

From Records to Relationships

Construct joint and marginal counts, then investigate an association.

HIGH SCHOOL • MA.912.DP.3.1

MA.912.DP.3.1 "Construct a two-way frequency table summarizing bivariate categorical data. Interpret joint and marginal frequencies and determine possible associations in terms of a real-world context."

NAME _____

DATE _____

Keep the two categories paired

A two-way frequency table counts each person once in the cell for both recorded categories. Row and column totals are marginal frequencies. A conditional relative frequency divides by the named subgroup's total; compare the same outcome across groups to investigate association.

Worked example

Ten simulated library requests record format and book type. What fraction of print requests are novels?

Practice library requests

Format	Novel	Biography	Total
Print	2	3	5
Digital	1	4	5
Total	3	7	10

1. Restrict attention to the Print row: its total is 5 requests.

2. Use the Novel count in that row: $2/5 = 40\%$.

40% of print requests are novels. This differs from $3/10 = 30\%$ of all requests being novels.

Each record gives part-time job status (job or no job) and ride home (bus or carpool). These 24 paired records are invented classroom data, not a real school survey. Use them for tasks 1-5. Tasks 6 and 7 supply separate data.

Each ID is one simulated respondent; paired categories stay together

Records	Records	Records	Records
01: Job / Bus	02: Job / Bus	03: No job / Bus	04: No job / Carpool
05: Job / Bus	06: Job / Carpool	07: No job / Carpool	08: Job / Bus
09: Job / Bus	10: No job / Carpool	11: No job / Carpool	12: Job / Bus
13: No job / Bus	14: No job / Carpool	15: Job / Bus	16: Job / Carpool
17: No job / Carpool	18: No job / Carpool	19: Job / Bus	20: No job / Bus
21: No job / Carpool	22: Job / Bus	23: Job / Carpool	24: No job / Carpool

1. Construct the frequency table

Tally each paired record into the table. Fill all joint frequencies and every row, column and grand total. Check that each respondent is counted exactly once.

Simulated respondent frequencies (complete every cell)

Job status	Bus	Carpool	Total
Job			
No job			
Total			

2. Interpret counts

Report and interpret three frequencies: Job and Bus; all respondents with a job; all respondents who carpool. Identify which is joint and which are marginal.

3. Change the denominator

Use your frequency table to complete a row-conditional percentage table. Divide each joint count by its own row total. Each row represents 100% of that row's group; do not add a grand-total row.

Conditional relative frequencies within each row (%) (complete every cell)

Job status	Bus	Carpool	Total
Job			
No job			

4. Reverse the condition

Among bus riders, what percent have a job? How is that conditional percentage different from the joint relative frequency for Job and Bus? State each denominator.

5. Reason about association

Compare bus-riding percentages for respondents with and without a job. Describe a possible association in this sample. Explain why the table does not establish that having a job causes a transportation choice.

6. Equal counts, different rates

In a separate simulated survey, Group A has 20 people and 12 club members; Group B has 40 people and 12 club members. Construct the table. A student says membership is equally common because both groups have 12 members. Use conditional percentages to evaluate that claim.

A separate simulated club survey (complete every cell)

Group	Member	Not member	Total
Group A			
Group B			
Total			

7. What margins do not determine

A different survey has 20 respondents: 10 with jobs, 10 without jobs, 8 bus riders and 12 carpoolers. Construct a table with these margins in which the bus-riding rate is the same for both job groups. Could these same margins also allow different bus-riding rates? Give a different Job-and-Bus count and explain.

A different possible job/ride survey (complete every cell)

Job status	Bus	Carpool	Total
Job			
No job			
Total			

TEACHER NOTES

Require both category labels, all joint counts and margins. Keep paired observations intact. Row-conditional tables use the row totals, not the overall total. Accept equivalent fractions and accurate explanations; percentages here are exact. Simulated classroom data describe only the supplied records. For a uniformly selected record, empirical probabilities can test independence within that sample space; they do not prove independence or causation in a wider population.

TASK 1

The completed table below counts every paired record once; both sets of marginal totals sum to the number of records.

Simulated respondent frequencies

JOB STATUS	BUS	CARPOOL	TOTAL
JOB	9	3	12
NO JOB	3	9	12
TOTAL	12	12	24

TASK 2

9 have a job and ride the bus: a joint frequency. 12 have a job, regardless of ride: a marginal row frequency. 12 carpool, regardless of job status: a marginal column frequency.

TASK 3

Each row uses its own group total as the denominator. The two percentages within a row sum to 100%.

Conditional relative frequencies within each row (%)

JOB STATUS	BUS	CARPOOL	TOTAL
JOB	75%	25%	100%
NO JOB	25%	75%	100%

TASK 4

$9/12 = 75\%$ of bus riders have a job; the denominator is the 12 bus riders. The joint relative frequency is $9/24 = 37.5\%$ of all respondents; the denominator is all 24 records. Name the starting group before choosing a denominator; the joint cell stays the same when the condition is reversed.

TASK 5

75% with a job and 25% without a job ride the bus. This suggests an association between job status and ride in these records. The simulated observational data do not assign jobs or transportation, and other factors may matter; they do not establish causation. Compare rates that use the same outcome and explicitly name each denominator.

TASK 6

The claim is false: Group A has $12/20 = 60\%$ members, while Group B has $12/40 = 30\%$. Equal joint counts do not imply equal within-group rates when group sizes differ. Subtract each club count from its group total to find nonmembers, then divide club counts by the corresponding group totals.

A separate simulated club survey

GROUP	MEMBER	NOT MEMBER	TOTAL
GROUP A	12	8	20
GROUP B	12	28	40
TOTAL	24	36	60

TASK 7

Equal rates require 4 bus riders in each job group: $4/10 = 40\%$. The same margins can allow different rates: if Job-and-Bus is 6, the other cells are Job/Carpool 4, No job/Bus 2, No job/Carpool 8, giving 60% versus 20%. Marginal totals alone do not determine the joint counts or association.

A different possible job/ride survey

JOB STATUS	BUS	CARPOOL	TOTAL
JOB	4	6	10
NO JOB	4	6	10
TOTAL	8	12	20