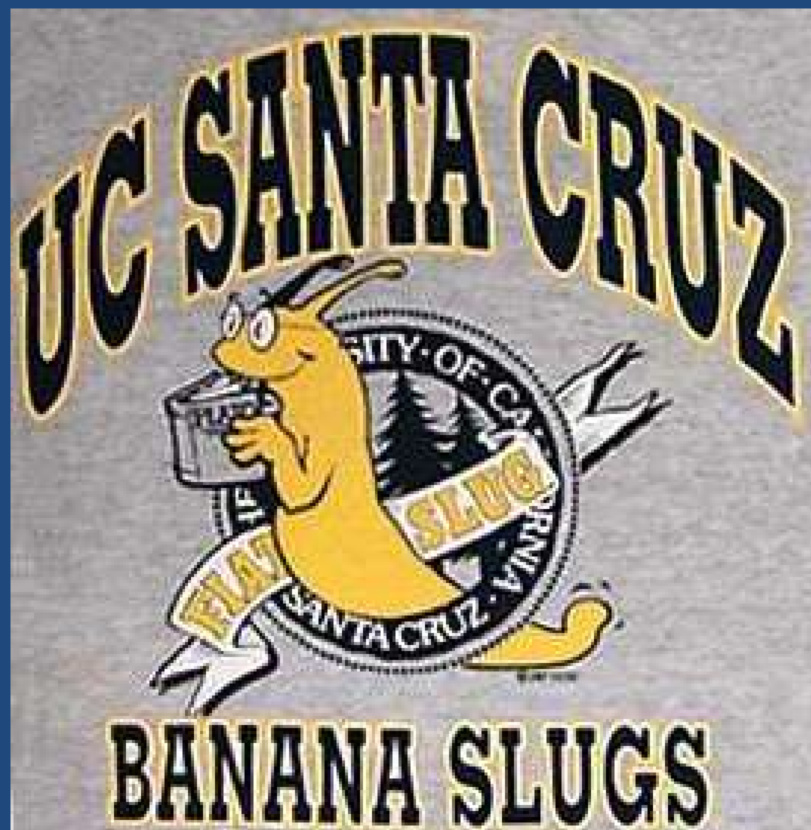
Warm Up

- A company is criticized because only 13 out of 43 people in executive level positions are women. The company explains that although this proportion is lower than it might wish, it’s not surprising given that only 40% of all its employees are women. What do you think? Test an appropriate hypothesis and state your conclusion. Be sure the appropriate assumptions and conditions are satisfied before you proceed.

Part V – From the Data at Hand to the World at Large

Ch. 21 – More About Tests

(Day 1 – Alpha Levels, Significance & 2-Tailed Tests)



Alpha Levels

- We have said that if a p-value is small, we will reject H_0
- We call such a result statistically significant
- So far we have been using 5% as our cutoff value
- Depending on the situation, we may want to have a stricter or looser threshold for calling results statistically significant
- From now on, when we decide on a test we will also set a cut-off value which will determine when we reject H_0
- This value is called α

More About α

- Common values for α are 0.01, 0.05, and 0.10
- α is also called the “significance level”
- If a problem does not give us an α to use, 5% will be our standard value
- This week we will learn more about why statisticians would choose different values of α
- If $p < \alpha$, reject H_0; the results are statistically significant

Using α in a test

A recent article in *USA Today* stated that 73% of first-year college students feel that being well-off financially is important. A UC Santa Cruz professor believes that students at his university are less materialistic than other students. He conducts a random sample of 200 first-year UCSC students and finds that 134 of them feel that being well-off financially is important. Does his survey prove his belief to be true at the 1% significance level?

p = The proportion of all first-year UCSC students who think being well-off financially is important

$H_0: p = .73$ Left-tailed one-proportion z-test, $\alpha = .01$

$H_a: p < .73$

$$p = \frac{134}{200} = .67$$

Condition	Check
Random Sample	Stated
n < 10% N	200 is less than 10% of all 1st year students at UCSC
$np \geq 10$ $n(1-p) \geq 10$	$200(.73) \geq 10$ $200(.27) \geq 10$

$$z =$$

$$p = .0281$$

Since $p > \alpha$, fail to reject H_0.

