

# Summary/Advice for One Proportion Hypothesis Test

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## What to Look For

### *Is it a hypothesis test?*

You will be asked to “test a claim” or “whether there is significant evidence to draw some conclusion”.

You will be given a level of significance like 0.05 or 0.01 and not a level of confidence like 90%, 95%, 99%.

### *Is it a One Proportion test?*

Sample data will be of the form “x out of n”, which is the sample proportion  $\hat{p}$ .

The data come from answers to a question that will be categorical in nature, not numerical.

You will not be given a sample mean & sample standard deviation or a set of numerical data.

## Before You Begin

You must verify three conditions.

1. The sample is a simple random sample.

*We will assume that this is true, you do not have to verify this in this class.*

2.  $np(1-p) \geq 10$

*n is the sample size, p is the claimed population proportion that will be listed in the null hypothesis  $H_0$ . If this condition fails, the sampling distribution does not follow a normal distribution and we cannot proceed with the hypothesis test.*

3. The sample size  $n$  is no more than 5% of the population size  $N$ .

*To check this, try multiplying the sample size by 20 and then reason out whether the population size is likely larger than this number.*

If any condition fails, you cannot perform the hypothesis test. You say something like “We cannot test these hypotheses because the necessary conditions are not met.”

## Template for the One Proportion Test

1)  $H_0: p =$  \_\_\_\_\_  $H_1: p$  \_\_\_\_\_

2)  $\alpha =$  \_\_\_\_\_

3) One Proportion Test

4) z-stat = \_\_\_\_\_ P-value = \_\_\_\_\_

5)        Reject / Fail to Reject  $H_0$ .

There        is / is not        sufficient evidence to conclude that " $H_1$  is true".

### Step 1 – Statement of the Hypotheses

The null hypothesis is the statement we assume to be true, and the alternative hypothesis is the statement we are trying to prove is true.

The null hypothesis  $H_0$  will always be of the form  $p = \#$ . Read through the problem to determine what % the population proportion is being compared to in the wording of the problem.

Be sure to change that % to a decimal by moving the decimal point 2 places to the left.

The alternative hypothesis  $H_1$  will also compare  $p$  to that same value, but will replace the equal sign by either  $<$ ,  $>$ , or  $\neq$ .

If the wording of the problem suggests that the proportion is lower than the %, use  $<$ .

If the wording of the problem suggests that the proportion is higher than the %, use  $>$ .

If the wording of the problem does not suggest that we are looking for evidence that the proportion is lower than or higher than the %, use  $\neq$ . This happens when the claim is that the proportion **IS** \_\_\_%.

#### **StatCrunch:**

Begin by following the menu path *Stat > Proportion statistics > One sample > With summary*

Enter the correct value in the null hypothesis, and select the correct sign for the alternative hypothesis.

## Step 2 – Level of Significance $\alpha$

The level of significance  $\alpha$  (alpha) is the borderline between what is significant evidence against the null hypothesis and what is not significant evidence.

The level of significance will be used in Step 5 when we are deciding whether to reject the null hypothesis or not.

Just write down what alpha is equal to, and move on to Step 3.

### StatCrunch:

There is nothing to do with StatCrunch in this step.

## Step 3 – State Which Test You Are Performing

This tells the reader of your hypothesis test exactly which test you are conducting.

So far, the only test we know is the One Proportion test, so we write that on Step 3. As we cover more sections, this will change.

### StatCrunch:

There is nothing to do with StatCrunch in this step.

## Step 4 – Calculations

We use StatCrunch to calculate the test statistic (z-stat) and P-value, and report these values in Step 4.

The test statistic is basically a conversion of the sample information to a z-value.

The P-value is the probability of getting a sample as extreme as ours if the null hypothesis is actually true.

If the P-value is low, that is strong evidence that the null hypothesis is not true.

Write down these two values, and advance to Step 5.

### StatCrunch:

Begin by following the menu path *Stat > Proportion statistics > One sample > With summary*

Enter the correct value in the null hypothesis, and select the correct sign for the alternative hypothesis.

## Step 5 – Decision about $H_0$ , Conclusion about $H_1$

In this finishing step, we begin by making a decision about the null hypothesis  $H_0$ .

There are only two options:

1. Reject  $H_0$ .  
This occurs whenever the P-value is less than the level of significance  $\alpha$ .  
This is considered strong evidence that  $H_0$  is false and  $H_1$  is true.
2. Fail to Reject  $H_0$ .  
We make this decision when the P-value is **NOT** less than  $\alpha$ .  
This means that we do not have significant evidence that  $H_0$  is false and  $H_1$  is true.

