Hypothesis Testing about Two Independent Means

Hypothesis Testing Comparing Two Means $\boldsymbol{\mu_1}$ and $\boldsymbol{\mu_2}$

Language

The means are the same.
The means are not different.
$\boldsymbol{\mu_1 = \mu_2}$

The means are not the same.
The means are different.
$\boldsymbol{\mu_1 \neq \mu_2}$

μ_1 is more than μ_2
$\boldsymbol{\mu_1 > \mu_2}$

μ_1 is less than μ_2
$\boldsymbol{\mu_1 < \mu_2}$

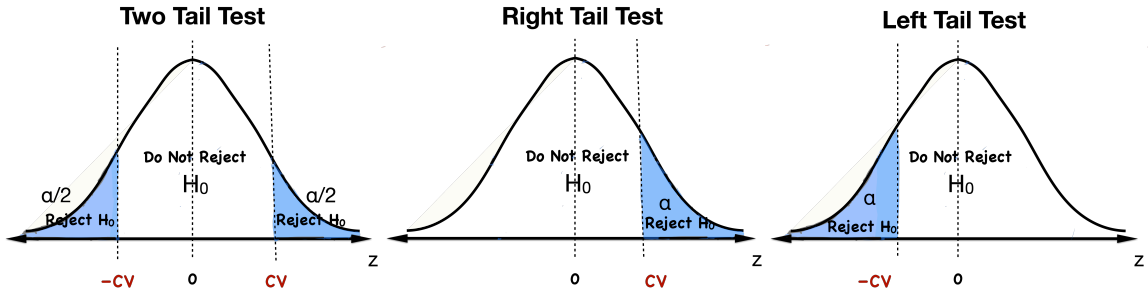
μ_1 is no more than μ_2
$\boldsymbol{\mu_1 \leq \mu_2}$

μ_1 is at least μ_2
$\boldsymbol{\mu_1 \leq \mu_2}$

Traditional Hypothesis Testing Procedure

Step1- Set up your Hypothesis and **Step 2-** Create your **decision rule** based on the Hypothesis Testing set up (step 1).

$H_0: =$	$H_0: \leq$	$H_0: \geq$
$H_1: \neq$	$H_1: >$	$H_1: <$



Label which Hypothesis is the claim!

Step 3- Take your Sample.

Step 4- Compute your Test Statistic

$$ts = \frac{\bar{p}-p}{\sqrt{\frac{p(1-p)}{n}}} \qquad ts = \frac{\bar{x}-\mu}{s/\sqrt{n}} \qquad ts = \frac{\overline{p_1}-\overline{p_2}}{\sqrt{\frac{\tilde{p}(1-\tilde{p})}{n_1}+\frac{\tilde{p}(1-\tilde{p})}{n_2}}} \qquad ts = \frac{\overline{x_1}-\overline{x_2}}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}}$$

Step 5- State your **Conclusion.**
Either the **sample supports the claim** or the **sample does not support the claim**.

Assuming the population standard deviations σ_1 and σ_2 are unknown use the t-table.

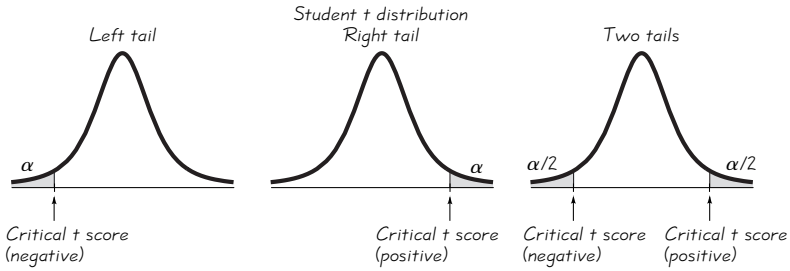


TABLE A-3 *t* Distribution

	α					
Degrees of Freedom	.005 (one tail) 0.01 (two tails)	.01 (one tail) .02 (two tails)	.025 (one tail) .05 (two tails)	.05 (one tail) .10 (two tails)	.10 (one tail) .20 (two tails)	.25 (one tail) .50 (two tails)
1	63.657	31.821	12.706	6.314	3.078	1.000
2	9.925	6.965	4.303	2.920	1.886	.816
3	5.841	4.541	3.182	2.353	1.638	.765
4	4.604	3.747	2.776	2.132	1.533	.741
5	4.032	3.365	2.571	2.015	1.476	.727
6	3.707	3.143	2.447	1.943	1.440	.718
7	3.500	2.998	2.365	1.895	1.415	.711
8	3.355	2.896	2.306	1.860	1.397	.706
9	3.250	2.821	2.262	1.833	1.383	.703
10	3.169	2.764	2.228	1.812	1.372	.700
11	3.106	2.718	2.201	1.796	1.363	.697
12	3.054	2.681	2.179	1.782	1.356	.696
13	3.012	2.650	2.160	1.771	1.350	.694
14	2.977	2.625	2.145	1.761	1.345	.692
15	2.947	2.602	2.132	1.753	1.341	.691
16	2.921	2.584	2.120	1.746	1.337	.690
17	2.898	2.567	2.110	1.740	1.333	.689
18	2.878	2.552	2.101	1.734	1.330	.688
19	2.861	2.540	2.093	1.729	1.328	.688
20	2.845	2.528	2.086	1.725	1.325	.687
21	2.831	2.518	2.080	1.721	1.323	.686
22	2.819	2.508	2.074	1.717	1.321	.686
23	2.807	2.500	2.069	1.714	1.320	.685
24	2.797	2.492	2.064	1.711	1.318	.685
25	2.787	2.485	2.060	1.708	1.316	.684
26	2.779	2.479	2.056	1.706	1.315	.684
27	2.771	2.473	2.052	1.703	1.314	.684
28	2.763	2.467	2.048	1.701	1.313	.683
29	2.756	2.462	2.045	1.699	1.311	.683
Large (z)	2.575	2.326	1.960	1.645	1.282	.675

Age of College Students

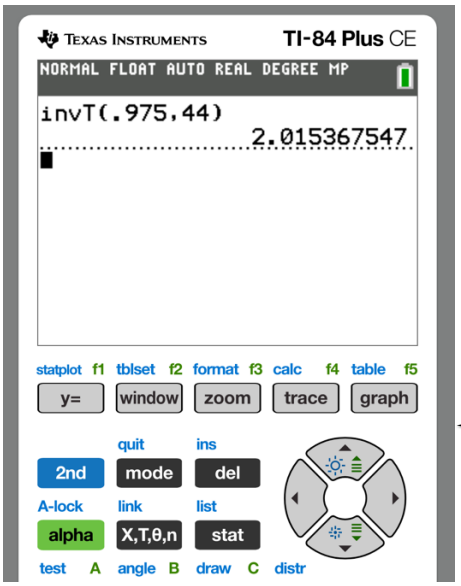
The mean age of female college students is not the same as the mean age of male college students as claimed by Professor Snodgrass. A sample of 45 female college students reveal a mean age of 24.8 years with a standard deviation of 3.6 years, while a sample of 85 male college students reveal a mean age of 26.9 years and a standard deviation of 2.6 years. Use the 5% level of significance to test this claim.

