

What do we do when requirements are violated?

The statistical methods presented in the preceding chapters typically include requirements, such as these:

Requirement: The population must be normally distributed or the sample must include more than 30 values. (Section 8-4)

Requirement: The two sample sizes are both large (with $n_1 > 30$ and $n_2 > 30$) or both samples come from populations having normal distributions. (Section 9-3)

Requirement: The populations have distributions that are approximately normal. (Section 12-2)

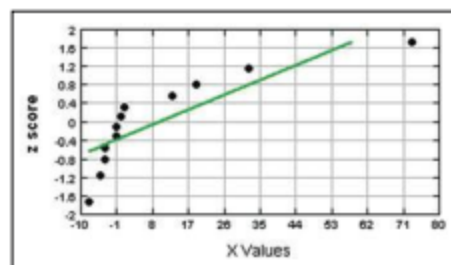
When requirements are violated, we can sometimes use different methods not having the same requirements. Let's consider American Airlines Flight 19 and Flight 21 from New York's JFK airport to LAX in Los Angeles. Table 13-1 lists the departure delay times for samples of flights from January of a recent year. The data are included in Data Set 15 from Appendix B, and the times are in minutes.

Table 13-1 Departure Delay Times (min) for American Airlines Flight 19 and Flight 21

Flight 19	19	-4	-5	-1	-4	73	0	1	13	-1	-8	32
Flight 21	18	60	142	-1	-11	-1	47	13	12	123	1	4

If we want to test the claim that the population of departure delay times for Flight 19 has the same mean as the population of departure delay times for Flight 21, we have this null hypothesis: $H_0: \mu_1 = \mu_2$. Because we want to test for equality of means from two independent populations, we consider using the t test method described in Section 9-3, which includes this requirement: "The two sample sizes are both large (with $n_1 > 30$ and $n_2 > 30$) or both samples come from populations having normal distributions." The sample sizes are both $n = 12$, so neither sample is large. Also, both samples have distributions that are very far from normal. See the accompanying normal quantile plot of the Flight 19 departure delay times, which shows points in a pattern that is not close to a straight-line pattern, so the sample data appear to be from a population with a distribution that is not a normal distribution. The Flight 21 departure times have a similar normal quantile plot, so the population of Flight 21 departure delay times does not appear to have a normal distribution. Both samples are small and they both appear to be from populations not having a normal distribution, so the requirement is violated and the t test method of Section 9-3 should not be used. This chapter introduces methods that can often be used when methods from the preceding chapters should not be used because the requirements are violated. We will revisit the data in Table 13-1 in Section 13-4 where we present a method that does not have the same requirements for the t test method presented in Section 9-3.

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- 13-1** Review and Preview
- 13-2** Sign Test
- 13-3** Wilcoxon Signed-Ranks Test for Matched Pairs
- 13-4** Wilcoxon Rank-Sum Test for Two Independent Samples
- 13-5** Kruskal-Wallis Test
- 13-6** Rank Correlation
- 13-7** Runs Test for Randomness