Finite Population Correction Factor

If we know the population size — of course, we often do not — but if we do, then we can use that information to reduce our sampling error ($\varepsilon$). What we do is multiply $\varepsilon$ by the finite population correction factor, whose formula follows.

$$\frac{\sqrt{N-n}}{N-1}$$

So, let’s say that we have the following data, which I have modified from p. 283 of our textbook:

$\bar{x} = $1076.39  
$s = $273.62 
$n = 77 
$N = 1000$

Understand that $N$ (the population size) is the value that we don’t usually have.

Let’s figure out a 95% confidence interval without making use of $N$:

$$\left( \bar{x} - t_{\alpha/2, df} \frac{s}{\sqrt{n}}, \bar{x} + t_{\alpha/2, df} \frac{s}{\sqrt{n}} \right)$$

$$= \left( 1076.39 - 1.9917 \frac{273.62}{\sqrt{77}}, 1076.39 + 1.9917 \frac{273.62}{\sqrt{77}} \right)$$

$$= (1014.29, 1138.49)$$

[And you will get a very slightly different, and more correct, answer if you do the interval using your calculator function.]

Now, let’s multiply $\varepsilon$ by the finite population correction factor, as such:

$$\left( \bar{x} - t_{\alpha/2, df} \frac{s}{\sqrt{n}} \frac{N-n}{N-1}, \bar{x} + t_{\alpha/2, df} \frac{s}{\sqrt{n}} \frac{N-n}{N-1} \right)$$

$$= \left( 1076.39 - 1.9917 \frac{273.62}{\sqrt{77}} \frac{1000-77}{1000-1}, 1076.39 + 1.9917 \frac{273.62}{\sqrt{77}} \frac{1000-77}{1000-1} \right)$$

$$= (1016.69, 1136.09)$$

What have we gained? A more precise confidence interval, without any loss of confidence.

And how did we accomplish this? By reducing the sampling error some 3.9%. Notice the value of the finite population correction factor in the present case:

$$\frac{\sqrt{N-n}}{N-1} = \frac{\sqrt{1000-77}}{1000-1} \approx 96.1\%$$