The decision about  $H_0$  leads directly to the conclusion about  $H_1$ .

- If we reject  $H_0$ , we are supporting  $H_1$  as true.
- If we fail to reject  $H_0$  (we cannot say  $H_0$  is false), then we cannot support  $H_1$  as true.

If we reject  $H_0$ , then the correct conclusion about  $H_1$  is ...

*There **IS** sufficient evidence to conclude that “ $H_1$  is true”.*

If we fail to reject  $H_0$ , then the correct conclusion about  $H_1$  is ...

*There is **NOT** sufficient evidence to conclude that “ $H_1$  is true”.*

In both cases, replace “ $H_1$  is true” with the words that relate to the problem like “The mean age for COS students is less than 20” or “The mean SAT score for all high school seniors is different than 600.”

### **StatCrunch:**

Nothing to do in StatCrunch in this step, just evaluate your results from Step 4.

## Example

In a survey, 45% of the respondents stated that they talk to their pets on the answering machine or telephone. A veterinarian believed this result to be too high, so she randomly selected 150 pet owners and discovered that 63 of them spoke to their pet on the answering machine or telephone. Does the veterinarian have a right to be skeptical? Use the  $\alpha = 0.1$  level of significance.

## What to Look For

We are trying to conclude that the veterinarian has a right to be skeptical, or, in other words, that fewer than 45% of all pet owners talk to their pets on an answering machine or telephone.

We are given a level of significance.

This situation calls for a hypothesis test.

This is a one proportion test because we have one sample of 63 out of 150, the data are categorical (Yes I talk to my pet or No I do not talk to my pet), and we are comparing the proportion of one group to a single number (45%).

## Before You Begin

Verify the conditions:

1. We assume that the sample is a simple random sample.

2.  $np(1-p) \geq 10$

$n = 150$  pet owners

$p = 0.45$  (because the report claimed that 45% of pet owners talked to their pets)

$$np(1-p) = 150(0.45)(1-0.45) = 150(0.45)(0.55) = 37.125 \geq 10$$

3. The sample size  $n$  is no more than 5% of the population size  $N$ .

$$20(n) = 20(150) = 3000 \text{ pet owners}$$

Are there more than 3000 pet owners? Since we know this is true, we can perform the test.

## Step 1

### Null Hypothesis:

In a survey, **45% of the respondents stated that they talk to their pets on the answering machine or telephone**. A veterinarian believed this result to be too high, ...

We are comparing a proportion of pet owners to 45%, so the null hypothesis is  $p = 0.45$ .

### Alternative Hypothesis:

In a survey, 45% of the respondents stated that they talk to their pets on the answering machine or telephone. **A veterinarian believed this result to be too high**, ...

Since the veterinarian felt the result was too high, she believes that the true population proportion is lower than 45%, so the alternative hypothesis is  $p < 0.45$ .

## Step 2

Look for the level of significance in the problem.

*Use the  $\alpha = 0.1$  level of significance.*

So,  $\alpha = 0.1$ .

