Is It Standard?

ID: 12583

Time required
15 minutes

Activity Overview

In this activity, students will test a claim about the standard deviation by comparing the χ^2-value to the critical value.

Topic: Statistical Inference

- *Chi-square distribution*
- *Hypothesis testing*

Teacher Preparation and Notes

- *This can be used as a stand alone lesson on hypothesis testing about standard deviation. Homework problems are included.*
- *Students should record their responses on the accompanying worksheet.*
- *Depending on the degrees of freedom, the INVERSX2 program may take up to several minutes to calculate.*
- ***To download the student worksheet, go to education.ti.com/exchange and enter "12583" in the quick search box.***

Associated Materials

- *StatWeek30_ClaimStdDev_worksheet_TI84.doc*
- *INVERSX2 program*

Suggested Related Activities

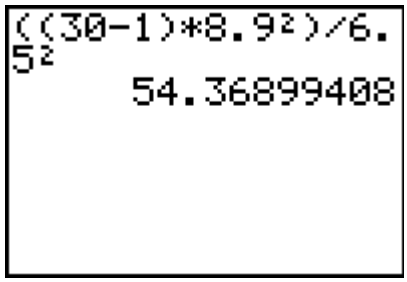
To download any activity listed, go to education.ti.com/exchange and enter the number in the quick search box.

- *Claims About Two Proportions (TI-Nspire technology) — 10259*
- *Testing Claims About Proportions (TI-Nspire technology) — 10131*
- *Comparing Two Means (TI-84 Plus) — 10258*
- *Run Me a Hypothesis Test (TI-84 Plus) — 5135*

Problem 1 – One-tailed test

Students are reminded that s^2 (sample variance) is an unbiased estimate for σ^2 (population variance) and similarly, s (sample standard deviation) is a good estimate for σ (population standard deviation). These values can be represented using the chi-square distribution.

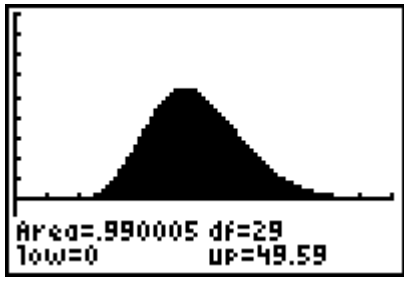
Students are led through the problem, step-by-step, to test a claim. Multiple choice questions are provided on the worksheet. In these questions, students will determine the claim, the null and alternative hypothesis, the χ^2-value, and the critical value.



Students may use the formula $\chi^2 = \frac{(n-1)s^2}{\sigma^2}$ to determine the chi-squared value. Then they will need to use a chi-square distribution chart or the **INVERSX2** program to find the critical value.

When using the program, students need to enter the cumulative area (significance level subtracted from 1) and the degrees of freedom (n – 1).They should find that the critical value is 49.59.

To graph the critical region and confirm that they have found the correct critical value, students will use the **Shadeχ^2** command. They should enter 0 as the left bound and the critical value, 49.59, as the right bound.



0 to 60 for the x-axis
–0.3 to 0.9 for the y-axis

Each time students change the window settings, they will have to press ENTER on the Home screen to re-evaluate the command.

The command will appear to shade the entire graph, but it the shaded area is the critical region.

Student solutions:

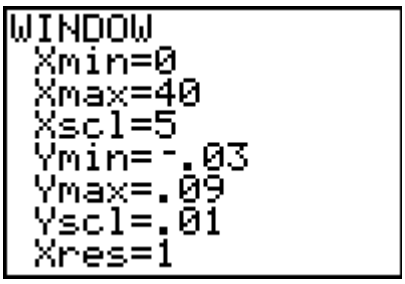
1. $\sigma > 6.5$ (D)
2. H_0: $\sigma \leq 6.5$; H_1: $\sigma > 6.5$ (D)
3. $\chi^2 = \frac{(n-1)s^2}{\sigma^2} = \frac{(30-1)8.9^2}{6.5^2} = 54.37$ (A)
4. It is one-tailed since the null hypothesis is only one-sided. (A)
5. invχ^2(0.99,29) = 49.59 (C)
6. 54.37 is to the right of the shaded region. So, the null hypothesis should be rejected.
7. The evidence suggests that this year's biology class has more variation than classes in the past.

Homework problems

Students are given two problems on the student worksheet. The data for the homework problems comes from the following websites:

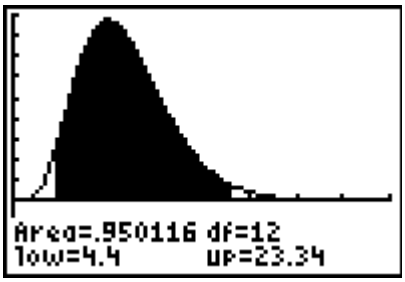
1. www.CBSsportsline.com (3/2/09)
2. www.act.org/news/data/08/states.html

Note: For the homework questions, students may need to adjust the graphing window to see an acceptable graph. To adjust the window settings press WINDOW and enter the information shown.



Problem 1 Solution:

1. Claim: $\sigma = 5.2$
2. H_0: $\sigma = 5.2$; H_1: $\sigma \neq 5.2$
3. $\chi^2 = \frac{(13-1)6.2^2}{5.2^2} = 17.06$
4. It is two-tailed because the null hypothesis can be in both sides of the graph.
5. invχ^2(0.975,12) = 23.34. invχ^2(0.025,12) = 4.40.
6. The χ^2-value is within the interval so we fail to reject the null hypothesis.
7. The evidence suggests that the SU basketball team has a standard deviation that is not significantly different than the standard deviation of the Big East division.



Problem 2 Solution:

1. Claim: $\sigma < 5.2$
2. H_0: $\sigma \geq 5.2$; H_1: $\sigma < 5.2$
3. $\chi^2 = \frac{(25640-1)4.1^2}{5.2^2} = 15939$
4. It is left-tailed.
5. invχ^2(0.01,25639) = 25115
6. The null hypothesis should be rejected because the χ^2-value is not in the critical region.
7. The evidence suggests that the group of Mississippi test takers has less variance than the national variance.