Interpreting Tables

Tables & simple measures of association

- Interpreting a table
- Using inferential statistics on sample data: Chi-square statistic
- Computing a simple measure of association from nominal data: Cramers phi

A basic 2 X 2 table

TABLE 6.1 Smoking and Divorce, GSS Surveys 1991–1993

	Ever Divorced?		
Smoke?	*Yes*	*No*	*Total*
Yes	238	247	485
No	374	810	1184
Total	612	1057	1669

Data Source: SDA archive at UC Berkeley web site (www.csa.berkeley.edu:7502/).

Row Total

Column Total

Grand Total *or n*

Incidences

- This table, if it represents a population, tells us the likelihood or probability that an adult is divorced:
  - e.g., 612/1669 = .367
  - Or 367 persons per 1,000 as a rate *(the incidence)*
  - Or as a ratio = 1/.367 or 1 in 2.7 persons is divorced.

  - Smoking? 485/1669 = .291
  - Or 291 persons per 1,000 as a rate *(the incidence)*
  - Or as a ratio = 1/.291 or 1 in 3.44 persons has ever smoked

What about overlapping incidences?

- Would divorce cause smoking?
- Would smoking cause divorce? (49% v 32%)
- Causation would be questionable but correlation would be interesting

- Might we simply discern that the incidence of smoking is different between persons who have been divorced, or
- Might we simply discern that the incidence of divorce is different among persons who smoked?
- And
- if there is a difference, is it significant in a statistical sense?
- If it is significant in a statistical sense, is it a strong difference?

The Chi-Squared Statistic

•**Chi-square statistic** measures the difference between the **observed counts** and the counts that would be **expected** if there were no relationship between two categorical variables.

•Large differences are evidence of a relationship.

Chi-Squared Formula

$$X^2 = \sum \frac{(\text{Observed frequencies} - \text{Expected frequencies})^2}{\text{Expected frequencies}}$$

$$= \sum \frac{(Fo - Fe)^2}{Fe}$$

Fe = Expected frequency
Fo = Observed frequency

Fe = (row total X column total) / grand total

Example Of A Chi-Squared Test

Question: Is there a relationship between gender and opinion about capital punishment?

Given: The contingency table of observed counts

	Favor	Oppose	Row Total
Men	38	12	**50**
Women	32	18	**50**
Column Total	**70**	**30**	**100**

Grand total

Research Hypotheses

Null hypothesis: There is no relationship between gender and opinion about capital punishment

Alternative hypothesis: There is a relationship between gender and opinion about capital punishment

Expected cell values if there is no effect of gender on opinion:

Compute table of expected counts : (row total * column total)/ total n for table

	Favor	Oppose	Total
Men	(50 * 70) /100 =35	15	50
Women	35	15	50
Total	70	30	100

Compute the chi-squared statistic:

Compute: (Actual count – Expected count)^2/Expected count for each cell. Then sum the values.

Chi-Squared =

$(38\text{-}35)^2/35 + (12\text{-}15)^2/15 + (32\text{-}35)^2/35 + (18\text{-}15)^2/15$

Or $.257 + .600 + .257 + .600 = 1.714$

- *Use a Chi-Squared table in a statistics text to determine the level of significance of the relationship.*
- *Need degrees of freedom:* ***df = Rows – 1 X Columns -1***
- *In this case, the Chi-Squared statistic is relatively small. We can accept the null hypothesis and reject the alternative hypothesis*

Chi-Squared Table

df	P = 0.05	P = 0.01	P = 0.001
1	3.84	6.64	10.83
2	5.99	9.21	13.82
3	7.82	11.35	16.27
4	9.49	13.28	18.47
5	11.07	15.09	20.52
6	12.59	16.81	22.46
7	14.07	18.48	24.32
8	15.51	20.09	26.13
9	16.92	21.67	27.88
10	18.31	23.21	29.59

Another Example

Observed Values

	Ever Divorced?		
Do You Smoke?	Yes	No	Total
Yes	238	247	485
No	374	810	1184
	612	1057	1669

Expected Values

	Ever Divorced?		
Do You Smoke?	Yes	No	Total
Yes	***178***	***307***	***485***
No	***434***	***750***	***1184***
	612	***1057***	***1669***

Computing Chi-Squared

Chi-Square Calculations

	Ever Divorced?		
Do You Smoke?	Yes	No	Total
Yes	***20.3***	***11.8***	
No	***8.3***	***4.8***	
			45.3

Converting to a measure of association: Cramers phi

1. N = 1669

2. Cramers phi = square root of Chi-squared divided by N

3. so, 45.3 / 1669 = **0.0271372**

4. The square root of 3 is Cramers phi **0.1647337**

Reporting The Result

- Conclusion 1: the results when using these sample data are not strong enough to conclude that there is a statistically significant relationship between gender and opinion about capital punishment.
- Conclusion 2: there seems to be a significant, but not strong association between smoking and divorce.

Basic Analytic Considerations

- Threats to conclusion validity:
  - Type I error – you conclude there is a relationship when there isn't
  - Type II error – you conclude there is no relationship when there is
- Level of significance (the *alpha* value)
  - We determine the cut-off level for importance:
    - *a = .05*
    - *a = .01*
  - It is our likelihood of a Type I error

Continued

- Inferential statistics: statistics used to extend one's findings beyond the group that is studied.