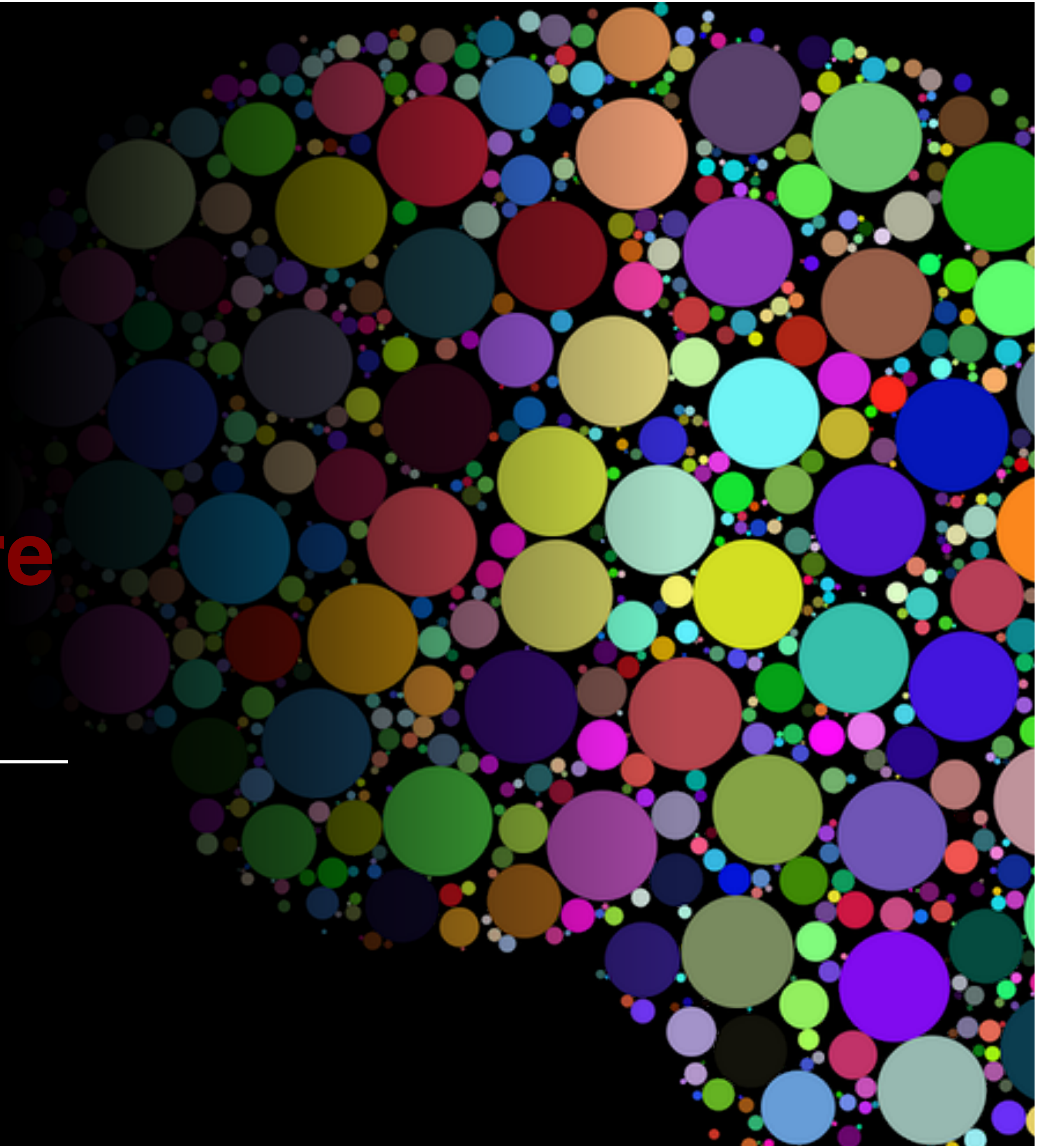


Chi Square Tests

Chapter 17

Assumptions for Parametrics

> Normal distributions

> DV is at least scale

> Random selection

- Sometimes other stuff: homogeneity, homoscedasticity

TABLE 17-1. A Summary of Research Designs

We have encountered several research designs so far, most of which fall in one of two categories. Some designs—those listed in category I—include at least one scale independent variable and a scale dependent variable. Other designs—those listed in category II—include a nominal (or sometimes ordinal) independent variable and a scale dependent variable. Until now, we have not encountered a research design with a nominal independent variable and a nominal dependent variable, or a research design with an ordinal dependent variable.

