Hypothesis Testing about Two Independent Proportions

Language

The proportions are the same.
The proportions are not different.
$\boldsymbol{P_1 = P_2}$

The proportions are not the same.
The proportions are different.
$\boldsymbol{P_1 \neq P_2}$

P_1 is more likely than P_2
$\boldsymbol{P_1 > P_2}$

P_1 is less likely than P_2
$\boldsymbol{P_1 < P_2}$

P_1 is no more than P_2
$\boldsymbol{P_1 \leq P_2}$

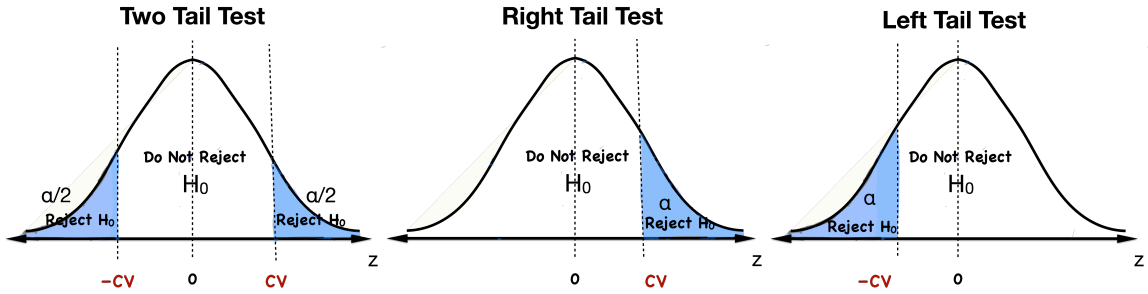
P_1 is at least P_2
$\boldsymbol{P_1 \leq P_2}$

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).

$H_0: =$ $\quad$ $H_0: \leq$ $\quad$ $H_0: \geq$

$H_1: \neq$ $\quad$ $H_1: >$ $\quad$ $H_1: <$



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**.

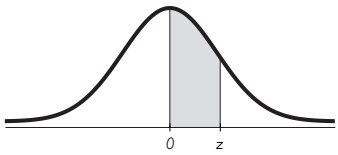


TABLE A-2 Standard Normal (z) Distribution

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495 *	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949 *	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.10 and higher	.4999									

NOTE: For values of z above 3.09, use 0.4999 for the area.

*Use these common values that result from interpolation:

z score	Area
1.645	0.4500
2.575	0.4950

From Frederick C. Mosteller and Robert E. K. Rourke, *Sturdy Statistics,* 1973, Addison-Wesley Publishing Co., Reading, MA. Reprinted with permission of Frederick Mosteller.

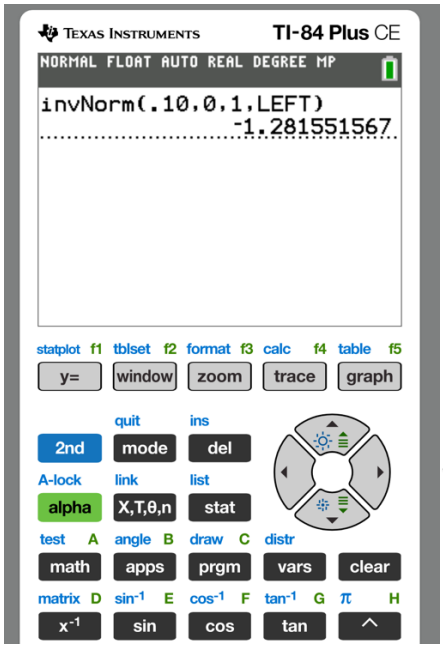
College Students

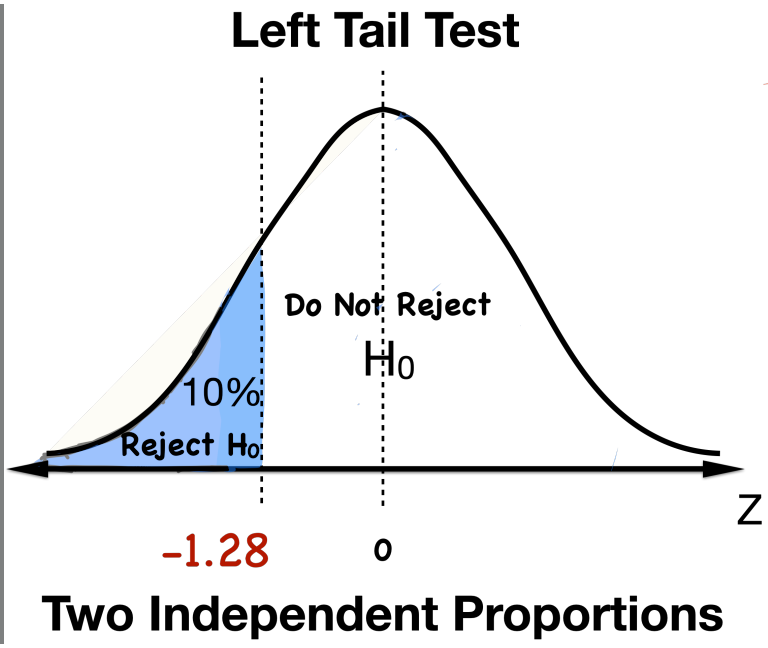
A study was conducted to determine the college student gender who is more likely to smoke. The proportion of female college students who smoke is less than the proportion of male college students who smoke as claimed by Professor Snodgrass. A sample of 1200 female college students reveal that 228 smoke and 1500 male college students reveal that 461 smoke. Use the 10% level of significance to test this claim.

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

1. Press **2nd** then **vars** to access DISTR (distributions) menu.
2. Select **InvNorm** and click **enter**.
3. Enter the area, mean μ, enter the standard deviation σ, tail.
4. Paste.

