

7-6

Testing a Claim about a Standard Deviation or Variance

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Assumptions

for testing claims about a population
standard deviation or variance

- 1) The sample is a simple random sample.
- 2) The population has a normal distribution (a strict requirement).

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Chi-Square Distribution

Test Statistic

$$X^2 = \frac{(n - 1) s^2}{\sigma^2}$$

n = sample size

s^2 = sample variance

σ^2 = population variance
(given in null hypothesis)

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Critical Values and P-values for Chi-Square Distribution

- ❖ Found in Table A-4
- ❖ Degrees of freedom = $n - 1$
- ❖ Based on cumulative areas from the RIGHT

Properties of Chi-Square Distribution

- ❖ All values of χ^2 are nonnegative, and the distribution is not symmetric.
- ❖ There is a different distribution for each number of degrees of freedom.
- ❖ The critical values are found in Table A-4 using $n-1$ degrees of freedom.

Properties of Chi-Square Distribution

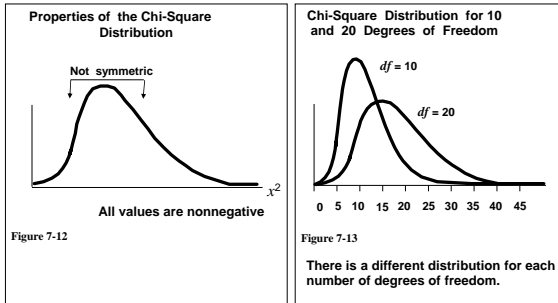
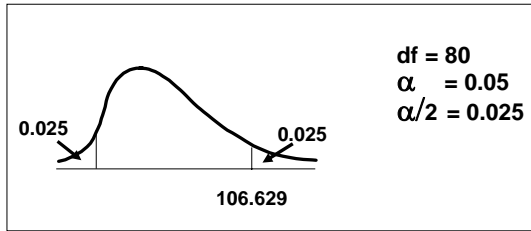


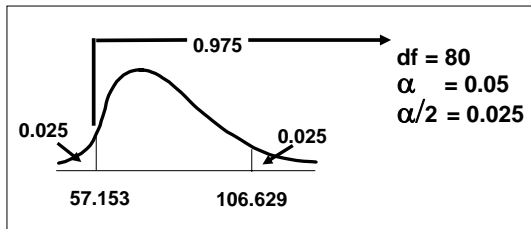
Table A-4: Critical values are found by determining the area to the RIGHT of the critical value.



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Table A-4: Critical values are found by determining the area to the RIGHT of the critical value.



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Example: Aircraft altimeters have measuring errors with a standard deviation of 43.7 ft. With new production equipment, 81 altimeters measure errors with a standard deviation of 52.3 ft. Use the 0.05 significance level to test the claim that the new altimeters have a standard deviation different from the old value of 43.7 ft.

Claim: $\sigma \neq 43.7$
 $H_0: \sigma = 43.7$ $\alpha = 0.05$ $\alpha/2 = 0.025$
 $H_1: \sigma \neq 43.7$

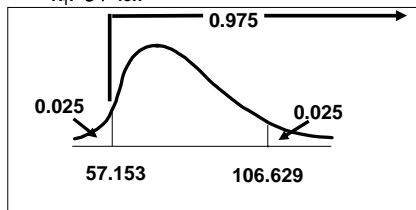
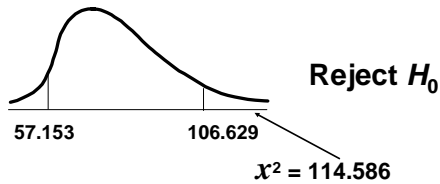


Table A-4

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$$\chi^2 = \frac{(n-1)s^2}{\sigma^2} = \frac{(81-1)(52.3)^2}{43.7^2} \approx 114.586$$



Example: Aircraft altimeters have measuring errors with a standard deviation of 43.7 ft. With new production equipment, 81 altimeters measure errors with a standard deviation of 52.3 ft. Use the 0.05 significance level to test the claim that the new altimeters have a standard deviation different from the old value of 43.7 ft.

SUPPORT Claim: $\sigma \neq 43.7$

REJECT $H_0: \sigma = 43.7$

$H_1: \sigma \neq 43.7$

The sample evidence supports the claim that the standard deviation is different from 43.7 ft.

Example: Aircraft altimeters have measuring errors with a standard deviation of 43.7 ft. With new production equipment, 81 altimeters measure errors with a standard deviation of 52.3 ft. Use the 0.05 significance level to test the claim that the new altimeters have a standard deviation different from the old value of 43.7 ft.

SUPPORT Claim: $\sigma \neq 43.7$

REJECT $H_0: \sigma = 43.7$

$H_1: \sigma \neq 43.7$

The new production method appears to be worse than the old method. The data supports that there is more variation in the error readings than before.

***P*-Value Method**

- ❖ Table A-4 includes only selected values of α
- ❖ Specific *P*-values usually cannot be found
- ❖ Use Table A- 4 to identify limits that contain the *P*-value
- ❖ Some calculators and computer programs will find exact *P*-values

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Example: Tests in the author's past statistics classes have scores with a standard deviation equal to 14.1. One of his recent classes has 27 test scores with a standard deviation of 9.3. Use the 0.01 significance level to test the claim that this current class has less variation than past classes. Does a lower standard deviation suggest that the current class is doing better?

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