A researcher claims that the average age of a woman before she has her first child is greater than the 1990 mean age of 26.4 years, on the basis of data obtained from the National Vital Statistics Report, Vol. 48, No. 14. She obtains a simple random sample of 40 women who gave birth to their first child in 1999 and finds the sample mean age to be 27.1 years. Assume that the standard deviation is 6.4 years. Are you convinced the average age has increased? Test at the 5% level of significance

The Claim

The Hypotheses

The test Statistic

The p-value

Make a decision

Write your decision in the context of the claim

The Claim

A researcher claims that the average age of a woman before she has her first child is greater than the 1990 mean age of 26.4 years, on the basis of data obtained from the National Vital Statistics Report, Vol. 48, No. 14. She obtains a simple random sample of 40 women who gave birth to their first child in 1999 and finds the sample mean age to be 27.1 years. Assume that the standard deviation is 6.4 years. Are you convinced the average age has increased? Test at the 5% level of significance

The Claim:

The average age of a woman before she has her first child is greater than the 1990 mean age

The Hypotheses

A researcher claims that the average age of a woman before she has her first child is greater than the 1990 mean age of 26.4 years, on the basis of data obtained from the National Vital Statistics Report, Vol. 48, No. 14. She obtains a simple random sample of 40 women who gave birth to their first child in 1999 and finds the sample mean age to be 27.1 years. Assume that the standard deviation is 6.4 years. Are you convinced the average age has increased? Test at the 5% level of significance

$H_0: \mu = 26.4$

$H_a: \mu > 26.4$ The claim

The Test Statistic

A researcher claims that the average age of a woman before she has her first child is greater than the 1990 mean age of 26.4 years, on the basis of data obtained from the National Vital Statistics Report, Vol. 48, No. 14. She obtains a simple random sample of 40 women who gave birth to their first child in 1999 and finds the sample mean age to be 27.1 years. Assume that the standard deviation is 6.4 years. Are you convinced the average age has increased? Test at the 5% level of significance

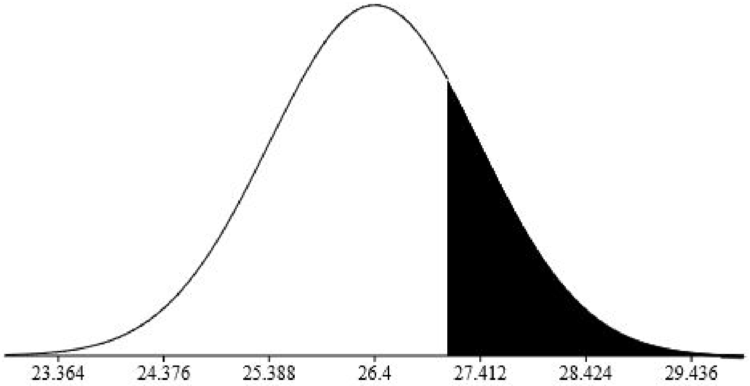
$$Z = \frac{\text{Measure} - \text{mean}}{\text{STD. Dev}}$$

$$\frac{27.1 - 26.4}{1.012} \rightarrow \frac{0.7}{1.012}$$

$$Z \approx 0.692$$

HyperStat Online Home Page

The p-value



(●) Area from a value (Use to compute p from Z)
( ) Value from an area (Use to compute Z for confidence intervals)

Specify Parameters:

Mean 26.4

SD 1.012

(●) Above 27.1
( ) Below 1.96
( ) Between -0.83 and 1.26
( ) Outside -1.96 and 1.96

Results:
Area (probability) 0.2446

Recalculate

Decision

We can't reject Ho

In Context

Testing Sample Proportions

The problem

About 10% of the human population is left-handed. Suppose that a researcher speculates that artists are more likely to be left-handed than are other people in the general population. The researcher conducts a SRS and surveys 150 artists and finds that 18 of them are left-handed. Does this sample support the researcher’s claim? Conduct a significance test using = 0.05

The Claim

About 10% of the human population is left-handed. Suppose that a researcher speculates that artists are more likely to be left-handed than are other people in the general population. The researcher conducts a SRS and surveys 150 artists and finds that 18 of them are left-handed. Does this sample support the researcher's claim? Conduct a significance test using = 0.05