InvNorm
area: 0.10
μ: 0
σ: 1
Tail: Left

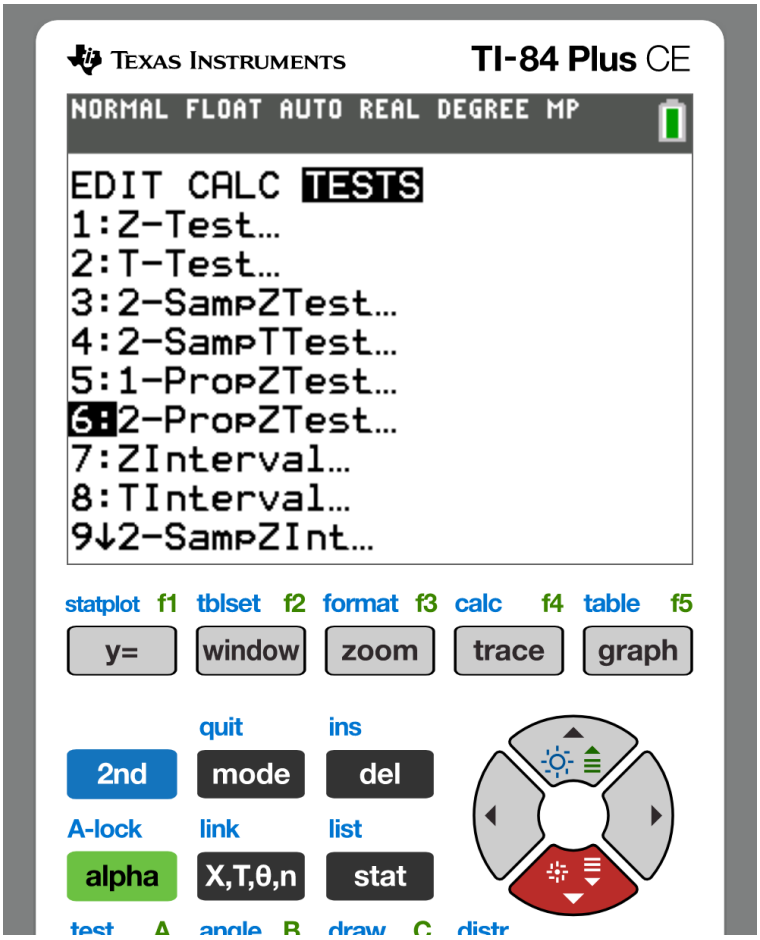


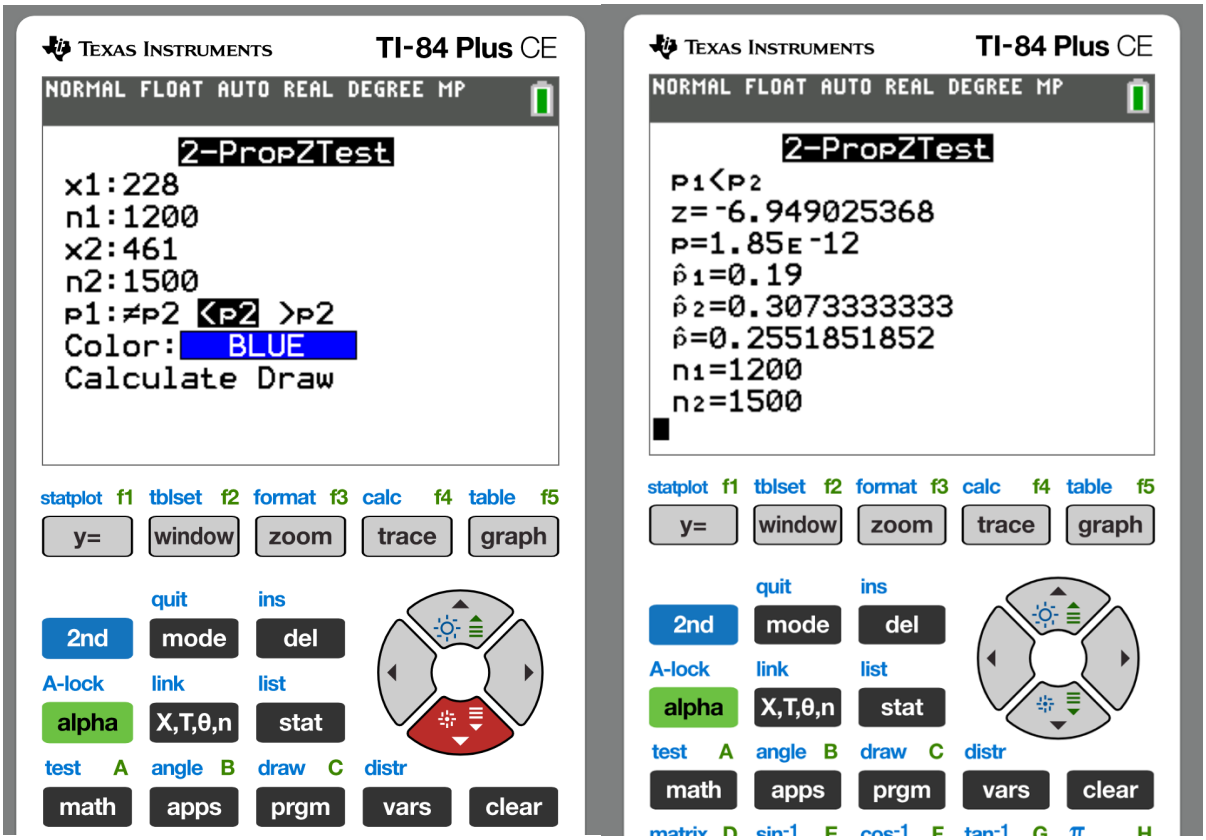


Two Independent Proportions

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-PropZ-Test** in the menu and press **ENTER.**
3. Enter the number of successes x and the sample size n for both samples. Enter the desired format for the alternate hypothesis p1.
4. Select **Calculate.**