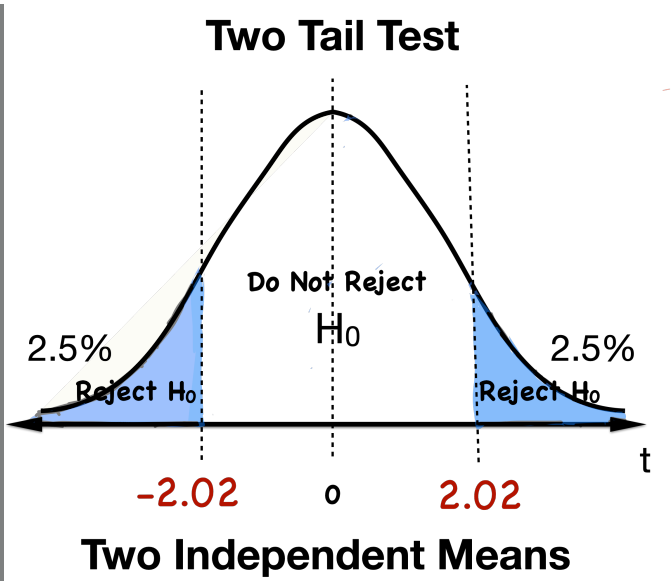
Create Your Decision Rule by determining your critical value(s).
Approximate the critical value(s) to the nearest hundredths.

TI-83 or TI-84 Plus Finding the t vaue corresponding to a known area.

1. Press **2nd** then **vars** to access DISTR (distributions) menu.
2. Select **InvT** and click **enter**.
3. Enter the **area to the left** of the right most **Critical Value**.
4. Enter the **degree of freedom of the smallest sample size**.

