3. The requirements $np \geq 5$ and $nq \geq 5$ are both satisfied with $n = 400$, $p = 0.93$, and $q = 0.07$. (The value of $p = 0.93$ comes from the claim. We get $np = (400)(0.93) = 372$, which is greater than or equal to 5, and we get $nq = (400)(0.07) = 28$, which is also greater than or equal to 5.)

The three requirements are satisfied. ✔

P-Value Method

Technology Computer programs and calculators usually provide a *P*-value, so the *P*-value method is used. See the accompanying TI-83/84 Plus calculator results showing the alternative hypothesis of "prop ≠ 0.93," the test statistic of $z = 1.57$ (rounded), and the *P*-value of 0.1169 (rounded).

TI-83/84 PLUS

```
1-PropZTest
 prop≠.93
 z=1.567723603
 p=.1169456657
 p̂=.95
 n=400
```

If technology is not available, Figure 8-1 in the preceding section lists the steps for using the *P*-value method. Using those steps from Figure 8-1, we can test the claim in Example 1 as follows.

Step 1: The original claim is that 93% of computers have antivirus programs, and that claim can be expressed in symbolic form as $p = 0.93$.

Step 2: The opposite of the original claim is $p \neq 0.93$.

Step 3: Of the preceding two symbolic expressions, the expression $p \neq 0.93$ does not contain equality, so it becomes the alternative hypothesis. The null hypothesis is the statement that p equals the fixed value of 0.93. We can therefore express H_0 and H_1 as follows:

$$H_0: p = 0.93 \quad \text{(original claim)}$$

$$H_1: p \neq 0.93$$

Step 4: For the significance level, we select $\alpha = 0.05$, which is a very common choice.

Step 5: Because we are testing a claim about a population proportion p, the sample statistic $\hat{p}$ is relevant to this test. The sampling distribution of sample proportions $\hat{p}$ can be approximated by a normal distribution in this case.

Step 6: The test statistic $z = 1.57$ can be calculated by using $\hat{p} = 380/400$ (sample proportion), $n = 400$ (sample size), $p = 0.93$ (assumed in the null hypothesis), and $q = 1 - 0.93 = 0.07$.

$$z = \frac{\hat{p} - p}{\sqrt{\dfrac{pq}{n}}} = \frac{\dfrac{380}{400} - 0.93}{\sqrt{\dfrac{(0.93)(0.07)}{400}}} = 1.57$$

Lie Detectors and the Law

Why not simply require all criminal suspects to take polygraph (lie detector) tests and eliminate trials by jury? According to the Council of Scientific Affairs of the American Medical Association, when lie detectors are used to determine guilt, accuracy can range from 75% to 97%. However, a high accuracy rate of 97% can still result in a high percentage of false positives, so it is possible that 50% of innocent subjects incorrectly appear to be guilty. Such a high chance of false positives rules out the use of polygraph tests as the single criterion for determining guilt.