The test statistic value is $z \approx -6.949$

p-value versus the level of significance α

$0.00000000002 < 0.10$

Accept H_1

The Sample Does Not Supports the Claim

Fast Food Order Accuracy

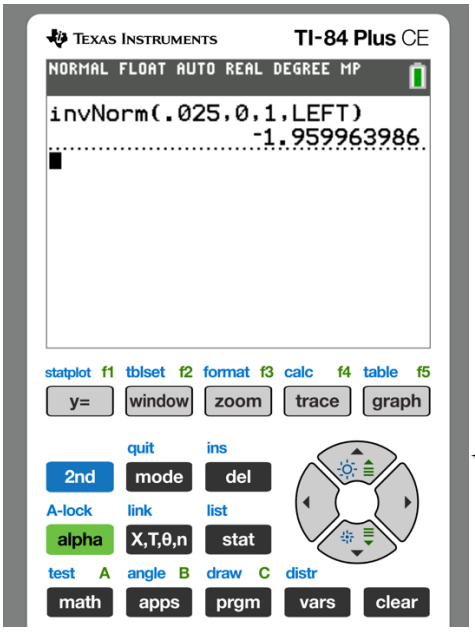
In a study of Burger King Dive through orders, it was found that 285 orders were accurate, and 36 orders were not accurate. For Mc Donald's, it was found that 332 orders were accurate and 52 were not accurate. Use the 5% level of significance to test the claim that Burger King and McDonalds have different accuracy rates.

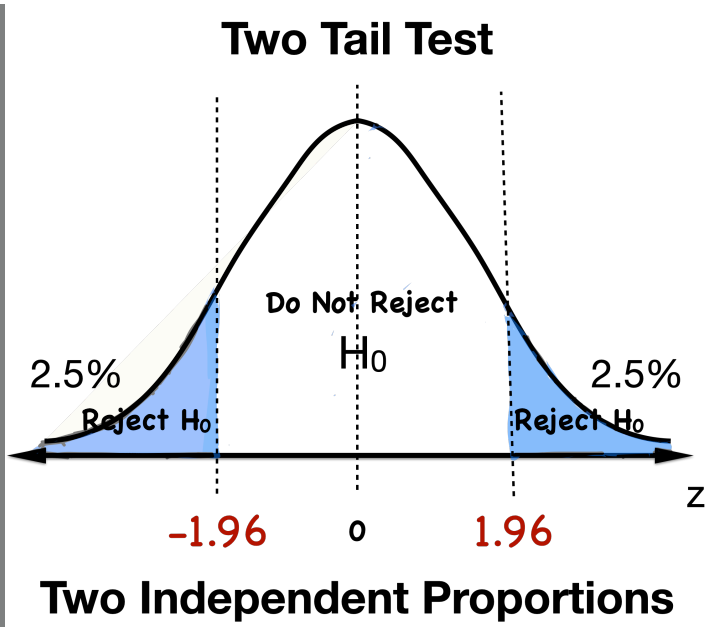
Create Your Decision Rule by determining your critical value(s).
Approximate the critical value(s) to the nearest hundredths.

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

1. Press **2nd** then **vars** to access DISTR (distributions) menu.
2. Select **InvNorm** and click **enter**.
3. Enter the area, mean μ, enter the standard deviation σ, tail.
4. Paste.