The proportion of artists that are left handed is higher than the general population of people

The Hypotheses

About 10% of the human population is left-handed. Suppose that a researcher speculates that artists are more likely to be left-handed than are other people in the general population. The researcher conducts a SRS and surveys 150 artists and finds that 18 of them are left-handed. Does this sample support the researcher's claim? Conduct a significance test using = 0.05

$H_0: P = 0.1$

$H_a: P > 0.1$ The Claim

The test statistic and P-value(an applet)

http://goo.gl/vU8upM

Decision and context

P-value0: 0.2071

Level of Significance: 0.05

Cannot Reject Ho

The sample evidence does not support the the claim the proportion of artists that are left handed is higher than the general population of people

Testing Sample Means

The t-distribution

An example

Check for Normality

SRS (or a random sample of some type)

Is the sample size at least 30 pieces of data? (n>30)?

If not, is the Parent population Normally distributed (or check with a Normal Probability Plot <link>)

Vehicle Emission Inspection A certain vehicle emission inspection station advertises that the wait time for customers is less than 8 minutes. A local resident is skeptical and collects a random sample of 49 wait times for customers at the testing station. He finds that the sample mean is 7.34 minutes, with a standard deviation of 3.2 minutes. Does the sample evidence support the resident's skepticism? Use the $\alpha = 0.01$ level of significance.

The Claim

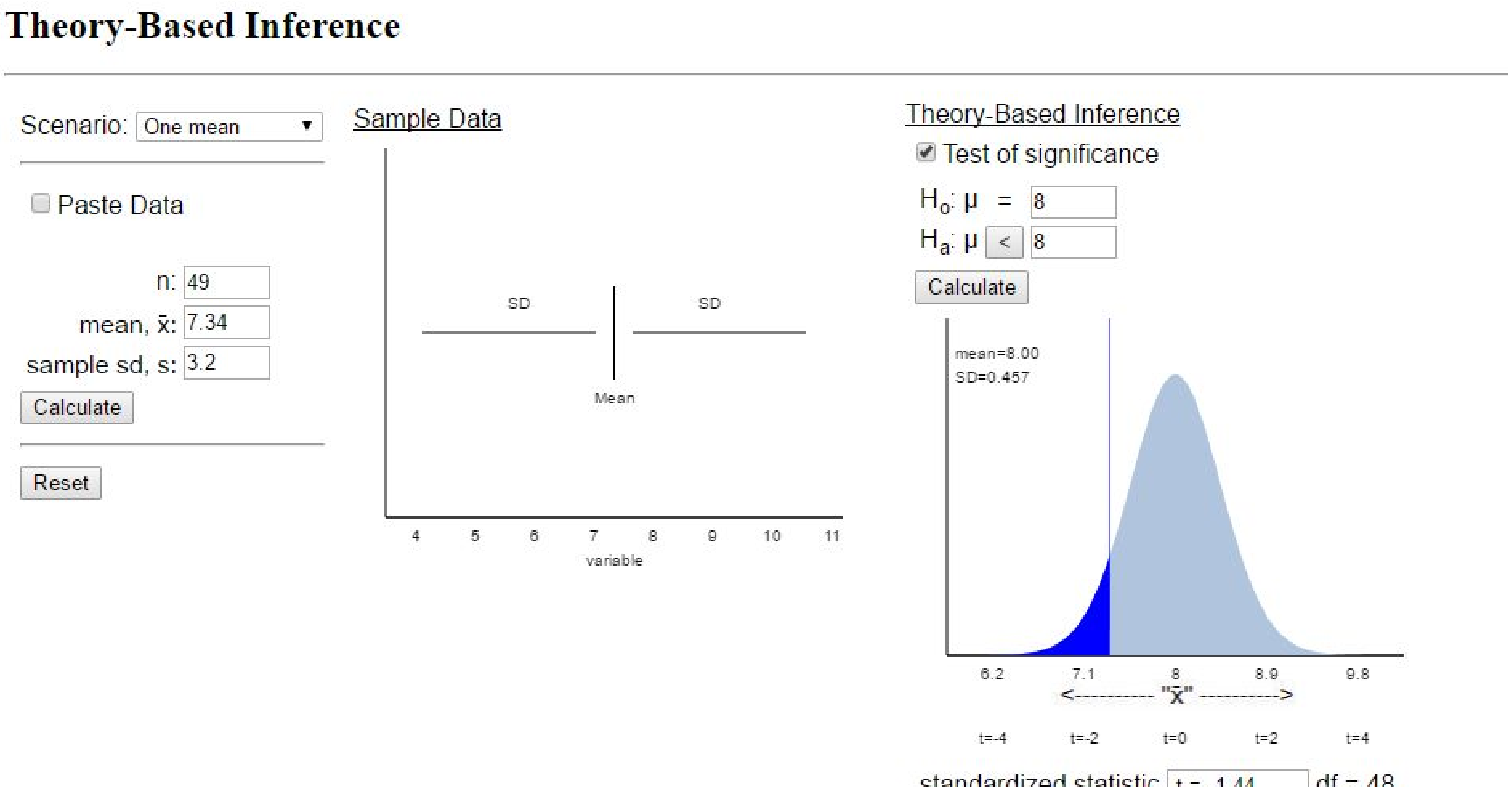
Vehicle Emission Inspection A certain vehicle emission inspection station advertises that the wait time for customers is less than 8 minutes. A local resident is skeptical and collects a random sample of 49 wait times for customers at the testing station. He finds that the sample mean is 7.34 minutes, with a standard deviation of 3.2 minutes. Does the sample evidence support the resident's skepticism? Use the $\alpha = 0.01$ level of significance.

