group of blue has a higher mean), the test statistic of $t = -2.979$ (rounded), and the P-value of 0.0021 (rounded). Because the P-value of 0.0021 is less than the significance level of $\alpha = 0.01$, we reject the null hypothesis. See the interpretation at the end of this example.

We can test the claim using the critical value method as follows.

Step 1: The claim that "blue enhances performance on a creative task" can be restated as the claim that people with a blue background have a higher mean creativity score than those in the first group with a red background. The first group of red background subjects therefore has a lower mean creativity score than the second blue group, and this can be expressed as $\mu_1 < \mu_2$.

Step 2: If the original claim is false, then $\mu_1 \geq \mu_2$.

Step 3: The alternative hypothesis is the expression not containing equality, and the null hypothesis is an expression of equality, so we have

$$H_0: \mu_1 = \mu_2 \qquad H_1: \mu_1 < \mu_2 \text{ (original claim)}$$

We now proceed with the assumption that $\mu_1 = \mu_2$, or $\mu_1 - \mu_2 = 0$.

Step 4: The significance level is $\alpha = 0.01$.

Step 5: Because we have two independent samples and we are testing a claim about the two population means, we use a t distribution with the test statistic given earlier in this section.

Step 6: The test statistic is calculated as follows:

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{(3.39 - 3.97) - 0}{\sqrt{\frac{0.97^2}{35} + \frac{0.63^2}{36}}} = -2.979$$

Critical Values Because we are using a t distribution, the critical value of $t = -2.441$ is found from Table A-3. With an area of 0.01 in the left tail, we want the t value corresponding to 34 degrees of freedom, which is the smaller of $n_1 - 1$ and $n_2 - 1$ (or the smaller of 34 and 35). The test statistic, critical values, and critical region are shown in Figure 9-2.

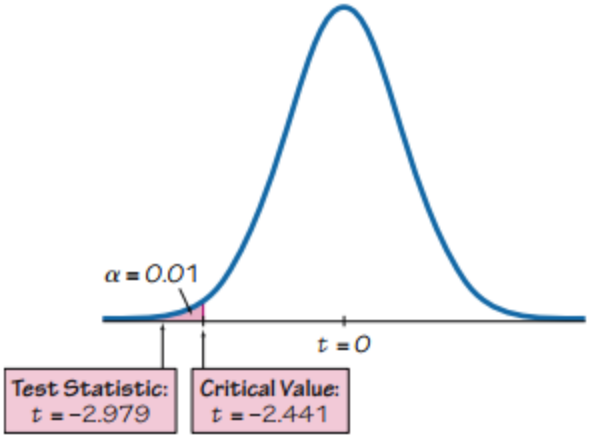

Figure 9-2 Hypothesis Test of Means from Two Independent Populations

Step 7. Because the test statistic does fall within the critical region, we reject the null hypothesis $\mu_1 = \mu_2$ (or $\mu_1 - \mu_2 = 0$).

Do Real Estate Agents Get You the Best Price?

When a real estate agent sells a home, does he or she get the best price for the seller? This question was addressed by Steven Levitt and Stephen Dubner in *Freakonomics*. They collected data from thousands of homes near Chicago, including homes owned by the agents themselves. Here is what they write: "There's one way to find out: measure the difference between the sales data for houses that belong to real-estate agents themselves and the houses they sold on behalf of clients. Using the data from the sales of those 100,000 Chicago homes, and controlling for any number of variables—location, age and quality of the house, aesthetics, and so on—it turns out that a real-estate agent keeps her own home on the market an average of ten days longer and sells it for an extra 3-plus percent, or $10,000 on a $300,000 house." A conclusion such as this can be obtained by using the methods of this section.