There is not enough evidence to conclude that the proportion of first-year UCSC students for whom this goal is important is lower than 73%.

Statistical Significance

- Since we didn't reject H_0, we say that the professor's results were <u>not statistically significant</u>
- Would the results have been significant at the 5% or 10% levels?
- Yes, since $p < .05$ and $p < .10$

Statistical Significance vs. Practical Significance

- Even if we *do* find a statistically significant result from a hypothesis test, it doesn't necessarily mean that the result is *practically significant* (in other words, *useful*)
- Remember that statistically significant results are those unlikely to have occurred by chance if H_0 is true
- A difference which is statistically significant may still be too small to matter in the real world

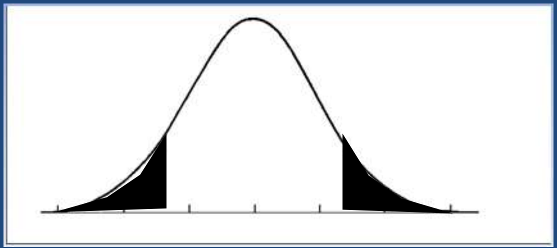
A Two-Tailed Test

A telephone company representative estimates that 40% of the company's customers want call-waiting service. To test this hypothesis, she selected a sample of 90 customers and found that 52 want call waiting. Is her estimate appropriate at the 5% significance level?

The First Few Steps…

p = the proportion of all customers who want call waiting

H_0: p = .40
H_a: p ≠ .40



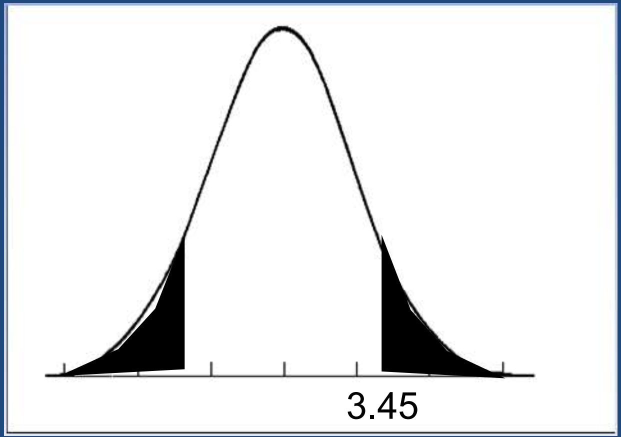
2-tailed one-proportion z-test, α=.05

$$\hat{p} = \frac{52}{90} = .578$$

$$z =$$

Condition	Check
Random Sample	Assume
n < 10% N	Assume that 90 is less than 10% of all customers
np ≥ 10 and n(1 – p) ≥ 10	90(.40)≥10 90(.60)≥10

The p-value



- Since this value falls on the right side, we are looking at the tail on the right
- The area to the right of

z = 3.45 is 1 - .9997 = .0003

- This only represents the area in the right tail, but this is a 2-tailed test
- In order to account for both tails, we need to double this area to calculate the p-value
- So for this problem, p = 2(.0003) = .0006

Conclusion

- Since $p < .05$, reject H_0. There is enough evidence to conclude that the proportion of customers who want call waiting is different from 40%.
- Her estimate is not appropriate.
- Note: This result would have been significant at the 1% level as well.

A reminder about interpreting p…

- A study of a new medication compared the average reduction in pulse rate to the average reduction provided by the drug currently on the market, 10.2 beats per minute. The researchers found a p-value of 0.24. Explain what this p-value means in the context of this situation.
- If H_0 were true (meaning the new medication really had an average reduction of 10.2)

there would be a 24% chance of seeing a random sample with a pulse rate reduction as large as the one our study found (or larger).

Homework 21-1

- p. 476 #21

(2-tailed test)

- p. 499 #2, 3, 4, 5,
- 6, 7, 8

(p-values & α)