1. Which of the following is **not** required for the distribution of the sample **proportion** to be nearly normal?

- ○ There should be at least 10 failures.
- ◉ Sample size should be at least 30 and the population distribution should not be extremely skewed.
- ○ Observations should be independent.
- ○ There should be at least 10 successes.

2. When checking conditions for calculating a confidence interval for a proportion, you should use which number of successes and failures?

- ○ Expected (based on the null value)
- ○ Depends on the context
- ○ Not applicable. The number of successes and failures (observed or otherwise) is not part of the conditions required for calculating a confidence interval for a proportion.
- ◉ Observed

✓ **Correct**

For confidence intervals use $\hat{p}$ (observed sample proportion) when calculating the standard error and checking the success/failure condition. For hypothesis tests use p_0 (null value) when calculating the standard error and checking the success/failure condition.

Use the observed number of successes and failures when calculating a confidence interval for a proportion, but not when doing a hypothesis test. In a hypothesis test for a proportion, you should use $np0$ and $n(1 - p_0)$ successes and failures; that is, the expected number based on the **null proportion**.

3. In May 2011, Gallup asked 1,721 students in grades five through twelve if their school teaches them about money and banking. Researchers are interested in finding out if a majority of students receive such education. Which of the following is the correct set of hypotheses?

- $H_0 : \mu = 0.5$; $H_A : \mu > 0.5$
- $H_0 : p = 0.5$; $H_A : p > 0.5$
- $H_0 : p < 0.5$; $H_A : p > 0.5$
- $H_0 : \hat{p} = 0.5$; $H_A : \hat{p} \neq 0.5$

✓ **Correct**

This question revisits the setup of hypothesis testing within the categorical data / proportions.

The wording of the question tells us we're interested in whether the true proportion of students receiving this education is greater than 50% (i.e. makes them "a majority").

4. The campaign manager for a congressional candidate claims that the candidate has **more than** 50% support from the district's electorate. A newspaper collects a simple random sample of 500 likely voters in this district and estimates the support for this candidate to be 52%. The p-value for the hypothesis test evaluating the campaign manager's claim is 0.19. Which of the below is **correct**?

- 95% of random samples of size 500 will estimate the support for this candidate to be 52%.
- The data provide convincing evidence for the campaign manager's claim.
- The success-failure condition is not met, so this p-value is not reliable.
- If in fact 50% of likely voters support this candidate, the probability of obtaining a random sample of 500 likely voters where 52% or more support the candidate is 0.19.

✓ **Correct**

p-value = P(observed or more extreme test statistic | H_0 true)

5. Voters in the U.S. state of New Jersey voted on a measure that would legalize sports betting. Before the vote, SurveyUSA asked a random sample of registered voters the following question: "'If betting on sports were to become legal in New Jersey, would you yourself place bets?" The distribution of responses by age group is shown in the table below. Consider a hypothesis test evaluating whether there is a difference between proportions of 18 to 34 year olds and 35+ year olds who would never place bets. Using the information from the table, calculate the standard error for this hypothesis test. Choose the closest answer.

		age group		
		18 to 34	35+	total
response	regularly	3	30	33
	occasionally	69	128	197
	never	71	224	295
	not sure	1	7	8
	total	144	389	533

- 0.5758
- 0.0485
- 0.0024
- 0.5535
- 0.4931

6. To evaluate the following hypotheses

$H_0 : p = 0.3$

$H_A : p \neq 0.3$

we use a random sample of 50 observations where $\hat{p} = 0.36$. Which of the following is the correct standard error? Choose the closest answer.

- 0.0297
- 0.0648
- 0.0042
- 0.0679
- 0.0092
- 0.0096

7. At the beginning of a semester an anonymous survey was conducted on students in a statistics class. Two of the questions on the survey were about gender and whether or not students have equal, more, or less energy in the afternoon compared to the morning. Below are the results.

	Equal	Less	More
Female	18	37	24
Male	9	15	24

What test should we perform to see if gender and energy level are associated?

