Plus calculator is not available, we can use Table A-3 to identify a *range of values* containing the *P*-value. We recommend this strategy for finding *P*-values using the *t* distribution:

1. Use software or a TI-83/84 Plus calculator. (STATDISK, Minitab, XLSTAT, StatCrunch, the TI-83/84 Plus calculator, SPSS, and SAS all provide *P*-values for *t* tests.)
2. If technology is not available, use Table A-3 to identify a range of *P*-values as follows: Use the number of degrees of freedom to locate the relevant row of Table A-3, then determine where the test statistic lies relative to the *t* values in that row. Based on a comparison of the *t* test statistic and the *t* values in the row of Table A-3, identify a range of values by referring to the area values given at the top of Table A-3.

Example 2 Finding the *P*-Value

Assuming that neither computer software nor a TI-83/84 Plus calculator is available, use Table A-3 to find a range of values for the *P*-value corresponding to the test statistic of $t = -0.486$ from Example 1.

Solution

Requirement check The requirements have already been verified in Example 1. ✓

Example 1 involves a left-tailed test, so the *P*-value is the area to the left of the test statistic $t = -0.486$. Because the sample size is $n = 11$, refer to Table A-3 and locate the row corresponding to 10 degrees of freedom ($\text{df} = 11 - 1 = 10$). The test statistic of $t = 0.486$ is less than every value in the row for $\text{df} = 10$, so the "area in one tail" (to the right of the test statistic) is greater than 0.10. If the area to the right of $t = 0.486$ is greater than 0.10, it follows from symmetry that the area to the left of $t = -0.486$ is also greater than 0.10. Although we can't find the exact *P*-value from Table A-3, we can conclude that the *P*-value is greater than 0.10. When creating a professional report, definitely use technology to find an exact *P*-value instead of a range of *P*-values found from Table A-3.

Because the *P*-value is greater than the significance level of 0.05, we again fail to reject the null hypothesis. There is not sufficient evidence to support the claim that cell phones have a mean radiation level that is less than 1.00 W/kg.

Example 3 Finding the *P*-Value

When using the 40 red blood cell counts for males as listed in Data Set 1 in Appendix B, we get the test statistic $t = 1.956$ when testing the claim that $\mu = 4.950$. Assuming that neither computer software nor a TI-83/84 Plus calculator is available, use Table A-3 to find a range of values for the *P*-value.

Solution

Because the sample size is 40, refer to Table A-3 and locate the row corresponding to 39 degrees of freedom ($\text{df} = n - 1$). In the 39th row, the test statistic $t = 1.956$ falls between 2.023 and 1.685, so the area in two tails is between 0.05 and 0.10. (Be sure to use the "Area in Two Tails" whenever the test is two-tailed.) Although we can't find the exact *P*-value, we can conclude that the *P*-value is greater than 0.05 and less than 0.10. (Computer software and the TI-83/84 Plus calculator provide the exact *P*-value of 0.0576.)

"How Statistics Can Help Save Failing Hearts"

A *New York Times* article by David Leonhardt featured the headline of "How Statistics Can Help Save Failing Hearts." Leonhardt writes that patients have the best chance of recovery if their clogged arteries are opened within two hours of a heart attack. In 2005, the U.S. Department of Health and Human Services began posting hospital data on its Web site www.hospitalcompare.hhs.gov, and it included the percentage of heart attack patients who received treatment for blocked arteries within two hours of arrival at the hospital. Not wanting to be embarrassed by poor data, doctors and hospitals are reducing the time it takes to unblock those clogged arteries. Leonhardt writes about the University of California, San Francisco Medical Center, which cut its time in half from almost three hours to about 90 minutes. Effective use of simple statistics can save lives.