MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1. In a large statistics class, the professor has each student toss a coin 12 times and calculate the proportion of tosses that come up tails. The students then report their results, and the professor plots a histogram of these several proportions. May a Normal model be used here?

   A. A Normal model may be used:
   Coin flips are independent of each other - no need to check the 10% condition
   Success/Failure condition is satisfied: np = nq = 12 which are both greater than 10
   
   B. A Normal model may be used:
   Coin flips are independent of each other - no need to check the 10% condition
   Success/Failure condition is satisfied: np = nq = 6 which are both less than 10
   
   C. A Normal model should not be used because the 10% condition is not satisfied: the sample size, 12, is larger than 10% of the population of all coin flips.
   
   D. A Normal model should not be used because the sample size is not large enough to satisfy the success/failure condition. For this sample size, np = 6 = nq = 6 which are both less than 10.
   
   E. A Normal model may not be used because the population distribution is not Normal.

2. A candy company claims that 25% of the jelly beans in its spring mix are pink. Suppose that the candies are packaged at random in small bags containing about 300 jelly beans. A class of students opens several bags, counts the various colors of jelly beans, and calculates the proportion that are pink in each bag. Is it appropriate to use a Normal model to describe the distribution of the proportion of pink jelly beans?

   A. A Normal model is not appropriate because the 10% condition is not satisfied: the sample size, 300, is larger than 10% of the population of all jelly beans.
   
   B. A Normal model is appropriate:
   Randomization condition is satisfied: the 300 jelly beans in the bag are selected at random and can be considered representative of all jelly beans
   10% condition is satisfied: the sample size, 300, is less than 10% of the population of all jelly beans.
   success/failure condition is satisfied: np = 75 and nq = 225 are both greater than 10
   
   C. A Normal model is not appropriate because the population distribution is not Normal.
   
   D. A Normal model is not appropriate because the randomization condition is not satisfied: the 300 jelly beans in the bag are not a simple random sample and cannot be considered representative of all jelly beans.
   
   E. A Normal model is not appropriate because the success/failure condition is not satisfied: np = 75 and nq = 225 neither of which is less than 10
4. Assume that 25% of students at a university wear contact lenses. We randomly pick 200 students. Find the mean of the sample proportion.

4% = 50%  B. 4% = 3.6%  C. 4% = 25%  D. 4% = 12.5%  E. 4% = 7.0%

5. Based on past experience, a bank believes that 5% of the people who receive loans will not make payments on time. The bank has recently approved 300 loans. What is the standard deviation of the proportion of defaults?

\[ \sigma = \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \]

\[ \hat{p} = 0.05 \]

\[ n = 300 \]

\[ \sigma = \sqrt{\frac{0.05(1-0.05)}{300}} \]

\[ \sigma \approx 0.017 \]

3. A health worker believes that 10% of students at a certain college suffer from depression. She sets up a booth outside the student union building and selects 100 students at random from those passing by.

10% condition is satisfied. The 100 students are less than 10% of all students at the college.

A Normal model may not be used to describe the distribution of sample proportions.

B. Normal model may be used to describe the distribution of sample proportions.

C. Normal model may be used to describe the distribution of sample proportions.

D. Normal model may not be used to describe the distribution of sample proportions.

E. Normal model is not normal.

Success/failure condition is satisfied. np = 10 and nq = 90 are both greater than 10.

Normal model may be used to describe the distribution of sample proportions.

Randomization condition is satisfied. The students were selected at random and are therefore a simple random sample from the population of all students at the college.

Randomization condition is not satisfied. The 100 students are not a simple random sample from the student population.

A Normal model may be used to describe the distribution of sample proportions.

B. Normal model may be used to describe the distribution of sample proportions.

C. Normal model may be used to describe the distribution of sample proportions.

D. Normal model may not be used to describe the distribution of sample proportions.

E. Normal model is not normal.
In a large class, the professor has each person toss a coin several times and calculate the proportion of his or her tosses that come up heads. The students then report their results, and the professor plots a histogram of these proportions. Use the 68–95–99.7 Rule to provide the appropriate response.

