



AP Statistics FRQ Practice · Unit 8

Favorite Study Resource by Grade · numberbender.com

Name: _____

Date: _____

Score: / 4

What this question practices

- Choosing between chi-square tests
- Expected counts and conditions
- Degrees of freedom, P-value and conclusion
- Finding the largest contributor to the chi-square statistic

Show all your work. Answer each part in complete sentences, in the context of the problem. The data are hypothetical.
Suggested time: 13 minutes.

A large high school selected separate random samples of 100 students from each of Grades 9, 10 and 11. Each grade has more than 1,000 students. Each student was asked which resource helps them most when studying for a math test. The results are shown.

	Videos	Textbook	Tutor or classmate	Total
Grade 9	52	30	18	100
Grade 10	45	33	22	100
Grade 11	33	37	30	100
Total	130	100	70	300

(a) Identify the appropriate chi-square test and state the hypotheses.

(b) Calculate the expected count of Grade 9 students who prefer videos, and show that the conditions for the test are met.

(c) The test statistic is $\chi^2 = 8.20$. Find the degrees of freedom and the P-value, and state a conclusion at the $\alpha = 0.05$ level.



(d) Which cell contributes most to the chi-square statistic? What does that cell suggest?





Each part is scored *E* (essentially correct), *P* (partially correct) or *I* (incorrect), the way AP readers score free-response questions. Compare your work with the model solution, then with the scoring note.

(a) Identify the appropriate chi-square test and state the hypotheses.

→ The school took separate random samples from three grades and recorded one categorical variable, so this is a chi-square test for **homogeneity**.

→ H_0 : the distribution of preferred study resource is the same for Grade 9, Grade 10 and Grade 11 students at the school. H_a : the distribution is not the same for all three grades.

Scoring. Essentially correct: names the homogeneity test (with a reason) and states hypotheses about the distributions in context.

(b) Calculate the expected count of Grade 9 students who prefer videos, and show that the conditions for the test are met.

$$\text{Expected} = \frac{(100)(130)}{300} \approx 43.33$$

→ **Random:** separate random samples were taken from each grade.

→ **10%:** 100 students is less than 10% of each grade (each has more than 1,000).

→ **Large Counts:** the smallest expected count is $100(70) \div 300 \approx 23.33$, so all expected counts are at least 5.

Scoring. Essentially correct: correct expected count with work and all three conditions checked.

(c) The test statistic is $\chi^2 = 8.20$. Find the degrees of freedom and the P-value, and state a conclusion at the $\alpha = 0.05$ level.

$$df = (3 - 1)(3 - 1) = 4$$

$$P\text{-value} = P(\chi^2 \geq 8.20) \approx 0.085$$

→ Because the P-value of about 0.085 is greater than $\alpha = 0.05$, we fail to reject H_0 .

→ There is not convincing evidence that the distribution of preferred study resource differs among Grade 9, 10 and 11 students at this school. (This does not prove the distributions are the same.)

Scoring. Essentially correct: correct df and P-value, the correct decision, and a conclusion in context that does not accept H_0 .

(d) Which cell contributes most to the chi-square statistic? What does that cell suggest?

→ The Grade 11, Videos cell contributes the most, about 2.46 of the 8.20.

$$\frac{(33 - 43.33)^2}{43.33} \approx 2.46$$

→ Fewer Grade 11 students named videos (33) than we would expect (43.33) if all three grades had the same distribution. Even so, the overall test did not find convincing evidence of a difference.

Scoring. Essentially correct: identifies the cell with its contribution and compares observed with expected in context.