InvNorm
area: 0.025
μ: 0
σ: 1
Tail: Left





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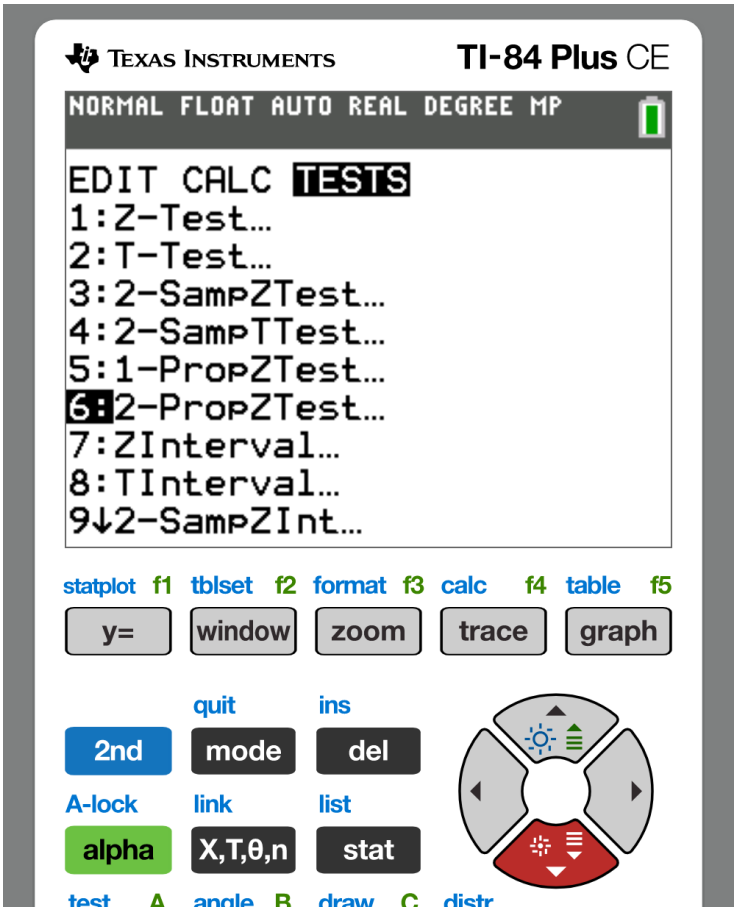
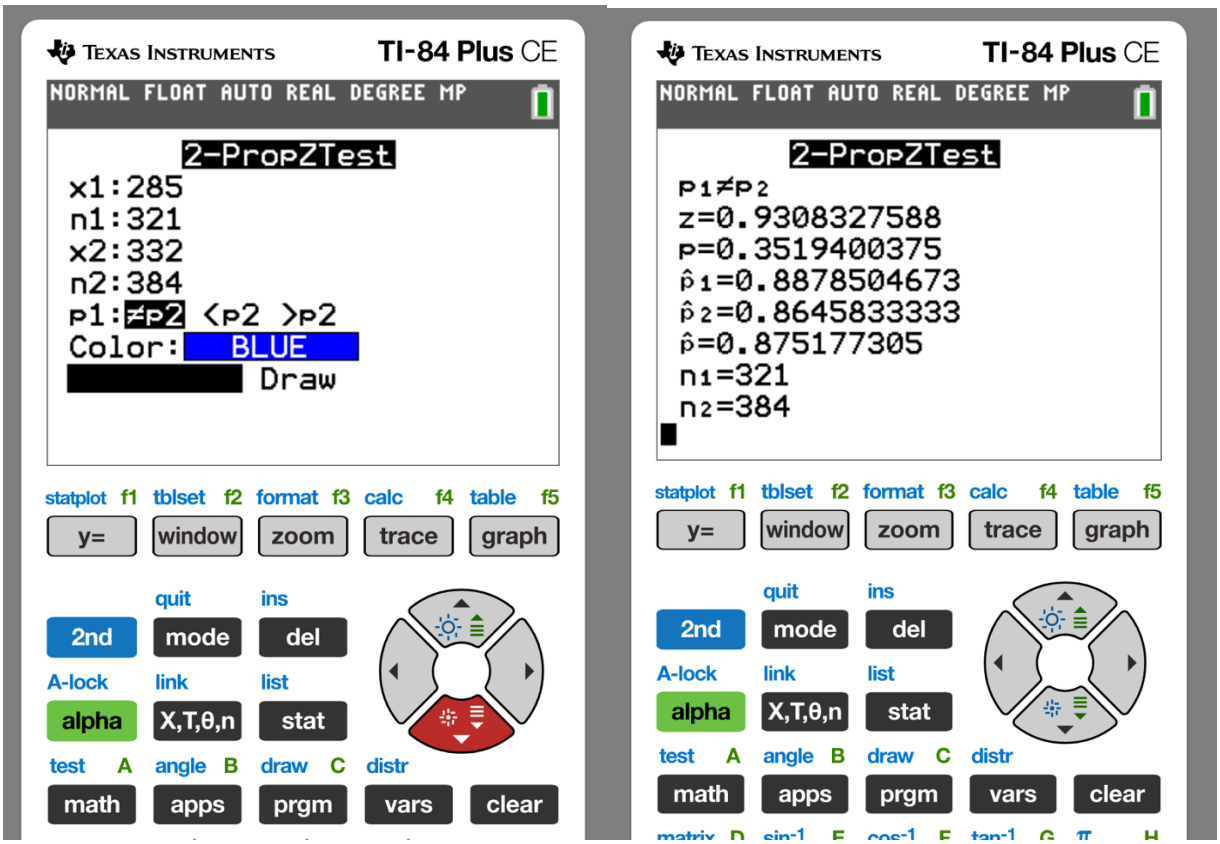




The test statistic value is $\boldsymbol{z \approx 0.931}$

p-value versus the level of significance α

$$\boldsymbol{0.352 \nprec 0.05}$$

Accept H_0

The Sample Does Not Supports the Claim

Dreaming in Black and White

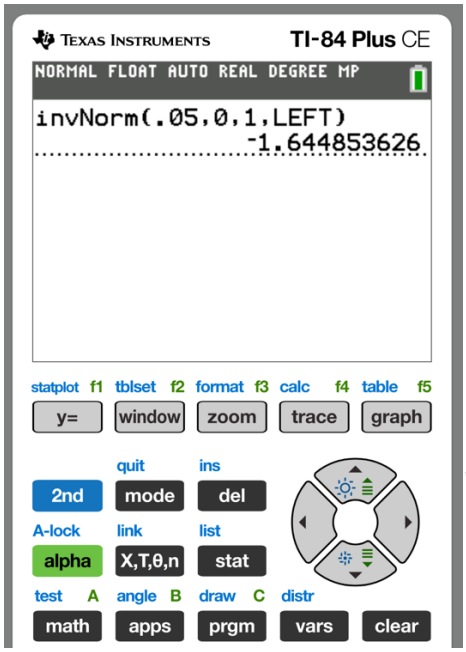
A study was conducted to determine the proportion of people who dream in black and white as opposed to color. Among 400 people over the age of 50, 68 dream in black and white. Among 275 people below the age of 28, 22 dream in black and white. Use the 10% level of significance to test the claim that the proportion of people over 50 who dream in black and white is different than the proportion of people below 28 who dream in black and white.

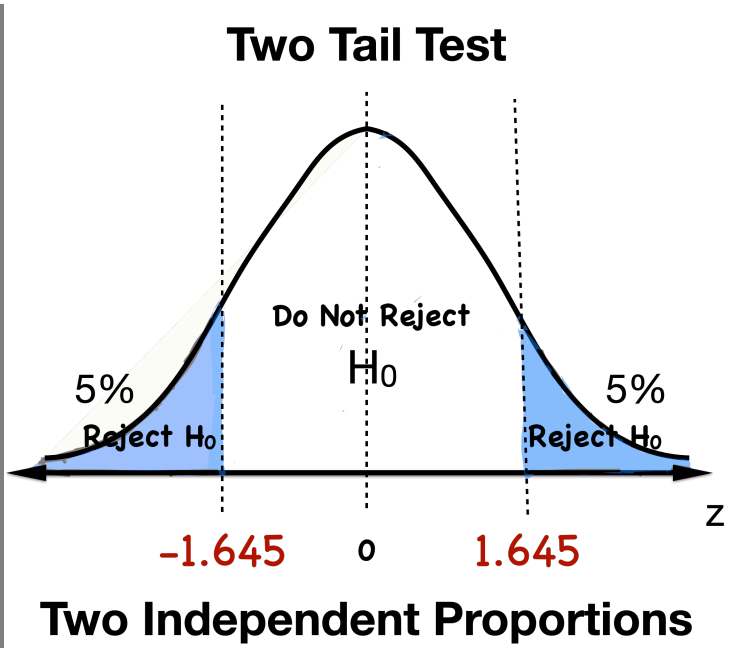
Create Your Decision Rule by determining your critical value(s).
Approximate the critical value(s) to the nearest hundredths.