6. If each student tosses the coin 200 times, about 95% of the sample proportions should be between what two numbers?
A. 0.495 and 0.505
B. 0.2375 and 0.7375
C. 0.025 and 0.975
D. 0.071 and 0.106
E. 0.429 and 0.571

\[ n = 0.50 \pm 1.96 \times \frac{0.50 \times 0.50}{200} = 0.035 \]

57

\[ \sqrt{\frac{150 \times 0.50}{200}} = 0.35 \]

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Find the specified probability, from a table of Normal probabilities. Assume that the necessary conditions and assumptions are met.

7. A candy company claims that its jelly bean mix contains 15% blue jelly beans. Suppose that the candies are packaged at random in small bags containing about 200 jelly beans. What is the probability that a bag will contain more than 10% blue jelly beans?
A. 0.9544
B. 0.0478
C. 0.9227
D. 0.0239
E. 0.9761

\[ n = 0.70 \pm 1.96 \times \frac{0.70 \times 0.30}{200} = 0.08 \]

8. Researchers believe that 7% of children have a gene that may be linked to a certain childhood disease. In an effort to track 50 of these children, researchers test 950 newborns for the presence of this gene. What is the probability that they find enough subjects for their study?
A. 0.0358
B. 0.9216
C. 0.0179
D. 0.9821
E. 0.9581

Answer the question.

9. A national study reported that 74% of high school graduates pursue a college education immediately after graduation. A private high school advertises that 155 of their 196 graduates last year went on to college. Does this school have an unusually high proportion of students going to college?
A. This school can boast an unusually high proportion of students going to college. Their proportion is 1.30 standard deviations above the mean.
B. This school cannot boast an unusually high proportion of students going to college. Their proportion is only 0.97 standard deviations above the mean.
C. This school cannot boast an unusually high proportion of students going to college. Their proportion is only 1.30 standard deviations above the mean.
D. This school can boast an unusually high proportion of students going to college. Their proportion is 2.61 standard deviations above the mean.
E. This school cannot boast an unusually high proportion of students going to college. Their proportion is only 1.62 standard deviations above the mean.

\[ P = 0.74 \]

\[ \frac{155}{196} = 0.79 \]

\[ \frac{0.79 - 0.74}{\sqrt{0.74 \times 0.26 \times \frac{200}{196}}} = 1.8 \]
11. The mean annual income for women in one city is $28,520 and the standard deviation of the incomes is $5600. The distribution of incomes is skewed to the right. Suppose a sample of 12 women is selected at random from the city and the mean income, $\bar{x}$ is determined for the women in the sample. May the Normal model be used to describe the sampling distribution of the mean, $\bar{x}$?

A. Yes, Normal model may be used.
   - **Randomization condition:** The women were selected at random
   - **Independence assumption:** It is reasonable to think that incomes of randomly selected women are mutually independent.
   - **Large enough sample condition:** A sample of 12 is large enough for the Central Limit Theorem to apply
   - **10% condition** is satisfied since the 12 women in the sample certainly represent less than 10% of women in the city

B. No, Normal model may not be used:
   - **10% condition** is not satisfied since the 12 women in the sample represent less than 10% of women in the city

C. No, Normal model may not be used:
   - **Large enough sample condition is not satisfied:** since the distribution of incomes in the original population is skewed, a sample of 12 is not large enough

D. No, Normal model may not be used since incomes of women in the city are not normally distributed but are skewed to the right

E. No, Normal model may not be used:
   - **Independence assumption is not satisfied:** since the women in the sample may live in the same neighborhood, the chance of picking a woman with a high income depends on who has already been selected.

Describe the indicated sampling distribution.

12. The heights of people in a certain population are normally distributed with a mean of 67 inches and a standard deviation of 3.9 inches. Describe the sampling distribution of the mean for samples of size 41. In particular, state whether the distribution of the sample mean is normal or approximately normal and give its mean and standard deviation.

