AP Statistics - CHI: Chi-Square Tests

AP Statistics Chi-Square Tests (CHI) - 20 questions

20 Questions | 40 min

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1. Data from a simple random sample (SRS) of teachers is cross-classified by gender and support for a new educational initiative, resulting in the following table.

	Male	Female
For	37	41
Against	42	62
No Opinion	41	29

Is there evidence of a relationship between gender and support for the initiative among teachers?

(A) There is strong evidence of a relationship between gender and support for the initiative among teachers, P < 0.05.

(B) There is weak evidence of a relationship between gender and support for the initiative among teachers, 0.05 < P < 0.10.

(C) There is not sufficient evidence of a relationship between gender and support for the initiative among teachers, P > 0.10.

(D) Further information is needed to be able to perform a chi-square test of independence.

(E) The test is inconclusive.

2. A survey of 150 high school seniors is conducted to see if there is a relationship between whether or not a student is taking AP Statistics and whether students have positive or negative outlooks on their future. The data are summarized in the following table.

	Positive Outlook	Negative Outlook
Taking AP Stats	46	24
Not Taking AP Stats	37	43

What is the appropriate test statistic for a hypothesis test with H_0: Student outlook on the future is independent of taking AP Statistics?

(A) $\dfrac{(46-38.7)^2}{38.7} + \dfrac{(24-31.3)^2}{31.3} + \dfrac{(37-44.3)^2}{44.3} + \dfrac{(43-35.7)^2}{35.7}$

(B) $\dfrac{(46-38.7)^2}{46} + \dfrac{(24-31.3)^2}{24} + \dfrac{(37-44.3)^2}{37} + \dfrac{(43-35.7)^2}{43}$

(C) $\dfrac{(46-35)^2}{35} + \dfrac{(24-35)^2}{35} + \dfrac{(37-40)^2}{40} + \dfrac{(43-40)^2}{40}$

(D) $\dfrac{(46-41.5)^2}{41.5} + \dfrac{(24-33.5)^2}{33.5} + \dfrac{(37-41.5)^2}{41.5} + \dfrac{(43-33.5)^2}{33.5}$

(E) $\dfrac{(46-37.5)^2}{46} + \dfrac{(24-37.5)^2}{24} + \dfrac{(37-37.5)^2}{37} + \dfrac{(43-37.5)^2}{43}$

3. Which of the following is not true with regard to contingency tables for chi-square tests for independence?

(A) Categorical rather than quantitative variables are being considered.

(B) Observed frequencies should be whole numbers.

(C) Expected frequencies should be whole numbers.

(D) Expected frequencies in each cell should be at least 5, and to achieve this, one sometimes combines categories for one or the other or for both of the variables.

(E) The expected frequency for any cell can be found by multiplying the row total by the column total and then dividing by the sample size.

4. The table below shows the number of employees arriving late for work at an office and is broken down by the day of the week. An HR officer would like to know if such late arrivals are related to the day of the week.

Monday	Tuesday	Wednesday	Thursday	Friday
12	5	9	4	15

What is the value of chi-square for the appropriate test?

(A) $\dfrac{(12-9)^2}{12} + \dfrac{(5-9)^2}{5} + \dfrac{(9-9)^2}{9} + \dfrac{(4-9)^2}{4} + \dfrac{(15-9)^2}{15}$

(B) $\dfrac{(12-9)^2}{9} + \dfrac{(5-9)^2}{9} + \dfrac{(9-9)^2}{9} + \dfrac{(4-9)^2}{9} + \dfrac{(15-9)^2}{9}$

(C) $\dfrac{(12-9)^2}{45} + \dfrac{(5-9)^2}{45} + \dfrac{(9-9)^2}{45} + \dfrac{(4-9)^2}{45} + \dfrac{(15-9)^2}{45}$

(D) $\dfrac{(12-5)^2}{12} + \dfrac{(5-5)^2}{5} + \dfrac{(9-5)^2}{9} + \dfrac{(4-5)^2}{4} + \dfrac{(15-5)^2}{15}$

