Two-Way Tables

Name: _____ Date: _____ Score: _____ / 24

Quick Review

A **two-way table** organizes data sorted by *two* categories at once — one across the rows, one down the columns. Each inside cell is a **joint frequency** (a count for one row-and-column combination). The row and column totals are **marginal frequencies**, and they all add up to the grand total. To find a probability, divide the count you want by the appropriate total: divide by the *grand total* for an overall chance, or by a *row or column total* for a *conditional* chance ("given that…"). Reading these tables carefully helps you spot associations between the two categories.

◇ **Example:** In a survey of 50 students about liking sports and liking music: 20 like both, 10 like sports but not music, 15 like music but not sports, and 5 like neither. Find the probability a random student likes sports, and the probability a student likes sports *given* they like music.

⇒ Let's total things up first. Students who like sports $= 20 + 10 = 30$, so out of 50 the chance is $\frac{30}{50} = \frac{3}{5}$. Now for the conditional part, we only look at music-likers: that group is $20 + 15 = 35$ students. Of those, 20 also like sports, so the probability of liking sports *given* liking music is $\frac{20}{35} = \frac{4}{7}$. Notice we changed the denominator to match the "given" group — that is the key move with conditional probability!

Answer: $P(\text{sports}) = \frac{3}{5}$, $P(\text{sports} \mid \text{music}) = \frac{4}{7}$

PRACTICE

Use the described two-way table to answer each question.

1. Table A: cats 12, dogs 18. Total pets? _____
2. Table A (total 30): $P(\text{cat})$? _____
3. Table A (total 30): $P(\text{dog})$? _____
4. Table B: walk 8, bus 12, bike 5, car 25. Total? _____
5. Table B (total 50): $P(\text{bus})$? _____
6. Table B (total 50): $P(\text{car})$? _____
7. Table C: boys-pizza 9, boys-taco 6, girls-pizza 10, girls-taco 5. Total? _____
8. Table C: how many boys total? _____
9. Table C: how many chose pizza? _____
10. Table C (total 30): $P(\text{pizza})$? _____
11. Table C: $P(\text{pizza} \mid \text{boy})$? _____
12. Table C: $P(\text{boy} \mid \text{taco})$? _____
13. Table D: pass-studied 24, pass-not 4, fail-studied 2, fail-not 10. T _____
14. Table D: how many studied? _____
15. Table D: how many passed? _____
16. Table D (total 40): $P(\text{pass})$? _____
17. Table D: $P(\text{pass} \mid \text{studied})$? _____
18. Table D: $P(\text{fail} \mid \text{not studied})$? _____
19. Table E: yes-A 7, yes-B 3, no-A 5, no-B 5. $P(\text{yes})$? _____
20. Table E: $P(\text{A} \mid \text{yes})$? _____

Word Problems

21. A class of 40 is surveyed: 18 have a pet and play sports, 7 have a pet but no sports, 9 play sports but have no pet, and 6 have neither. What is the probability a random student has a pet? _____

22. At a movie theater, 60 people are surveyed: 22 bought popcorn and soda, 14 bought popcorn only, 16 bought soda only, 8 bought neither. Given a person bought soda, what is the probability they also bought popcorn? _____

23. A survey of 80 commuters records: 30 drive and arrive on time, 10 drive and are late, 28 take transit and are on time, 12 take transit and are late. Is being on time associated with how you commute? _____

24. In a poll of 100 people: 35 are teens who like the app, 5 are teens who dislike it, 20 are adults who like it, 40 are adults who dislike it. What fraction of teens like the app? _____