The Company's Claim: The wait time for an inspection is longer than 8 minutes

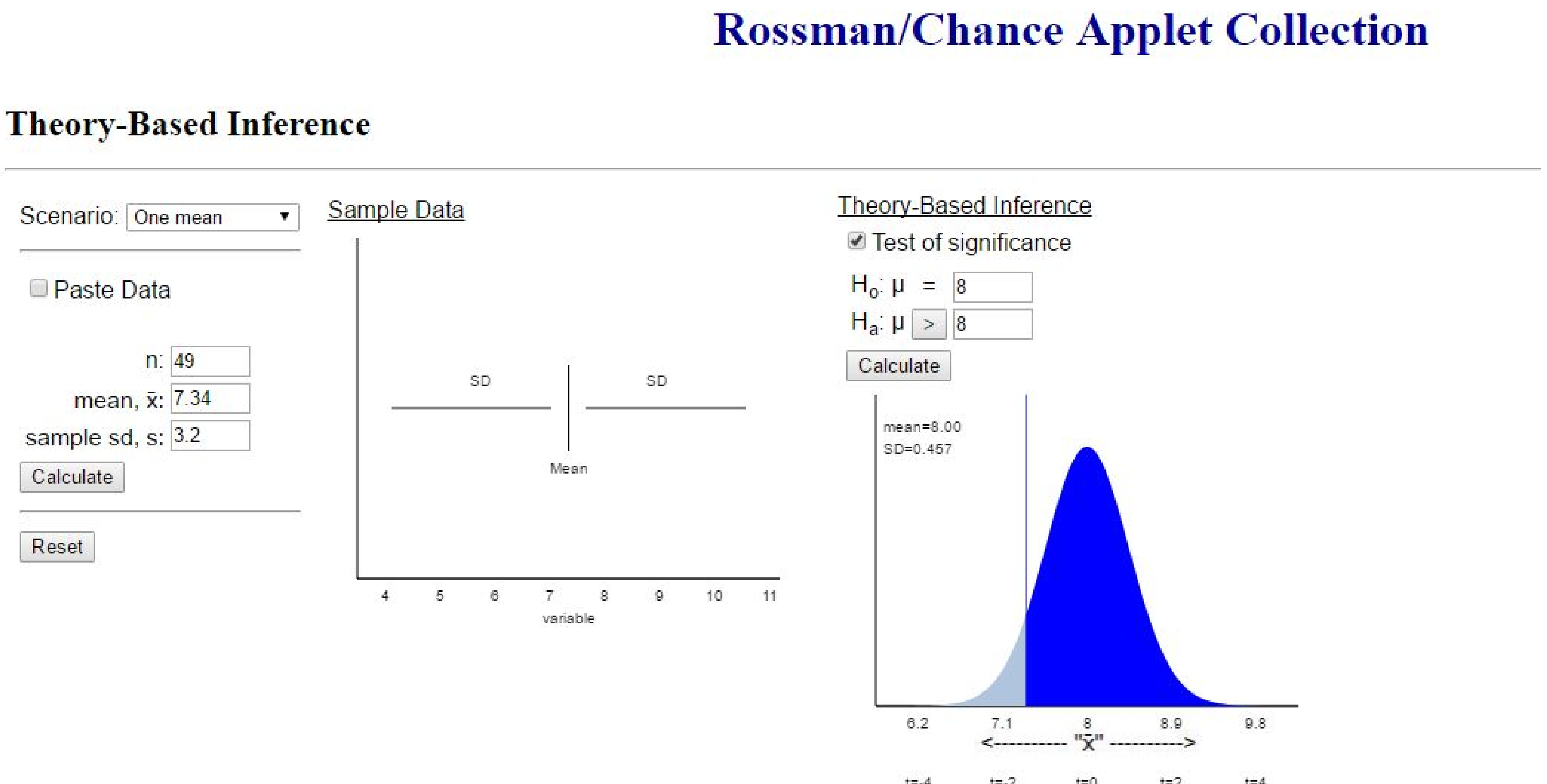
The Hypotheses

Vehicle Emission Inspection A certain vehicle emission inspection station advertises that the wait time for customers is less than 8 minutes. A local resident is skeptical and collects a random sample of 49 wait times for customers at the testing station. He finds that the sample mean is 7.34 minutes, with a standard deviation of 3.2 minutes. Does the sample evidence support the resident's skepticism? Use the $\alpha = 0.01$ level of significance.