(E) $\dfrac{(12-5)^2}{5} + \dfrac{(5-5)^2}{5} + \dfrac{(9-5)^2}{5} + \dfrac{(4-5)^2}{5} + \dfrac{(15-5)^2}{5}$

5. A geneticist claims that three species of fruit flies should appear in the ratio 1:6:9. Suppose that a random sample of 320 flies contained 25, 100, and 195 flies of each species, respectively. Does a chi-square test show sufficient evidence to reject the geneticist's claim at the 5% significance level?

(A) The test proves the geneticist's claim.

(B) The test proves the geneticist's claim is false.

(C) The test does not give sufficient evidence to reject the geneticist's claim at the 5% significance level.

(D) The test gives sufficient evidence to reject the geneticist's claim at the 5% significance level.

(E) The test is inconclusive.

6. Three English professors are interviewed regarding a random sampling of 20 of their term paper grades. The following table gives the resulting counts.

	Professor A	Professor B	Professor C
Grades A, B	5	7	9
Grade C	13	10	7
Grades D, F	2	3	4

A statistics student runs a chi-square test of homogeneity. What is the most proper conclusion?

(A) There is no evidence that these professors give different distributions of grades.

(B) There is evidence at the 10% level, but not at the 5% level, that the professors give different grade distributions.

(C) There is evidence at the 5% level, but not at the 1% level, that the professors give different grade distributions.

(D) There is evidence at the 1% level that the professors give different grade distributions.

(E) A chi-square test of homogeneity is not appropriate.

7. Researchers wanted to determine if preference between baseball and chess is independent of age. 210 interviews yielded the following numbers.

	Age 10-19	20-49	50-89	Total
Prefer Baseball	55	40	15	110
Prefer Chess	10	15	35	60
Total	65	55	50	170

What is the P-value for an appropriate test?

(A) $P\left(\chi^2 > \dfrac{(55-42.1)^2}{55} + \dfrac{(40-35.6)^2}{40} + \dfrac{(15-32.4)^2}{15} + \dfrac{(10-22.9)^2}{10} + \dfrac{(15-19.4)^2}{15} + \dfrac{(35-17.6)^2}{35}, \mathrm{df}=2\right)$

(B) $P\left(\chi^2 > \dfrac{(55-42.1)^2}{42.1} + \dfrac{(40-35.6)^2}{35.6} + \dfrac{(15-32.4)^2}{32.4} + \dfrac{(10-22.9)^2}{22.9} + \dfrac{(15-19.4)^2}{19.4} + \dfrac{(35-17.6)^2}{17.6}, \mathrm{df}=2\right)$

(C) $P\left(\chi^2 > \dfrac{(55-42.1)^2}{55} + \dfrac{(40-35.6)^2}{40} + \dfrac{(15-32.4)^2}{15} + \dfrac{(10-22.9)^2}{10} + \dfrac{(15-19.4)^2}{15} + \dfrac{(35-17.6)^2}{35}, \mathrm{df}=3\right)$

(D) $P\left(\chi^2 > \dfrac{(55-42.1)^2}{42.1} + \dfrac{(40-35.6)^2}{35.6} + \dfrac{(15-32.4)^2}{32.4} + \dfrac{(10-22.9)^2}{22.9} + \dfrac{(15-19.4)^2}{19.4} + \dfrac{(35-17.6)^2}{17.6}, \mathrm{df}=3\right)$

(E) $P\left(\chi^2 > \dfrac{(55-42.1)^2}{28.33} + \dfrac{(40-35.6)^2}{28.33} + \dfrac{(15-32.4)^2}{28.33} + \dfrac{(10-22.9)^2}{28.33} + \dfrac{(15-19.4)^2}{28.33} + \dfrac{(35-17.6)^2}{28.33}, \mathrm{df}=6\right)$