## Step 3

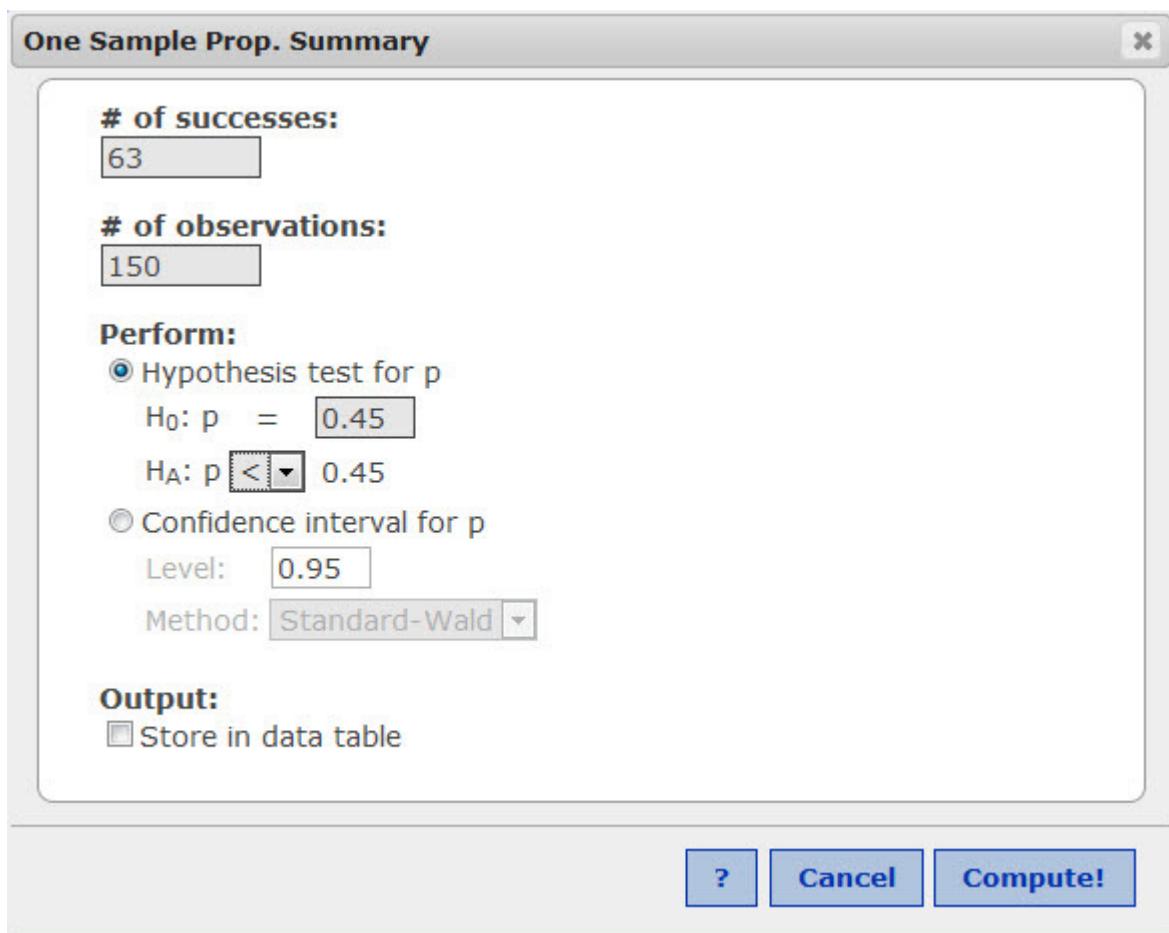
Since we have already determined that this is a one proportion test ...

One Proportion Test

## Step 4

Go to StatCrunch, and follow this menu path: Stat > Proportion Statistics > One Sample > With summary

Fill in the box as shown.



The screenshot shows the 'One Sample Prop. Summary' dialog box in StatCrunch. The dialog box has a title bar with a close button (X). The main content area is divided into several sections:

- # of successes:** A text input field containing the value '63'.
- # of observations:** A text input field containing the value '150'.
- Perform:** This section contains two radio button options:
  - The first option, 'Hypothesis test for p', is selected. It includes:
    - $H_0: p =$  followed by a text input field containing '0.45'.
    - $H_A: p$  followed by a dropdown menu showing '<' and a text input field containing '0.45'.
  - The second option, 'Confidence interval for p', is unselected. It includes:
    - 'Level:' followed by a text input field containing '0.95'.
    - 'Method:' followed by a dropdown menu showing 'Standard-Wald'.
- Output:** This section contains a checkbox labeled 'Store in data table', which is currently unchecked.

At the bottom of the dialog box, there are three buttons: a help button with a question mark, a 'Cancel' button, and a 'Compute!' button.

Press Compute! to get your results.

Options							
<b>Hypothesis test results:</b>							
p : Proportion of successes							
$H_0 : p = 0.45$							
$H_A : p < 0.45$							
Proportion	Count	Total	Sample Prop.	Std. Err.	Z-Stat	P-value	
p	63	150	0.42	0.040620192	-0.73854895	0.2301	

Z-stat = -0.74

P-value = 0.2301

## Step 5

Since the P-value (0.2301) is not less than  $\alpha$  (0.1), there is not strong evidence that  $H_1$  is true.

Decision: Fail to reject  $H_0$ .

Since we did not reject  $H_0$ , we do not have sufficient evidence to conclude that  $H_1$  is true.

Conclusion: There is not significant evidence to conclude that the proportion of all pet owners who speak to their pets on an answering machine or telephone is lower than 45%.

1)  $H_0: p = \underline{0.45}$                        $H_1: p \underline{<} 0.45$

2)  $\alpha = \underline{0.1}$

3) One Proportion Test

4) z-stat = -0.74                      P-value = 0.2301

5) Fail to Reject  $H_0$ .

There is not sufficient evidence to conclude that the proportion of all pet owners who speak to their pets on an answering machine or telephone is lower than 45%.