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

1. Press **2nd** then **vars** to access DISTR (distributions) menu.
2. Select **InvNorm** and click **enter**.
3. Enter the area, mean μ, enter the standard deviation σ, tail.
4. Paste.

InvNorm
area: 0.95
μ: 0
σ: 1
Tail: Left





Two Independent Proportions

Approximate your test statistic to the nearest hundredths.

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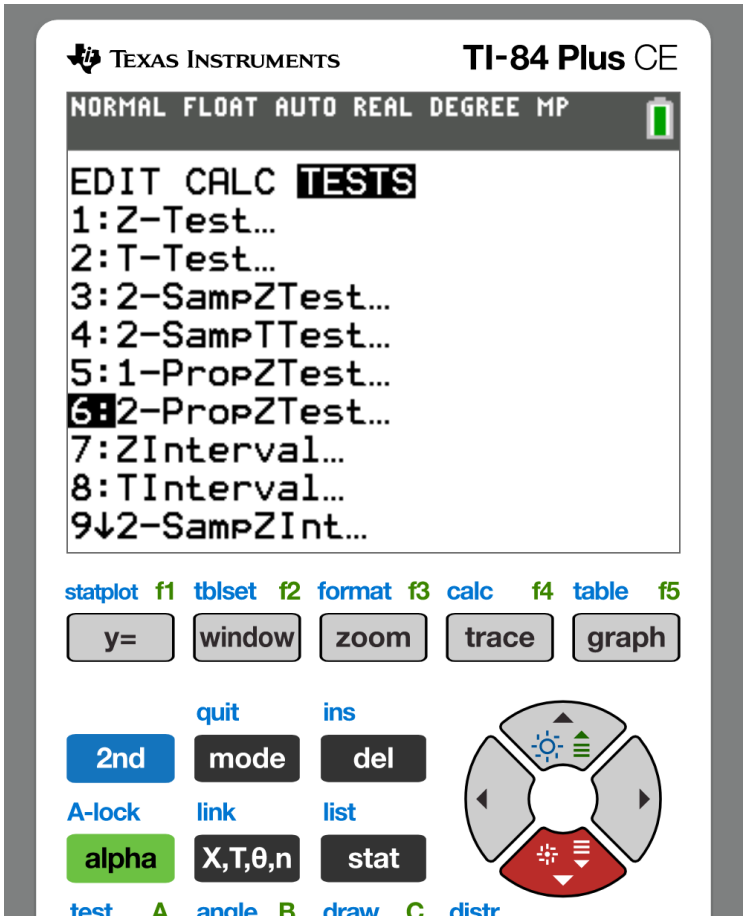
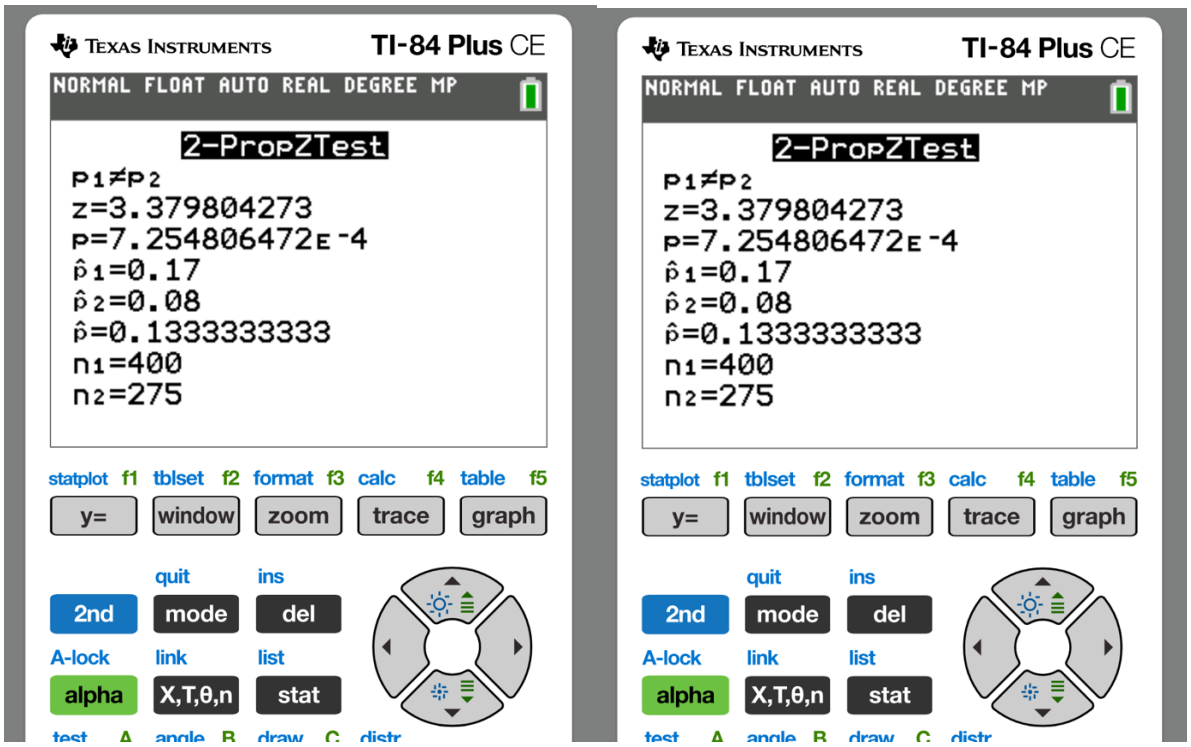




