KEY Hypothesis Testing for a Proportion \( p \) KEY

1. What statements below, if any, are true statements about the \( P \)-value?

   a. The \( P \)-value is the probability that the null hypothesis is false
   b. The \( P \)-value is the probability that the null hypothesis is true
   c. A very high \( P \)-value is strong evidence that the null hypothesis is false.
   d. The \( P \)-value weighs the evidence in the data against the null hypothesis \( H_0 \).
   e. The \( P \)-value is the probability that you've made an error when doing the hypothesis test
   f. A very low \( P \)-value proves that the null hypothesis is false.
   g. The \( P \)-value weighs the evidence in the data against the alternative hypothesis \( H_A \).
   h. If the null hypothesis is true, you can't get a \( P \)-value below 0.01.

2. A report on health care in the United States said that 28% of Americans have experienced times when they haven’t been able to afford medical care. A news organization randomly sampled 801 black Americans, of whom 38% reported that there had been times in the last year when they had not been able to afford medical care. Does this indicate that this problem is more severe among black Americans?

   a. Test an appropriate hypothesis and state your conclusion. (Define the parameter of interest, check any necessary conditions and state a conclusion in the context of the problem.)

   \[ H_0 : p = 0.28. \] The proportion of all black Americans that were unable to afford medical care in the last year is 28%.

   \[ H_A : p > 0.28. \] The proportion of all black Americans that were unable to afford medical care in the last year is greater than 28%.

   check conditions: \( np = (801)(0.28) = 224.28 > 10 \) and \( n(1 - p) = (801)(0.72) = 576.72 > 10 \)
Conclusion: With a P-value so small (barely above zero), reject the null hypothesis. There is evidence to suggest that the proportion of black Americans who were not able to afford medical care in the past year is more than 28%.

b. Explain what your P-value means in the context of the problem.
If the proportion of black Americans that were unable to afford medical care is 28% (that is, $H_0$ is true), then the probability of obtaining the data we observed is extremely small.

3. The Mars Corp. makes M&M’s® chocolate candies. Mars claims that 20% of all regular M&M’s® are orange. Suppose a bag of 122 has only 21 orange ones. Does this support the claim that the percentage is a value different than 20%?

$H_0 : p = .20$
$H_A : p \neq .20$

where $p$ is the proportion of regular M&M's that are orange.

$$\hat{p} = \frac{21}{122} = .17213115 \quad z = -0.76955$$

$P$-value = 0.4416

Conclusion: Since the P-value is large, there is no evidence in the data that leads us to reject the null hypothesis that 20% of M&M's are orange.

4. True or False.

a. If you are using an alpha level of 0.05 (that is, $\alpha = .05$), then a P-value of 0.04 results in rejecting $H_0$. **T**

b. The alpha level depends on the sample size. **F**

c. If you are using an alpha level of 0.01, a P-value of 0.10 results in rejecting $H_0$. **F**

d. If you are using an alpha level of 0.05, a P-value of 0.06 means $H_0$ is true. **F**

e. If the P-value is 0.01, we reject $H_0$ for any alpha level greater than 0.01. **T**

5. In November 2011, Barack Obama's approval rating stood at 45% in Rasmussen's daily tracking poll of 1500 randomly survey adults. Test the hypothesis that Obama's approval rating was worse than his November 2009 approval rating of 50%. Use $\alpha = .05$.

$H_0 : p = .50$
$H_A : p < .50$ where $p$ is the proportion of adults in Nov. 2011 who approve of Obama's performance in office.

rejection region: $z < -1.645$
\[ z = \frac{45 - 50}{\sqrt{\frac{50(0.50(0.50))}{700}}} = -3.87; \text{ since } z \text{ is in the rejection region, reject } H_0. \]

\[ (P-value = P(z < -3.87) < .0001) \]

Reject \( H_0 \); the data indicates that Obama's approval rating among all adults is lower than 50\% in Nov. 2011.