Recall 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).

Also recall that these are roughly Chi-square (χ^2) distributed.

** What is the formula for χ^2?

A) $\chi^2 = \dfrac{ns^2}{\sigma^2}$ **B)** $\chi^2 = \dfrac{(n-1)s^2}{\sigma^2}$ **C)** $\chi^2 = \dfrac{(n-1)\sigma^2}{s^2}$ **D)** $\chi^2 = \dfrac{n\sigma^2}{s^2}$

Let's use this to test a claim and work through an example.

Suppose that in the past, the standard deviation for Mrs. West's biology final exam is 6.5. This year, her class of 30 has a standard deviation of 8.9. Use a 0.01 level of significance to test the claim that this year's class has more variation than the past.

1. What is the claim?

    A) $\sigma = 8.9$ **B)** $\sigma \neq 8.9$ **C)** $\sigma < 6.5$ **D)** $\sigma > 6.5$

2. What are the null hypothesis, H_0, and the alternative hypothesis, H_1?

    A) $H_0: \sigma > 6.5$ **B)** $H_0: \sigma \geq 6.5$ **C)** $H_0: \sigma < 6.5$ **D)** $H_0: \sigma \leq 6.5$

    $H_a: \sigma \leq 6.5$ $H_a: \sigma < 6.5$ $H_a: \sigma \geq 6.5$ $H_a: \sigma > 6.5$

3. Calculate χ^2 using the formula.

    A) 54.37   **B)** 56.24   **C)** 15.47   **D)** 16.01

Discuss the scenario with a partner and determine whether the test is one or two-tailed. Look at the null hypothesis. A two-tailed test is always testing only for equality.

4. Is it right or left-tailed? Why?

    A) Right because the claim is that σ is greater than in the past.

    B) Right because null hypothesis is wrong.

    C) Left because the null hypothesis is σ is less than or equal to the past.

    D) Left because it can't be right.

5. Find the critical value(s) using a chi-square distribution table or the **INVERSX2** program.
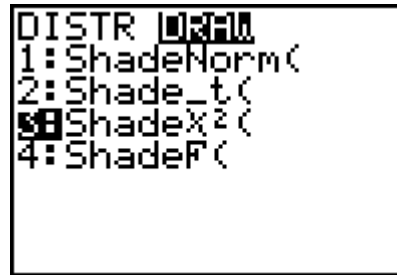
    A) 14.26   **B)** 14.95   **C)** 49.59   **D)** 50.89

Is It Standard?

To graph the critical region, use the **Shade**χ^2 command from the DRAW menu ([2nd] [DISTR]). On the Home screen, select the command, enter the left bound, the right bound, and then the degrees of freedom.

Select an appropriate window.

```
DISTR DRAW
1:ShadeNorm(
2:Shade_t(
3:ShadeX²(
4:ShadeF(
```

6. Does your χ^2-value fall in the critical region? If yes, then fail to reject the null hypothesis. If no, then reject it. Should the null hypothesis be rejected or fail to be rejected? Why?

7. State your conclusion about the claim.

Homework Problems

Use the process above to test the claim in each problem.

1. The men's basketball players in the Big East division have a mean of 8.4 and a standard deviation of 5.2 for points per game. Syracuse University, one of the Big East teams, has 13 players and a standard deviation of 6.2.

    Test the claim that Syracuse University basketball team has the same standard deviation as the Big East division. Use a 0.05 level of significance.

2. In 2008, the national average on the ACT Math exam was 21.0 and the standard deviation was 5.2. A group of 25,640 test takers in Mississippi had a standard deviation of 4.1.

    Test the claim that the group of Mississippi test takers has a smaller standard deviation than the national standard deviation. Use a 0.01 level of significance.