

Ch 9.5 part 1 Hypothesis Test for Population Proportion

Ch 9.5- part 1 Full Hypothesis Test for population proportion

Notations:

x = number of success

n = sample size (number of observations)

\hat{p} = sample proportion

p = claim proportion mentioned in claim, use in H_0

$q = 1 - p$

α = significant level. (probability of unlikely)

STEPS:

1) Write claim, H_0 and H_a in symbolic form.

Identify n , x .

2) Determine significant level α , type of test (left-tail, right-tail or two-tail test based on H_a and sampling distribution. Sampling distribution of \hat{p} is Normal.

3) Use Statdisk.com to find test-statistic and p-value:

Analysis/Hypothesis testing/Proportion One sample.

Select Population proportion “not equal” or “ $>$ ” or

“ $<$ ” “claimed proportion according to H_a .

Input Significance α ; claimed proportion (in H_0); sample size n ; number of successes x . Evaluate.

Output: test stat z and p-value p .

4) Make conclusion about H_0 .

If $p\text{-value} \leq \alpha$, reject H_0 . Sample is significant.

If $p\text{-value} > \alpha$, fail to reject H_0

5) Conclusion about the claim:

There is (sufficient or not sufficient) evidence to
(support / reject) the claim that

Use table or flowchart for wordings.

6) Make additional inference from the conclusion.

The three conditions for using the hypothesis test are:

a) Number of success and failures are at least 5.

$$np \geq 5, nq \geq 5.$$

b) Fixed number of samples with two outcomes and independent sample. (binomial requirement)

c) Sample are randomly collected.

Ex1: A Pitney Bowers survey of 1009 customers shows that 545 of customers are uncomfortable with Drone deliveries. Test the claim that majority of customers are uncomfortable with Drone deliveries. Use $\alpha=0.05$.

(Majority means greater than 50%.)

Answer:

1) Claim: $p > 0.50$ $H_0: p = 0.50$ $H_a: p > 0.5$

$n = 1009$, $x = 545$,

2) $\alpha = 0.05$, right- tail test, use z distribution

3) Use Statdisk/Analysis/Hypothesis Test/proportion one sample. Select ">" for Alternative hypothesis. Enter significance = 0.05, claim proportion 0.5.

$n = 1009$, $x = 545$, calculate.

Output: z-stat = 2.55 and p-value = 0.0054

This means the sample is 2.55 sd from the mean of $p = 0.5$ and the probability of getting the sample or worse is 0.0054 when H_0 is true.

4) Since $0.0054 < 0.05$ Reject H_0 , significant sample.

5) Use "sufficient evidence" because p-value $< \alpha$,

Use "support the claim" because claim is H_a .

"There is sufficient evidence to support the claim that majority of customers are uncomfortable with drone deliveries."

b) Should a company start to invest in drone deliveries now?

No, because majority of customers are uncomfortable with drone deliveries.

Ex2: Test the claim that less than 30% of adults have sleep-walked. Use significant level $\alpha = 0.05$. A random sample shows 29.7% of 1913 adults have sleep-walked.

Answer:

1) claim: $p < 0.30$ $H_0: p = 0.30$ $H_a: p < 0.30$

$n = 1913$, $x = 1913(0.297) = 568$

2) $\alpha = 0.05$, left-tail test, use z distribution

3) Use Statdisk/Analysis/Hyp Test/proportion one sample. Select "<" for Alternative Hypothesis. Enter Significance = 0.05, claimed proportion 0.3,

$n = 1913$, $x = 568$, calculate.

Output: $Z = -0.29$, p-value = 0.384

This means the sample is -0.29 of s.d. below the assumed true H_0 value. The probability of getting the sample is 0.384 when H_0 is true.

4) $0.384 > 0.05$, fail to reject H_0 . (not significant)

5) Fail to reject H_0 : use "not sufficient evidence.."

claim is in H_a : use "...support the claim."

There is not sufficient evidence to support the claim that less than 30% of adults have sleep-walked.

b) Is the claim true?

No, not sufficient evidence to support the claim so the claim is not true.

Ex3: In a USA today survey of 510 people, 53% said that we should replace passwords with biometric security such as fingerprints.

a) Use a significant level of 0.1 to test the claim that exactly 50% of all adults like the idea of replacing passwords with biometric security.

Answer:

1) Claim: $p = 0.5$, $H_0: p = 0.5$, $H_a: p \neq 0.5$

$$n = 510, x = 510(0.53) = 270,$$

2) $\alpha = 0.1$, two-tail test, use z- distribution.

3) Use Statdisk/Analysis/Hypothesis Test/proportion one sample. Select “not =” for Alternative hypothesis.

Enter Significance = 0.1, claimed proportion 0.5,

$n = 510$, $x = 270$, calculate.

output: Test statistic $z = 1.33$, $p\text{-value} = 0.184$

4) $0.184 > 0.1$, fail to reject H_0 .

Since we fail to reject H_0 : use “ not sufficient evidence...”

The claim is in H_0 , use “... reject the claim.” statement.

There is not sufficient evidence to reject the claim that half of all adults like the idea of replacing password with biometrics.

b) Is the claim true?

yes, not sufficient evidence to reject the 50% proportion, conclude the only 50% of the population like the idea.

c) Discuss if the conditions for hypothesis test of proportion is satisfied?

The success-failure condition: $np = 510(0.5) > 5$

$nq = 510(1-0.5) \geq 5$. Assuming the sample is a simple random sample, so conditions are satisfied.

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