

Solutions:

(a) We use the t -distribution because this is a quantitative variable whose standard deviation is found from the sample. The mean of the sample has a t -distribution with 89 degrees of freedom; the standard error is $SE = 0.3/\sqrt{90} = 0.0316$. From the t -table, we find $t = 1.99$, so the confidence interval is

$$\begin{aligned} & (4.6 - 1.99 \cdot 0.0316, \quad 4.6 + 1.99 \cdot 0.0316) \\ & = (4.54, 4.67). \end{aligned}$$

(b) The margin of error is $1.99 \cdot 0.0316 = 0.063$.

(c) Roughly, the confidence interval tells us that there's a 95% chance that the true mean pH in this region is between 4.54 and 4.67. More precisely, it tells us that 95% of the confidence intervals calculated from a random sample of 90 readings in this way will contain the true mean.

Note: The confidence interval does *not* tell us that 95% of the pH readings are between these values.

(d) Longer, because there is larger probability the true mean is included.

(e) Increase in length because standard deviation is in numerator.

(f) Half as long, because of the \sqrt{n} in the denominator.

(g) Since 5.6 is outside the confidence interval, the rain in this area is significantly more acidic than pure rain.