A. Normal, mean = 67 inches, standard deviation = 3.9 inches
B. Approximately normal, mean = 67 inches, standard deviation = 0.61 inches
C. Normal, mean = 67 inches, standard deviation = 0.1 inches
D. Approximately normal, mean = 67 inches, standard deviation = 0.1 inches
E. Normal, mean = 67 inches, standard deviation = 0.61 inches

$$\mu = 67 \quad SD = \frac{3.9}{\sqrt{41}} = .61$$
Find the percentage of error for the given confidence interval.

\[
\frac{0.58}{8000} = 0.072\%
\]

Find the margin of error for the given confidence interval.

\[
\frac{0.99}{800} = 0.0128
\]

Find the standard deviation of a skewed distribution with a skewness of 2. A researcher finds that the cost of customer dinners has a skewed distribution with a skewness of 2. Below is an example of a box plot of a skewed distribution.

A. $2,348.22 and $2,661.78
B. $2,494.11 and $2,561.78
C. $2,348.22 and $2,700
D. $2,494.11 and $2,727.69
E. $2,348.22 and $2,727.69

Find the number of students in a random sample of 250 students at this university, 68% of the students believe that the school cafeteria is decent and inexpensive. Use the sampling distribution of the sample proportion to answer the question about the mean cafeteria cost for the students in this sample.

\[
\frac{1380}{250} = 5.52
\]

\[
\frac{1.58}{1.5} = 1.05
\]

\[
\frac{1.72}{2} = 0.86
\]

\[
\frac{1.98}{1.05} = 1.88
\]
Use the given degree of confidence and sample data to construct a confidence interval for the population proportion.

18. A survey of 865 voters in one state reveals that 408 favor approval of an issue before the legislature. Construct a 95% confidence interval for the percentage of all voters in the state who favor approval.

   A. (43.1%, 51.2%)
   B. (42.3%, 52.0%)
   C. (43.8%, 50.5%)
   D. (46.9%, 47.5%)
   E. (44.4%, 50.0%)

19. A survey of 300 union members in New York State reveals that 112 favor the Republican candidate for governor. Construct a 98% confidence interval for the percentage of all New York State union members who favor the Republican candidate.

   A. (31.9%, 42.8%)
   B. (26.7%, 47.9%)
   C. (30.1%, 44.5%)
   D. (30.8%, 43.8%)
   E. (17.8%, 56.8%)

20. Of 92 adults selected randomly from one town, 60 have health insurance. Construct a 90% confidence interval for the percentage of all adults in the town who have health insurance.

   A. (55.5%, 74.9%)
   B. (52.4%, 78.0%)
   C. (53.6%, 76.8%)
   D. (57.7%, 72.7%)
   E. (57.0%, 73.4%)

21. A study involves 638 randomly selected deaths, with 27 of them caused by accidents. Construct a 98% confidence interval for the percentage of all deaths that are caused by accidents.

   A. (2.18%, 6.29%)
   B. (2.37%, 6.09%)
   C. (2.92%, 5.55%)
   D. (3.0%, 5.4%)
   E. (2.67%, 5.79%)
26. Which is true about a 99% confidence interval for a population proportion based on a given sample?
   A. The interval is wider than a 95% confidence interval.
   B. The interval is narrower than a 95% confidence interval.
   C. The interval contains the population proportion.
   D. None of the above.
   
25. In a survey of 1,000 television viewers, 40% said they watch network news programs. For a 99% confidence level, the margin of error is rounded to the nearest number.
   A. 9%  B. 9.9%  C. 9.8%  D. None of the above.

Provide an appropriate response.

E. Not enough information is given.
D. 99%
C. 98%
B. 99%
A. 96%

Answer: The margin of error for this sample is 3.99%. If we only want to be 99% confident, the margin of error will be smaller.

What is the sample size used in the poll?

A. 121 B. 136 C. 408 D. 436

E. Not enough information is given.

23. A political action committee is interested in finding out what kind of political support they might expect on an environmental initiative. Suppose they have gotten 94% support from the committee. What size sample would be necessary to estimate the proportion of undecided California registered voters with a certain level of confidence and with a certain margin of error?
   A. 399  B. 397  C. 395  D. 399
   
E. Not enough information is given.

22. A researcher wishes to estimate the proportion of adults in a certain lake that is inhabitable due to pollution. How large a sample should be selected in order to be 99% confident that the proportion of adults who are true to the lake. How large a sample should be selected in order to be 99% confident that the proportion of adults who are true to the lake, with a margin of error of ±0.01?
   A. 399  B. 397  C. 395  D. 399

E. Not enough information is given.

21. E. None of the above.
27. Write the null and alternative hypotheses you would use to test the following situation.

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.

