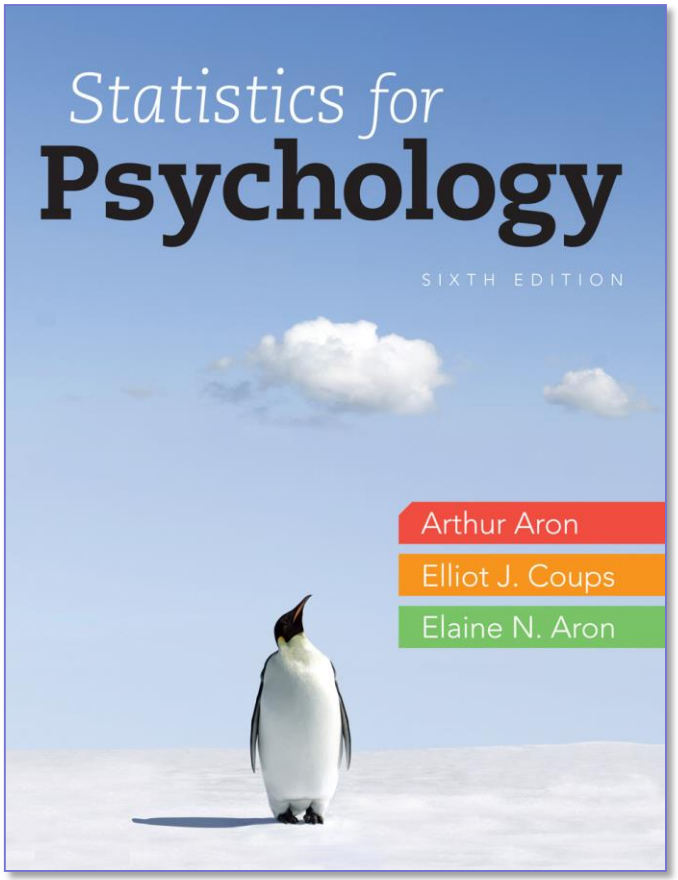
Statistics for **Psychology**

SIXTH EDITION



CHAPTER 13

Chi-Square Tests

Chi-Square Tests

- Hypothesis testing procedures for nominal variables (variables whose values are categories)
- Focus on the number of people in different categories
- Symbol (greek) χ

Chi-Square Statistic

- Key idea is the comparison of observed and expected frequencies in each category
- **Observed frequency**
  - # of people actually found in the study to be in a category or cell
- **Expected frequency**
  - # of people in the category expected if the null hypothesis were true

Chi square statistics

- Example
- Harter et al. (1997)
- Three styles of relating to romantic partners: self focused autonomy style, an other-focused connection style, a mutuality style
- Respondents' style and their partners' style were gathered
- Self focused autonomy style would be likely to match with partners with other focused style?
- 101 self focused men: 50 had other-focused partners, 26 had self focused partners, 25 had mutuality style partners
- Lets make a table for them

Chi square statistics

Partner style	Observed frequency	Expected frequency	Difference (O-E)	Difference squared $(O-E)^2$
Other focused	50	33,67	16,33	266,67
Self-focused	26	33,67	-7,67	58,83
Mutuality	25	33,67	-8,67	75,17

Chi-Square Statistic

- Observed frequency distribution
- Expected frequency distribution
- Chi-square statistic (χ^2)

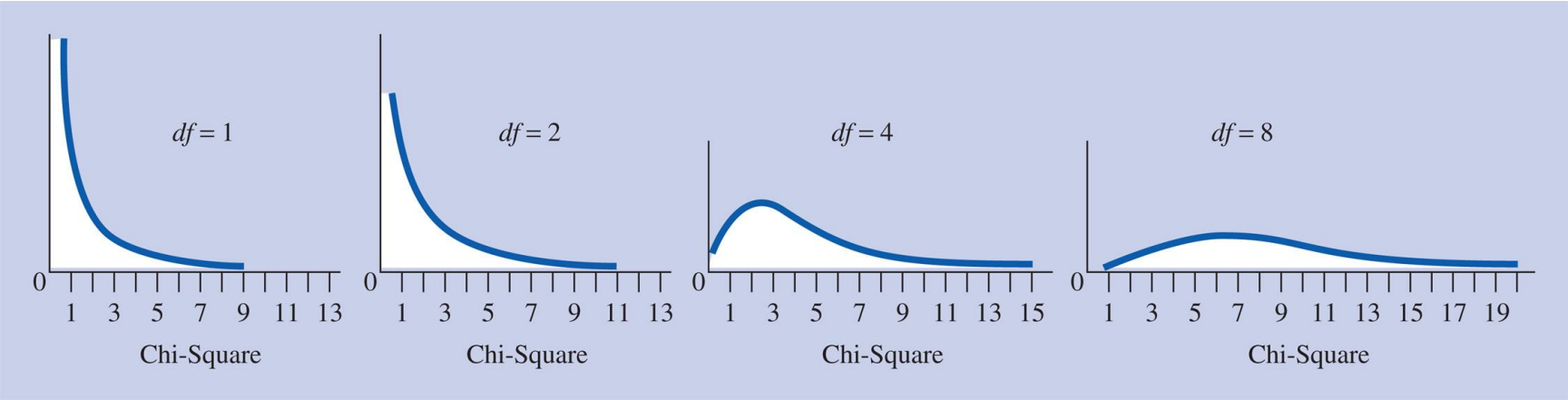
$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

