

AP Statistics - Two Categorical Variables and Two-Way Tables - Answer Key

Common Core AP STAT 2.1, AP STAT 2.2, AP STAT 2.3, HSS-ID.B.5 · maths-pdf.fr/en/

Each solution shows the division for the percent and names the kind of relative frequency. Conditional percentages within each explanatory group add to 100%, which is a handy check.

AP Statistics · Common Core State Standards: **AP STAT 2.1, AP STAT 2.2, AP STAT 2.3, HSS-ID.B.5**

Exercise 1 - Explanatory and response

The explanatory variable is the one that may help explain the other.

(a) Explanatory: type of breakfast; response: alertness. (b) Explanatory: grade level; response: buying lunch.

Exercise 2 - Complete the table

Bike \ Year	Sophomore	Junior	Total
Owens bike	24	30	54
No bike	16	30	46
Total	40	60	100

Completed table.

No bike: sophomores $40 - 24 = 16$, juniors $60 - 30 = 30$. Row totals: $24 + 30 = 54$ and $16 + 30 = 46$.

54 own a bike and 46 do not.

Exercise 3 - Marginal relative frequency

Reading \ Grade	Grade 9	Grade 10	Grade 11	Total
Reads daily	40	20	10	70
Does not	30	50	50	130
Total	70	70	60	200

Reading habit by grade.

Reads daily: $\frac{70}{200} = 35\%$. Grade 10: $\frac{20}{70} = 28.6\%$.

35% and 28.6%.

Exercise 4 - Joint relative frequency

The cell is 50 out of the grand total 200: $\frac{50}{200} = 25\%$.

25%.

Exercise 5 - Conditional given a column

Grade 9: $\frac{40}{70} \approx 57.1\%$. Grade 11: $\frac{10}{60} \approx 16.7\%$.

About 57.1% and 16.7%.

Exercise 6 - Conditional given a row

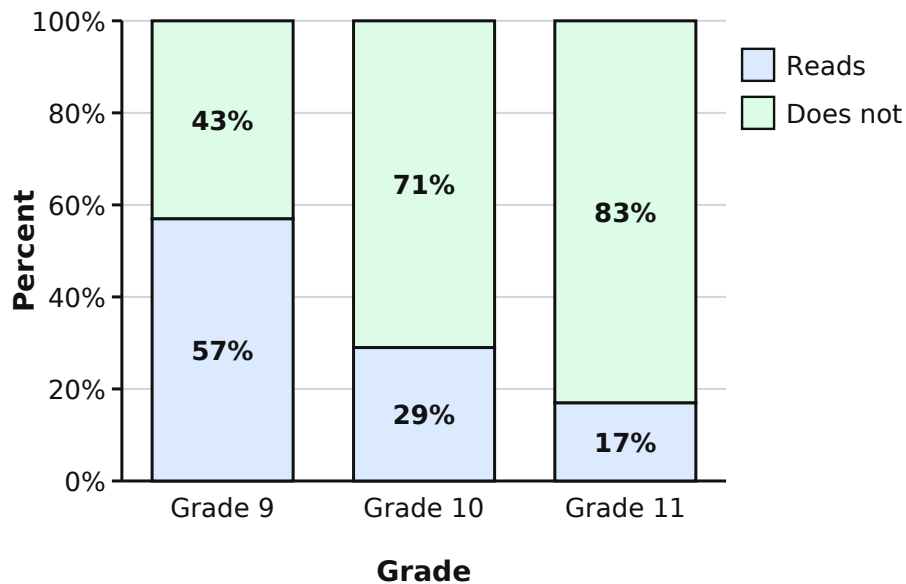
The row total is 70.

- a. $\frac{40}{70} \approx 57.1\%$
- b. $\frac{20}{70} \approx 28.6\%$
- c. $\frac{10}{70} \approx 14.3\%$

57.1%, 28.6%, 14.3% (they add to 100%).

