RESEARCH METHODS · STATISTICS

Chi-Squared: Worked Example

Nominal data · independent groups · looking for a difference or association.

The method

1. Expected frequency for each cell = (row total × column total) ÷ grand total
2. For each cell, calculate $(O - E)^2 \div E$
3. Add them up: $\chi^2 = \Sigma (O - E)^2 \div E$
4. Degrees of freedom = (rows − 1) × (columns − 1)
5. Significant if χ^2 is **equal to or greater than** the critical value

Worked example

60 children watched a model rewarded or punished for aggression. Did they imitate?

Observed (expected)	Imitated	Did not imitate	Total
Model rewarded	22 (17)	8 (13)	30
Model punished	12 (17)	18 (13)	30
Total	34	26	60

$(22 - 17)^2 \div 17 = 1.471$ · $(8 - 13)^2 \div 13 = 1.923$ · $(12 - 17)^2 \div 17 = 1.471$ · $(18 - 13)^2 \div 13 = 1.923$

$\chi^2 = 6.79$ · df = 1 · critical value ($p \leq 0.05$, two-tailed) = 3.84 · $6.79 \geq 3.84$ → **significant**: reject the null hypothesis.

df	p ≤ 0.10	p ≤ 0.05	p ≤ 0.025	p ≤ 0.01
1	2.71	3.84	5.02	6.63
2	4.61	5.99	7.38	9.21
3	6.25	7.81	9.35	11.34

Excerpt of critical values (levels of significance for a two-tailed test). Always use the table printed in your exam paper.

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RESEARCH METHODS · PRACTICE

Your Turn

Try it, then check the answers at the bottom.

100 students were asked whether they prefer revising alone or in a group, split by year group.

Observed	Alone	Group	Total
Year 12	30	20	50
Year 13	40	10	50
Total	70	30	100

1. Calculate the expected frequencies.

2. Calculate χ^2 to 2 decimal places.

3. State the degrees of freedom and whether the result is significant at $p \leq 0.05$ (two-tailed).

Which test when?

	Difference: independent groups	Difference: repeated measures	Correlation
Nominal	Chi-squared	–	–
Ordinal or above	Mann-Whitney U	Wilcoxon	Spearman's rho

Answers: E = 35, 15, 35, 15 · $(O - E)^2 \div E$ = 0.714, 1.667, 0.714, 1.667 · χ^2 = 4.76 · df = 1 · 4.76 ≥ 3.84, so significant.

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