008$. Interpret this value.

Alternate Example: *A better golf club?*
When Mike was testing a new 7-iron, the hypotheses were H_0: $\sigma = 15$ versus H_a: $\sigma < 15$ where σ = the true standard deviation of the distances Mike hits golf balls using the new 7-iron. Based on a sample of shots with the new 7-iron, the standard deviation was $s_x = 13.9$ yards.

(a) What are the two explanations for why $s_x < 15$?

(b) A significance test using the sample data produced a *P*-value of 0.28. Interpret the *P*-value in this context.

Read 544–547
What are the two possible conclusions for a significance test?

What are some common errors that students make in their conclusions?

The ____ determines what is a "small" P-value. The level is denoted with ________ and is chosen by the statistician/tester **prior** to testing hypotheses.

If the P-value is ______________________, we say that the results of a study are ____.

__Alternate Example__: *Tasty chips*
For his second semester project in AP Statistics, Zenon decided to investigate whether students at his school prefer name-brand potato chips to generic potato chips. After collecting data, Zenon performed a significance test using the hypotheses $H_0: p = 0.5$ versus $H_a: p > 0.5$ where p = the true proportion of students at his school who prefer name-brand chips. The resulting *P*-value was 0.074. What conclusion would you make at each of the following significance levels?

(a) $\alpha = 0.10$

(b) $\alpha = 0.05$

What should be considered when choosing a significance level?

HW page 551 (1–17 odd)

9.1 Type I & Types II Errors

Read 547–550

In a jury trial, what two errors could a jury make?

In a significance test, what two errors can we make? Which error is worse?

Describe a Type I and a Type II error in the context of the CEO example. Which error could the researchers have made? Explain.

What is the probability of a Type I error? What can we do to reduce the probability of a Type I error? Are there any drawbacks to this?

No HW