Chi square statistics

Partner style	Observed frequency	Expected frequency	Difference (O-E)	Difference squared $(O-E)^2$	Difference squared weighted by expected frequency $(O-E)^2/E$
Other focused	50	33,67	16,33	266,67	7,92
Self-focused	26	33,67	-7,67	58,83	1,75
Mutuality	25	33,67	-8,67	75,17	2,23

Chi-Square Statistic

- Chi-square distributions



Chi-Square Statistic

- Chi-square table
- It is included in the tables you get from the photocopy room
- Degrees of freedom (*df)*
  - $df = N_{categories}-1$
  - The things which are free to vary
  - Seçme/değişme özgürlüğünün olması

Table 13-2 Portion of a Chi-Square Table (with Cutoff Value Highlighted for the Black et al. Example)

	Significance Level		
df	.10	.05	.01
1	2.706	3.841	6.635
2	4.605	5.992	9.211
3	6.252	7.815	11.345
4	7.780	9.488	13.277
5	9.237	11.071	15.087

Note: Full table is Table A-4 in the Appendix.

Table 13-2 Portion of a Chi-Square Table (with Cutoff Value Highlighted for the Black et al. Example)

Two types of Chi Square

- 1. chi square test for goodness of fit
- 2. chi square test for independence

1) Chi-Square Test for Goodness of Fit

- Levels of a single nominal variable

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

2) Chi-Square Test for Independence

- Two nominal variables, each with several categories
- Contingency table

Table 13-4 Contingency Table of Observed Frequencies of Gender and Age of Characters on Cereal Boxes (Data from Black et al., 2009)

		Gender		
		Male	Female	Total
Age	Child	28	30	58 (26.1%)
	Adult	125	39	164 (73.9%)
	Total	153	69	222 (100%)

Chi-Square Test for Independence

- Independence
  - No relationship exists between the variables in a contingency table
  - If there is no relation, the proportion of one IVs levels should be the same for the other IVs levels
  - So the cells should have the same # of people in them
- Sample and population
  - Whether the lack of independence in the sample is large enough to reject the null hypothesis of independence in the population.
  - We need chi square test for independence!

Chi-Square Test for Independence

- Determining expected frequencies
- A cell's expected is the number in its row divided by the total number of people, multiplied by the number in its column.

$$E = \left(\frac{R}{N}\right)(C)$$

Table 13-5 Contingency Table of Observed (and Expected) Frequencies of Gender and Age of Characters on Cereal Boxes (Data from Black et al., 2009)

		Gender		
		Male	**Female**	**Total**
Age	Child	28 (39.9)[a]	30 (18.0)	58 (26.1%)
	Adult	125 (113.1)	39 (51.0)	164 (73.9%)
	Total	153	69	222 (100%)

[a] Expected frequencies are in parentheses.

Chi-Square Test for Independence

- Figuring chi-square

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

- Degrees of freedom

$$df = (N_{\text{Columns}} - 1)(N_{\text{Rows}} - 1)$$

Chi-Square Test for Independence

- Please check the cutoff (baraj) chi square from the table
- Then compare the cutoff score you calculated
- If your calculated cutoff score is bigger/larger than the cutoff score, it means that your results are significantly different from the expected case.

Assumptions for Chi-Square Tests

- No individual can be counted in more than one category or cell

Effect Size for the Chi-Square Test for Independence -1

- 2 X 2 contingency table
  - Phi coefficient (φ)

$$\phi = \sqrt{\frac{\chi^2}{N}}$$

  - small φ = .10
  - medium φ = .30
  - large φ = .50

An example

Riehl (1994) studied the college experience of students who were the first generation in their family to attend college.

These students were compared to other students who were not the first generation in their family to go to college.

All students in the study were from Indiana University.

One of the variables Riehl (1994) measured was whether or not students dropped out during their first semester.

What are the variables?

An example

	First generation	Other generation	Total
Dropped out	73	89	*162*
Did not dropped out	657	1226	*1883*
Total	*730*	*1315*	**2045**

An example

	First generation	Other generation	Total
Dropped out	73 (57,83)	89 (104,17)	*162*
Did not dropped out	657 (672,17)	1226 (1210,83)	*1883*
Total	*730*	*1315*	**2045**

73→ (162/2045)x 730 = 57,83
89→ (162/2045)x 1315 = 104,17
657→ (1883/2045)x 730 = 672,17
1226→ (1883/2045)x 1315 = 1210,83
df = (2-1). (2-1) = 1

An example

- $\chi^2 = 4.06 + 2.14 + .35 + .18 = 6.73$
- Check the table, for df =1, cutoff Chi square is 6.635
- Since my result chi square score (6,73) is larger than the cutoff chi square (6.635); my result is statistically significant.

End of Chapter 13