8. Which of the following is the proper use of a chi-square test of independence?

(A) To test whether the distribution of counts on a categorical variable matches a claimed distribution

(B) To test whether the distribution of counts on a numerical variable matches a claimed distribution

(C) To test whether the distribution of two different groups on the same categorical variable matches

(D) To test whether two categorical variables on one set of subjects are related

(E) To test whether two numerical variables on one set of subjects are related

9. Last year, college students learned about major news events from the following sources: MSNBC: 21%, CNN: 26%, FOX: 12%, The Daily Show: 41%. In a random sample of 80 college students this year, 23 watched MSNBC, 14 watched CNN, 10 watched FOX, and 33 watched The Daily Show to learn about major news events. If a goodness-of-fit test is performed, what will be the P-value?

(A) $P\left(\chi^2 > \dfrac{(23-16.8)^2}{23} + \dfrac{(14-20.8)^2}{14} + \dfrac{(10-9.6)^2}{10} + \dfrac{(33-32.8)^2}{32.8} \right)$ with df = 3

(B) $P\left(\chi^2 > \dfrac{(23-16.8)^2}{23} + \dfrac{(14-20.8)^2}{14} + \dfrac{(10-9.6)^2}{10} + \dfrac{(33-32.8)^2}{32.8} \right)$ with df = 4

(C) $P\left(\chi^2 > \dfrac{(23-16.8)^2}{16.8} + \dfrac{(14-20.8)^2}{20.8} + \dfrac{(10-9.6)^2}{9.6} + \dfrac{(33-32.8)^2}{32.8} \right)$ with df = 3

(D) $P\left(\chi^2 > \dfrac{(23-16.8)^2}{16.8} + \dfrac{(14-20.8)^2}{20.8} + \dfrac{(10-9.6)^2}{9.6} + \dfrac{(33-32.8)^2}{32.8} \right)$ with df = 4

(E) $P\left(\chi^2 > \dfrac{(23-16.8)^2}{0.25} + \dfrac{(14-20.8)^2}{0.25} + \dfrac{(10-9.6)^2}{0.25} + \dfrac{(33-32.8)^2}{0.25} \right)$ with df = 79

10. Researchers wanted to determine if people know Mitt Romney's real first name. Data from random samples of 170 Democrats and 170 Republicans are summarized in the following table.

	Mittens	Willard	Something Else
Democrats	23	41	106
Republicans	55	52	63

Assuming that people from each party have the same pattern of responses when asked about Romney's real first name, what is the expected number of Republicans who answer Willard (which is actually the correct answer) from this group of 340 people?

(A) $\dfrac{93}{170}$

(B) $\dfrac{52}{93}$

(C) $\dfrac{52}{170}$

(D) $\dfrac{(170)(93)}{211}$

(E) $\dfrac{(170)(93)}{340}$

11. A study of hospital admissions in a small town reported the following numbers for three different days broken down by phase of the moon.

	New Moon	Full Moon	Half Moon
Accidents	35	77	53

Is there sufficient evidence to say that the number of admissions on the three days is not the same?

(A) There is sufficient evidence at the 0.001 significance level that the number of admissions on each day is not the same.

(B) There is sufficient evidence at the 0.01 level, but not at the 0.001 level, that the number of admissions on each day is not the same.

(C) There is sufficient evidence at the 0.05 level, but not at the 0.01 level, that the number of admissions on each day is not the same.

(D) There is sufficient evidence at the 0.10 level, but not at the 0.05 level, that the number of admissions on each day is not the same.

(E) There is not sufficient evidence to say that the number of admissions on each day is not the same.

12. A random sample of 100 men was cross-classified by heart disease and baldness. The table below summarizes the tallies.

	No Baldness	Some Baldness	Extreme Baldness
Heart Disease	120	85	38
Healthy	256	51	5

Which of the procedures below is most appropriate to investigate whether there is an association between heart disease and baldness?