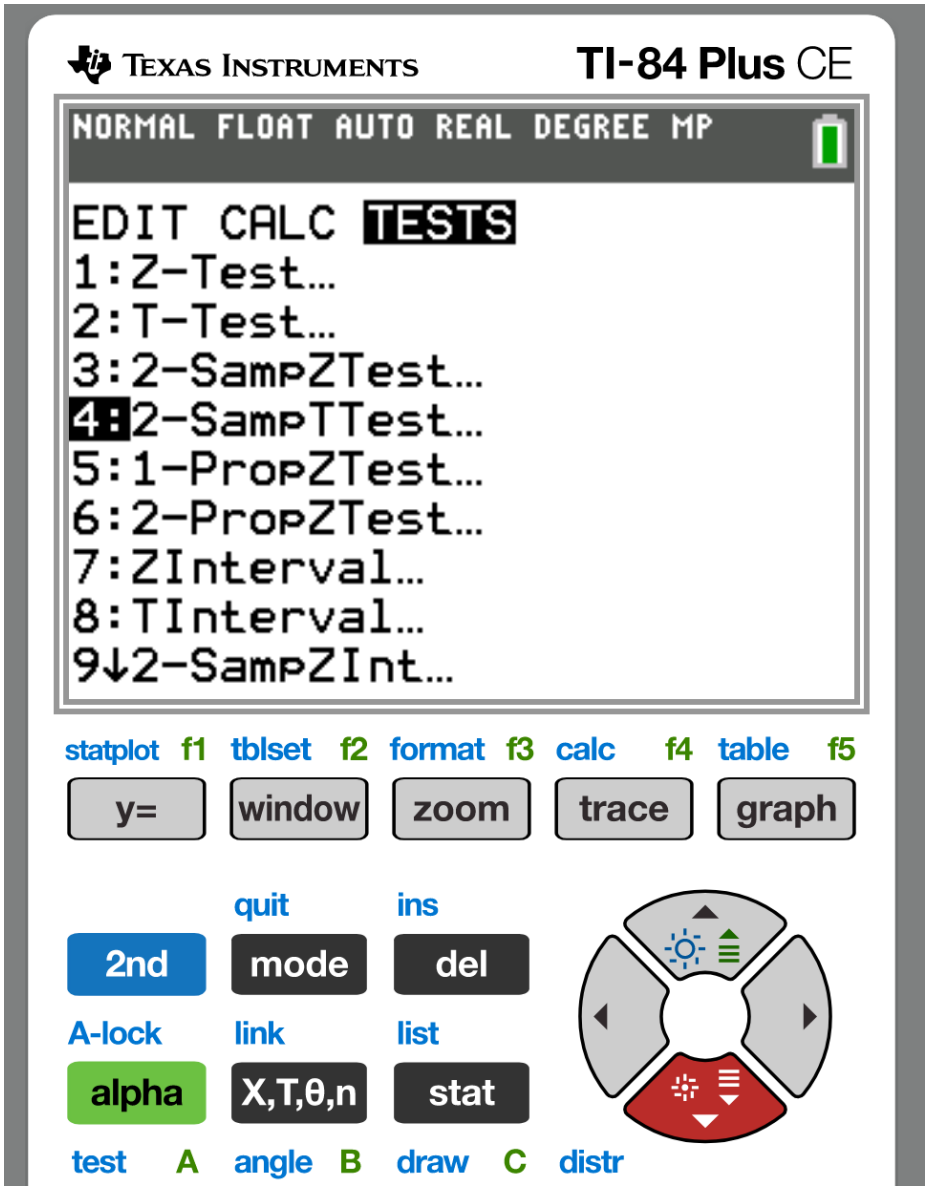
InvT
area: 0.975
$df: 44$

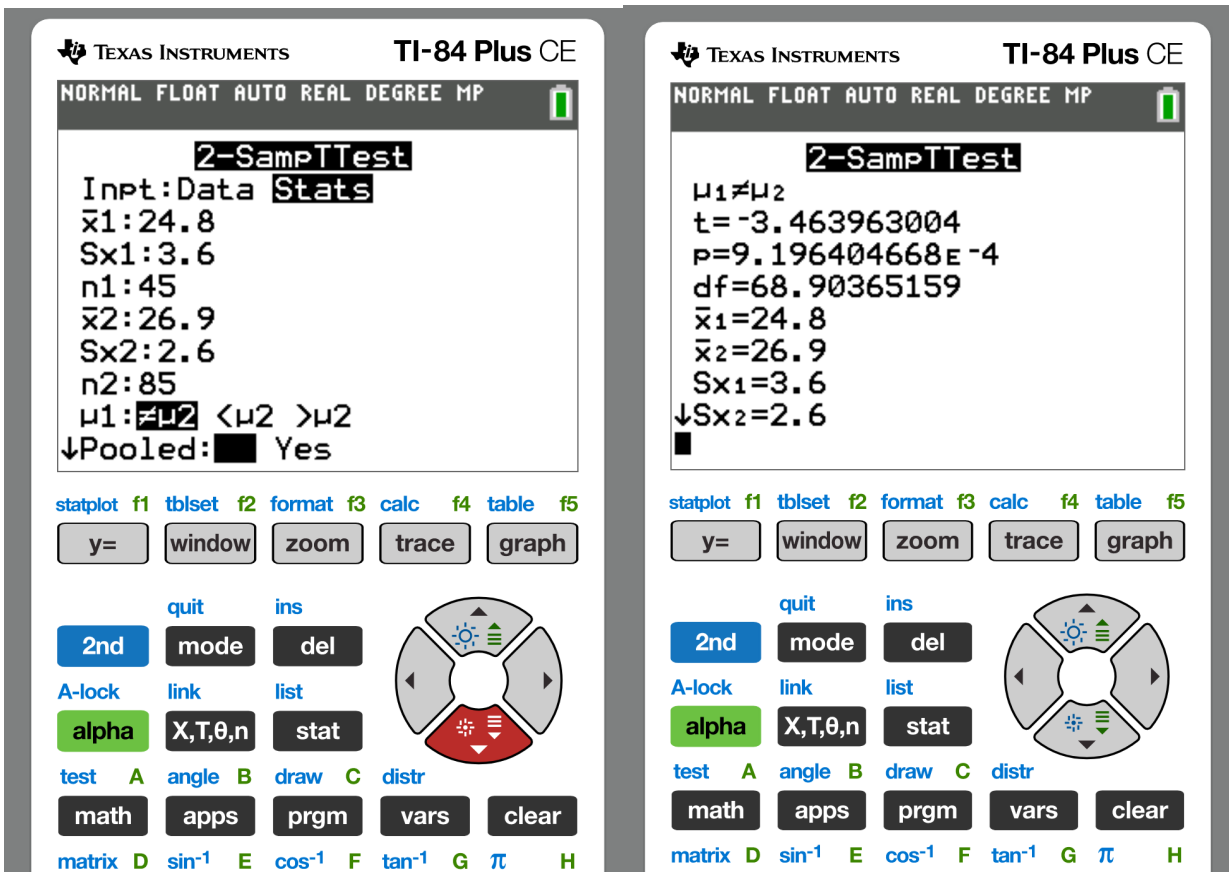




Approximate your test statistic to the nearest hundredths.

TI-84 Plus CE
1. Press **STAT**, then select **TESTS** in the top menu.
2. Select **2-SampT-Test** in the menu and press **ENTER.**
3. Enter sample mean $\bar{x}1$ 1 and the sample standard deviation and $Sx1$ and sample size n_1 from sample 1. The sample mean $\bar{x}2$ and the sample standard deviation and $Sx2$ and sample size n_2 from sample 2. Enter the desired format for the alternate hypothesis $\mu 1$.
4. Select **Calculate.**





The test Statistic is measured as a t value as $t = -3.46$

$$p < \alpha$$

$$0.00 < 0.05$$

Accept H_1

The Sample Supports the Claim

Lifespan of Hawaiian Residents

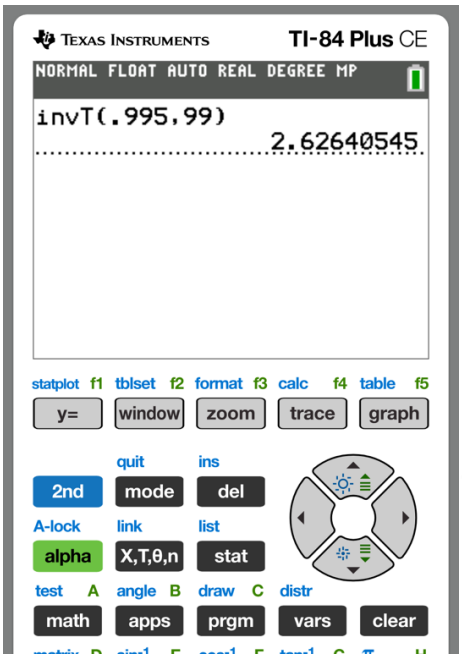
The mean lifespan of male Hawaiian residents is the same as the mean lifespan of female Hawaiian residents as claimed by the State of Hawaii. A sample of 120 male Hawaiian residents reveal a mean lifespan of 78.2 years with a standard deviation of 5.8 years, while a sample of 100 female Hawaiian residents reveal a mean of 82. 1 years with a standard deviation of 8.3 years. Use the 1% level of significance to test this claim.

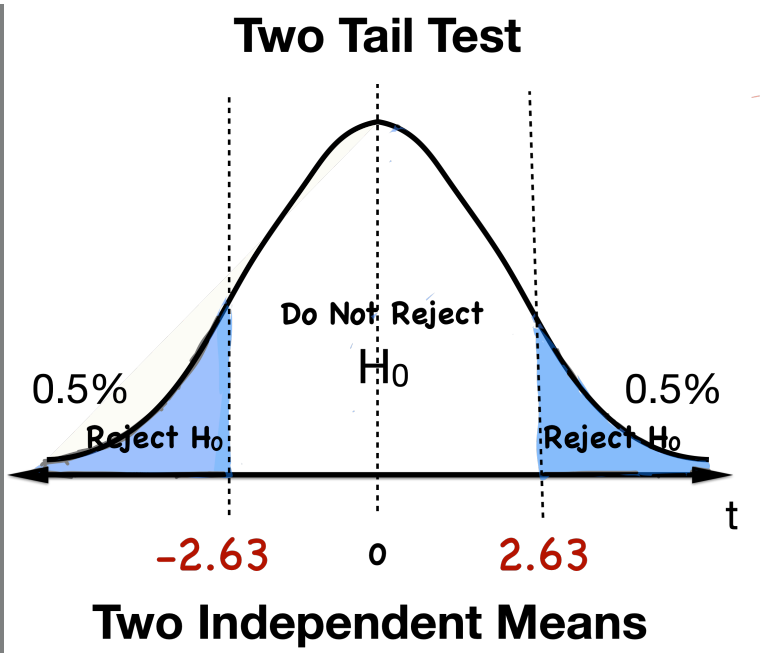
Create Your Decision Rule by determining your critical value(s).
Approximate the critical value(s) to the nearest hundredths.

TI-83 or TI-84 Plus Finding the t vaue corresponding to a known area.

1. Press **2nd** then **vars** to access DISTR (distributions) menu.
2. Select **InvT** and click **enter**.
3. Enter the **area to the left** of the right most **Critical Value**.
4. Enter the **degree of freedom of the smallest sample size**.

InvT
area: 0.995
$df: 99$





Approximate your test statistic to the nearest hundredths.