A. \( H_0: p = 0.03 \)
   \( H_A: p < 0.03 \)
B. \( H_0: p = 0.03 \)
   \( H_A: p > 0.03 \)
C. \( H_0: p < 0.03 \)
   \( H_A: p = 0.03 \)
D. \( H_0: p = 0.03 \)
   \( H_A: p > 0.03 \)
E. \( H_0: p = 0.03 \)
   \( H_A: p < 0.03 \)

28. A survey investigates whether the proportion of 8% for employees who commute by car to work is higher than it was five years ago. What are the null and alternative hypotheses?

A. \( H_0: p = 0.08 \)
   \( H_A: p > 0.08 \)
B. \( H_0: p = 0.08 \)
   \( H_A: p < 0.08 \)
C. \( H_0: p = 0.08 \)
   \( H_A: p < 0.08 \)
D. \( H_0: p > 0.08 \)
   \( H_A: p < 0.08 \)
E. \( H_0: p < 0.08 \)
   \( H_A: p = 0.08 \)
29. The county health department has concerns about the chlorine level of 0.4 mg/mL at a local water park, increasing to unsafe levels. The water department tests the hypothesis that the local water park’s chlorine proportions have remained the same, and finds a p-value of 0.035. Provide an appropriate conclusion.

A. We can say there is a 0.5% chance of seeing no change in the chlorine proportion in the results we observed from natural sampling variation. There is no evidence of a higher chlorine proportion, but we cannot conclude the chlorine proportion is the same.

B. We can say there is a 0.5% chance of seeing a change in the chlorine proportion.

C. There is only a 0.5% chance of seeing a change in the chlorine proportion in the results we observed from natural sampling variation. We conclude the chlorine proportion is higher.

D. There is only a 0.5% chance of seeing no change in the chlorine proportion.

30. A company hopes to improve its engines, setting a goal of no more than 2% of customers using their warranty on defective engine parts. A random survey of 1400 customers found only 30 with complaints. Create a 95% confidence interval for the true level of warranty users among all customers.

A. Based on the data, we are 95% confident the proportion of warranty users is between 1% and 2.1%.

B. Based on the data, we are 95% confident the proportion of warranty users is between 1% and 3.6%.

C. Based on the data, we are 95% confident the proportion of warranty users is between 0% and 3.6%.

D. Based on the data, we are 95% confident the proportion of warranty users is between 1% and 2.9%.

E. Based on the data, we are 95% confident the proportion of warranty users is between 1% and 2.9%.

Therefore, the company has met its goal.
Explain what the P-value means in the given context.

31. The federal guideline for smog is 12% pollutants per 10,000 volume of air. A metropolitan city is trying to bring its smog level into federal guidelines. The city comes up with a new policy where city employees are to use city transportation to and from work. A local environmental group does not think the city is doing enough and no real decrease will occur. An independent agency, hired by the city, runs its tests and comes up with a P-value of 0.055. What is reasonable to conclude about the new strategy using α = 0.025?

A. There is a 5.5% chance of the new policy having no effect on smog.
B. There is a 94.5% chance of the new policy having no effect on smog.
C. There's only a 5.5% chance of seeing the new policy having no effect on smog in the results we observed from natural sampling variation. We conclude the new policy is more effective.
D. We can say there is a 5.5% chance of seeing the new policy having an effect on smog in the results observed from natural sampling variation. We conclude the new policy is more effective.
E. We can say there is a 5.5% chance of seeing the new policy having no effect on smog in the results observed from natural sampling variation. There is no evidence the new policy is more effective, but we cannot conclude the policy has no effect on smog.

Provide an appropriate response.

