

Key Terms

Central limit theorem
Cluster sampling
Confidence interval
Convenience sampling
Degrees of freedom (df)
Estimation
Estimators
Interval estimate
Judgment sampling
Level of confidence
Nonsampling error
Point estimate

Population frame
Prediction interval
Probability interval
Sample proportion
Sampling (statistical) error
Sampling distribution of the mean
Sampling plan
Simple random sampling
Standard error of the mean
Stratified sampling
Systematic (or periodic) sampling
 t -Distribution

Problems and Exercises

1. Your college or university wishes to obtain reliable information about student perceptions of administrative communication. Describe how to design a sampling plan for this situation based on your knowledge of the structure and organization of your college or university. How would you implement simple random sampling, stratified sampling, and cluster sampling for this study? What would be the pros and cons of using each of these methods?
2. Number the rows in the Excel file *Credit Risk Data* to identify each record. The bank wants to sample from this database to conduct a more-detailed audit. Use the Excel *Sampling* tool to find a simple random sample of 20 unique records.
3. Describe how to apply stratified sampling to sample from the *Credit Risk Data* file based on the different types of loans. Implement your process in Excel to choose a random sample consisting of 10% of the records for each type of loan.
4. Find the current 30 stocks that comprise the Dow Jones Industrial Average. Set up an Excel spreadsheet for their names, market capitalization, and one or two other key financial statistics (search Yahoo! Finance or a similar Web source). Using the Excel *Sampling* tool, obtain a random sample of 5 stocks, compute point estimates for the mean and standard deviation, and compare them to the population parameters.
5. Repeat the sampling experiment in Example 6.3 for sample sizes 50, 100, 250, and 500. Compare your results to the example and use the empirical rules to

analyze the sampling error. For each sample, also find the standard error of the mean using formula (6.1).

6. Uncle's Pizza is doing good business in Delhi due to its prompt home delivery system. It guarantees that the pizza will be delivered within 30 minutes from the time order was placed or the order is free. The time that it takes to deliver each order on time is maintained in the Pizza Time System. Fourteen random entries from the Pizza Time System are listed.

10.1	19.6	12.2	32.6	18.2	29.5	13.2
30	10.8	14.8	22.1	15.6	45.6	15.6

- a. Find the mean for the sample.
 - b. Explain if this sample can be used to estimate the average time that it takes for Uncle's Pizza to deliver the pizza.
7. A soft drink bottle filling machine is known to have a mean of 200 ml and a standard variation of 10 ml. The quality control manager took a random sample of the filled bottles and found the sample mean to be 215 ml. She assumed the sample must not be representative. Do you agree with the conclusion made by the quality control manager? Justify your answer.
 8. A sample of 33 airline passengers found that the average check-in time is 2.167. Based on long-term data, the population standard deviation is known to be 0.48. Find a 95% confidence interval for the mean check-in time. Use the appropriate formula and verify your result using the *Confidence Intervals* workbook.

9. A sample of 20 international students attending an urban U.S. university found that the average amount budgeted for expenses per month was \$1612.50 with a standard deviation of \$1179.64. Find a 95% confidence interval for the mean monthly expense budget of the population of international students. Use the appropriate formula and verify your result using the *Confidence Intervals* workbook.
10. A sample of 25 individuals at a shopping mall found that the mean number of visits to a restaurant per week was 2.88 with a standard deviation of 1.59. Find a 99% confidence interval for the mean number of restaurant visits. Use the appropriate formula and verify your result using the *Confidence Intervals* workbook.
11. A bank sampled its customers to determine the proportion of customers who use their debit card at least once each month. A sample of 50 customers found that only 12 use their debit card monthly. Find 95% and 99% confidence intervals for the proportion of customers who use their debit card monthly. Use the appropriate formula and verify your result using the *Confidence Intervals* workbook.
12. If, based on a sample size of 850, a political candidate finds that 458 people would vote for him in a two-person race, what is the 95% confidence interval for his expected proportion of the vote? Would he be confident of winning based on this poll? Use the appropriate formula and verify your result using the *Confidence Intervals* workbook.
13. If, based on a sample size of 200, a political candidate found that 125 people would vote for her in a two-person race, what is the 99% confidence interval for her expected proportion of the vote? Would she be confident of winning based on this poll?
14. Using the data in the Excel file *Accounting Professionals*, find and interpret 95% confidence intervals for the following:
 - a. mean years of service
 - b. proportion of employees who have a graduate degree
15. Find the standard deviation of the total assets held by the bank in the Excel file *Credit Risk Data*.
 - a. Treating the records in the database as a population, use your sample in Problem 2 and compute 90%, 95%, and 99% confidence intervals for the total assets held in the bank by loan applicants using formula (6.2) and any appropriate Excel functions. Explain the differences as the level of confidence increases.
 - b. How do your confidence intervals differ if you assume that the population standard deviation is not known but estimated using your sample data?
16. The Excel file *Restaurant Sales* provides sample information on lunch, dinner, and delivery sales for a local Italian restaurant. Develop 95% confidence intervals for the mean of each of these variables, as well as total sales for weekdays and weekends. What conclusions can you reach?
17. Using the data in the worksheet *Consumer Transportation Survey*, develop 95% confidence intervals for the following:
 - a. the proportion of individuals who are satisfied with their vehicle
 - b. the proportion of individuals who have at least one child
18. The monthly sales of a mobile phone shop have been distributed with a standard deviation of \$900. A statistical study of sales in the last nine months has found a confidence interval for the mean of monthly sales with extremes of \$5663 and \$6839.
 - a. What were the average sales over the nine month period?
 - b. What is the confidence level for this interval?
19. Using data in the Excel file *Colleges and Universities*, find 95% confidence intervals for the median SAT for each of the two groups, liberal arts colleges and research universities. Based on these confidence intervals, does there appear to be a difference in the median SAT scores between the two groups?
20. The Excel file *Baseball Attendance* shows the attendance in thousands at San Francisco Giants' baseball games for the 10 years before the Oakland A's moved to the Bay Area in 1968, as well as the combined attendance for both teams for the next 11 years. Develop 95% confidence intervals for the mean attendance of each of the two groups. Based on these confidence intervals, would you conclude that attendance has changed after the move?

