Name Key
8A; Algebra 1

Date
Period

Two-Way Tables

(uni-variate) Frequency

You have worked with one-way tables (even though you may not have called them by that name). A one-way table is simply the data from a bar graph put into table form. In a one-way table, you are only working with one categorical variable.

(Qualitative, can't be measured)

Two-Way Frequency Table: (displays "counts")

You can probably guess that a two-way frequency table will deal with two variables (referred to as bivariate data). In so doing, these tables examine the relationships between the two categorical variables. Two-way frequency tables are especially important because they are often used to analyze survey results. Two-way frequency tables are also called contingency tables.

The Basics of a Two-Way Frequency Table

Two-way frequency tables are a visual representation of the possible relationships between two sets of categorical data. The categories are labeled at the top and the left side of the table, with the frequency (count) information appearing in the four (or more) interior cells of the table. The "totals" of each row appear at the right, and the "totals" of each column appear at the bottom.

Note: the "sum of the row totals" **equals** the "sum of the column totals" (the 240 seen in the lower right corner). This value (240) is also the sum of all of the counts from the interior cells.

A survey asked, "If you could have a new vehicle, would you want a sport utility vehicle or a sports car?

(categories) Column headings

> #'s inside (frequency)

(categories) row headings

	Sport Utility Vehicle (SUV)	Sports Car	Totals
male	21	39	60
female	135	45	180
Totals	156	84	240

ADD → (across rows)

ADD ↓ (down columns)

Row Totals

MathBits.com

Column Totals

total for the entire table (total amount surveyed)

Examples

1) Eighth grade students were asked whether they participate in an after-school activity.
 Complete the two-way frequency table below.

After-school Activity

Gender		Yes	No	Total
	Male	52	40	92
	Female	50	45	95
	Total	102	85	187

187 − 102 = 85

187 − 95 = 92

85 − 40 = 45

in total for table

in total / swim

2) There are 150 children at a summer camp and 71 signed up for swimming. There were a total of 62 children that signed up for canoeing and 28 of them also signed up for swimming. Construct a two-way table summarizing the data.

total / canoeing

swim & and canoeing

	Canoeing	No Canoeing	Total
Swimming	28	43	71
No Swimming	34	45	79
Total	62	88	150

62 − 28 = 34

3) The gym teachers surveyed their classes to see what sport they wanted to play next in gym class. The teachers started to organize the data in a two-way frequency table.

a) Fill in the table

Column variables/categories → joint frequencies

Row variables/categories

	Soccer	Basketball	Lacrosse	Total
Boys	50	30	66	146
Girls	18	32	4	54
Total	68	62	70	200

marginal frequencies

total for the table

→ titles/categories → marginal frequencies

b) What are the **column variables** (the variables whose frequency is recorded in the columns)

Soccer, Basketball, Lacrosse (sports).

→ titles/categories

c) What are the **row variables** (the variables whose frequency is recorded in the rows)

Boys, Girls (gender).

d) Circle the **joint frequencies** (the cells in the body of the table that jointly contain the count of the data items for both the row variable and the column variable) of the two-way table above.

→ total

e) Box the **marginal frequencies** (the cells which contain the sum of each column and row) are called on the two way table above.

→ fraction

f) Now let's create a two-way **relative frequency table** (a ratio of the number of recorded data to the value of the total) for the data above. Give each relative frequency as a percent.

→ for the table

Denominator = 200 (who is being surveyed)

	Soccer	Basketball	Lacrosse	Total
Boys	$\frac{50}{200}=25\%$	$\frac{30}{200}=15\%$	$\frac{66}{200}=33\%$	$\frac{146}{200}=73\%$
Girls	$\frac{18}{200}=9\%$	$\frac{32}{200}=16\%$	$\frac{4}{200}=2\%$	$\frac{54}{200}=27\%$
Total	$\frac{68}{200}=34\%$	$\frac{62}{200}=31\%$	$\frac{70}{200}=35\%$	$\frac{200}{200}=100\%$

→ Denom = total for the table always

g) Find the **joint relative frequency** (determines how the frequency of one cell of joint recorded data compares with the total count of items in the entire data collection over the total of the table) of students surveyed that were boys and voted for basketball.

Denominator (who is being surveyed) (total for the table)

Numerator a joint freq #

$\boxed{\frac{30}{200} = .15 = 15\%}$

total for table

→ Denom = total for the table always

h) Find the **marginal relative frequency** (a comparison between the total of each category of each variable and the overall total of the table) of students that voted for lacrosse. (in total)

(who is being surveyed) (total for the table)

Denominator

Numerator

a marginal Freq # → $\boxed{\frac{70}{200} = .35 = 35\%}$

total for table

Denominator: either the total for that row or for that column, not the entire table

4) Let's see if there is a connection between eye color and hair color by using **conditional relative frequencies** (a comparison within one variable (either row or column) of the data in each category it contains compared with the total in that particular row or column)

		Hair Color			
		Black	Blond	Red	Total
Eye Color	Blue	3	4	1	8
	Brown	5	2	0	7
	Green	1	1	3	5
	Total	9	7	4	20

(a) What is the conditional relative frequency of having green eyes if you have red hair? (This is equivalent to asking what percent of people with red hair hav green eyes.)

Numerator

Denominator (who is being surveyed)

$\boxed{\frac{3}{4} = .75 = 75\%}$

total of column

(b) What is the conditional relative frequency of having green eyes if you have black hair?

Numerator

Denominator (who is being surveyed)

$\boxed{\frac{1}{9} = .11 = 11\%}$

total of column

aka Correlational relative

(c) Does it appear that having green eyes has a dependency or at least an **association** (a response to one category tells us something about the response to the other category) with having red hair?

Yes! B/c overall 5 out of 20 people, or 25% have green eyes. But, if you look at our answer to part (a) that percent jumps to 75% if you have red hair. So you are three times as likely to have green eyes if you have red hair vs. the population as a whole.

Denominator (who is being surveyed) Numerator Denominator (who is being surveyed)

(d) Is it more likely that a person with black hair has blue eyes or that a person with blond hair has brown eyes? Use conditional marginal frequencies to support your answer.

Numerator

Blue eyes / black hair

$\boxed{\frac{3}{9} = .33 = 33\%}$

total of column

more likely B/c higher %

brown eyes / blond hair

$\frac{2}{7} = .29 = 29\%$

total of column

5) A survey of 52 graduating seniors was conducted to determine if there was a connection between the gender of the student and whether they were going on to college. Based on this data, what is more likely: that someone going to college is female or that someone who is female is going to college? They may seem like the same thing, but they are quite different.

Denominator (who is being surveyed) Numerator Denominator (who is being surveyed) Numerator

Female / College

$\frac{13}{29} = .45 = 45\%$

(total of row)

College / Female

$\boxed{\frac{13}{22} = .59 = 59\%}$

(total of column)

more likely B/c higher %

	Gender		
	Male	Female	Total
Going to College	16	13	29
Not Going to College	14	9	23
Total	30	22	52