Date _____

In Class Activity

p-Values: Bob and Tim

Activity modified and used with permission from A. Rossman and B. Chance.

Introduction – Facial Prototyping

A study in *Psychonomic Bulletin and Review* (Lea, Thomas, Lamkin, & Bell, 2007) presented evidence that "people use facial prototypes when they encounter different names."

Let's consider this idea together now. Below is a profile photo. Without discussing with anyone else, which name do you think belongs to this man: Bob or Tim? (We do not know the right answer to this question, so just put your best guess.)

Photo copyright of *Psychonomic Bulletin and Review*.

Name: _____

Similar to one of the experiments described in the article, 100 people on the campus of Middle Tennessee State University were asked to assign names to the photo. We wish to use this survey to **test the hypothesis that more people will assign the name "Tim" to the photo than the name "Bob".**

Part One – Set the Conditions for the Hypothesis Test

1. As a class, determine the population parameter we are interested in for this study. Describe this parameter in words and symbols.

2. Specify in words the null and alternative hypotheses for this study. Write them symbolically as well.

Part Two – Using a Simulation Method

1. Explain how you could use a coin flip to simulate selecting a name under the null hypothesis. Give details to clarify what would represent heads or tails and what you would be keeping track of, etc.

2. Why or how is simulating this process using a coin flip useful?

3. Of the 100 people who participated in this study, 67 assigned the name "Tim" to the man in the photo. Calculate the sample proportion. _____

> **DEFINITION**
>
> ***p-value:*** The probability of obtaining results similar to, or more extreme than, the results that were actually seen, if the null hypothesis is true.

4. As a class, use a coin tossing applet to simulate 1000 repetitions of this study, assuming the null model/hypothesis that people assign names to faces at random (no preference). Use the simulation results to determine the approximate *p*-value of these data.

   Approximate *p*-value (rounded to 4 decimal places): _____

Part Three – Using the Binomial Method

1. Recall that repeated independent coin flips can be modeled with the Binomial distribution. Use this distribution to calculate this *p*-value theoretically, which in this context is the probability of a result of 67 (or more extreme) who assigned the name "Tim" to the man in the photo. To do this, you can use the **binomcdf** function on your calculator, or the "by-hand" method for the binomial probability calculation.
   a. Remember when using the **binomcdf** function on your calculator, you need to consider the *direction* of the probability (Circle one) Fewer than 67 67 or more
   b. Include the values and the calculator steps you use to compute the *p*-value.

   c. Theoretical *p*-value (rounded to 4 decimal places): _____

2. Summarize your conclusion about whether these data provide strong evidence against the null model/theory of random selections, in favor of the idea of facial prototyping. Also explain the reasoning process behind your conclusion.

Part Four – Using Normal Distribution Approximation Method

1. Recall that if the sample size is large, the binomial distribution can be approximated with the normal distribution. Your calculator uses this fact to calculate approximate *p*-values for hypothesis tests for proportions.

   Go to STAT -> Tests -> 1PropZTest. Enter in the correct values for p_0, *x*, and *n*, and highlight the correct alternate hypothesis. Then click DRAW. The reported *p*-value will be under the curve. Compare it to the theoretical *p*-value that you calculated using the Binomial method.

   p_0: _____ *x*: _____ *n*: _____

   Alternate hypothesis: _____

   p-value (4 decimal places): _____ Decision: Reject null or not? _____

2. State the conclusion in the context of the problem.

3. Suppose that the sample size had been twice as large, with the same proportional results, as reported in Part Two, number 3. How would you expect this to affect your analysis and conclusion? In particular, would you expect the *p*-value to be larger, smaller, or the same? What would this mean about the strength of evidence for facial prototyping? Explain.

KEY IDEA:
Sample size plays an important role in assessing statistical significance.
A larger sample size produces a smaller *p*-value; thus, stronger evidence against the null hypothesis,

- if all else remains the same
- and if the sample result is in the direction of the alternative hypothesis.

Part Five – Extensions

Consider a scenario where the proportion of students in your class who put Tim's name with the photo was actually larger than than 67 out of 100.

1. How would this have affected the *p*-value? (circle one) Larger Same Smaller

2. How would this have affected the standardized value of the test statistics? (circle one)
   Larger Same Smaller

3. How would this have affected the strength of evidence against the null hypothesis:

   Stronger Same Weaker

MAIN IDEAS: List the Main Ideas for Today's Lesson