Directions: Show all your work. Indicate clearly the methods you use, because you will be graded on the correctness of your methods as well as on the accuracy of your results and explanations.

1. A certain state's education commissioner released a new report card for all the public schools in that state. This report card provides a new tool for comparing schools across the state. One of the key measures that can be computed from the report card is the student-to-teacher ratio, which is the number of students enrolled in a given school divided by the number of teachers at that school.

   The data below give the student-to-teacher ratio at the 10 schools with the highest proportion of students meeting the state reading standards in the third grade and at the 10 schools with the lowest proportion of students meeting the state reading standards in the third grade.

   Ratios in the 10 Schools
   with Highest Proportion of Students Meeting Standards

7	21	18	22	9	16	12	17	17	16

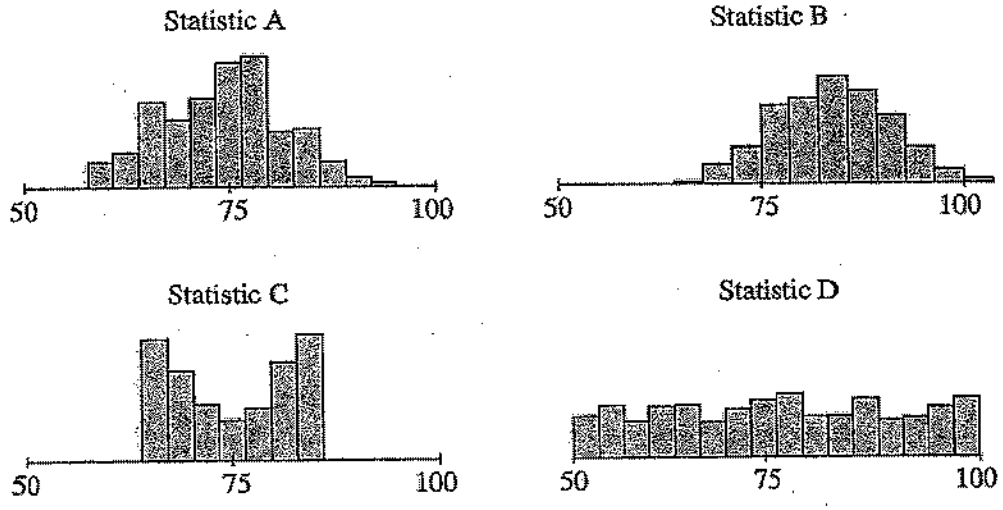
   Ratios in the 10 Schools
   with Lowest Proportion of Students Meeting Standards

14	16	18	20	12	14	16	12	20	19

   (a) Display a dotplot for each group to compare the distribution of student-to-teacher ratios in the top 10 schools with the distribution in the bottom 10 schools. Comment on the similarities and differences between the two distributions.

   (b) Any statistical test that is used to determine whether the mean student-to-teacher ratio is the same for the top 10 schools as it is for the bottom 10 schools would be inappropriate. Explain why in a few sentences.

2. Four different statistics have been proposed as estimators of a population parameter. To investigate the behavior of these estimators, 500 random samples are selected from a known population and each statistic is calculated for each sample. The true value of the population parameter is 75. The graphs below show the distribution of values for each statistic.



   (a) Which of the statistics appear to be unbiased estimators of the population parameter?

   How can you tell?

   (b) Which of statistics A or B would be a better estimator of the population parameter?

   Explain your choice.

   (c) Which of statistics C or D would be a better estimator of the population parameter?

   Explain your choice.

3. A car manufacturer is interested in conducting a study to estimate the mean stopping distance for a new type of brakes when used in a car that is traveling at 60 miles per hour. These new brakes will be installed on cars of the same model and the stopping distance will be observed. The cost of each observation is \$100. A budget of \$12,000 is available to conduct the study and the goal is to carry it out in the most economical way possible. Preliminary studies indicate that $\sigma = 12$ feet for stopping distances.

   (a) Are sufficient funds available to estimate the mean stopping distance to within 2 feet of the true mean stopping distance with 95% confidence?

   Explain your answer.

   (b) A regulatory agency requires a 95% level of confidence for an estimate of mean stopping distance that is within 2 feet of the true mean stopping distance. The car manufacturer cannot exceed the budget of \$12,000 for the study. Discuss the consequences of these constraints.

4. A husband and wife, Mike and Lori, share a digital music player that has a feature that randomly selects which song to play. A total of 2,384 songs were loaded onto the player, some by Mike and the rest by Lori. Suppose that when the player was in the random-selection mode, 13 of the first 50 songs selected were songs loaded by Lori.

   (a) Construct and interpret a 90 percent confidence interval for the proportion of songs on the player that were loaded by Lori.

   (b) Mike and Lori are unsure about whether the player samples the songs with replacement or without replacement when the player is in random-selection mode. Explain why this distinction is not important for the construction of the interval in part (a).