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Answer Keys

1. $\boxed{30}$
2. $\boxed{\frac{2}{5}}$
3. $\boxed{\frac{3}{5}}$
4. $\boxed{50}$
5. $\boxed{\frac{6}{25}}$
6. $\boxed{\frac{1}{2}}$
7. $\boxed{30}$
8. $\boxed{15}$
9. $\boxed{19}$
10. $\boxed{\frac{19}{30}}$
11. $\boxed{\frac{3}{5}}$
12. $\boxed{\frac{6}{11}}$
13. $\boxed{40}$
14. $\boxed{26}$
15. $\boxed{28}$
16. $\boxed{\frac{7}{10}}$
17. $\boxed{\frac{12}{13}}$
18. $\boxed{\frac{5}{7}}$
19. $\boxed{\frac{1}{2}}$
20. $\boxed{\frac{7}{10}}$
21. $\boxed{P(\text{pet}) = \frac{25}{40} = \frac{5}{8}}$
22. $\boxed{P(\text{popcorn} \mid \text{soda}) = \frac{22}{38} = \frac{11}{19}}$
23. $\boxed{\text{drive on-time rate } \frac{3}{4} \text{ vs transit } \frac{7}{10} \text{ — a small association}}$
24. $\boxed{\frac{35}{40} = \frac{7}{8} \text{ of teens}}$

Step-by-Step Explanations

1. Add the two cells: $12 + 18 = 30$ pets in all.
2. There are 12 cats out of 30 pets: $\frac{12}{30} = \frac{2}{5}$.
3. There are 18 dogs out of 30: $\frac{18}{30} = \frac{3}{5}$.
4. Add all four counts: $8 + 12 + 5 + 25 = 50$ students.
5. 12 ride the bus out of 50: $\frac{12}{50} = \frac{6}{25}$.
6. 25 ride in a car out of 50: $\frac{25}{50} = \frac{1}{2}$.
7. Add all four joint counts: $9 + 6 + 10 + 5 = 30$ students.
8. Boys $=$ boys-pizza $+$ boys-taco $= 9 + 6 = 15$.
9. Pizza $=$ boys-pizza $+$ girls-pizza $= 9 + 10 = 19$.
10. 19 of 30 students chose pizza, so $P = \frac{19}{30}$.
11. Among the 15 boys, 9 chose pizza: $\frac{9}{15} = \frac{3}{5}$.
12. Tacos were chosen by $6 + 5 = 11$ students; 6 are boys, so $\frac{6}{11}$.
13. Add all four counts: $24 + 4 + 2 + 10 = 40$ students.
14. Studied $= 24 + 2 = 26$ students (pass and fail combined).
15. Passed $= 24 + 4 = 28$ students.
16. 28 of 40 passed: $\frac{28}{40} = \frac{7}{10}$.
17. Of the 26 who studied, 24 passed: $\frac{24}{26} = \frac{12}{13}$.
18. Of the $4 + 10 = 14$ who did not study, 10 failed: $\frac{10}{14} = \frac{5}{7}$.
19. "Yes" total $= 7 + 3 = 10$ out of 20: $\frac{10}{20} = \frac{1}{2}$.
20. Among the 10 "yes" responses, 7 are A: $\frac{7}{10}$.
21. Students with a pet $= 18 + 7 = 25$. Out of the 40 total, the probability is $\frac{25}{40} = \frac{5}{8}$.
22. Soda buyers $= 22 + 16 = 38$. Of those, 22 also bought popcorn, so the conditional probability is $\frac{22}{38} = \frac{11}{19}$.
23. Among 40 drivers, 30 are on time: $\frac{30}{40} = \frac{3}{4}$. Among 40 transit riders, 28 are on time: $\frac{28}{40} = \frac{7}{10}$. The rates differ a little, so there is a small association.
24. Teens total $= 35 + 5 = 40$. Of those, 35 like the app, so the fraction is $\frac{35}{40} = \frac{7}{8}$ — much higher than adults.

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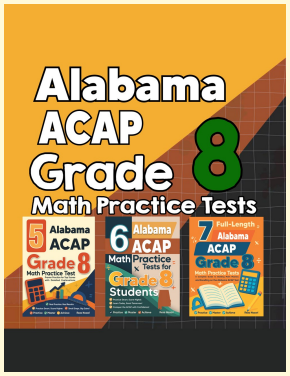

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