

Statistics

Review questions for Test-3

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Find the margin of error for the given confidence interval.

- 1) A survey found that 89% of a random sample of 1024 American adults approved of cloning endangered animals. Find the margin of error for this survey if we want 90% confidence in our estimate of the percent of American adults who approve of cloning endangered animals.

Provide an appropriate response.

- 2) A mayoral election race is tightly contested. In a random sample of 1000 likely voters, 520 said that they were planning to vote for the current mayor. Based on this sample, would you claim that the mayor will win a majority of the votes? Explain.

Write the null and alternative hypotheses you would use to test the following situation.

- 3) 3% of trucks of a certain model have needed new engines after being driven between 0 and 100 miles. The manufacturer hopes that the redesign of one of the engine's components has solved this problem.

Provide an appropriate response.

- 4) The seller of a loaded die claims that it will favor the outcome 5. We don't believe that claim, and roll the die 300 times to test an appropriate hypothesis. Our P-value turns out to be 0.02. Provide an appropriate conclusion.
- 5) A newspaper is considering the launch of an online edition. The newspaper plans to go ahead only if it's convinced that at least 40% of current readers would subscribe. The newspaper contacts a simple random sample of 1500 current subscribers, and 610 of those surveyed expressed interest. What should the company do? Test an appropriate hypothesis and state your conclusion. Be sure the appropriate assumptions and conditions are satisfied before you proceed.

Create a 95% confidence interval for the given data.

- 6) Data in 1980 showed that about 50% of the adult population had never smoked cigarettes. In 2004, a national health survey interviewed a random sample of 6000 adults and found that 55% had never been smokers. Create a 95% confidence interval for the proportion of adults (in 2004) who had never been smokers.

Provide the appropriate response.

- 7) A Math professor has observed over several years that about 38% of the students who initially major in Math drop out of the program after their freshman year. The department head suggested making the curriculum easier by taking a couple of 300 level courses out of the requirements. With the new curriculum intact, 207 began their freshman year as Math majors and only 59 dropped out of the program. Should the college continue with the easier curriculum? Support your recommendation with an appropriate test. Explain carefully what your P-value means in this context.

Researchers conduct a study to test a potential side effect of a new allergy medication. A random sample of 160 subjects with allergies was selected for the study. The new "improved" Brand I medication was randomly assigned to 80 subjects, and the current Brand C medication was randomly assigned to the other 80 subjects. 14 of the 80 patients with Brand I reported drowsiness, and 22 of the 80 patients with Brand C reported drowsiness.

- 8) Compute a 95% confidence interval for the difference in proportions of subjects reporting drowsiness. Show all steps.

- 9) Does the interval in question 1 provide evidence that the side effect of drowsiness is different with the new medication?

A statistics professor asked her students whether or not they were registered to vote. In a sample of 50 of her students (randomly sampled from her 700 students), 35 said they were registered to vote.

- 10) Find a 95% confidence interval for the true proportion of the professor's students who were registered to vote. (Make sure to check any necessary conditions and to state a conclusion in the context of the problem.)
- 11) Explain what 95% confidence means in this context.
- 12) According to a September 2004 Gallup poll, about 73% of 18- to 29-year-olds said that they were registered to vote. Does the 73% figure from Gallup seem reasonable for the professor's class? Explain.
- 13) If the professor only knew the information from the September 2004 Gallup poll and wanted to estimate the percentage of her students who were registered to vote to within $\pm 4\%$ with 95% confidence, how many students should she sample?