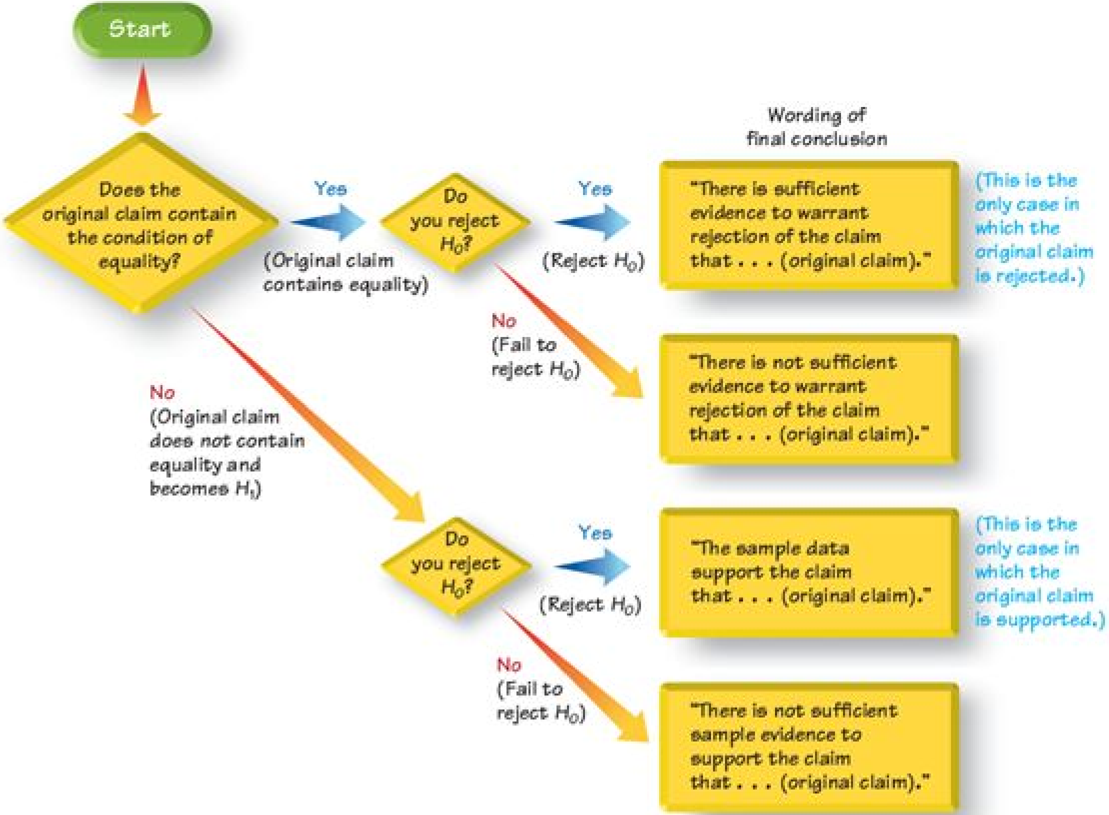
The test statistic and p-value



Wrong way


Rossman/Chance Applet Collection
Theory-Based Inference
Scenario: One mean
Paste Data
n: 49
mean, x̄: 7.34
sample sd, s: 3.2
Calculate
Reset
Sample Data
SD
SD
Mean
4 5 6 7 8 9 10 11
variable
Theory-Based Inference
Test of significance
H0: μ = 8
Ha: μ > 8
Calculate
mean=8.00
SD=0.457
6.2 7.1 8 8.9 9.8
<---------- "x̄" ---------->

Decision in context

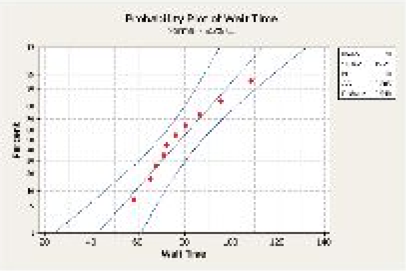


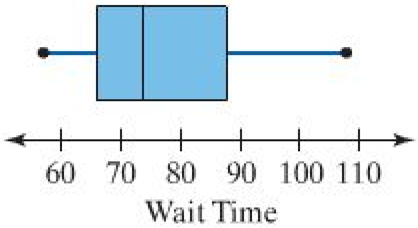
Conditions

Waiting in Line The mean waiting time at the drive-through of a fast-food restaurant from the time an order is placed to the time the order is received is 84.3 seconds. A manager devises a new drive-through system that he believes will decrease wait time. He initiates the new system at his restaurant and measures the wait time for 10 randomly selected orders. The wait times are provided in the table.

108.5	67.4	58.0	75.9	65.1
80.4	95.5	86.3	70.9	72.0

(a) Because the sample size is small, the manager must verify that wait time is normally distributed and the sample does not contain any outliers. The normal probability plot and boxplot are shown. Are the conditions for testing the hypothesis satisfied?





(b) Is the new system effective? Use the $\alpha = 0.1$ level of significance.

The claim

Waiting in Line The mean waiting time at the drive-through of a fast-food restaurant from the time an order is placed to the time the order is received is 84.3 seconds. A manager devises a new drive-through system that he believes will decrease wait time. He initiates the new system at his restaurant and measures the wait time for 10 randomly selected orders. The wait times are provided in the table.