(A) Two-sample t-test of the difference between population means

(B) Two-sample z-test of the difference between population proportions

(C) Matched pair t-test

(D) Chi-square goodness-of-fit test

(E) Chi-square test of independence

13. An electronics store sales representative believes men and women have different preferences with regard to TV sizes. To test his belief, he shows models of four different TVs with different sizes to a random sample of 80 men and a random sample of 70 women. He plans to use a chi-square test of homogeneity. Assuming that conditions for inference are met, which of the following is a true statement?

(A) The test is not valid because the sample sizes are different.

(B) The test would be more appropriate if 75 married couples had been used.

(C) Given the number of choices, four, the sample sizes are too small for a test of homogeneity of proportions.

(D) The null hypothesis is that the proportion of each gender who prefer each TV is $\frac{1}{4}$.

(E) The more that men and women differ in their TV preferences, the larger the chi-square statistic will be.

14. A highway engineer claims that the four highways leading into a city are used in the ratio 3:2:3:4 during the morning rush hour. A study involving a simple random sample (SRS) of 3,600 cars counted 920, 570, 700, and 1,410 cars using the four highways, respectively. What is the P-value for the appropriate test?

(A) $P\left(\dfrac{(920-900)^2}{920} + \dfrac{(570-600)^2}{570} + \dfrac{(700-900)^2}{700} + \dfrac{(1410-1200)^2}{1410} \right)$ with df = 3

(B) $P\left(\dfrac{(920-900)^2}{920} + \dfrac{(570-600)^2}{570} + \dfrac{(700-900)^2}{700} + \dfrac{(1410-1200)^2}{1410} \right)$ with df = 4

(C) $P\left(\dfrac{(920-900)^2}{900} + \dfrac{(570-600)^2}{600} + \dfrac{(700-900)^2}{900} + \dfrac{(1410-1200)^2}{1200} \right)$ with df = 3

(D) $P\left(\dfrac{(920-900)^2}{900} + \dfrac{(570-600)^2}{600} + \dfrac{(700-900)^2}{900} + \dfrac{(1410-1200)^2}{1200} \right)$ with df = 4

(E) $P\left(\dfrac{(920-900)^2}{900} + \dfrac{(570-600)^2}{900} + \dfrac{(700-900)^2}{900} + \dfrac{(1410-1200)^2}{900} \right)$ with df = 3

15. In a random sample of 920 college students, all were surveyed as to whether they had parlor tattoos, tattoos from elsewhere, or no tattoos. Then all were tested for hepatitis C. The data are displayed in the table below.

	Parlor Tattoo	Nonparlor Tattoo	No Tattoo
Hepatitis C	24	11	32
Healthy	37	52	764

In a test of independence, which of the following is used as an expected cell count for healthy students with no tattoo?

(A) 764

(B) $\frac{1}{6}(920)$

(C) $\frac{1}{2}(32 + 764)$

(D) $\frac{1}{3}(37 + 52 + 764)$

(E) $\frac{(37 + 52 + 764)(32 + 764)}{920}$

16. It is hypothesized that scores on a certain intelligence test are normally distributed with a mean of 100 and a standard deviation of 15. A psychologist runs a goodness-of-fit test on a simple random sample (SRS) of 200 scores, which results in the table below.

Score	Below 85	85–100	100–115	Above 115
Number of People	21	84	67	28

What is the χ^2 statistic for this test?

(A) $\dfrac{(21-32)^2}{21} + \dfrac{(84-68)^2}{84} + \dfrac{(67-68)^2}{67} + \dfrac{(28-32)^2}{28}$

(B) $\dfrac{(21-32)^2}{32} + \dfrac{(84-68)^2}{68} + \dfrac{(67-68)^2}{68} + \dfrac{(28-32)^2}{32}$

(C) $\dfrac{(21-50)^2}{50} + \dfrac{(84-50)^2}{50} + \dfrac{(67-50)^2}{50} + \dfrac{(28-50)^2}{50}$

(D) $\dfrac{(21-50)^2}{21} + \dfrac{(84-50)^2}{84} + \dfrac{(67-50)^2}{67} + \dfrac{(28-50)^2}{28}$

(E) $\dfrac{(21-50)^2}{32} + \dfrac{(84-50)^2}{68} + \dfrac{(67-50)^2}{68} + \dfrac{(28-50)^2}{32}$

17. A small study was made to investigate whether police searches of stopped vehicles are independent of the driver's race. The data counts for one day are summarized in the table below.

