

AP Statistics: Chi-Square (χ^2) Distribution & Testing

From Simple Studies, <https://simplestudies.edublogs.org> & @simplestudiesinc on Instagram

Chi-Square Testing

- χ^2 is skewed to the right
- Two types of testing:
 - Goodness of fit
 - Ex. Is there a difference in the proportions of people with brown, blue, and green eyes in 1900 and 2000?
 - d.f. = (number of categories) - 1
 - Association
 - Ex. Is there an association between the level of hiking experience and the direction the hiker would head if lost?
 - Data will always be provided in a matrix
 - d.f. = (number of rows - 1)(number of columns - 1)

Five Steps

1. Hypothesis
2. Conditions
3. Formula
4. P Value
5. Conclusion

Step 1: Hypothesis

Hypothesis	Goodness of Fit	Association
H_0	There is no difference. The proportions are the same	They are independent. They are not associated

H_a	There is a difference. The proportions are not the same	They are not independent. They are associated
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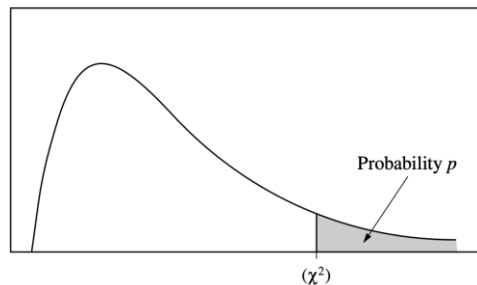
- Put H_0 and H_a in context!

Step 2: Conditions/Assumptions

- Random Sample
 - The stem of the problem states that [*sample*] was chosen at random
- Expected Values
 - The expected values are all ≥ 5
 - You can either list the expected values or put them in a table

Step 3: Formula

- $\chi^2 = \sum \frac{(O - E)^2}{E}$
- List the formula, your substitution, degrees of freedom, and your unrounded answer
- O is the observed value, E is the expected value
- Association: Expected = $\frac{(\text{Row Total})(\text{Column Total})}{\text{Total}}$



From [HYPERLINK](#)

["https://apcoronavirusupdates.collegeboard.org/media](https://apcoronavirusupdates.collegeboard.org/media)

Step 4: P Value

- $P(\chi^2 > _) = _$

Step 5: Conclusion

- “Assuming H_0 is true, since the p value (*p value*) is [*greater/less*] than $\alpha = _$, we [*fail to reject/reject*] H_0 ”
 - α will usually be given in the problem. If it is not, use $\alpha = .05$
- “We [*do not/do*] have sufficient evidence to suggest H_a .”

Calculator (TI-84 Plus)

- Stat → Test
 - C = Association
 - Put all the observed values in a matrix, and put that matrix for observed.
 - To get the expected values, put in a different matrix, compute the test, and go to that matrix (the calculator will automatically put in the expected values into the matrix). The expected value for each data will match positions with the observed.
 - D = Goodness of Fit
 - Put your observed values in one list (stat → Edit) and your expected in a different list.
 - Ensure the observed and expected values for each data are in the same row.