



Significance Test for a Proportion

State/Plan/Do/Conclude



Learning Targets

- Perform a significance test about a population proportion

Lesson 9.2: Day 2: Can you taste the rainbow?

Many students claim that they can taste the different colors of Skittles. Today we will conduct an experiment and perform a significance test to see if students really can "taste the rainbow".

Collect data: How many correct? 101 How many total? 190 ← n

STATE: Parameter: $p \rightarrow$ true proportion of correct guesses

Statistic: $\hat{p} = \frac{101}{190} \approx .53$

Hypotheses:
 $H_0: p = .20$
 $H_a: p > .20$

Significance level: 5% ($\alpha = 0.05$)

PLAN: Name of procedure: One sample z test for p

Check conditions:

① Random
 Random sample of skittles ✓

② Independent (10%)
 $10 (190) <$ pop of all skittles ✓
 Reasonable to assume

③ Normal (Large Counts)
 $np \geq 10$ $190(.20) \geq 10$
 $n(1-p) \geq 10$ $38 \geq 10$
 $190(.80) \geq 10$
 $152 \geq 10$ ✓

DO: General Formula:
 Test Statistic = $\frac{\text{statistic} - \text{null}}{\text{stand. dev.}}$

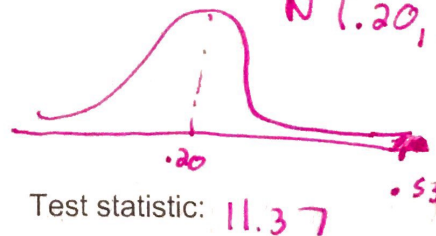
Specific Formula:
 $z = \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}}$

Work:

Side note:

$$z = \frac{.53 - .20}{\sqrt{\frac{.20(.80)}{190}}} \approx 11.37$$

Picture (of the Normal curve): $\mu_{\hat{p}} = p = .20$
 $\sigma_{\hat{p}} = .029$
 $N(.20, .029)$



P-value: 0

$$P\text{-value} = \text{normalcdf}(.53, 100, .20, .029) \approx 2.7 \times 10^{-30} \approx 0$$

CONCLUDE: Based on the P-value, what conclusion do you make?

Since P-value of $0 < \alpha$ of .05, we can reject H_0 .

Therefore we have convincing evidence that $p > .20$, meaning students can taste the rainbow.

Lesson 9.2 Day 2– Significance Tests: The 4 Steps

Important ideas:

L.T. #1 4-Step Process

- 1) **STATE:** Parameter (in context)
 Statistic
 Hypotheses
 Significance Level

- 2) **Plan:** Name the Procedure and Check Conditions

One sample z-test for p

- 3) **Do:** Give General Formula $\xrightarrow{\text{Test Statistic}}$ $\frac{\text{stat} - \text{null}}{SD}$

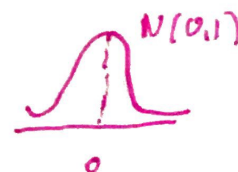
Give Specific Formula $\rightarrow z = \frac{\hat{p} - p}{\sqrt{p(1-p)/n}}$

Work, Picture, and P-Value



normal f

can also use
test statistic



- 4) **Conclude:** We do/do not have convincing evidence against the null.
always use context

L.T. #2 Two sided

This is when $H_0: p = .25$
 $H_a: p \neq .25$

Multiply the p-value by 2.

Check Your Understanding

According to the National Institute for Occupational Safety and Health, job stress poses a major threat to the health of workers. A news report claims that 75% of restaurant employees feel that work stress has a negative impact on their personal lives. Managers of a large restaurant chain wonder whether this claim is valid for their employees. A random sample of $n=100$ employees finds that 68 answer "Yes" when asked, "Does work stress have a negative impact on your personal life?"

1. Do these data provide convincing evidence at the $\alpha = 0.10$ significance level that the proportion of all employees in this chain who would say "Yes" differs from 0.75?

STATE: Parameter: $p \rightarrow$ true proportion of employees who say yes

Statistic: $\hat{p} = 68/100 = .68$

Hypotheses: $H_0: p = .75$
 $H_a: p \neq .75$

Significance level: $\alpha = 0.10$

PLAN: Name of procedure: One sample z test for p

Check conditions:

① Random: Random Sample of 100 ✓

② Independent (10%)
 $10(100) < \text{all restaurant employees}$
 1000
 Reasonable to assume ✓

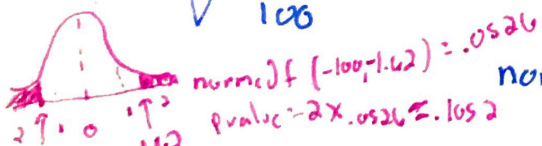
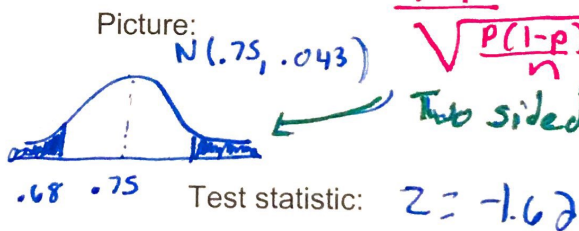
③ Normal (Large Counts)
 $100(.75) \geq 10$
 $75 \geq 10$ ✓
 $100(.25) \geq 10$
 $25 \geq 10$ ✓

DO: General Formula: Test Stat = $\frac{\text{stat} - \text{Null}}{SD}$

Specific Formula: $Z = \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}}$

Work:

$$Z = \frac{.68 - .75}{\sqrt{\frac{.75(.25)}{100}}} = -1.62$$



normalcdf (-100, .68, .75, .043) = .0518
 P-value:

CONCLUDE: Since P value of $.1032 > \alpha$ of $.10$, we fail to reject H_0 . There for we do not have enough evidence against the true p of employees who say yes is 0.75 .
 $.0518 \times 2 = .1032$

2. A 90% confidence interval for the restaurant worker data was also created and found to be (0.603272, 0.756728). Explain how the confidence interval is consistent with, but gives more information than, the test.

The null value of 0.75 is included in the interval, so it is plausible. The interval also gives other plausible values for the null as well.