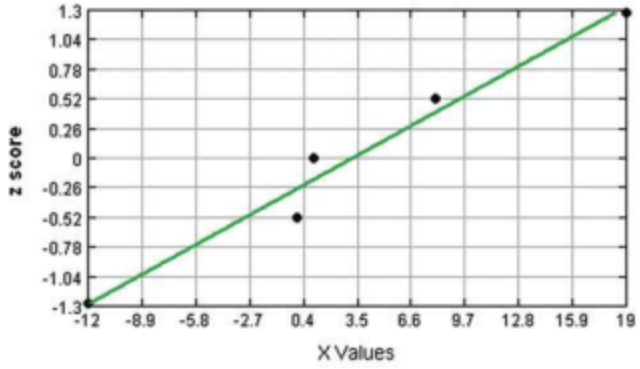
Twins in Twinsburg

During the first weekend in August of each year, Twinsburg, Ohio celebrates its annual "Twins Days in Twinsburg" festival. Thousands of twins from around the world have attended this festival in the past. Scientists saw the festival as an opportunity to study identical twins. Because they have the same basic genetic structure, identical twins are ideal for studying the different effects of heredity and environment on a variety of traits, such as male baldness, heart disease, and deafness—traits that were recently studied at one Twinsburg festival. A study of twins showed that myopia (near-sightedness) is strongly affected by hereditary factors, not by environmental factors such as watching television, surfing the Internet, or playing computer or video games.

Solution

Requirement check We address the three requirements listed earlier in this section. (1) The samples are dependent because the values are paired. Each pair consists of the height of the winning president and the height of the main opponent in the same election. (2) The pairs of data are randomly selected from the data available as of this writing. We will consider the data to be a simple random sample. (3) The number of pairs of data in Table 9-1 is $n = 5$, which is not large, so we should check for normality of the differences and we should check for outliers. Inspection of the differences shows that there are no outliers. A histogram isn't too helpful with only five data values, but the accompanying STATDISK display shows the normal quantile plot. Because the points approximate a straight-line pattern with no other pattern, we conclude that the differences satisfy the loose requirement of being from a normally distributed population. All requirements are satisfied. ✔

STATDISK



If we use μ_d (where the subscript d denotes "difference") to denote the mean of the differences in height, the claim is that $\mu_d > 0$ cm.

Technology Computer programs and calculators usually provide a P-value, so the P-value method is typically used. See the accompanying SPSS results showing the test statistic of $t = 0.628$. SPSS provides the two-tailed P-value of 0.564, so we halve that value for this right-tailed test to get a P-value of 0.282. Because the P-value of 0.282 is greater than the significance level of 0.05, we fail to reject the null hypothesis and we conclude that there is not sufficient evidence to support the claim that presidents tend to be taller than their opponents.

SPSS

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					90% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	President - Opponent	3.20000	11.38859	5.09313	-7.65778	14.05778	.628	4	.564

If technology is not available, the P-value method, the critical value method, or a confidence interval are all described in Section 8-2. We can test the claim using the critical value method as follows. We will follow the same basic method of hypothesis testing that was introduced in Chapter 8, but we use the test statistic for dependent samples that was given earlier in this section.

Step 1: The claim is that $\mu_d > 0$ cm. (That is, the mean difference is greater than 0 cm.)

Step 2: If the original claim is not true, we have $\mu_d \leq 0$ cm.