

Chi-Square Tests for Two-Way Tables

Grade 12 – AP Statistics math · Worksheet · Standards: AP Statistics Unit 3 (2026-27)

Name: _____ Date: _____ Class: _____

These twenty problems train the chi-square skills of AP Statistics Unit 3: expected counts, the statistic, degrees of freedom, p-values, the conditions, and complete tests of homogeneity and independence. Later problems ask for conclusions in context and the difference between association and causation.

Standards: AP Statistics Unit 3 (2026-27) · **Level:** Grade 12 AP Statistics

Problem 1 Homogeneity or Independence (easy)

Name the appropriate chi-square test (homogeneity or independence) for each study.

- A random sample of 400 adults is asked for their age group and whether they voted in the last election.
- Random samples of 150 students from each of three schools are asked to name their favorite lunch.
- Ninety patients are randomly assigned to one of three therapies and each is recorded as improved or not improved.

Problem 2 One Expected Count (easy)

A two-way table has a row total of 85, a column total of 120 and a table total of 340. Find the expected count for the cell in that row and column.

Problem 3 An Expected Count Table (medium)

A school counted passing and failing students by whether they used a study app.

	Passed	Failed	Total
Used app	34	26	60
No app	46	64	110
Total	80	90	170

Find all four expected counts.

Problem 4 Degrees of Freedom (easy)

Find the degrees of freedom for a chi-square test on a table with (a) 3 rows and 4 columns, (b) 2 rows and 2 columns, (c) 5 rows and 3 columns.

Problem 5 A Cell's Contribution (easy)

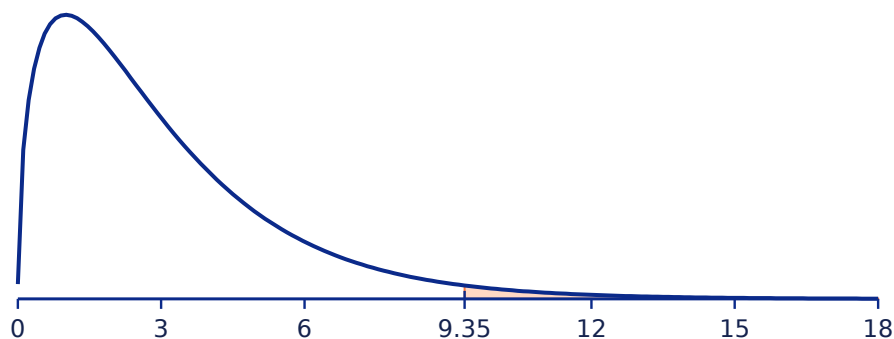
In one cell of a table the observed count is 41 and the expected count is 33.2. Find the contribution of this cell to the chi-square statistic.

Problem 6 The Statistic for a 2 by 2 Table (medium)

Use the study app table from Problem 3. Compute the chi-square statistic, the degrees of freedom and the p-value.

Problem 7 Finding a p-Value (medium)

A chi-square test gives $\chi^2 = 9.35$ with $df = 3$. Find the p-value and state the decision at $\alpha = 0.05$.



χ^2 (df = 3)

The p-value is the shaded right tail.

Problem 8 Checking the Expected Counts (medium)

A random sample of 100 people was classified by group and response.

	Yes	Maybe	No	Total
Group 1	4	6	20	30
Group 2	9	11	50	70
Total	13	17	70	100

Compute the expected counts and decide whether a chi-square test is appropriate.

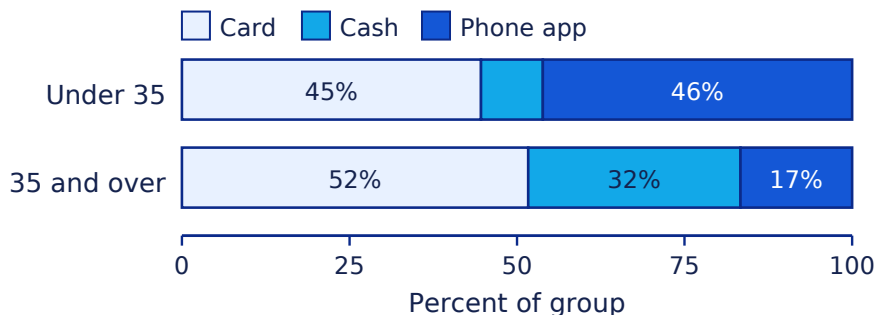
Problem 9 Writing Hypotheses (easy)

Write the null and alternative hypotheses for (a) a test of homogeneity comparing how residents of three cities commute (bike, bus, car), and (b) a test of independence for one sample of voters classified by age group and preferred candidate.

Problem 10 A Complete Test of Independence (hard)

A random sample of 250 shoppers was classified by age group and payment method.