Answer Key

Testname: REVIEWTEST-3FALL12(H)

- 1) 1.61%
- 2) No; in the sample 52% said that they were planning to vote for the current mayor however the margin of error (with 95% confidence) is greater than 2% (it is 3.2 percentage points) so we cannot be 95% confident that the mayor will win more than 50% of the votes. The 95% confidence interval for the population proportion includes some values smaller than 50%.
- 3) $H_0: p = 0.03$
 $H_A: p < 0.03$
- 4) There's a 2% chance that a fair die could randomly produce the results we observed, so it's reasonable to conclude that the die is loaded.
- 5) $H_0: p = 0.40$; $H_A: p > 0.40$; $p > 0.30$; Sample is less than 10% of all potential subscribers; $(0.40)(1500) > 10$; $z = 0.53$; $P\text{-value} = 0.2991$. This data does not show that more than 40% of current readers would subscribe; the company should not go ahead with the online site.
- 6) Based on the data, we are 95% confident the proportion of adults in 2004 who had never smoked cigarettes is between 53.7% and 56.3%.
- 7) $z = -2.82$, $p = 0.0024$. The change is statistically significant. A 95% confidence interval is (22.4%, 34.7%). This is clearly lower than 38%. The chance of observing 59 or fewer dropouts in a class of 207 is only 0.24% if the dropout rate is really 38%.
- 8) Conditions:
 - * Randomization Condition: The treatments were randomly assigned to subjects.
 - * 10% Condition: The subjects were randomly selected. We assume it is from a large population of allergy sufferers.
 - * Independent samples condition: The two groups are independent of each other because the treatments were assigned at random.
 - * Success/Failure Condition: For Brand C, 22 were drowsy and 58 were not. For Brand I, 14 were drowsy and 66 were not. The observed number of both successes and failures in both groups is larger than 10.

Because the conditions are satisfied, we can model the sampling distribution of the difference in proportions with a Normal model.

We know: $n_I = 80$, $\hat{p}_I = 0.175$, $n_C = 80$, $\hat{p}_C = 0.275$

We estimate $SD(\hat{p}_C - \hat{p}_I)$ as

$$SE(\hat{p}_C - \hat{p}_I) = \sqrt{\frac{\hat{p}_C \hat{q}_C}{n_C} + \frac{\hat{p}_I \hat{q}_I}{n_I}} = \sqrt{\frac{(0.275)(0.725)}{80} + \frac{(0.175)(0.825)}{80}} = 0.066$$

$$ME = z^* \times SE(\hat{p}_C - \hat{p}_I) = 1.96(0.066) = 0.128$$

The observed difference in sample proportions = $\hat{p}_C - \hat{p}_I = 0.275 - 0.175 = 0.10$, so the 95% confidence interval is 0.10 ± 0.128 , or $(-0.028, 0.228)$

We are 95% confident that the difference between the population proportions of patients that reported drowsiness for Brand C and Brand I is between -2.8% and 22.8%.

- 9) There is not sufficient evidence because 0 is contained in the interval. There may be no difference in the proportion of drowsiness reported.

Answer Key

Testname: REVIEWTEST-3FALL12(H)

- 10) We have a random sample of less than 10% of the professor's students, with 35 expected successes (registered) and 15 expected failures (not registered), so a Normal model applies.

$$n = 50, \hat{p} = \frac{35}{50} = 0.70, \hat{q} = 1 - \hat{p} = 0.30, \text{ so } SE(\hat{p}) = \sqrt{\frac{\hat{p}\hat{q}}{n}} = \sqrt{\frac{(0.70)(0.30)}{50}} = 0.065$$

Our 95% confidence interval is:

$$\hat{p} \pm z^* SE(\hat{p}) = 0.70 \pm 1.96(0.065) = 0.70 \pm 0.127 = 0.573 \text{ to } 0.827$$

We are 95% confident that between 57.3% and 82.7% of the professor's students are registered to vote.

- 11) If many random samples were taken, 95% of the confidence intervals produced would contain the actual percentage of the professor's students who are registered to vote.
12) The 73% figure from Gallup seems reasonable since 73% lies in our confidence interval.

13) $ME = z^* \sqrt{\frac{pq}{n}}$

$$0.04 = 1.96 \sqrt{\frac{(0.73)(0.27)}{n}}$$

$$n = \frac{(1.96)^2(0.73)(0.27)}{(0.04)^2} = 473.24 \Rightarrow n = 474$$

Note: Since there are only 700 students in the professor's class, she cannot sample this many students without violating the 10% condition!