Exercise 7 - Segmented bar graph

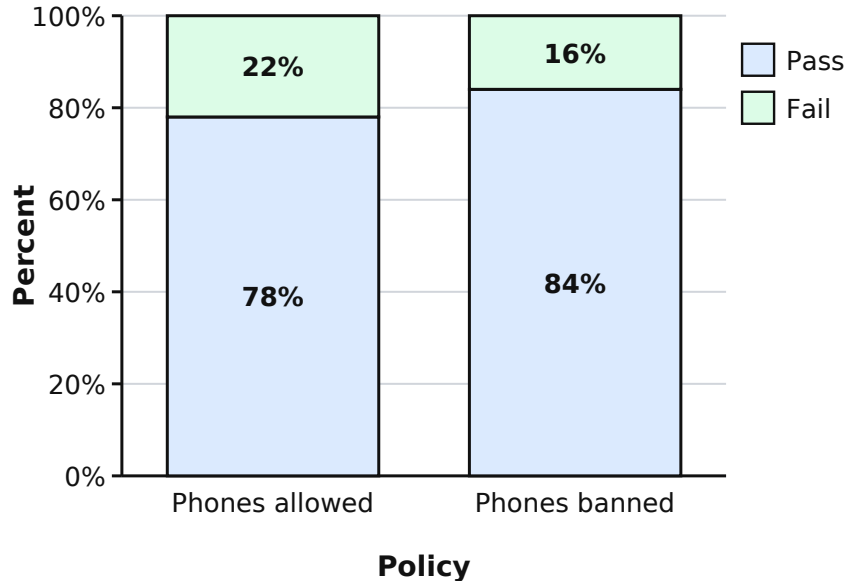
Percent who read daily within each grade: 57%, 29%, 17% (rounded).



Percent who read daily within each grade (rounded).

The percent who read daily falls steadily from Grade 9 to Grade 11, so reading habit and grade are associated: younger students read daily more often.

Exercise 8 - Read a segmented bar graph



Class results under two phone policies.

Allowed: $0.78 \times 200 = 156$ passed. Banned: $0.84 \times 200 = 168$ passed.

156 and 168. The pass percents differ (78% compared with 84%), so there is an association, but not necessarily causation.

Exercise 9 - Which direction?

Smokers who cough: $\frac{60}{150} = 40\%$. Coughers who smoke: $\frac{60}{100} = 60\%$ (100 coughers in all).

40% of smokers cough; 60% of coughers smoke. The two conditionals are different questions.

Exercise 10 - Build a table from percents

Band \ Sex	Girls	Boys	Total
Band	60	40	100
No band	140	160	300
Total	200	200	400

Counts for 400 students.

Girls: 200; in band $0.30 \times 200 = 60$. Boys: 200; in band $0.20 \times 200 = 40$.

Band: 60 girls, 40 boys; not in band: 140 girls, 160 boys.

Exercise 11 - Simpson's paradox: the data

Easy: X $\frac{72}{80} = 90\%$, Y $\frac{10}{10} = 100\%$. Hard: X $\frac{2}{20} = 10\%$, Y $\frac{12}{90} \approx 13.3\%$.

Overall: X $\frac{74}{100} = 74\%$, Y $\frac{22}{100} = 22\%$.

Y is better in each course, but X is better overall.

Exercise 12 - Explain the paradox

Program X enrolled mostly students in the easy course (80 of 100), where passing is common. Program Y enrolled mostly students in the hard course (90 of 100).

Course difficulty is a lurking variable; the combined data hide it. Compare within courses.

Exercise 13 - Association or not?

The conditional percents of preferring online classes are equal in both groups.

No association: knowing a student's sex does not change the percent who prefer online classes.

Exercise 14 - Causation

The study shows an association in observational data.

No. Students who eat breakfast may differ in sleep, family support, or other lurking variables. Only a randomized experiment can support a cause-and-effect claim.

Exercise 15 - Pet ad

Opinion \ Owner	Cat owners	Dog owners	Total
Likes	48	32	80
Dislikes	12	108	120
Total	60	140	200

Opinion of a pet-store ad.

Cat owners: $\frac{48}{60} = 80\%$. Dog owners: $\frac{32}{140} \approx 22.9\%$.

80% compared with about 22.9%. The difference is large, so type of pet owned and opinion of the ad are associated.

Exercise 16 - Describe the association

Use comparison words and the context.

Cat owners were much more likely to like the ad than dog owners (80% compared with 22.9%). Among dog owners, 77.1% disliked the ad.

Exercise 17 - Fill in with totals

Females who prefer coffee: $140 - 63 = 77$. Total coffee: $250 - 90 = 160$. Males who prefer coffee: $160 - 77 = 83$.

83 males prefer coffee.

Exercise 18 - Expected counts preview

Overall tea: $\frac{90}{250} = 36\%$. Expected: $0.36 \times 140 = 50.4$.

Expected 50.4 females prefer tea if there were no association; the observed 63 is higher.

Exercise 19 - Multi-step

Rural: $\frac{540}{1500} = 36\%$. Non-rural: teens $4000 - 1500 = 2500$, vaping $1200 - 540 = 660$, so $\frac{660}{2500} = 26.4\%$.

36% of rural teens and 26.4% of non-rural teens vape.

Exercise 20 - Percent of a group

Bus riders: $0.35 \times 600 = 210$. Grade 9 riders: $0.40 \times 210 = 84$.

Percent of all students: $\frac{84}{600} = 14\%$.

84 students, 14% of all students.