

Example 11
Chi-square - Variance
Comparing sample and population variances
Setup

You work at a pharmacy company and are charged with testing the efficacy of new drugs. Your company would like to have a new drug certified by the FDA. The FDA requires that the variability (variance) of this type of drug should not exceed 100 (activity units/cc)². Your company tested the drug on 10 volunteers (well-compensated volunteers) and measured the drug's activity (data provided, activity units). Does your company's drug meet the FDA standard?

Drug activity (activity units)

284

298

308

308

287

285

289

305

282

310

Example 11

Chi-square - Variance Comparing sample and population variances Solution

1. State your question: Does the variance of drug effectiveness exceed $100(\text{activity units/cc})^2$
 - a. Is it a good scientific question? Definable, measurable, and controllable.
 - b. Identify your population: Propose drug activity variability.
 - c. Identify your dependent variable: Drug activity
 - d. Identify your independent variable: Drug type (ours vs. standard)
2. State your hypothesis set
 - a. Verbal hypothesis: The variance in the drug activity does not exceed $100 (\text{activity units/cc})^2$
 - b. Statistical hypothesis (H_0 , H_A).
 $H_0: s^2 < 100$ The variance in the drug activity does not exceed $100 (\text{activity units/cc})^2$
 $H_A: s^2 > 100$ The variance in the drug activity exceeds $100 (\text{activity units/cc})^2$
 - c. Is your hypothesis set exhaustive? No, truncated
 - d. Is your hypothesis set exclusive? Yes
3. State your significance level: $\alpha = 0.05$
4. State the test to be used
 - i. Dependent variable: Ratio
 - o Converted or transformed? No
 - ii. Independent variable: Nominal
 - o Converted or transformed? No
 - a. What information is given or available?
 - i. Sample data
 - ii. Parameters? Regulation (parameter)
 - b. Number of samples: 1
 - c. Are the data paired or unpaired: Not applicable
 - d. What aspect of the variable do you want to compare: Variability - variance.
 - e. State the test to be used: Chi-square - Variance
 - i. Are the assumptions of the test met? Yes
 - o Random sample
 - o Independent samples
5. Conduct your sampling
We measured activity of the drug on 10 volunteers.

6. Graph the data

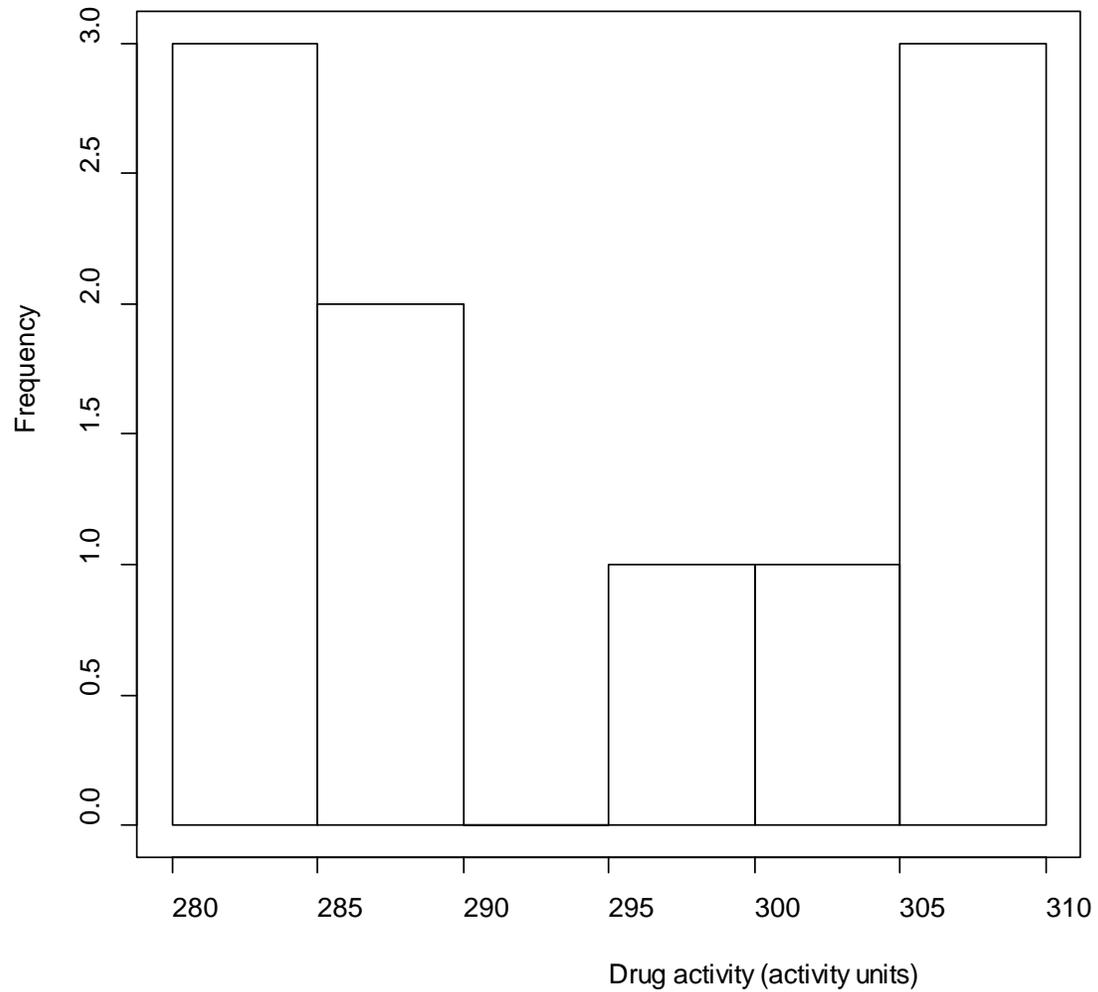


Figure 1. Drug activity (activity units) on 10 volunteers.

7. Summarize the data

Population parameters (Mandated by FDA)

$$\sigma^2 = 100 \text{ (activity units/cc)}^2$$

Sample description

$$n = 10$$

$$\bar{x} = 295.6 \text{ activity units/cc}$$

$$s^2 = 128.7 \text{ (activity units/cc)}^2$$

8. Calculate your test statistic.

One sample Chi-squared test for variance

data: SampleData
X-squared = 11.584, df = 9, p-value = 0.2378
alternative hypothesis: true variance is greater than 100
95 percent confidence interval:
68.46749 Inf
sample estimates:
var of SampleData
128.7111

9. Retain or reject your null hypothesis based on your test statistic.
The calculated p-value (0.2378) is greater than the significance level (0.05) and the sample variance of 128.7 (activity units/cc)² is greater than the population variance of 100 (activity units/cc)², herefore we retain the null hypothesis and reject the alternate hypothesis.
10. Interpret the results in biological terms.
The variance of our drug is not significantly greater than 100 (activity units/cc)² ($X^2=11.584$, $df=9$, $p=0.2378$).

There may however be important issues related to statistical power that should be considered.