Previously we learned how to conduct a hypothesis test about a population proportion. Today we turn our attention to quantitative variables and learn a t-test for a population mean.

**Example 16-1: Children’s Television Viewing**

In a study conducted by Stanford researchers, children in two elementary schools in San Jose were asked to keep track of how much television they watch in a week. When I first read about this study, one question that occurred to me is whether the average amount of television watching per week among elementary school children exceeds fourteen hours per week (or two hours per day).

a) Identify the cases (observational units) and variable in this study. Also classify the variable as categorical or quantitative.

b) Express my question as a null hypothesis and an alternative hypothesis, both in symbols and in words.

The sample in this study consisted of 198 children. The mean time spent watching television per week in the sample was 15.41 hours, and the standard deviation was 14.16 hours.

c) Are these numbers parameters or statistics? Explain, and indicate the symbols used to represent them.

d) Is the sample mean consistent with my conjecture? Is it possible to obtain such a large sample mean even if my conjecture weren’t true? Explain.
We will use a \textit{t-test} to conduct a hypothesis test about a population mean. The structure, reasoning, and interpretation are the same as with all hypothesis tests.

\begin{itemize}
  \item The null hypothesis is $H_0: \mu = \text{hypothesized value}$
  \item The alternative hypothesis is $H_a: \mu > \text{hypothesized value}$ or $H_a: \mu < \text{hypothesized value}$ or $H_a: \mu \neq \text{hypothesized value}$.
  \item The test statistic is $t = \frac{\bar{x} - \text{hypothesized value}}{s/\sqrt{n}}$.
  \item The p-value is the area under the $t$-distribution (with $n-1$ degrees of freedom) more extreme than the test statistic, in the direction indicated by the alternative hypothesis.
  \item The test decision is to reject $H_0$ whenever $p$-value $< \alpha$ (significance level).
  \item The technical conditions required for this procedure to be valid are:
    \begin{itemize}
      \item that the data can be regarded as a random sample from the population
      \item $n \geq 30$ or normally distributed population
    \end{itemize}
\end{itemize}

e) Calculate the value of the test statistic. Also interpret this value.

f) Determine the p-value of the test, as accurately as possible from Table T. Then interpret what this p-value says (probability of what, assuming what?)

g) Use Minitab (Stat> Basic Statistics> 1-Sample t...) or the Theory-Based Inference applet to verify your calculations.

h) Based on this p-value, would you reject the null hypothesis at the .05 significance level? What about at the .10 significance level?

i) Comment on whether the technical conditions for the $t$-test are satisfied here. Also comment on what population you would be willing to generalize these results to.
j) Summarize the conclusions that you would draw from this test, and explain the reasoning process by which they follow.

Example 16-2: Body Temperatures
In a recent study, 130 healthy adults had their body temperature measured in degrees Fahrenheit.

a) Use Minitab (BodyTemps.mtw) to produce graphical and numerical summaries, and comment on what these reveal about the distribution of body temperatures.

b) Conduct a \( t \)-test of whether these sample data provide strong evidence that the population mean body temperature differs from 98.6 degrees. Provide all components of a hypothesis test, including a check of technical conditions and the test decision at the \( \alpha = .01 \) significance level. Also summarize your conclusions.

c) Estimate the population mean body temperature with 95% confidence. Interpret this interval, and comment on whether it is consistent with your test decision in (b).