32. A psychologist claims that more than 14% of the population suffers from professional problems due to extreme shyness. Identify the Type II error in this context.

A. The error of rejecting the claim that the true proportion is at most 14% when it really is at most 14%.
B. The error of rejecting the claim that the true proportion is more than 14% when it really is more than 14%.
C. The error of failing to accept the claim that the true proportion is at most 14% when it is actually more than 14%.
D. The error of accepting the claim that the true proportion is more than 14% when it really is more than 14%.
E. The error of failing to reject the claim that the true proportion is at most 14% when it is actually more than 14%.

33. A state university wants to increase its retention rate of 4% for graduating students from the previous year. After implementing several new programs during the last two years, the university reevaluated its retention rate. Identify the Type I error in this context.

A. The product of the university's sample size and sample proportion was less than 10.
B. The university concludes that retention is on the rise, but in fact the new programs do not help retention.
C. The university stops all new programs, but in fact retention is on the rise and the programs help.
D. The university sampled all students at the university.
E. The university concludes that retention is on the rise since the retention rate can only increase.
33. A new manager hired at a large warehouse was told to reduce the 26% employee sick leave. The manager introduced a new incentive program for employees with perfect attendance. The manager decided to test the new program to see if it is better. What are the null and alternative hypotheses?

\[ H_0: \pi = 0.26 \]
\[ H_A: \pi > 0.26 \]

34. A skeptical paranormal researcher claims that the proportion of Americans that have seen a UFO is less than 4%.

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

\[ H_0: \pi \geq 0.04 \]
\[ H_A: \pi < 0.04 \]
36. The county health department has concerns about the chlorine level of 0.4% mg/mL at a local water park increasing to unsafe level. The water department tests the hypothesis that the local water park’s chlorine proportions have remained the same. What are the null and alternative hypotheses?

A. $H_0: p = 0.004$
   $H_A: p > 0.004$

B. $H_0: p = 0.004$
   $H_A: p < 0.004$

C. $H_0: p > 0.004$
   $H_A: p = 0.004$

D. $H_0: p = 0.004$
   $H_A: p = 0.004$

E. $H_0: p > 0.004$
   $H_A: p < 0.004$

Provide an appropriate response.

37. A state university wants to increase its retention rate of 4% for graduating students from the previous year. After implementing several new programs during the last two years, the university reevaluated its retention rate using a random sample of 352 students and retained 18 students.

Should the university continue its new programs? Test an appropriate hypothesis using $\alpha = 0.10$ and state your conclusion. Be sure the appropriate assumptions and conditions are satisfied before you proceed.

A. $z = 1.07; P$-value = 0.8577. The change is statistically significant. A 90% confidence interval is (3.4%, 6.8%). This is clearly higher than 4%. The chance of observing 18 or more retained students of 352 is only 85.77% if the dropout rate is really 4%.

B. $z = 1.07; P$-value = 0.2846. The change is statistically significant. A 95% confidence interval is (3.1%, 67.2%). This is clearly lower than 4%. The chance of observing 18 or more retained students of 352 is only 28.46% if the dropout rate is really 4%.

C. $z = 1.07; P$-value = 0.1423. The change is statistically significant. A 98% confidence interval is (2.7%, 7.5%). This is clearly lower than 4%. The chance of observing 18 or more retained students of 352 is only 14.23% if the dropout rate is really 4%.

D. $z = 1.07; P$-value = 0.8577. The university should continue with the new programs. There is an 85.77% chance of having 18 or more of 352 students in a random sample be retained if in fact 4% are retained.

E. $z = 1.07; P$-value = 0.1423. The university should not continue with the new programs. There is a 14.23% chance of having 18 or more of 352 students in a random sample be retained if in fact 4% are retained. The $P$-value of 0.1423 is greater than the alpha level of 0.10.
If we reduce the risk of committing a Type I error, then the risk of a Type II error will also decrease.

II. If we can set a higher standard of proof by choosing \( \alpha \) instead of 5%, we can set a higher standard of proof by choosing \( \alpha \) instead of 5%

III. We are able to test a hypothesis using data from a well-designed study. Which is true?