(1) Which one of the following questions does a hypothesis test address? Explain briefly.
(i) Is the difference in the observed and hypothesized values due to chance?
(ii) Is the difference in the observed and hypothesized important?
(iii) What does the difference in the observed and hypothesized values prove?
(iv) Was the experiment properly designed?

(2) Carlota is an avid bowler. She has an expected score of 180 with a standard deviation of 30. Assume that her scores are Normally distributed and independent of each other. What are the probabilities that:
(a) her score in a game will be above 200?
(b) her score in a game will be below 120?
(c) her *average* score for a series of three games will be above 200?
(d) her *average* score for a series of three games will be below 120?
(e) Suppose Scotty is a poor bowler, averaging less than 120 per game. Would Scotty have a better chance of defeating Carlota in a single game, or over an entire series of three games? Explain briefly.

(3) In a study of cockpit noise levels and pilot hearing sensitivity, researchers measured cockpit noise levels in decibels of 18 commercial aircraft. (Assume these 18 aircraft are a random sample of all aircraft of this type.) The mean noise level in the 18 aircraft was 80.4 decibels, and SD was 5.2 decibels. (Sustained noise levels above 80 decibels are usually considered potentially hazardous.)
(a) Suppose that in a (hypothetical) laboratory experiment, sustained exposure to a noise level of 77.0 decibels resulted in hearing loss. Test the hypothesis that all aircraft of this type have an average noise level of 77.0 decibels.
(b) Calculate a 95% confidence interval for the true mean noise level of all aircraft of this type. Is your conclusion in part (a) consistent with your confidence interval?

(4) The inner planets (Mercury, Venus, Earth, and Mars) are those whose orbits lie inside the asteroid belt; the outer planets (Jupiter, Saturn, Uranus, Neptune) are those whose orbits lie beyond the asteroids. The relative masses of the planets are shown below, with the mass of the Earth taken to be 1.00:

Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
0.06	0.81	1.00	0.11	318	95	15	17

The masses of the inner planets average 0.49, while the masses of the outer planets average 111. Does it make sense to carry out a hypothesis test to determine whether this difference is statistically significant? Explain briefly. (Hint: refer to your answer to question 1.)
(Note: Pluto was recently "demoted" and is no longer considered a planet. See http://news.bbc.co.uk/1/hi/world/5282440.stm for details.)

(more on back)

(5) Ithaca, NY, averages 35.4 inches of rain annually, with an SD of 4.2 inches. Assume annual rainfall values are Normally distributed.
(a) During what percentage of years does Ithaca get more than 40 inches of rain?
(b) Less than how much rain falls in the driest 20% of all years?
(c) A college student lives in Ithaca for four years. Let $\bar{X}$ denote the average amount of rainfall per year in those four years. What is the sampling distribution of $\bar{X}$? (That is, in repeated samples of 4-year periods, what is the distribution of all possible values of $\bar{X}$?) What are the mean and SD of this distribution?
(d) What is the probability that those 4 years average less than 30 inches of rain?

(6) Computer assignment

You may work with one or two other people, in which case all of you may hand in the same response (each person should include a copy with his or her homework).

Go to the following web site: `http://www.ruf.rice.edu/~lane/stat_sim/sampling_dist`. On this page is a Java applet that demonstrates the Central Limit Theorem, which we looked at in class. Wait a few moments for the applet to load; when it is ready the button on the top left of the page will say "Begin". While you're waiting, read the instructions on the web site.

When you click the "Begin" button, a new window with four panels will open. First, check the box for "Fit normal" to the right of the third panel. Now, at the top right of the window, click on the "Clear lower 3" button to reset the applet, then select "Skewed" from the pop-up menu below that button. You should see a skewed histogram in the top panel; this represents the population. Click on "Animated sample" to the right of the second panel. The computer will take a random sample of five values and make a histogram of these values in the second panel. The mean of these five values will be shown in the third panel. Click on "Animated sample" again to take a second random sample of five values, and observe where the second sample mean falls.

You could repeatedly take random samples one at a time in this way, but that would be very time-consuming. Instead, Click on "1000 Samples" to the right of the second panel. The computer will take 1000 random samples (you won't see the individual values for each sample in the second panel) and plot the 1000 sample means in the third panel. This is the sampling distribution of the sample mean from samples of size 5. It should look somewhat, but not exactly, Normally distributed. The Central Limit Theorem is at work here, but the sample size is too small to make the sampling distribution appear completely Normal.

The goal of this assignment is to explore the Central Limit Theorem and see how the sampling distribution of the sample mean is affected by the population and by the sample size.
(a) Select "Custom" from the pop-up menu at the top right of the window. Using the mouse, you can draw any population you wish in the top panel. Try drawing various population distributions, then taking 1000 random samples of size $n = 5$, and seeing if the sample means are Normally distributed. **Hand in a printout of a window showing an example of a population for which the sample means are clearly NOT Normally distributed (using $n = 5$).**
(b) Change the sample size to $n = 25$ using the pop-up menu at the right of the third panel. Simulate another 1000 samples from the same population distribution. **Hand in a printout of this window as well. Are the sample means still non-Normally distributed? How does the sampling distribution of the sample mean change as you increase the sample size?**

(Note: If you use Internet Explorer or Netscape, you can print the Java applet screen using the Print command from the File menu. If you use Safari on Mac OS X, you won't be able to print this way. Instead, you can take a screen shot (use *command-shift-3*), which will create a pdf picture of the screen; then double click on the pdf (it will probably be saved as "Picture 1.png" on your desktop) to open it in Adobe Acrobat Reader and print from there.)