TI-84 Plus CE
1. Press **STAT**, then select **TESTS** in the top menu.
2. Select **2-SampT-Test** in the menu and press **ENTER.**
3. Enter sample mean $\bar{x}1$ 1 and the sample standard deviation and $Sx1$ and sample size n_1 from sample 1. The sample mean $\bar{x}2$ and the sample standard deviation and $Sx2$ and sample size n_2 from sample 2. Enter the desired format for the alternate hypothesis $\mu 1$.
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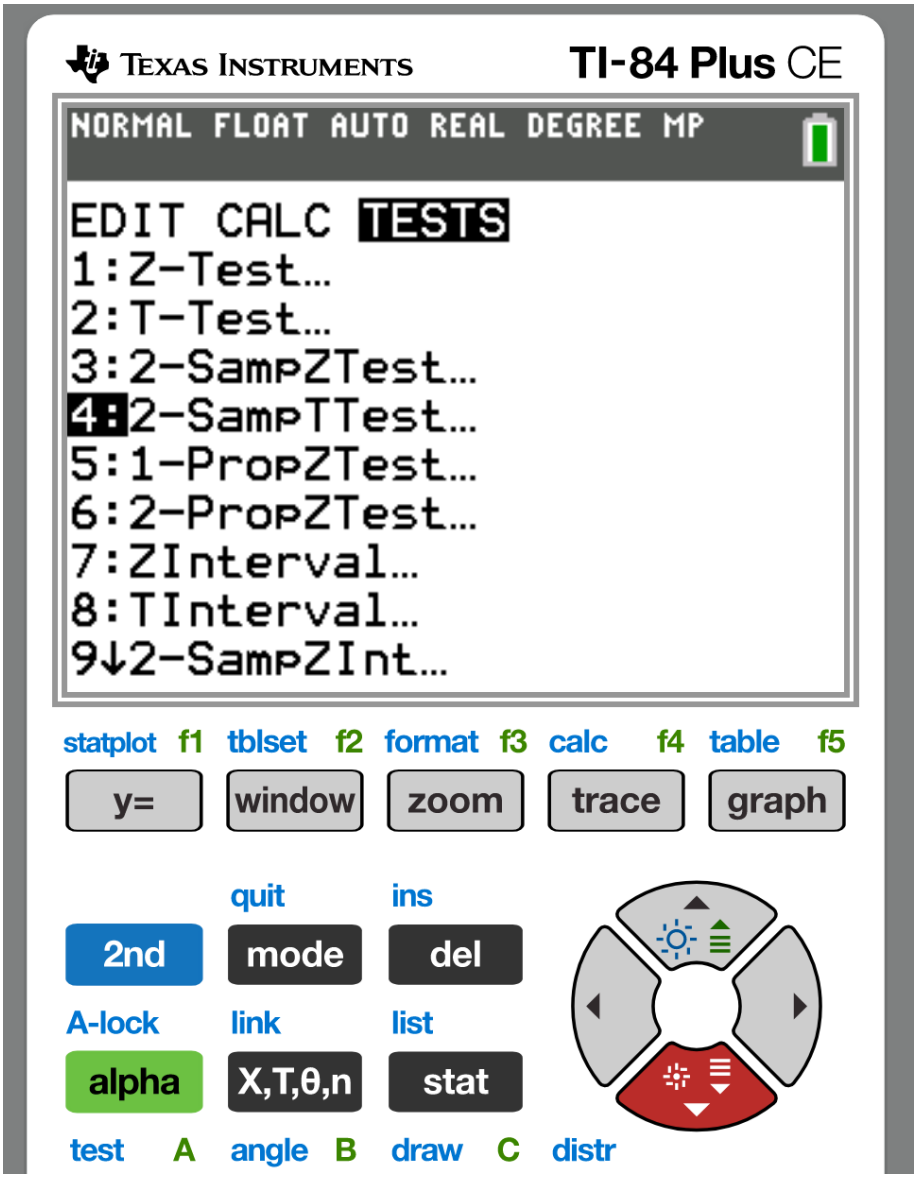

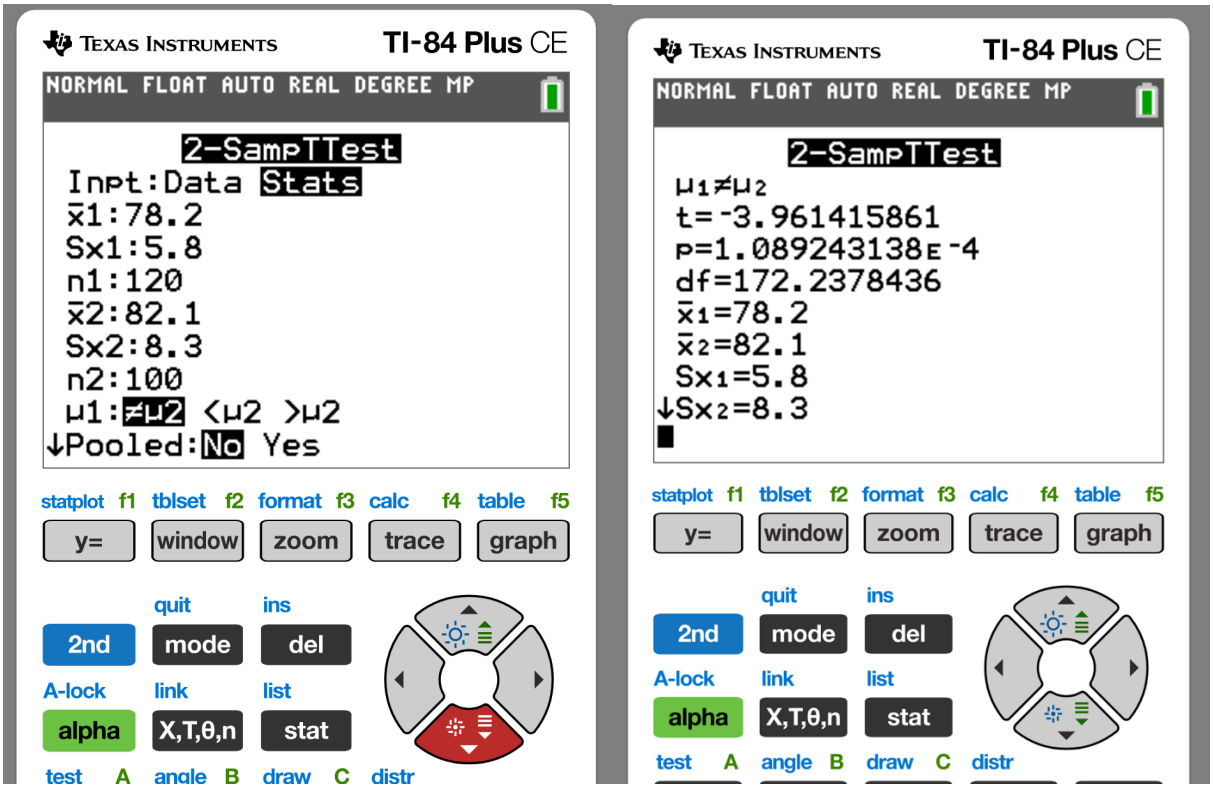

The test Statistic is measured as a t value as $\boldsymbol{t = -3.96}$

$$\boldsymbol{p < \alpha}$$

$$0.00 < 0.01$$

Accept H_1

The Sample Supports the Claim

Color and Cognition

Researchers conducted a study to investigate the effects of color and cognitive tasks. Words were displayed on a computer screen with background colors of red and blue. The results of word recall are given with the following sample data for each color.

Recall	**Sample Size**	**Sample Mean**	**Sample Standard Deviation**
Red	38	16.32	4.85
Blue	36	15.95	4.72

Use the 5% level of significance to test the claim that the means are the same.

Create Your Decision Rule by determining your critical value(s).
Approximate the critical value(s) to the nearest hundredths.

TI-83 or TI-84 Plus Finding the t vaue corresponding to a known area.