	White	Black	Other	Total
Yes	4	8	11	23
No	26	15	4	45
Total	30	23	15	68

A chi-square test of independence gives $\chi^2 = 16.1$ and a P-value of 0.00032. Which of the following is a correct statement?

(A) The degrees of freedom are $(3 - 1)(4 - 1)$.

(B) The chi-square test should not have been used because two of the cells are less than 5.

(C) The null hypothesis states that there is an association between whether police search a stopped vehicle and the driver's race.

(D) The very small P-value suggests that there is an association between whether police search a stopped vehicle and the driver's race.

(E) The chi-square test shows that police treat different races differently.

18. An ice cream distributor wants to know if adults and children prefer the same flavors of ice cream. A random sample of 100 adults and an independent random sample of 100 children are surveyed as to ice cream preferences. The data are shown in the table below.

	Vanilla	Chocolate	Strawberry	Coffee	Cookie Dough
Adults	25	20	15	35	5
Children	20	25	25	0	30

Which of the following procedures would be most appropriate to investigate whether there is a relationship between adults/children and ice cream flavor preference?

(A) Chi-square test of independence

(B) Chi-square test of homogeneity

(C) Chi-square test of goodness-of-fit

(D) Two-sample t-test

(E) Matched pairs t-test

19. A restaurant receives two food deliveries per day, and timeliness is critical. The restaurant manager tabulates the number of on-time deliveries for a random sample of 200 days, as shown in the table.

Number of On-Time Deliveries	0	1	2
Observed Number of Days	12	75	113

What is the χ^2 statistic for a goodness-of-fit test that the distribution is binomial with the probability equal to 0.8 that a delivery is on time?

(A) $\dfrac{(12-8)^2}{8} + \dfrac{(75-64)^2}{64} + \dfrac{(113-128)^2}{128}$

(B) $\dfrac{(12-8)^2}{12} + \dfrac{(75-64)^2}{75} + \dfrac{(113-128)^2}{113}$

(C) $\dfrac{(12-10)^2}{10} + \dfrac{(75-30)^2}{30} + \dfrac{(113-160)^2}{160}$

(D) $\dfrac{(12-10)^2}{12} + \dfrac{(75-30)^2}{75} + \dfrac{(113-160)^2}{113}$

(E) $\dfrac{(12-66)^2}{12} + \dfrac{(75-67)^2}{75} + \dfrac{(113-67)^2}{113}$

20. One survey of what middle school and high school students enjoy reading listed the top four choices as fantasy, science fiction, horror, and fairy tales. To test whether middle school and high school students make similar choices, independent random samples are taken from each group of students. Each student is asked what he/she enjoys reading most among the choices: fantasy, science fiction, horror, fairy tales, or other. A chi-square test of homogeneity is performed, and the resulting P-value is below 0.05. Which of the following is a proper conclusion?

(A) There is sufficient evidence that for all five choices, the proportion of middle school students who prefer each choice is equal to the corresponding proportion of high school students.

(B) There is sufficient evidence that the proportion of middle school students who prefer science fiction is different from the proportion of high school students who prefer science fiction.

(C) There is sufficient evidence that for all five choices, the proportion of middle school students who prefer each choice is different from the corresponding proportion of high school students.

(D) There is sufficient evidence that for at least one of the five choices, the proportion of middle school students who prefer that choice is equal to the corresponding proportion of high school students.

(E) There is sufficient evidence that for at least one of the five choices, the proportion of middle school students who prefer that choice is different from the corresponding proportion of high school students.