Testing a Hypothesis about a Population Proportion Using StatCrunch

### StatCrunch
1. If you have raw data, enter them into the spreadsheet. Name the column variable.
2. Select Stat, highlight Proportions, select One sample, and then choose either with data or with summary.
3. If you chose with data, select the column that has the observations, choose which outcome represents a success, then click Next>. If you chose with summary, enter the number of successes and the number of trials. Click Next>.
4. Choose the hypothesis test radio button. Enter the value of the proportion stated in the null hypothesis and choose the direction of the alternative hypothesis from the pull-down menu. Click Calculate.

### Example 1 Testing Hypotheses about a Population Proportion: Left-Tailed Test

**Problem** The two major college entrance exams that a majority of colleges accept for admission are the SAT and ACT. ACT looked at historical records and established 22 as the minimum ACT math score for a student to be considered prepared for college mathematics. [Note: “Being prepared” means there is a 75% probability of successfully completing College Algebra in college.] An official with the Illinois State Department of Education wonders whether less than half of the students in her state are prepared for College Algebra. She obtains a simple random sample of 500 records of students who have taken the ACT and finds that 219 are prepared for college mathematics (that is, scored at least 22 on the ACT math test). Does this represent significant evidence that less than half of Illinois students are prepared for college mathematics upon graduation from a high school? Use the $\alpha = 0.05$ level of significance. Source: ACT High School Profile Report.

**Approach** This problem deals with a hypothesis test of a proportion. We want to determine if the sample evidence shows that less than half of the students are prepared for college mathematics. Symbolically, we represent this as $p < \frac{1}{2}$ or $p < 0.5$.

Verify the three requirements to perform the hypothesis test: the sample must be a simple random sample, $np_0(1 - p_0) \geq 10$, and the sample size cannot be more than 5% of the population size (for independence). Then we follow Steps 1 through 5.

**Solution** We assume that $p = 0.5$. The sample is a simple random sample. Also, $np_0(1 - p_0) = 500(0.5)(1 - 0.5) = 125 > 10$. Provided that there are over 10,000 students in the state, the sample size is less than 5% of the population size. Assuming that this is the case, the requirements are satisfied. We now proceed with Steps 1 through 5.

**Step 1** The burden of proof lies in showing $p < 0.5$. We assume there is no difference between the proportion of students ready for college math and the proportion of students not ready for college math. Therefore, the statement in the null hypothesis is that $p = 0.5$. So we have $H_0: p = 0.5$ versus $H_1: p < 0.5$.

**Step 2** The level of significance is $\alpha = 0.05$.

**Step 3** Use StatCrunch to find the $P$-value. Select Stat > Proportions > One sample > with summary. Fill in the table as shown on the next page.
Click Next>. Enter the value of the proportion stated in the null hypothesis in the "Null: prop. =" cell. Select the correct direction of the alternative hypothesis is the "Alternative:" drop-down menu as shown below.

Click Calculate.
**Step 4** The $P$-value of 0.0028 means that if the null hypothesis that $p = 0.05$ is true, we expect 219 or fewer successes in 500 trials in less than 1 sample in 100! The observed results are unusual, indeed. Because the $P$-value is less than the level of significance, $\alpha = 0.05$ ($0.0028 < 0.05$), we reject the null hypothesis.

**Step 5** There is sufficient evidence at the $\alpha = 0.05$ level of significance to conclude that fewer than half of the Illinois students are prepared for college mathematics. In other words, the data suggest less than a majority of the students in the state of Illinois are prepared for college mathematics.