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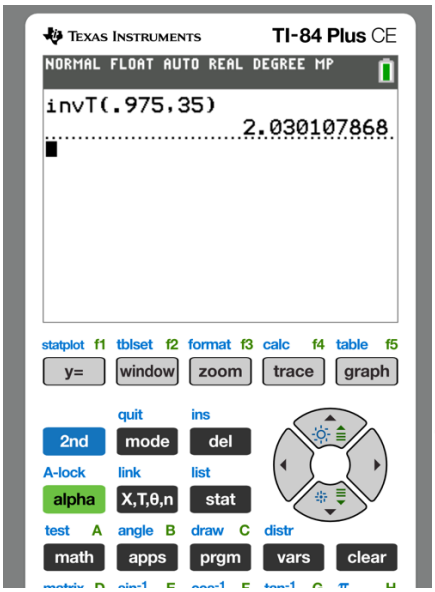
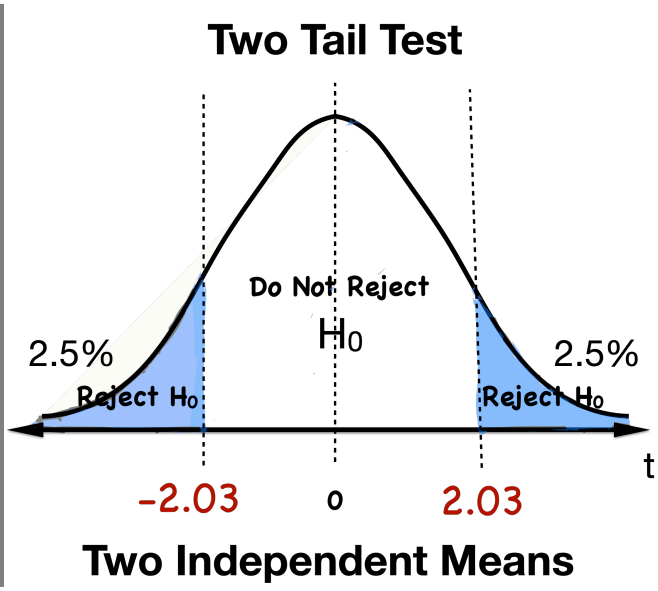
2. Select **InvT** and click **enter**.
3. Enter the **area to the left** of the right most **Critical Value**.
4. Enter the **degree of freedom of the smallest sample size**.

InvT
area: 0.975
$df: 35$





Approximate your test statistic to the nearest hundredths.

TI-84 Plus CE
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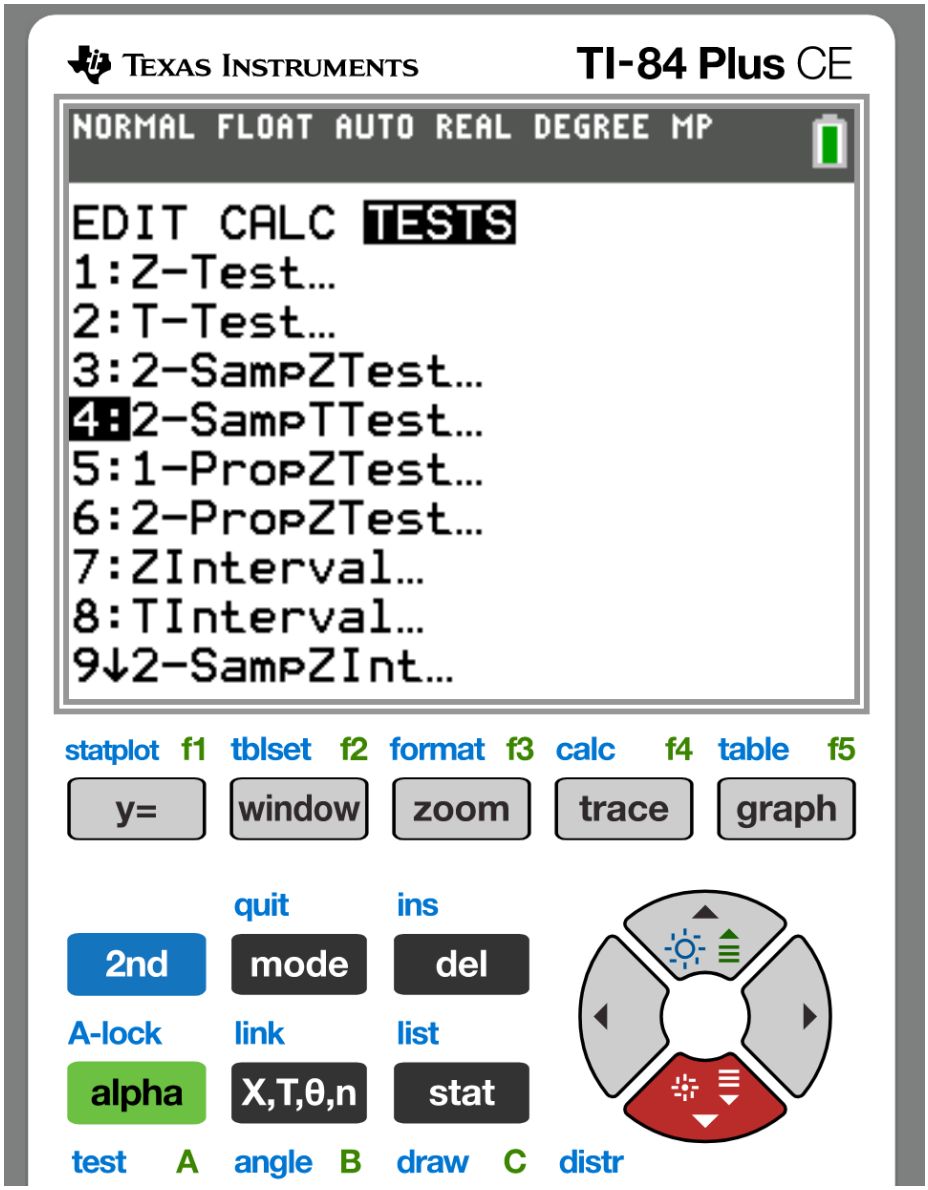
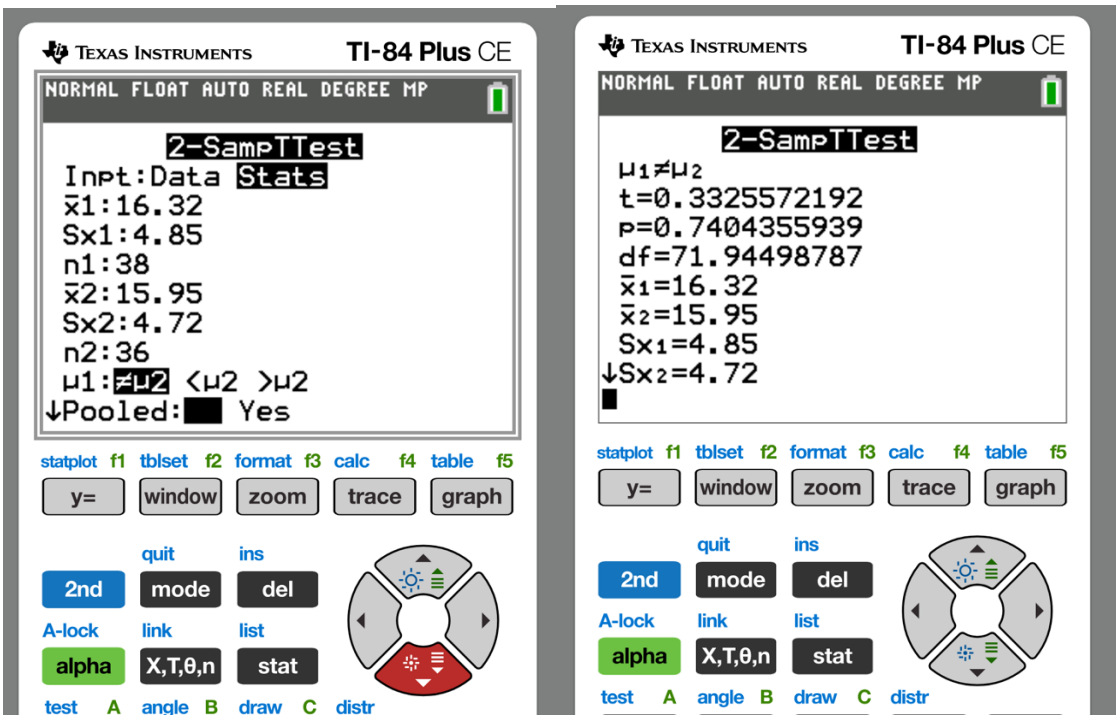
4. Select **Calculate.**





