

Two-Way Tables and Relative Frequencies

Grade 8 math · Lesson · Standards: 8.SP.A.4

Quick answer: A two-way table counts how many individuals fall into each pair of categories for two variables. Dividing a count by its row or column total gives a relative frequency. If the relative frequencies differ a lot between groups, the two variables are associated; if they are about equal, there is little or no association.

Standards: 8.SP.A.4 · **Level:** Grade 8

What is a two-way table?

Two-way table

A two-way table, also called a two-way frequency table, shows how many individuals fall into each combination of two categorical variables. One variable labels the rows and the other labels the columns, and the margins show totals.

In the survey below, each of 120 students is counted once, by grade and by lunch choice. The 38 in the highlighted cell means that 38 seventh graders buy school lunch.

Grade	School lunch	Bag lunch	Total
7th grade	38	22	60
8th grade	24	36	60
Total	62	58	120

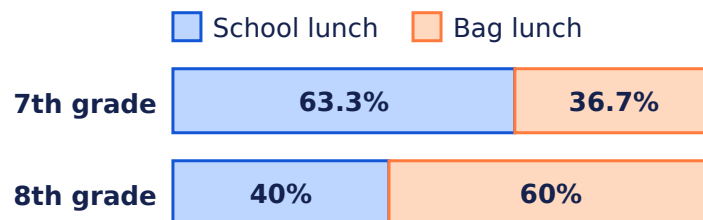
Lunch choice by grade: 120 students surveyed.

What are relative frequencies?

A relative frequency is a count divided by a total, usually written as a percent. Dividing by a row total gives row relative frequencies, which compare the choices inside one group. Dividing by a column total gives column relative frequencies.

Relative frequency

- Row relative frequency = cell count ÷ row total.
- Column relative frequency = cell count ÷ column total.
- Joint relative frequency = cell count ÷ grand total.



Row relative frequencies: $38 \div 60 \approx 63.3\%$ for seventh grade and $24 \div 60 = 40\%$ for eighth grade.

How do you decide whether two variables are associated?

Compare the relative frequencies for each group. If the percents are very different, the variables are associated. If the percents are nearly the same, there is little or no association. Here 63.3% of seventh graders buy school lunch but only 40% of eighth graders do, so grade and lunch choice appear to be associated.

Grade (school lunch column)	Count	Column %
7th grade	38	61.3%
8th grade	24	38.7%
Total	62	100%

Column relative frequencies: $38 \div 62 \approx 61.3\%$ and $24 \div 62 \approx 38.7\%$.

Method

1. Compute the row and column totals and the grand total.
2. Choose the groups you want to compare, and divide each cell by that group's total.
3. Write the results as percents, rounding consistently.
4. Compare the percents across groups and describe any association in words.

Worked example

Of 60 eighth graders, 36 bring a bag lunch. The row relative frequency is $36 \div 60 = 0.60$, or 60%. Among the 58 bag-lunch students, 36 are eighth graders: $36 \div 58 \approx 62.1\%$.

Common mistake

Percents from a row and from a column answer different questions. The share of eighth graders who bring lunch (60%) is not the share of lunch-packers who are eighth graders (62.1%). Check which total you divide by.

Mathbot's tip

Ask who the "of" refers to. In "what percent of 8th graders", divide by the 8th-grade row total.

Key points to remember

- A two-way table shows counts for two categorical variables, with row and column totals.
- Row relative frequency = $\text{count} \div \text{row total}$; column relative frequency = $\text{count} \div \text{column total}$.
- Compare percents across groups to look for an association.
- Nearly equal percents suggest little or no association.
- Row and column percents answer different questions.

Two-Way Tables and Relative Frequencies: frequently asked questions

What do the totals in a two-way table mean?

The row totals and column totals, called marginal frequencies, count the individuals in each category of one variable. The bottom-right number is the grand total, the number of individuals in the whole survey.

What is the difference between a row and a column relative frequency?

A row relative frequency divides by the row total and compares the choices within one group. A column relative frequency divides by the column total and shows what share of a choice comes from each group.

How do I know if two categorical variables are associated?

Compare the relative frequencies for each group. Very different percents, such as 63% and 40%, show an association. Percents that are close to each other show little or no association.

Does an association prove one variable causes the other?

No. A table can show that two variables go together, but it cannot show why. Other factors may explain the pattern, so use words like associated with instead of causes.

Why should I use percents instead of counts to compare groups?

Groups often have different sizes, so raw counts can mislead. Percents put every group on the same scale of 100, which makes a fair comparison possible.