Confidence Interval

1. After surveying students at Dartmouth College, a campus organization calculated that a 95% confidence interval for the mean cost of food for one term. Now the organization is trying to write its report, and considering the following interpretations. Comment on each.
   a) 95% of all students pay between $780 and $850 for food.
   b) 95% of the sampled students paid between $780 and $920.
   c) We are 95% sure that students in this sample averaged between $780 and $920.
   d) 95% of all samples of students will have average food costs between $780 and $920.
   e) We are 95% sure that the average amount all students pay for food is between $780 and $920.

2. A medical researcher measured the pulse rates (beats per minute) of a sample of randomly selected adults and found the following student’s confidence interval:

   \[ 70.887604 < \mu(Pulse) < 74.497011 \]

   a) Explain carefully what the software output means.
   b) What is the margin of error for this interval?
   c) If the researcher had calculated a 99% confidence interval, would the margin of error be larger or smaller? Explain.

3. Hoping to lure more shoppers downtown, a city builds a new public parking garage in the central business district. The city plans to pay for the structure through parking fees. During a two-month period (44 weekdays), daily fees collected averaged $126, with a standard deviation of $15.

   a) What assumptions must you make in order to use these statistics for inference?
   b) Write a 90% confidence interval for the mean daily income this parking garage will generate.
   c) Explain in context what this confidence interval means.
   d) Explain what “90% confidence” means in this context.

4. A radio talk show invites listeners to enter a dispute about a proposed pay increase for city council members. “What yearly pay do you think council members should get? Call us with your number.” In all, 958 people call. The mean pay they suggest is $8740 per year, and the standard deviation of the responses is $1125. For a large sample such as this, $ is very close to the unknown population \( \sigma \). The station calculates the 95% confidence interval for the mean pay \( \mu \) that all citizens would propose for council members to be $8669 to $8811.

   a) Is the station’s calculation correct?
   b) Does their conclusion describe the population of all the city’s citizens? Explain your answer.

5. Biologists studying the healing of skin wounds measured the rate at which new cells closed a razor cut made in the skin of an anesthetized newt (colorful salamander). Here are data from 18 newts, measured in micrometers (millionths of a meter) per hour:

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   a) Make a boxplot of the healing rates. It is difficult to assess normality from 18 observations, but look for outliers or skewness. Make a normal probability plot. What do you find?
   b) Scientists usually assume that animal subjects are SRSs from their species or genetic type. Treat these newts as an SRS and suppose you know that standard deviation of healing rates for this species of newt is 8 micrometers per hour. Construct and interpret a 90% confidence interval for the mean healing rate for the species.
   c) A friend who knows almost no statistics follows the formula \( \overline{x} \pm z \left( \frac{s}{\sqrt{n}} \right) \) in a biology lab manual to get a 95% confidence interval for the mean. Is her interval wider or narrower than yours? Explain to her why it makes sense that higher confidence changes the length of the interval.
   d) How large a sample would enable you to estimate the mean healing rate of skin wounds in newts within a margin of error of 1 micrometer per hour with 90% confidence?

6. A New York Times/CBS News Poll asked the question “Do you favor an amendment to the Constitution that would permit organized prayer in public school?” Sixty-six percent of the sample answered “Yes.” The article describing the poll says it “is based on telephone interviews conducted from Sept. 13 to Sept. 18 with 1,664 adults around the United States, excluding Alaska and Hawaii...the telephone numbers were formed by random digits, thus permitting access to both listed and unlisted residential numbers.”

   a) The article gives the margin of error as 3 percentage points. Make a 99% confidence statement about the percent of all adults who favor a school prayer amendment.
   b) The news article goes on to say: “The theoretical errors do not take into account a margin of additional error resulting from the various practical difficulties in taking any survey of public opinion.” List some of the “practical difficulties” that may cause errors in addition to the \( \pm 3\% \) margin of error. Pay particular attention to the news article’s description of the sampling method.