The test Statistic is measured as a t value as $\boldsymbol{t = 0.333}$

$$\boldsymbol{p < \alpha}$$

$$0.74 \nless 0.05$$

Accept H_0

The Sample Supports the Claim

Secondhand Smoke

Cotinine is a metabolite of nicotine. Meaning, when nicotine is absorbed by the body, cotinine is produced. Cotinine levels measured in a group of non-smokers exposed to tobacco smoke is compared to Cotinine levels of a group of smokers who are exposed to tobacco smoke. The following tables illustrates the data that was gathered.

Cotinine Levels for Non-Smokers	**Sample Size**	**Sample Mean**	**Sample Standard Deviation**
Exposed to Tobacco Smoke	42	60.12 ng/mL	136.48 ng/mL
Not Exposed to Tobacco Smoke	40	18.25 ng/mL	61.78 ng/mL

Use the 10% level of significance to test the claim that non-smokers exposed to tobacco smoke have a higher mean cotinine level than nonsmokers not exposed to tobacco smoke.

Create Your Decision Rule by determining your critical value(s).
Approximate the critical value(s) to the nearest hundredths.

TI-83 or TI-84 Plus Finding the t vaue corresponding to a known area.

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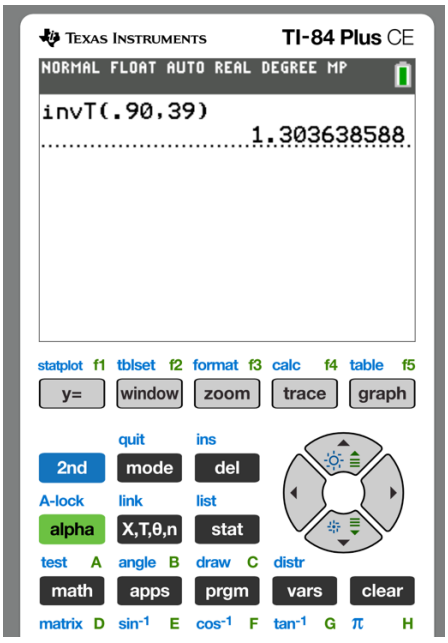
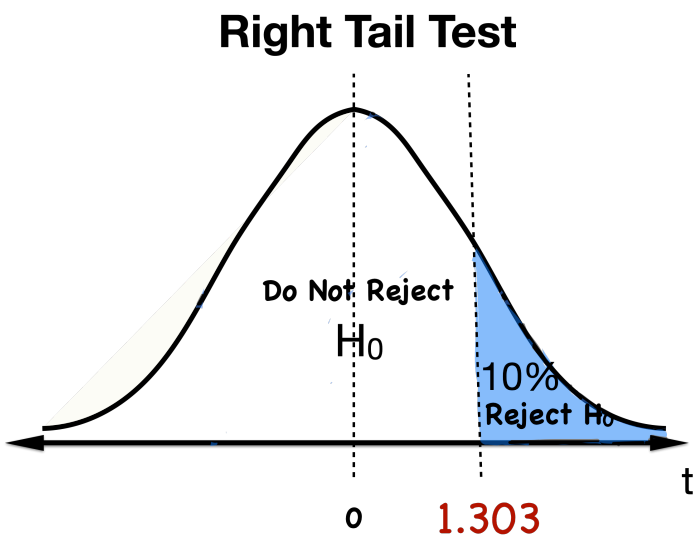
2. Select **InvT** and click **enter**.
3. Enter the **area to the left** of the right most **Critical Value**.
4. Enter the **degree of freedom of the smallest sample size**.

InvT
area: 0.90
$df: 39$





Two Independent Means

Approximate your test statistic to the nearest hundredths.

TI-84 Plus CE
1. Press **STAT**, then select **TESTS** in the top menu.
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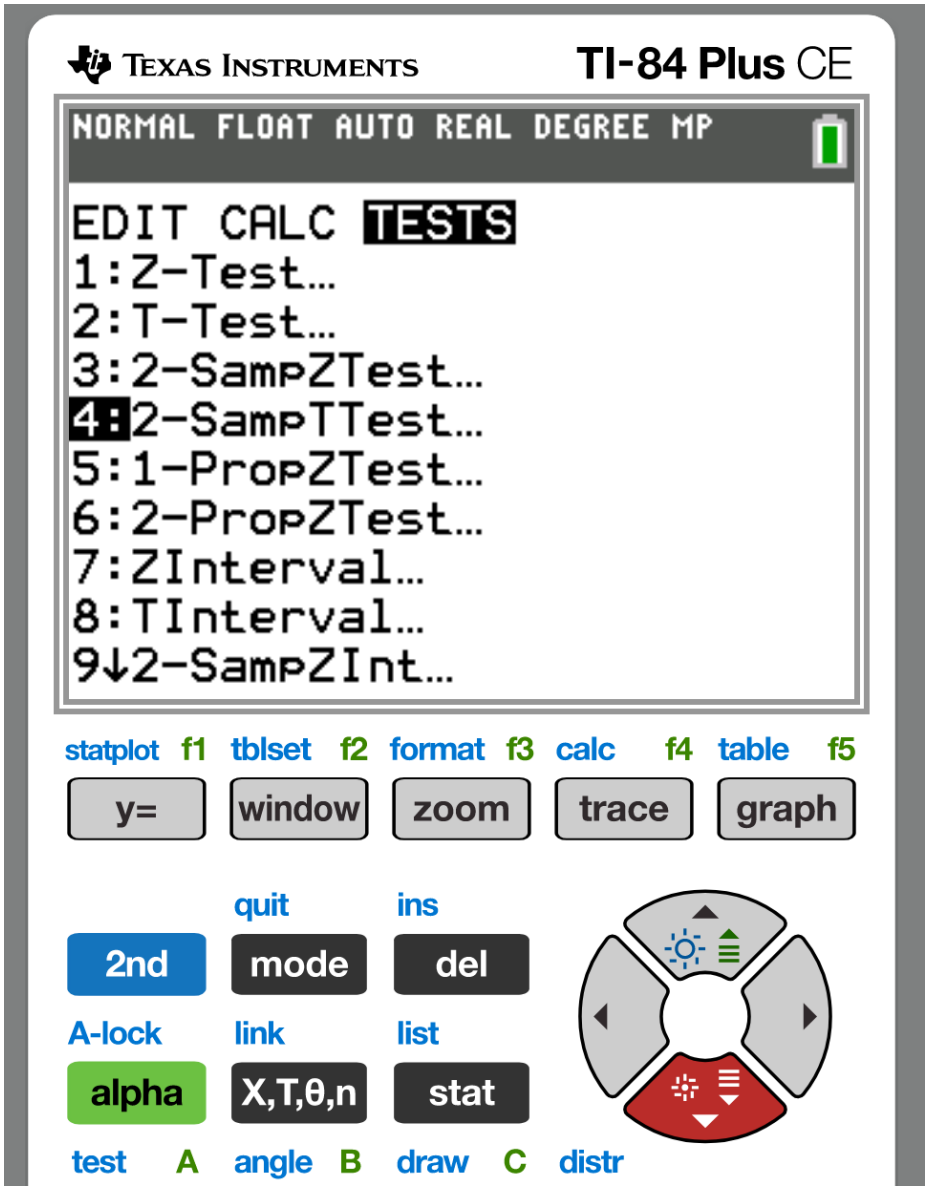