	Card	Cash	Phone app	Total
Under 35	58	12	60	130
35 and over	62	38	20	120
Total	120	50	80	250

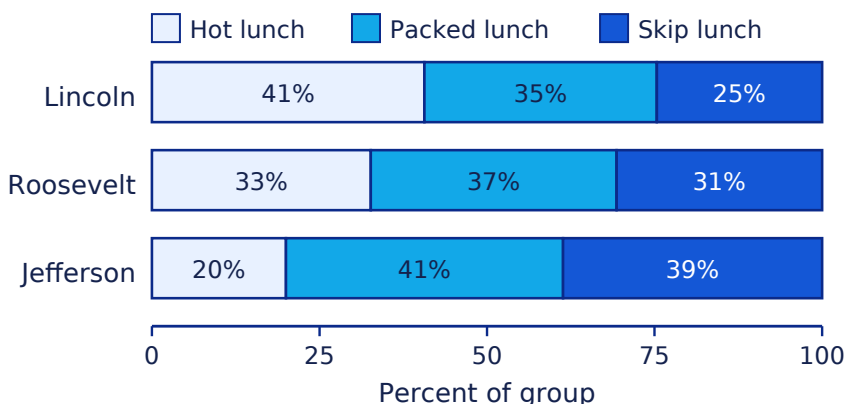


Payment method by age group.

Test whether age group and payment method are associated, using $\alpha = 0.05$.

Problem 11 Reading a Segmented Bar Graph (medium)

Random samples of 150 students were taken at each of three schools. The segmented bar graph shows the lunch choice distribution at each school.



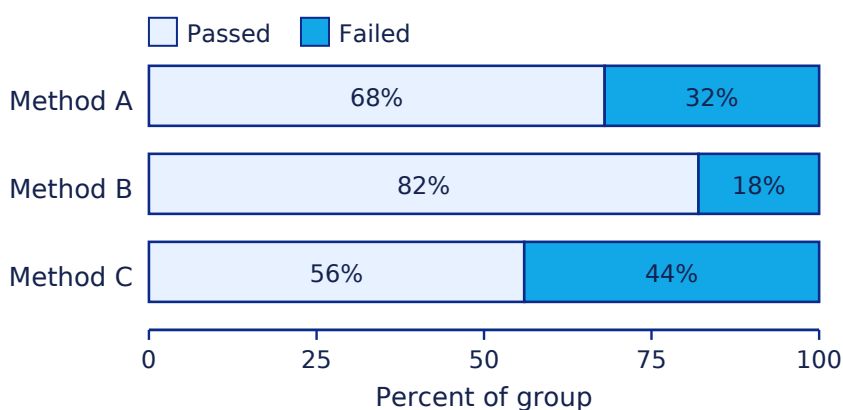
Lunch choice at three schools.

Compare the distributions. Does the graph suggest that the distribution is the same at all three schools? Which test would you use to confirm?

Problem 12 A Test of Homogeneity (hard)

One hundred fifty students were randomly assigned to three tutoring methods (50 each). The table shows the pass counts.

	Passed	Failed	Total
Method A	34	16	50
Method B	41	9	50
Method C	28	22	50
Total	103	47	150



Pass rates by tutoring method.

Do the data provide convincing evidence that the pass rates differ among the three methods? Use $\alpha = 0.05$.

Problem 13 Interpreting a p-Value (medium)

A chi-square test of independence for a sample of drivers gave a p-value of 0.027. Interpret the p-value in context if the two variables are vehicle type and region.

Problem 14 Decisions at Two Levels (easy)

For $\chi^2 = 11.7$ with $df = 4$, the p-value is 0.0197. State the decision at $\alpha = 0.05$ and $\alpha = 0.01$.

Problem 15 Which Cells Differ Most? (medium)

Return to the payment method table in Problem 10. Find the contribution of each cell and identify the two cells that differ most from what independence predicts.

Problem 16 A 3 by 3 Test (hard)

A random sample of 230 adults was classified by weekly screen time (low, medium, high) and sleep quality (poor, fair, good).

	Poor	Fair	Good	Total
Low	22	31	17	70
Medium	30	25	35	90
High	18	12	40	70
Total	70	68	92	230

Compute the chi-square statistic, df and the p-value, then state a conclusion at $\alpha = 0.05$.

Problem 17 Two Proportions and Chi-Square (hard)

In random samples, 68 of 150 customers at store A and 49 of 140 at store B use a loyalty card. (a) Compute the pooled two-proportion z statistic. (b) Make a 2 by 2 table and compute χ^2 . (c) Compare z^2 with χ^2 .

Problem 18 Combining Categories (hard)

Two groups of 100 randomly chosen customers rated how often they recommend a shop: Never, Rarely, Sometimes or Often.

	Never	Rarely	Sometimes	Often	Total
Group 1	3	8	30	59	100
Group 2	4	12	34	50	100
Total	7	20	64	109	200

Check the expected counts. If a condition fails, combine the first two categories and complete a test of homogeneity at $\alpha = 0.05$.

Problem 19 Association and Causation (medium)

A random sample of 400 adults was classified by whether they take a daily walk and whether they report good sleep. A chi-square test of independence gives a p-value of 0.003. (a) State the conclusion. (b) Can the researchers conclude that walking improves sleep? Explain.

Problem 20 An Experiment with Three Outcomes (hard)

Two hundred forty volunteers were randomly assigned to one of three study methods (80 each). Their grade outcomes are shown.

	A or B	C	D or F	Total
Flashcards	30	34	16	80
Mock quizzes	38	28	14	80
Rereading	22	36	22	80
Total	90	98	52	240

Do the data provide convincing evidence that the distribution of grade outcomes differs among the study methods? If so, may a cause-and-effect conclusion be drawn? Use $\alpha = 0.05$.