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80.4	95.5	86.3	70.9	72.0

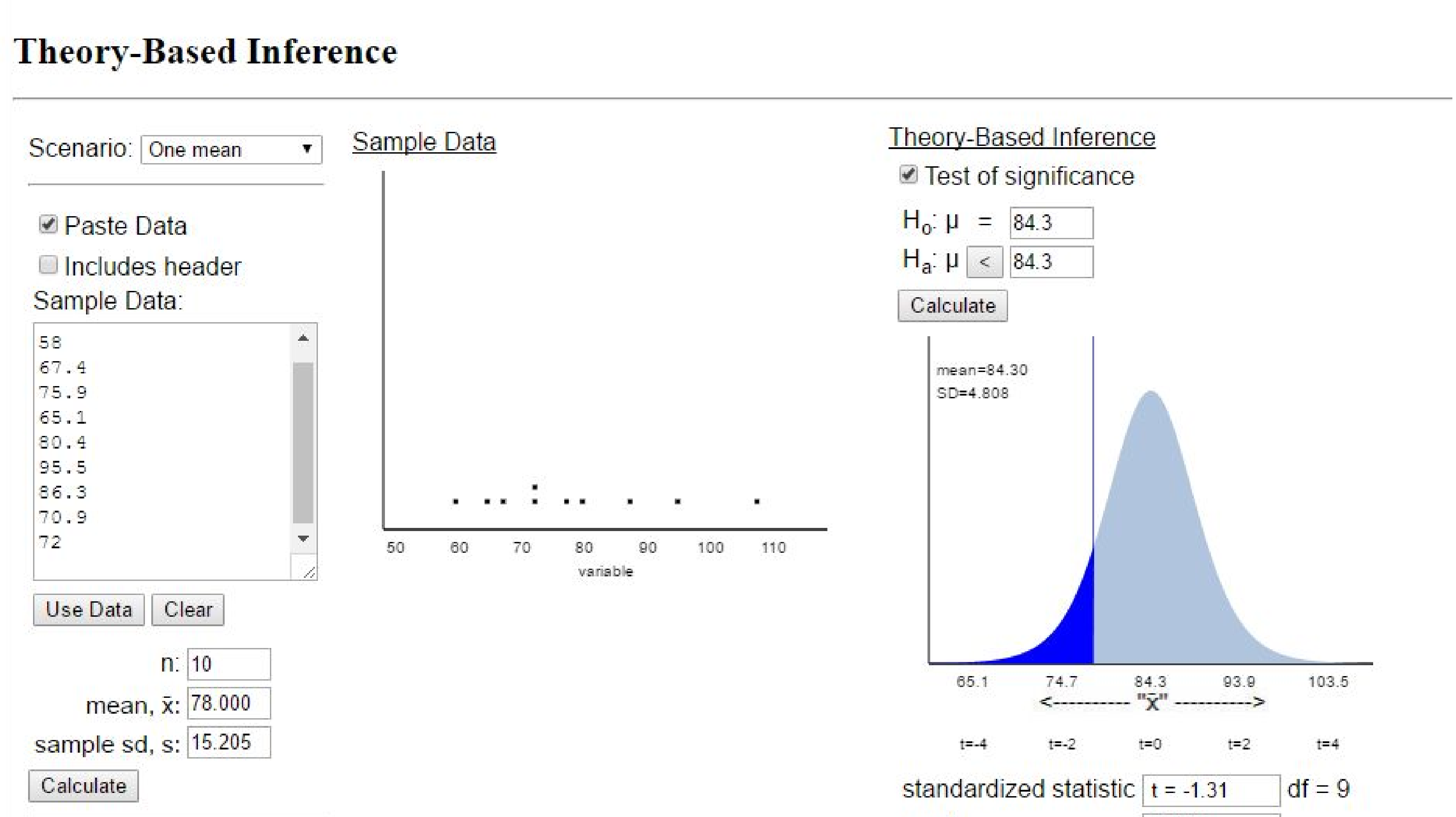
The new drive thru system will decrease the average wait time.

The Hypotheses

Waiting in Line The mean waiting time at the drive-through of a fast-food restaurant from the time an order is placed to the time the order is received is 84.3 seconds. A manager devises a new drive-through system that he believes will decrease wait time. He initiates the new system at his restaurant and measures the wait time for 10 randomly selected orders. The wait times are provided in the table.

108.5	67.4	58.0	75.9	65.1
80.4	95.5	86.3	70.9	72.0

Test statistic and p-value



Decision in Context

Cannot reject Ho

The sample data does not support the claim that the new drive thru system will decrease the average wait time.

Testing Sample Proportions

Check conditions: SRS and n(p)>= 10 and n(1-p)>=10

Write the claim

The Hypotheses:

Testing Hypotheses Regarding a Population Proportion, *p*

To test hypotheses regarding the population proportion, we can use the following steps, provided that

1. The sample is obtained by simple random sampling.
2. $np_0(1 - p_0) \geq 10$.
3. The sampled values are independent of each other.

Step 1: Determine the null and alternative hypotheses. The hypotheses can be structured in one of three ways:

Two-Tailed	Left-Tailed	Right-Tailed
H_0: $p = p_0$	H_0: $p = p_0$	H_0: $p = p_0$
H_1: $p \neq p_0$	H_1: $p < p_0$	H_1: $p > p_0$

Note: p_0 is the assumed value of the population proportion.

Run test with Rossman Chance applet <Link> to get the test statistic and the p-value

Make a decision in context

Testing Sample Means:

Write the claim

The Hypotheses

Two-Tailed	Left-Tailed	Right-Tailed
$H_0: \mu = \mu_0$	$H_0: \mu = \mu_0$	$H_0: \mu = \mu_0$
$H_1: \mu \neq \mu_0$	$H_1: \mu < \mu_0$	$H_1: \mu > \mu_0$

Note: μ_0 is the assumed value of the population mean.