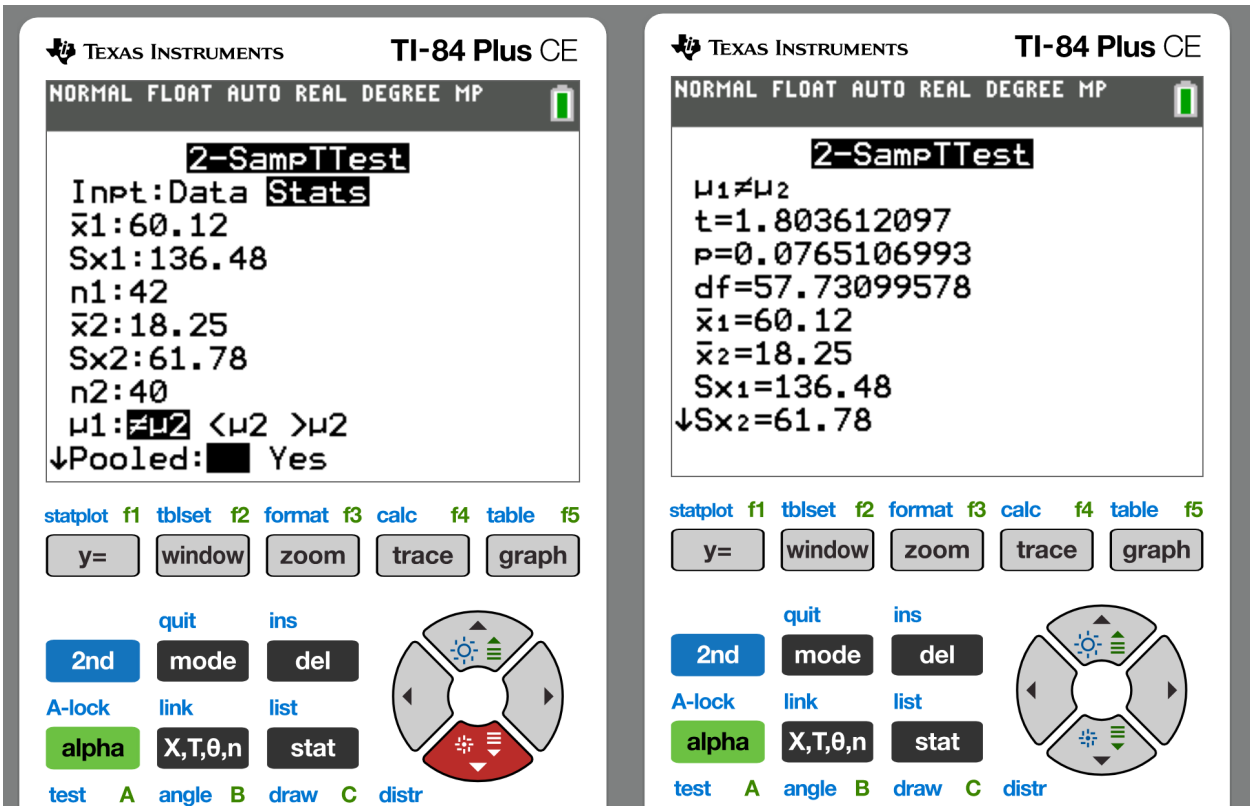

The test Statistic is measured as a t value as $\boldsymbol{t = 1.804}$

$$\boldsymbol{p < \alpha}$$

$$0.08 < 0.10$$

Accept H_1

The Sample Supports the Claim

Seat Belts

A study of seat belt use involved children who were hospitalized after motor vehicle crashes. For a group of 125 children who were wearing seat belts, the number of days in the ICU has a mean of 0.87 with a standard deviation of 1.89 days. Among a group of 300 children who were not wearing seatbelts, the number of days spent in the ICU has a mean of 1.35 days with a standard deviation of 2.95 days. Use the 1% level of significance to test the claim that children wearing seatbelts have a lower mean length of days in the ICU than the mean for children not wearing seatbelts.

Create Your Decision Rule by determining your critical value(s).
Approximate the critical value(s) to the nearest hundredths.

TI-83 or TI-84 Plus Finding the t vaue corresponding to a known area.

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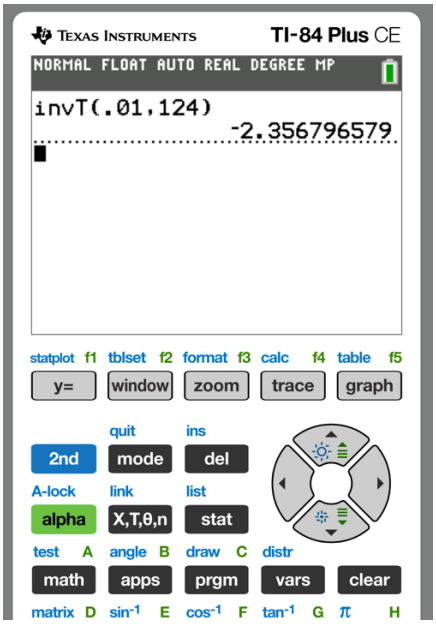
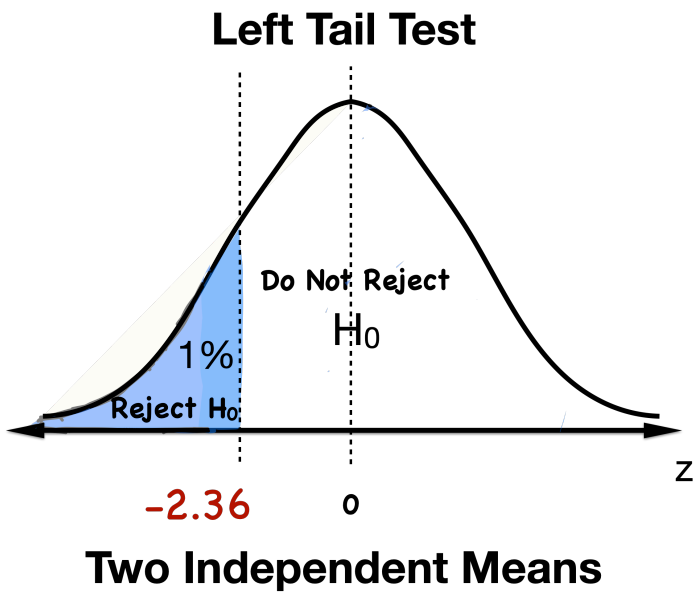
4. Enter the **degree of freedom of the smallest sample size**.

