

Homogeneity of Proportions

Are the proportions of some element the same in different populations?

Are the proportions of Taylor Swift fans the same for freshmen, sophomores, juniors, and seniors?

Are the categories of driving offenses the same for both genders? Do males get more speeding tickets and females more DUIs?

Use the same five step process, with two changes.

Hypotheses:

$H_0: p_1 = p_2 = p_3 = \dots$

H_1 : At least one proportion is different from the others.

Degrees of freedom:

Degrees of Freedom = $(\#Rows - 1)(\#Columns - 1)$

Note: the sample size must be the same for the rows or the columns.

e.g. A researcher wants to know if the proportions of senior students owning a car is the same across all grade categories (based on GPA).

A survey reveals these data.

| Own a car? | Average Grade | | | |
|------------|---------------|----------|----------|---------------|
| | <u>A</u> | <u>B</u> | <u>C</u> | <u>D or F</u> |
| <u>No</u> | 52 | 45 | 36 | 48 |
| <u>Yes</u> | 40 | 47 | 56 | 44 |

Use the X^2 test with $\alpha = 0.05$ test to see if the proportions of students are equal.

Step 1

State the hypotheses.

$$H_0: p_1 = p_2 = p_3 = p_4$$

H_1 : At least one proportion is different from the others.

Step 2

Find the critical value.

$$\text{Degrees of Freedom} = (2 - 1)(4 - 1) = 3$$

$$\alpha = 0.05$$

$$\text{c.v.} = 7.815$$

Step 3 Calculate the test value.

| Own a car? | Average Grade | | | | | | | | |
|------------|---------------|----------|----------|---------------|----|-------|----|-------|-----|
| | <u>A</u> | <u>B</u> | <u>C</u> | <u>D or F</u> | | | | | |
| <u>No</u> | 52 | 45.25 | 45 | 45.25 | 36 | 45.25 | 48 | 45.25 | 181 |
| <u>Yes</u> | 40 | 46.75 | 47 | 46.75 | 56 | 46.75 | 44 | 46.75 | 187 |
| | 92 | | 92 | | 92 | | 92 | | 368 |

First: calc. totals

Second: calc. expected values

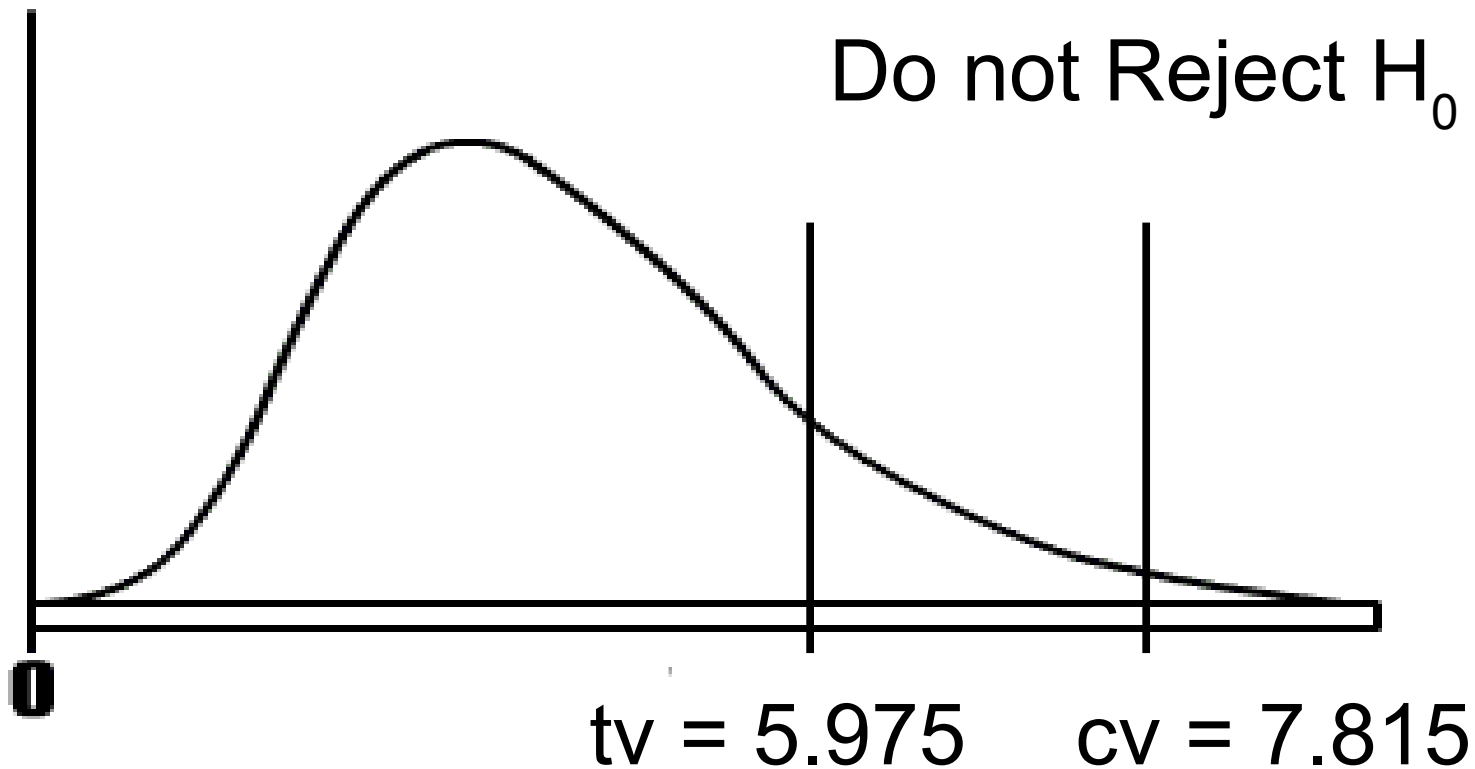
Finally calc. test value

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

t.v. = 5.975

Step 4

Make the decision



Step 5

5. There is not enough evidence to reject H_0 , at $\alpha=0.05$, that the proportions of students owning cars are equal for all grade categories.