The test statistic value is $\boldsymbol{z \approx 3.380}$

p-value versus the level of significance α

$$\mathbf{0.0007 < 0.10}$$

Accept H_1

The Sample Supports the Claim

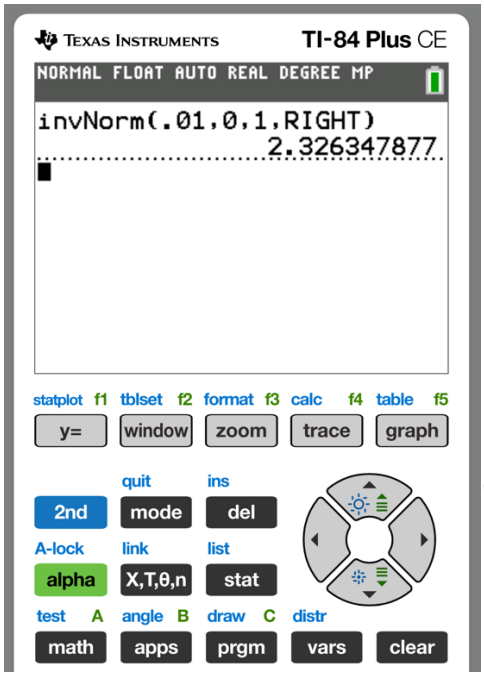
Seat Belts

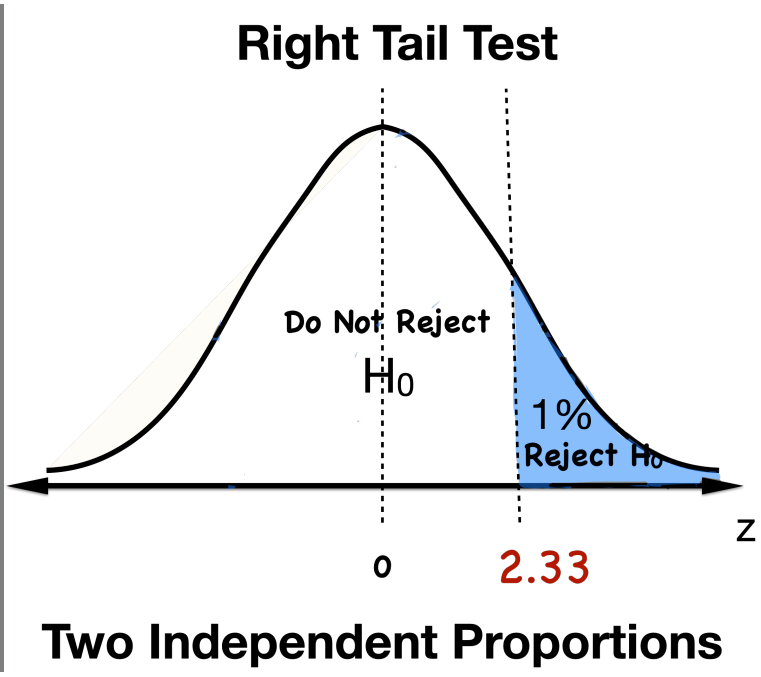
A random sample of front-seat occupants involved in car crashes is obtained. Among 3250 occupants not wearing seat belts, 42 were killed. Among 8,065 occupants who were wearing seat belts, 78 were killed. Use the 1% level of significance to test the claim that seat belts are effective in reducing fatalities. That is test the claim that the fatality rate for those not wearing seat belts is the greater than the fatality rate of those wearing seatbelts.

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

1. Press **2nd** then **vars** to access DISTR (distributions) menu.
2. Select **InvNorm** and click **enter**.
3. Enter the area, mean μ, enter the standard deviation σ, tail.
4. Paste.

InvNorm
area: 0.01
μ: 0
σ: 1
Tail: Right





Two Independent Proportions

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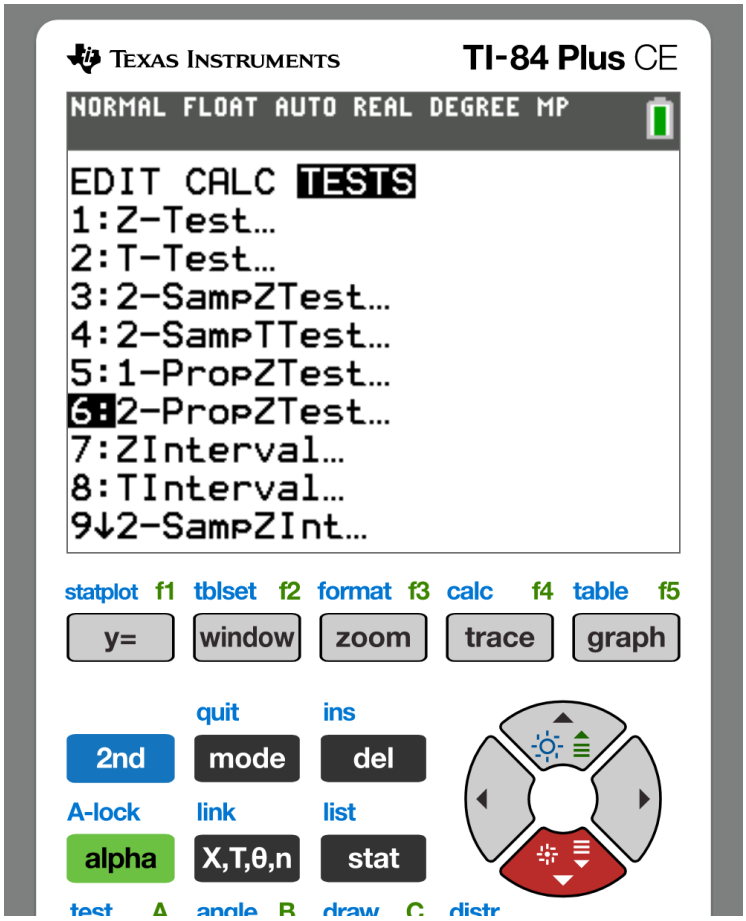