InvT
area: 0.01
df: 124





Two Independent Means

Approximate your test statistic to the nearest hundredths.

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2. Select **2-SampT-Test** in the menu and press **ENTER.**
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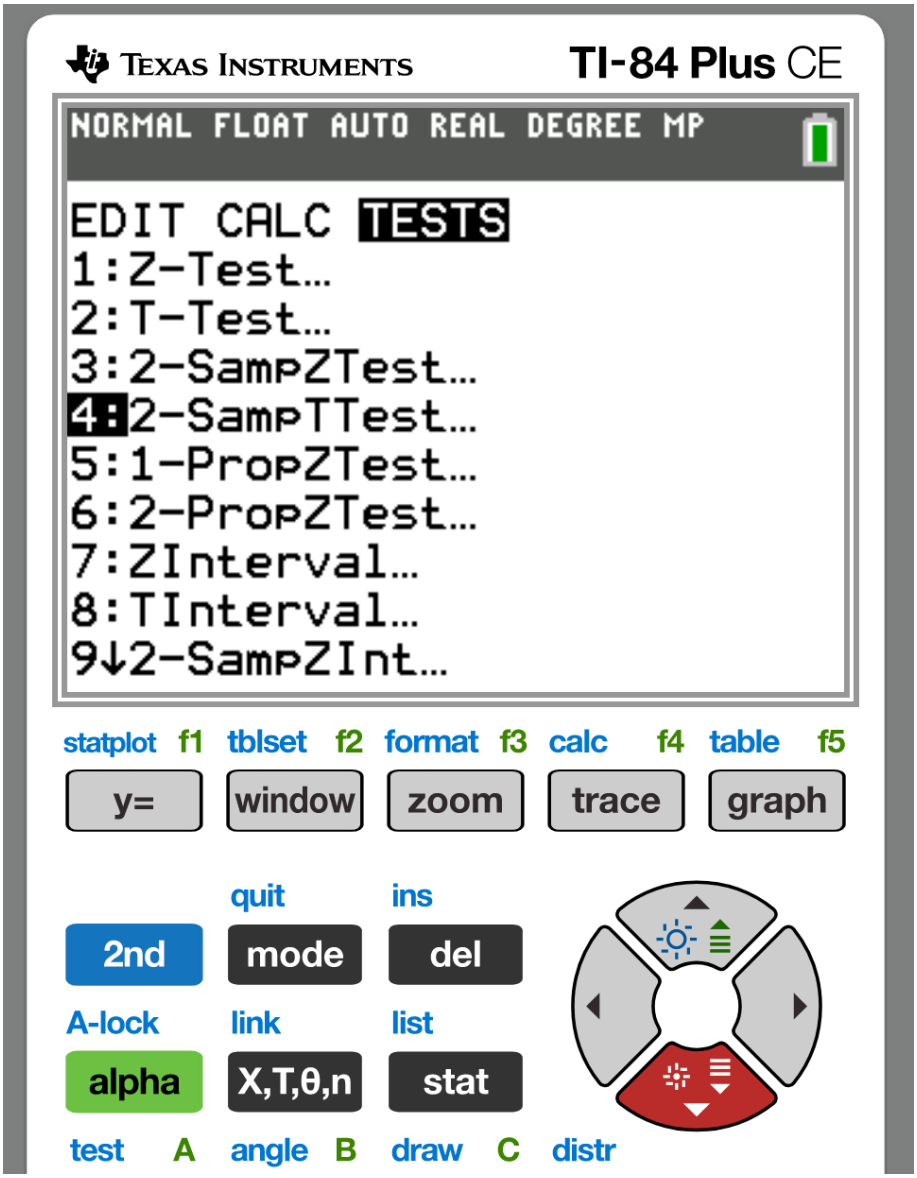

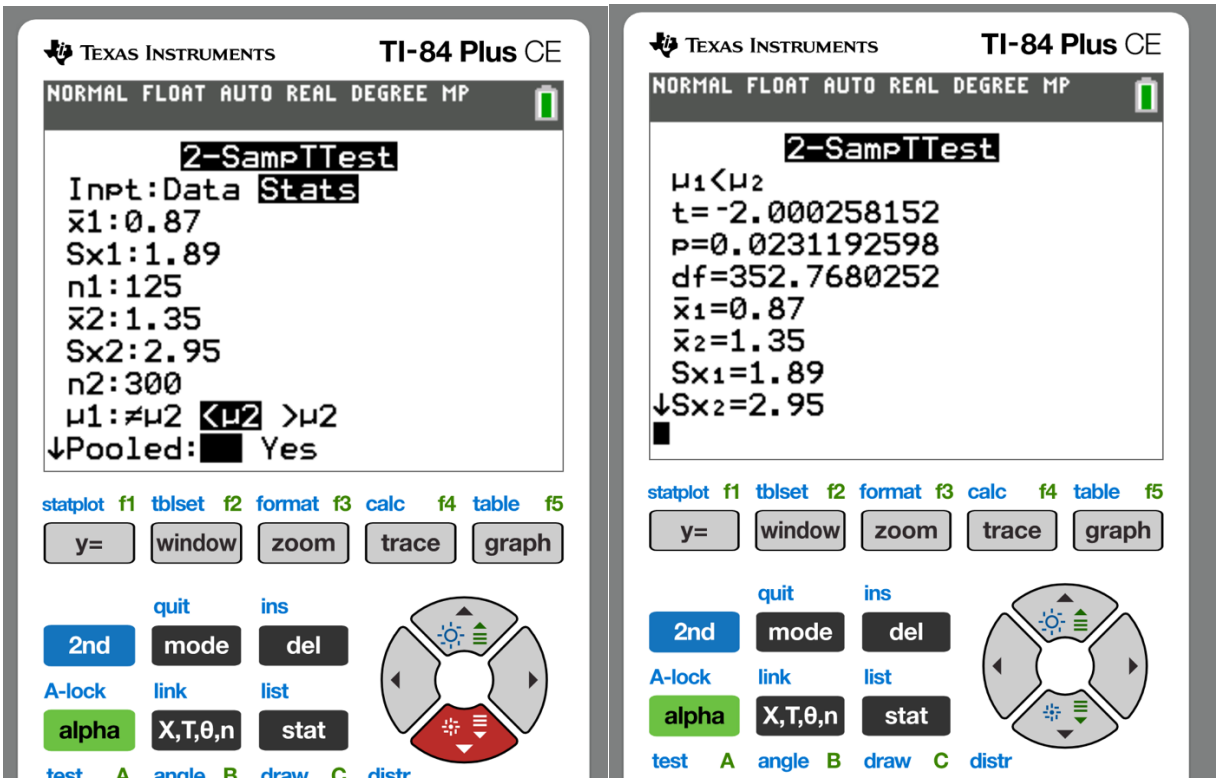

The test Statistic is measured as a t value as $\boldsymbol{t = -2.000}$

$$\boldsymbol{p < \alpha}$$

$$0.02 \not< 0.01$$

Accept H_0

The Sample Does Not Supports the Claim