

Chapter 11 AP[®] Statistics Practice Test

Section I: Multiple Choice *Select the best answer for each question.*

T11.1 A chi-square test is used to test whether a 0 to 9 spinner is “fair” (that is, the outcomes are all equally likely). The spinner is spun 100 times, and the results are recorded. The degrees of freedom for the test will be

- (a) 8. (b) 9. (c) 10. (d) 99. (e) None of these.

Exercises T11.2 and T11.3 refer to the following setting. Recent revenue shortfalls in a midwestern state led to a reduction in the state budget for higher education. To offset the reduction, the largest state university proposed a 25% tuition increase. It was determined that such an increase was needed simply to compensate for the lost support from the state. Separate random samples of 50 freshmen, 50 sophomores, 50 juniors, and 50 seniors from the university were asked whether they were strongly opposed to the increase, given that it was the minimum increase necessary to maintain the university’s budget at current levels. Here are the results.

Strongly Opposed?	Year			
	Freshman	Sophomore	Junior	Senior
Yes	39	36	29	18
No	11	14	21	32

T11.2 Which hypotheses would be appropriate for performing a chi-square test?

- The null hypothesis is that the closer students get to graduation, the less likely they are to be opposed to tuition increases. The alternative is that how close students are to graduation makes no difference in their opinion.
- The null hypothesis is that the mean number of students who are strongly opposed is the same for each of the 4 years. The alternative is that the mean is different for at least 2 of the 4 years.
- The null hypothesis is that the distribution of student opinion about the proposed tuition increase is the same for each of the 4 years at this university. The alternative is that the distribution is different for at least 2 of the 4 years.
- The null hypothesis is that year in school and student opinion about the tuition increase in the sample are independent. The alternative is that these variables are dependent.
- The null hypothesis is that there is an association between year in school and opinion about the tuition increase at this university. The alternative hypothesis is that these variables are not associated.

T11.3 The conditions for carrying out the chi-square test in exercise T11.2 are

- Independent random samples from the populations of interest.

II. All expected counts are at least 5.

III. The population sizes are at least 10 times the sample sizes.

Which of the conditions is (are) satisfied in this case?

- I only
- II only
- I and II only
- II and III only
- I, II, and III

Exercises T11.4 to T11.6 refer to the following setting. A random sample of traffic tickets given to motorists in a large city is examined. The tickets are classified according to the race of the driver. The results are summarized in the following table.

Race:	White	Black	Hispanic	Other
Number of tickets:	69	52	18	9

The proportion of this city’s population in each of the racial categories listed above is as follows:

Race:	White	Black	Hispanic	Other
Proportion:	0.55	0.30	0.08	0.07

We wish to test H_0 : The racial distribution of traffic tickets in the city is the same as the racial distribution of the city’s population.

T11.4 Assuming H_0 is true, the expected number of Hispanic drivers who would receive a ticket is

- 8.
- 10.36.
- 11.
- 11.84.
- 12.

T11.5 We compute the value of the χ^2 statistic to be 6.58. Assuming that the conditions for inference are met, the P -value of our test is

- greater than 0.20.
- between 0.10 and 0.20.
- between 0.05 and 0.10.
- between 0.01 and 0.05.
- less than 0.01.

T11.6 The category that contributes the largest component to the χ^2 statistic is

- White.
- Black.
- Hispanic.
- Other.
- The answer cannot be determined because this is only a sample.

Exercises T11.7 to T11.10 refer to the following setting. All current-carrying wires produce electromagnetic (EM) radiation, including the electrical wiring running into, through, and out of our homes. High-frequency EM radiation is thought to be a cause of cancer. The lower frequencies associated with household current are generally assumed to be harmless. To investigate the relationship between current configuration and type of cancer, researchers visited the addresses of a random sample of children who had died of some form of cancer (leukemia, lymphoma, or some other type) and classified the wiring configuration outside the dwelling as either a high-current configuration (HCC) or a low-current configuration (LCC). Here are the data:

	Leukemia	Lymphoma	Other cancers
HCC	52	10	17
LCC	84	21	31

Computer software was used to analyze the data. The output included the value $\chi^2 = 0.435$.

T11.7 The appropriate degrees of freedom for the χ^2 statistic is

- (a) 1. (b) 2. (c) 3. (d) 4. (e) 5.

T11.8 The expected count of cases with lymphoma in homes with an HCC is

- (a) $\frac{79 \cdot 31}{215}$ (b) $\frac{10 \cdot 21}{215}$ (c) $\frac{79 \cdot 31}{10}$ (d) $\frac{136 \cdot 31}{215}$
(e) None of these.