I. Scale Independent Variable and Scale Dependent Variable	II. Nominal Independent Variable and Scale Dependent Variable
Correlation	*z* test
Regression	All kinds of *t* tests
	All kinds of ANOVAs

Nonparametrics

> Specifically, for when the DV is NOT a scale variable.

- DV is nominal (frequency counts of categories)
- DV is ordinal (rankings of categories)
- IV is usually *also* one of these things as well.

Nonparametrics

> Used when the sample size is small

> Used when underlying population is not normal

Limitations of Nonparametric Tests

> Cannot easily use confidence intervals or effect sizes

> Other things I don’t think are true:

- *Have less statistical power than parametric tests*
- *Nominal and ordinal data provide less information*

Two types of Chi-Square

- Goodness of fit test
    - For when you have ONE nominal variable
- Independence test
    - For when you have TWO nominal variables

Goodness of Fit Test

> Step 1: list the variable involved

- Statistics classes

Goodness of Fit Test

> Step 2: chi-square is all about expected *fit*

- How much does the the data match what we would expect if these categories were assigned by chance?

Goodness of Fit Test

> Step 2:

- Observed statistic test categories match the expected variables (O = E)
- Observed statistic test categories do not match the expected variables (O/=E)

Goodness of Fit Test

> Step 3: List the observed and expect values

> List the *df*

Goodness of Fit Test

> Two ways to do expected values:

- N (total number of people) / Number of categories
- OR
- N (total number of people) * expected proportion for that category

Goodness of Fit Test

observed	**PSY 200**	**SOC 302**	**MTH 340**
A grades	25	18	11

expected	**PSY 200**	**SOC 302**	**MTH 340**
A grades	18	18	18

Goodness of Fit Test

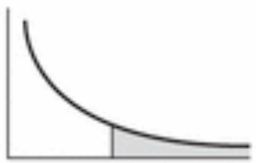
> *df*
  - Number of Categories – 1
  - 3 – 1 = 2

Goodness of Fit Test

> Step 4: Cut off score (5.992)

> Use a chi-square table

TABLE B.4 THE CHI-SQUARE DISTRIBUTIONS



df	SIGNIFICANCE (*p*) LEVEL .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
6	10.645	12.592	16.812
7	12.017	14.067	18.475
8	13.362	15.507	20.090
9	14.684	16.919	21.666
10	15.987	18.307	23.209

Goodness of Fit Test

$$X^2 = \sum \left[\frac{(O-E)^2}{E} \right]$$

Step 5: List chi-square = 5.44

http://vassarstats.net/csfit.h
tml

Cate-gory	Observed Frequency	Expected Frequency	Expected Proportion	Percentage Deviation	Standardized Residuals
A	25	18	0.333333:	+38.89%	+1.65
B	18	18	0.333333:	0%	0
C	11	18	0.333333:	-38.89%	-1.65
D				----	----
E				----	----
F				----	----
G				----	----
H				----	----

Sums:

Observed Frequencies: 54

Expected Frequencies: 54

Expected Proportions: 1.0

Reset Calculate

[Note that for df=1, the calculated value of chi-square is corrected for continuity.]	[For df=1, this is the uncorrected value of chi-square.]
chi-square = 5.44	
df = 2	[P is non-directional]
P = 0.0659	

Goodness of Fit Test

- Step 6:
  - Is the found chi-square value > the cut off chi-square value?
  - This test is like *F* – everything is squared, so all values are positive.
- Nope! Same number of As in each class.

Independence Test

> Independence test for two nominal variables
  - Are the observed values equal to the expect values given the combinations of categories?

Independence Test

> Step 1: list the variables involved.

