A sample of $N = 16$ people from a population with mean equal to 50 is given a treatment. After the treatment, we find a sample mean of $\overline{X} = 51$ with $SS = 296$. Does the treatment result in a significant increase over the mean score for the general population?

The librarian at the local elementary school claims that, on average, the books in the library are more than 20 years old. To test this claim, a student takes a sample of $N = 30$ books and records the publication date for each. The sample produces an average age of $\overline{X} = 23.8$ years with $SS = 1957$. Can we conclude from this sample that the average age of the library books is significantly greater than 20 years old?

A sample of $N = 16$ individuals is selected from a population with mean 70 and given a treatment. After treatment, the sample mean is found to be $\overline{X} = 73.6$ with $SS = 960$. Let $\mu$ represent the population mean of the treatment group.

- Perform a hypothesis test to determine whether $\mu > 70$.
- Perform a hypothesis test to determine whether $\mu \neq 70$.

For several years researchers have noticed that there appears to be a regular, year-by-year increase in the average IQ for the general population (this phenomenon is called the *Flynn effect*, and it means that psychologists must continuously update IQ tests to keep the population mean at 100). To evaluate this effect, a researcher obtained a 10-year-old IQ test that was standardized to produce a mean IQ of 100 for the population 10 years ago. The test was then given to a sample of $N = 64$ of today's 20-year-old adults. The average score for the sample was $\overline{X} = 107$ with an estimated standard deviation of $\hat{\sigma} = 12$. Based on the sample, can we conclude that the average IQ for today's population is significantly different from the average 10 years ago, when the test would have produced a mean of 100?