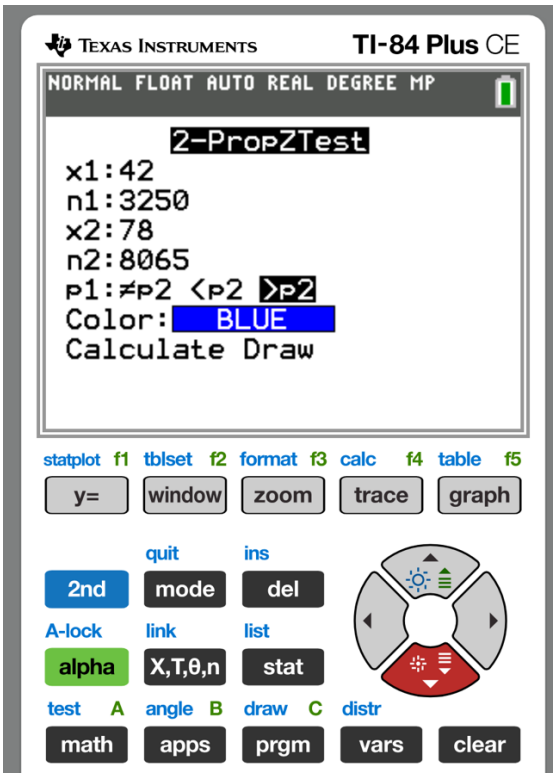

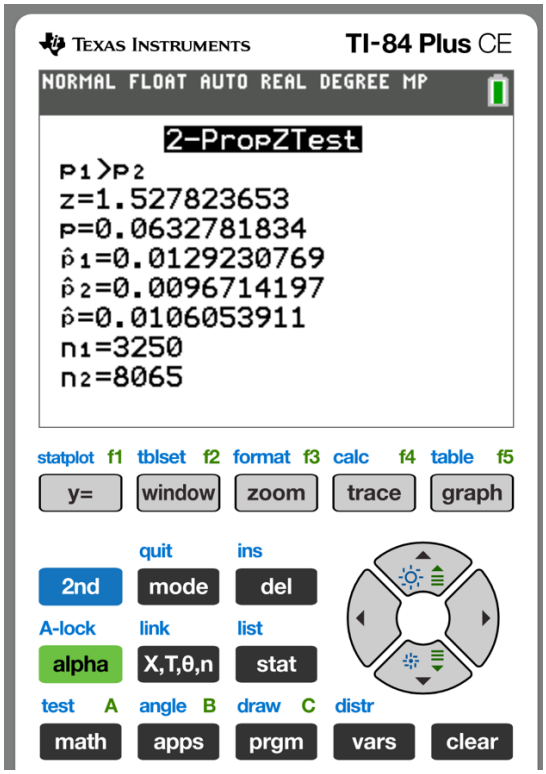

The test statistic value is $\boldsymbol{z \approx 1.528}$

p-value versus the level of significance α

$$\boldsymbol{0.06 \prec 0.01}$$

Accept H_0

The Sample Supports the Claim

Aspirin and Heart Disease

In a study designed to test the effectiveness of Aspirin in preventing heart disease 12,000 male physicians were treated with aspirin, and 11,000 male physicians were treated with placebos. Among the Among the subjects in the Aspirin treatment group, 152 experienced heart attacks. Among the subjects treated with the placebo, 242 experienced heart attacks. Use the 5% level of significance to test the claim that Aspirin has no effect on preventing heart attacks. That is, the heart attack rates are the same.

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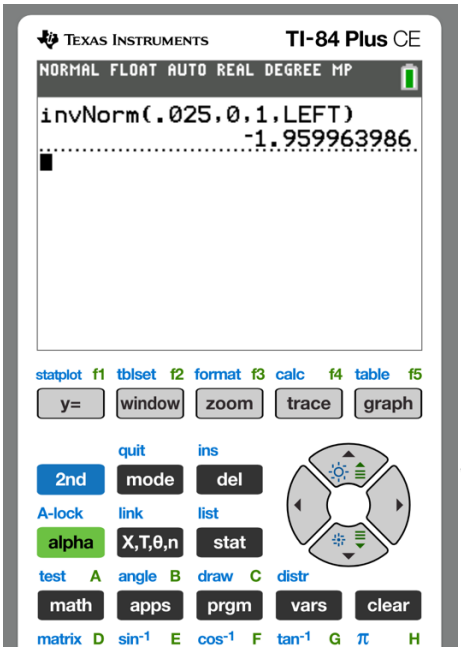
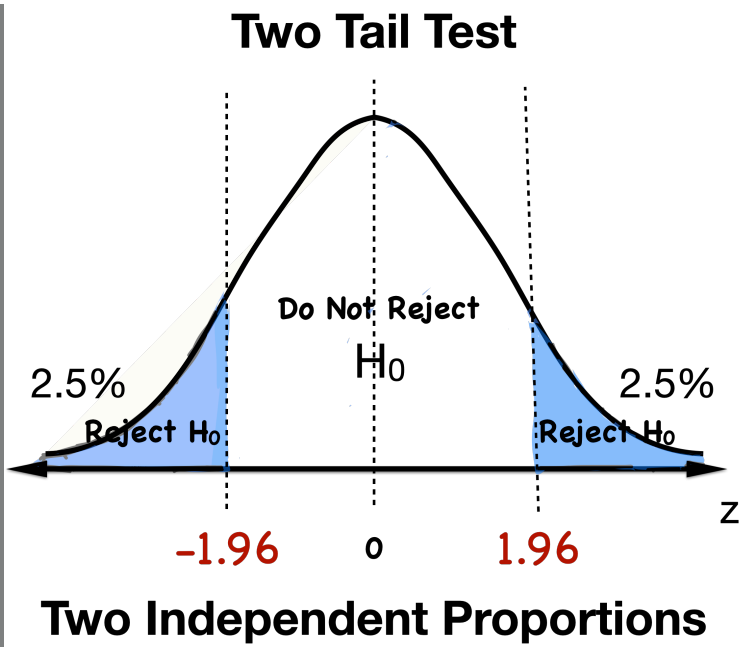
4. Paste.