T11.9 Which of the following may we conclude, based on the test results?

- (a) There is convincing evidence of an association between wiring configuration and the chance that a child will develop some form of cancer.
(b) HCC either causes cancer directly or is a major contributing factor to the development of cancer in children.

Section II: Free Response Show all your work. Indicate clearly the methods you use, because you will be graded on the correctness of your methods as well as on the accuracy and completeness of your results and explanations.

T11.11 A large distributor of gasoline claims that 60% of all cars stopping at their service stations choose regular unleaded gas and that premium and supreme are each selected 20% of the time. To investigate this claim, researchers collected data from a random sample of drivers who put gas in their vehicles at the distributor's service stations in a large city. The results were as follows:

	Gasoline Selected		
	Regular	Premium	Supreme
	261	51	88

Carry out a test of the distributor's claim at the 5% significance level.

T11.12 A study conducted in Charlotte, North Carolina, tested the effectiveness of three police responses to spouse abuse: (1) advise and possibly separate the couple, (2) issue a citation to the offender, and (3) arrest the offender. Police officers were trained to recognize eligible cases. When presented with an eligible case, a police officer called the dispatcher, who would randomly assign one of the three available treatments to be administered. There were a total of 650 cases in the study. Each case was classified according to

	Treatment		
	Advise and separate	Citation	Arrest
Subsequent arrest?			
No	187	181	175
Yes	25	43	39

(c) Leukemia is the most common type of cancer among children.

(d) There is not convincing evidence of an association between wiring configuration and the type of cancer that caused the deaths of children in the study.

(e) There is convincing evidence that HCC does not cause cancer in children.

T11.10 A Type I error would occur if we found convincing evidence that

- (a) HCC wiring caused cancer when it actually didn't.
(b) HCC wiring didn't cause cancer when it actually did.

(c) there is no association between the type of wiring and the form of cancer when there actually is an association.

(d) there is an association between the type of wiring and the form of cancer when there actually is no association.

(e) the type of wiring and the form of cancer have a positive correlation when they actually don't.

whether the abuser was subsequently arrested within six months of the original incident.³⁵

(a) Explain the purpose of the random assignment in the design of this study.

(b) Construct a well-labeled graph that is suitable for comparing the effectiveness of the three treatments.

(c) State an appropriate pair of hypotheses for performing a chi-square test in this setting.

(d) Assume that all the conditions for performing the test in part (b) are met. The test yields $\chi^2 = 5.063$ and a P-value of 0.0796. Interpret this P-value in context. What conclusion should we draw from the study?

T11.13 In the United States, there is a strong relationship between education and smoking: well-educated people are less likely to smoke. Does a similar relationship hold in France? To find out, researchers recorded the level of education and smoking status of a random sample of 459 French men aged 20 to 60 years.³⁶ The two-way table below displays the data.

Smoking Status	Education		
	Primary School	Secondary School	University
Nonsmoker	56	37	53
Former	54	43	28
Moderate	41	27	36
Heavy	36	32	16

Is there convincing evidence of an association between smoking status and educational level among French men aged 20 to 60 years?

Two more problems:

36. **Going Nuts** The UR Nuts Company sells Deluxe and Premium nut mixes, both of which contain only cashews, brazil nuts, almonds, and peanuts. The Premium nuts are much more expensive than the Deluxe nuts. A consumer group suspects that the two nut mixes are really the same. To find out, the group took separate random samples of 20 pounds of each nut mix and recorded the weights of each type of nut in the sample. Here are the data:¹⁸

Type of nut	Type of mix	
	Premium	Deluxe
Cashew	6 lb	5 lb
Brazil nut	3 lb	4 lb
Almond	5 lb	6 lb
Peanut	6 lb	5 lb

Explain why we can't use a chi-square test to determine whether these two distributions differ significantly.

1.

UNDERSTANDING Canada has universal health care. The United States does not but often offers more elaborate treatment to patients with access. How do the two systems compare in treating heart attacks? Researchers compared random samples of U.S. and Canadian heart attack patients. One key outcome was the patients' own assessment of their quality of life relative to what it had been before the heart attack. Here are the data for the patients who survived a year:

Quality of life	Canada	United States
Much better	75	541
Somewhat better	71	498
About the same	96	779
Somewhat worse	50	282
Much worse	19	65
Total	311	2165

- Construct an appropriate graph to compare the distributions of opinion about quality of life among heart attack patients in Canada and the United States.
 - Is there a significant difference between the two distributions of quality-of-life ratings? Carry out an appropriate test at the $\alpha = 0.01$ level.
- 2.