- ○ Z test
- ○ ANOVA
- ◉ Chi-square test of independence
- ○ F test
- ○ Chi-square test of goodness of fit
- ○ hypothesis test for a single mean
- ○ Comparing two proportions
- ○ Comparing two means

8. A variety of studies suggest that 10% of the world population is left-handed. It is also claimed that artists are more likely to be left-handed. In order to test this claim we take a random sample of 40 art students at a college and find that 6 of them (15%) are left handed. Which of the following is the correct set-up for calculating the p-value for this test?

- ○ Randomly sample 40 non-art students, and record the number of left-handed students in the sample. Repeat this many times and calculate the proportion of samples where at least 15% of the students are left-handed.
- ◉ In a bag place 40 chips, 6 red and 34 blue. Randomly sample 40 chips, with replacement, and record the proportion of red chips in the sample. Repeat this many times, and calculate the proportion of samples where at least 10% of the chips are red.
- ○ Roll a 10-sided die 40 times and record the proportion of times you get a 1. Repeat this many times, and calculate the proportion of simulations where the sample proportion is 10% or more.
- ○ Roll a 10-sided die 40 times and record the proportion of times you get a 1. Repeat this many times, and calculate the proportion of simulations where the sample proportion is 15% or more.

! **Incorrect**

The question refers to the following learning objective(s):

In hypothesis testing for one categorical variable, generate simulated samples based on the null hypothesis, and then calculate the number of samples that are at least as extreme as the observed data.

The chips in the bag should represent the null hypothesis (10% red chips) rather than the observed data (15% red chips).

9. One of the early studies linking smoking and lung cancer compared patients hospitalized with lung cancer to similar patients without lung cancer (hospitalized for other reasons), and recorded whether each patient smoked. For a hypothesis test testing whether the proportion of smokers is higher for the patients with lung cancer than for patients without lung cancer, the p-value is less than 0.000001. Does this provide significant evidence that smoking causes lung cancer?

		smoking status		
		smoker	non-smoker	total
cancer	lung cancer	647	2	649
	not sure	622	27	649
	total	1269	29	1298

Study reference: Doll, R. & Hill, A.B. (1950) "Smoking and carcinoma of the lung: preliminary report", *British Medical Journal.*

- ○ Yes, with the given p-value we would reject H0 in favor of HA, and conclude that smoking causes lung cancer.
- ○ No, with the given p-value we would fail to reject H0 in favor of HA.
- ○ Whether or not we can conclude that smoking causes lung cancer depends on the statistical method the researchers used to obtain the p-value.
- ◉ Based on this study we cannot conclude that smoking causes lung cancer,

  regardless of the p-value.

10. 80% of Americans start the day with a cereal breakfast. Based on this information, determine if the following statement is true or false.

"The sampling distribution of the proportions of Americans who start the day with a cereal breakfast in random samples of size 40 is right skewed."

- ○ True
- ◉ False

✓ **Correct**

The question refers to the following learning objective(s):

Note that if the CLT doesn't apply and the sample proportion is low (close to 0) the sampling distribution will likely be right skewed, if the sample proportion is high (close to 1) the sampling distribution will likely be left skewed.

S-F condition not met, and the true population is closer to 1 than 0, so the sampling distribution will be left skewed.

11. At a stop sign, some drivers come to a full stop, some come to a 'rolling stop' (not a full stop, but slow down), and some do not stop at all. We would like to test if there is an association between gender and type of stop (full, rolling, or no stop). We collect data by standing a few feet from a stop sign and taking note of type of stop and the gender of the driver. Below is a contingency table summarizing the data we collected. If gender is not associated with type of stop, how many males would we expect to not stop at all? Choose the closest answer.

		gender	
		female	male
stop	full stop	6	6
	rolling stop	16	15
	no stop	4	3

- 5.76
- 6.24
- 3.64
- 3.36 (selected)

✓ **Correct**

Calculate expected counts in two-way tables as

$$E = \frac{rowtotal \times columntotal}{grandtotal}$$

12. We would like to test the following hypotheses

H_0 :p = 0.05

H_A :p < 0.05

The sample size is 150 and the sample proportion is 8%, i.e. $\hat{p}$ = 0.08. Which of the below is the correct test for this situation?

- t-test for a mean
- z-test for comparing two proportions
- chi-square test of independence
- z-test for a proportion (selected)
- randomization test for a proportion

! **Incorrect**