> Professors and grade distributions

Independence Test

> Step 2: chi-square is all about expected *fit*

- How much does the the data match what we would expect if these categories were assigned by chance?

Independence Test

> Step 2:

- Observed statistic grades for each professor match the expected variables (O = E)
- Observed statistic grades for each professor do not match the expected variables (O/=E)

Independence Test

- Step 3: List the observed and expect values
- List the *df*

Independence Test

> df = (3-1)(3-1) = 4

$$df_{row} = k_{row} - 1$$

$$df_{column} = k_{column} - 1$$

$$df_{X^2} = (df_{row})(df_{column})$$

Independence Test

> Expected values:

- E = R*C / N
- E = expected
- R = row total
- C = column total
- N = total of everything

observed

	A	B	C	ROW TOTALS
Prof 1	5	6	5	16
Prof 2	12	4	3	19
Prof 3	11	9	3	23
COLUMN TOTALS	28	19	11	N = 58

expected

	A	B	C	ROW TOTALS
Prof 1	16*28/58	16*19/58	16*11/58	16
Prof 2	19*28/58	19*19/58	19*11/58	19
Prof 3	23*28/58	23*19/58	23*11/58	23
COLUMN TOTALS	28	19	11	N = 58

Independence Test

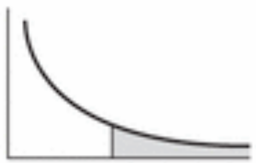
	A	**B**	**C**	**ROW TOTALS**
Prof 1	7.72	5.24	3.03	16
Prof 2	9.17	6.22	3.60	19
Prof 3	11.10	7.53	4.36	23
COLUMN TOTALS	28	19	11	N = 58

Independence Test

> Step 4: Cut off score (9.488)

> Use a chi-square table

TABLE B.4 THE CHI-SQUARE DISTRIBUTIONS



	SIGNIFICANCE (p) 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
6	10.645	12.592	16.812
7	12.017	14.067	18.475
8	13.362	15.507	20.090
9	14.684	16.919	21.666
10	15.987	18.307	23.209

Independence Test

$$X^2 = \sum \left[\frac{(O-E)^2}{E} \right]$$

Step 5: List chi-square = 4.82

http://vassarstats.net/newcs
.html

Data Entry

	B_1	B_2	B_3	B_4	B_5	Totals
A_1	5	6	5	-----	-----	16
A_2	12	4	3	-----	-----	19
A_3	11	9	3	-----	-----	23
A_4	-----	-----	-----	-----	-----	-----
A_5	-----	-----	-----	-----	-----	-----
Totals	28	19	11	-----	-----	58

Reset Calculate

Chi-Square	df	P
4.82	4	0.3063

Cramer's V = 0.2038

an expected frequency of 5 or greater, and no cell may have an expected frequency smaller than 1.0. For a 2x2 table, the chi-square test is valid only if all expected cell frequencies are equal to or greater than 5. If this requirement is not met for a 2x2 table, use instead the Fisher Exact Probability Test. The Fisher Exact Test is also available for 2x3, 2x4, and 3x3.

Independence Test

- Step 6:
  - Is the found chi-square value > the cut off chi-square value?
  - This test is like *F* – everything is squared, so all values are positive.
- Nope! Same number of ABC grades for each professor.

Cramer's *V* (phi)

> The effect size for chi-square test for independence

$$\phi = \sqrt{\frac{X^2}{(N)(df_{row/column})}}$$

df row/column = smaller number of (R–1) or (C–1)

TABLE 17-9. Conventions for Determining Effect Size Based on Cramer's *V*

Jacob Cohen (1992) developed guidelines to determine whether particular effect sizes should be considered small, medium, or large. The effect-size guidelines vary depending on the size of the contingency table. There are different guidelines based on whether the smaller of the two degrees of freedom (row or column) is 1, 2, or 3.

Effect Size	When $df_{row/column} = 1$	When $df_{row/column} = 2$	When $df_{row/column} = 3$
Small	0.10	0.07	0.06
Medium	0.30	0.21	0.17
Large	0.50	0.35	0.29