Online modules for quantitative skill building: Exploring adaptation and adoption

Descriptive Statistics Module

Example Problem

Biology

Seeds of many weed species germinate best in recently disturbed soil that lacks a light-blocking canopy of vegetation. Students in a biology class hypothesized that weed seeds germinate best when exposed to light. To test this hypothesis, the students placed a seed from crofton weed (*Ageratina adenophora*, an invasive species on several continents) in each of 20 petri dishes and covered the seeds with distilled water. They placed half the petri dishes in the dark and half in the light. After one week, the students measured the combined lengths in millimeters of the radicles and shoots extending from the seeds in each dish. The table below shows the data.

Petri Dishes	Dark (x_1) (mm)	Light (x_2) (mm)	Dark $(x_i - \bar{x}_1)^2$ (mm^2)	Light $(x_i - \bar{x}_2)^2$ (mm^2)
1 and 2	12	18	$(12-9.6)^2 = 5.8$	$(18-18.4)^2 = 0.16$
3 and 4	8	22	$(8-9.6)^2 = 2.6$	$(22-18.4)^2 = 12.96$
5 and 6	15	17	$(15-9.6)^2 = 29.1$	$(17-18.4)^2 = 1.96$
7 and 8	13	23	$(13-9.6)^2 = 11.5$	$(23-18.4)^2 = 21.16$
9 and 10	6	16	$(6-9.6)^2 = 13.0$	$(16-18.4)^2 = 5.76$
11 and 12	4	18	$(4-9.6)^2 = 31.4$	$(18-18.4)^2 = 0.16$
13 and 14	13	22	$(13-9.6)^2 = 11.6$	$(22-18.4)^2 = 12.96$
15 and 16	14	12	$(14-9.6)^2 = 19.3$	$(12-18.4)^2 = 40.96$
17 and 18	5	19	$(5-9.6)^2 = 21.1$	$(19-18.4)^2 = 0.36$
19 and 20	6	17	$(6-9.6)^2 = 13.0$	$(17-18.4)^2 = 1.96$
			$\sum (x_i - \bar{x}_1)^2 = 158.4$	$\sum (x_i - \bar{x}_2)^2 = 98.4$

1. What is the mean length of the seedlings that were grown in the dark? (Round to the nearest mm)

2. What is the mean length of the seedlings that were grown in the light? (Round to the nearest mm)

3. What is the standard deviation of the length of seedlings grown in the dark? (Round to the nearest 0.1 mm.)

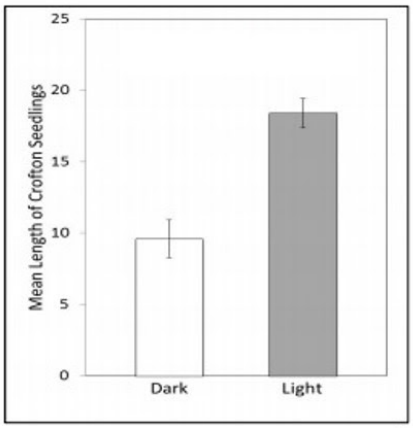
4. What is the standard deviation of the length of seedlings grown in the light? (Round to the nearest 0.1 mm.)

5. How will the standard error of the mean compare to the standard deviation?
   Smaller Larger The same

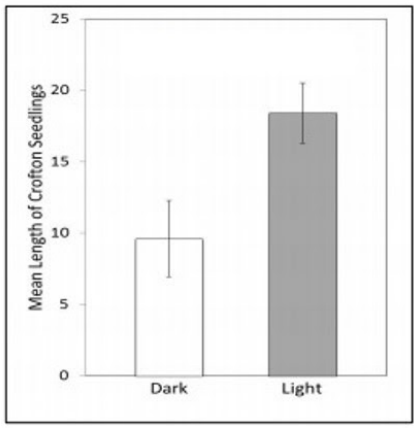
6. Consider the two graphs. One shows standard error as the error bars and the other shows 95% confidence intervals as the error bars. Which graph has 95% confidence interval error bars?

A B

A



B



7. From the data you have, do you think it is likely that light makes a difference?