21. A random sample of 100 teenagers was surveyed, and the mean number of songs that they had downloaded from the iTunes store in the past month was 9.4 with the results considered accurate is within 1.4 (18 times out of 20).
- What percent of confidence level is the result?
 - What is the margin of error?
 - What is the confidence interval? Explain.
22. A study of nonfatal occupational injuries in the United States found that about 31% of all injuries in the service sector involved the back. The National Institute for Occupational Safety and Health (NIOSH) recommended conducting a comprehensive ergonomics assessment of jobs and workstations. In response to this information, Mark Glassmeyer developed a unique ergonomic handcart to help field service engineers be more productive and also to reduce back injuries from lifting parts and equipment during service calls. Using a sample of 382 field service engineers who were provided with these carts, Mark collected the following data:

	Year 1 (without Cart)	Year 2 (with Cart)
Average call time	8.27 hours	7.98 hours
Standard deviation call time	1.36 hours	1.21 hours
Proportion of back injuries	0.018	0.010

Find 95% confidence intervals for the average call times and proportion of back injuries in each year. What conclusions would you reach based on your results?

23. Using the data in the worksheet *Consumer Transportation Survey*, develop 95% and 99% prediction intervals for the following:
- the hours per week that an individual will spend in his or her vehicle
 - the number of miles driven per week
24. The Excel file *Restaurant Sales* provides sample information on lunch, dinner, and delivery sales for a local Italian restaurant. Develop 95% prediction intervals for the daily dollar sales of each of these variables and also for the total sales dollars on a weekend day.
25. For the Excel file *Credit Approval Decisions*, find 95% confidence and prediction intervals for the credit scores and revolving balance of homeowners and nonhomeowners. How do they compare?
26. Trade associations, such as the United Dairy Farmers Association, frequently conduct surveys to identify characteristics of their membership. If this organization conducted a survey to estimate the annual per-capita consumption of milk and wanted to be 95% confident that the estimate was no more than ± 0.5 gallon away from the actual average, what sample size is needed? Past data have indicated that the standard deviation of consumption is approximately 6 gallons.
27. If a manufacturer conducted a survey among randomly selected target market households and wanted to be 95% confident that the difference between the sample estimate and the actual market share for its new product was no more than $\pm 2\%$, what sample size would be needed?
28. After regular complaints of tire blowouts on the Yamuna Expressway, in an automotive test conducted by the authorities, the average tire pressure in a sample of 62 tires was found to be 24 pounds per square inch and the standard deviation was 2.1 pound per square inch.
- What is the estimated population standard deviation for this population?
 - Calculate the estimated standard deviation error of the mean.
29. A music company wants to know how the illegal downloading of music online affects CD sales. 600 families are randomly chosen from various parts of a particular country and the number of songs that are downloaded in an hour are noted. The sample mean is 3947 with a sample standard deviation of 104. Determine a 90% confidence interval for this data. (Assume that the population variance is not known.)

Case: Drout Advertising Research Project

The background for this case was introduced in Chapter 1. This is a continuation of the case in Chapter 4. For this part of the case, compute confidence intervals for means and proportions, and analyze the sampling errors, possibly

suggesting larger sample sizes to obtain more precise estimates. Write up your findings in a formal report or add your findings to the report you completed for the case in Chapter 4, depending on your instructor's requirements.

Case: Performance Lawn Equipment

In reviewing your previous reports, several questions came to Elizabeth Burke's mind. Use point and interval estimates to help answer these questions.

1. What proportion of customers rate the company with "top box" survey responses (which is defined as scale levels 4 and 5) on quality, ease of use, price, and service in the *2012 Customer Survey* worksheet? How do these proportions differ by geographic region?
2. What estimates, with reasonable assurance, can PLE give customers for response times to customer service calls?
3. Engineering has collected data on alternative process costs for building transmissions in the worksheet *Transmission Costs*. Can you determine whether one of the proposed processes is better than the current process?
4. What would be a confidence interval for an additional sample of mower test performance as in the worksheet *Mower Test*?
5. For the data in the worksheet *Blade Weight*, what is the sampling distribution of the mean, the overall mean, and the standard error of the mean? Is a normal distribution an appropriate assumption for the sampling distribution of the mean?
6. How many blade weights must be measured to find a 95% confidence interval for the mean blade weight with a sampling error of at most 0.2? What if the sampling error is specified as 0.1?

Answer these questions and summarize your results in a formal report to Ms. Burke.