InvNorm
area: 0.025
μ: 0
σ: 1
Tail: Left





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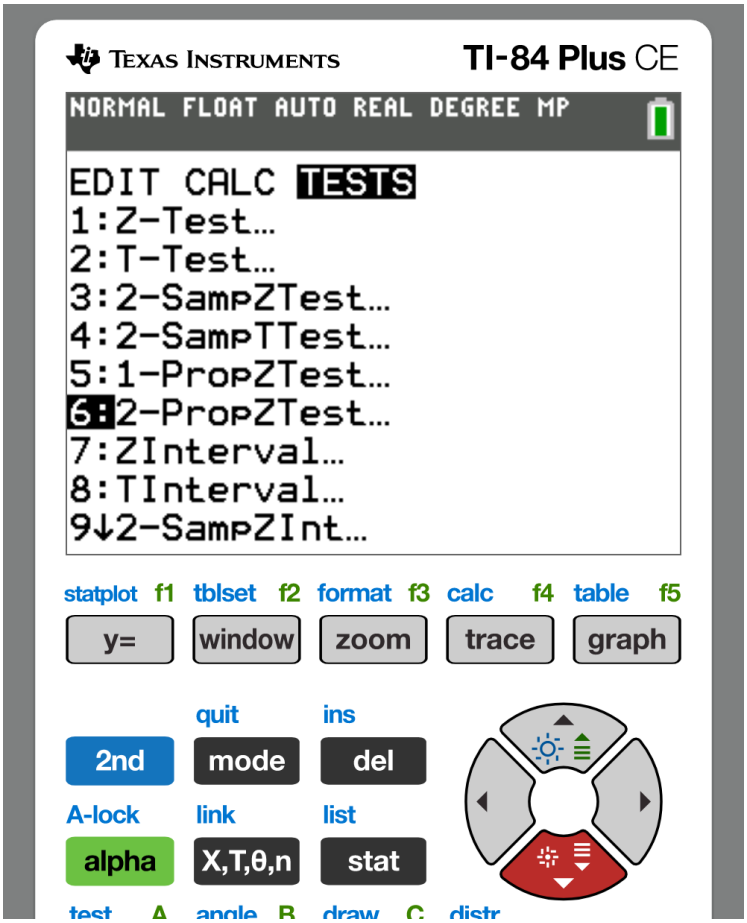

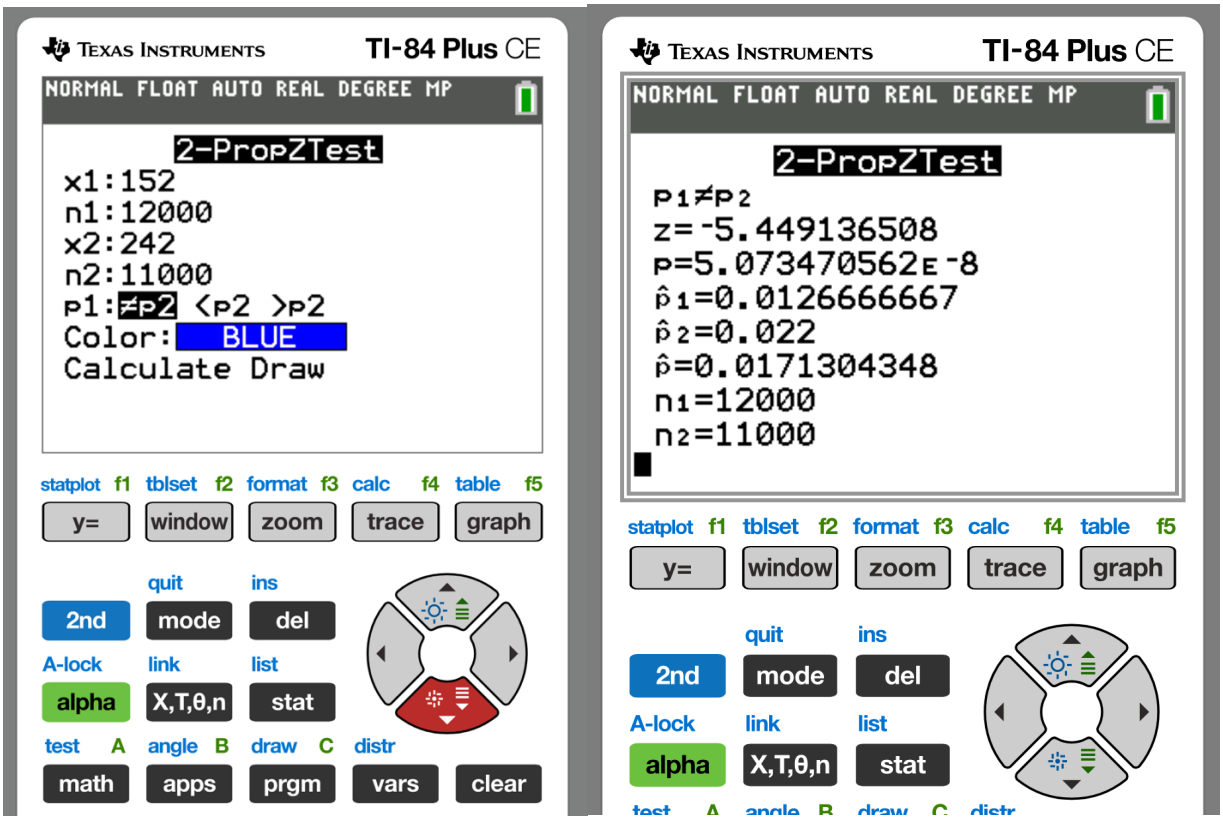

The test statistic value is $z \approx -5.449$

p-value versus the level of significance α

$0.00000005 < 0.05$

Accept H_1

The Sample Supports the Claim