Check for Normality

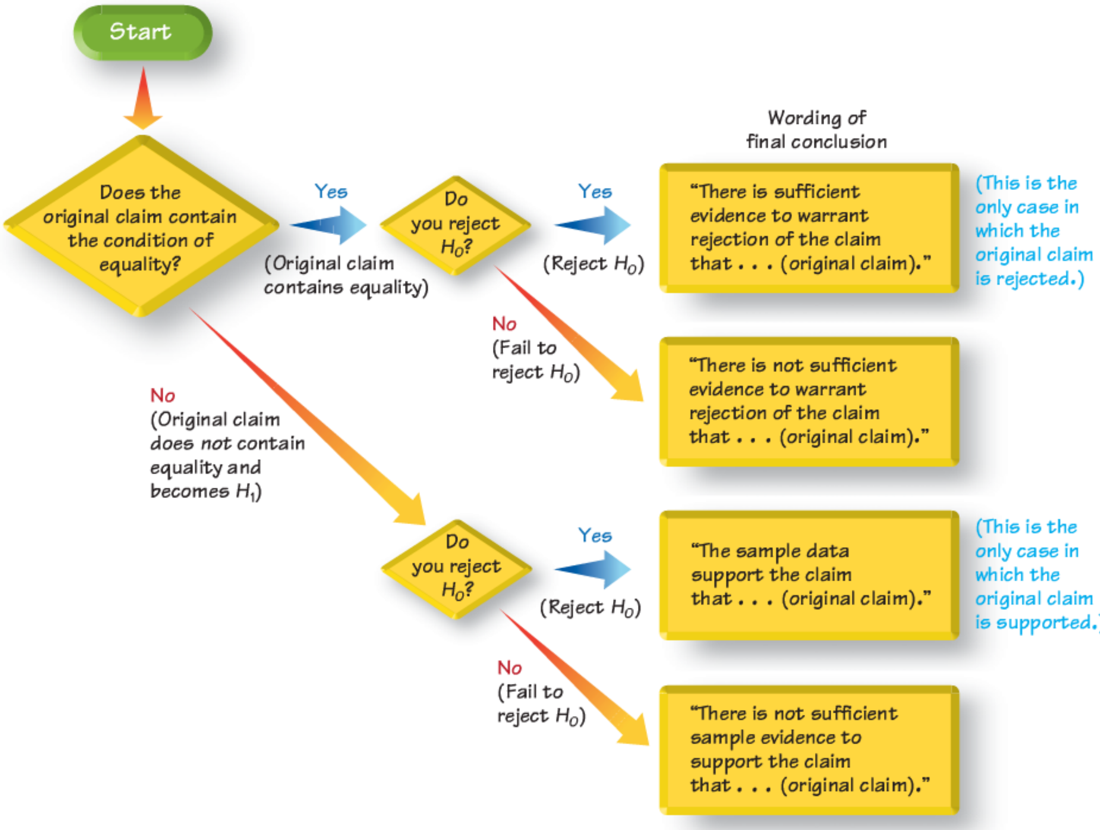
SRS (or a random sample of some type)

Is the sample size at least 30 pieces of data? (n>30)?

If not, is the Parent population Normally distributed (or check with a Normal Probability Plot <link>)

Run test with Rossman Chance applet <Link> to get the test statistic and the p-value

Make a decision in context



Start
Does the original claim contain the condition of equality?
Yes
(Original claim contains equality)
Do you reject H_0?
Yes
(Reject H_0)
Wording of final conclusion
"There is sufficient evidence to warrant rejection of the claim that . . . (original claim)."
(This is the only case in which the original claim is rejected.)
No
(Fail to reject H_0)
"There is not sufficient evidence to warrant rejection of the claim that . . . (original claim)."
No
(Original claim does not contain equality and becomes H_1)
Do you reject H_0?
Yes
(Reject H_0)
"The sample data support the claim that . . . (original claim)."
(This is the only case in which the original claim is supported.)
No
(Fail to reject H_0)
"There is not sufficient sample evidence to support the claim that . . . (original claim)."