by the IRS was $11,560. The file Taxes contains the data for the 50 accountants.

a. Compute a new variable that is the difference between the IRS number and the number determined by each accountant.

b. For this new variable computed in part a, develop a frequency distribution.

c. For the new variable computed in part a, determine the mean, median, and standard deviation.

d. Determine the percentile that would correspond to the “correct” tax figure if the IRS figure were one of the CPA firms’ estimated tax figures. Describe what this implies about the agreement between the IRS and consultants’ calculated tax.

VIDEO CASE 3

Drive-Thru Service Times @ McDonald’s

When you’re on the go and looking for a quick meal, where do you go? If you’re like millions of people every day, you make a stop at McDonald’s. Known as “quick service restaurants” in the industry (not “fast food”), companies such as McDonald’s invest heavily to determine the most efficient and effective ways to provide fast, high quality service in all phases of their business.

Drive-thru operations play a vital role. It’s not surprising that attention is focused on the drive-thru process. After all, over 60% of individual restaurant revenues in the United States come from the drive-thru experience. Yet understanding the process is more complex than just counting cars. Marla King, professor at the company’s international training center, Hamburger University, got her start 25 years ago working at a McDonald’s drive-thru. She now coaches new restaurant owners and managers. “Our stated drive-thru service time is 90 seconds or less. We train every manager and team member to understand that a quality customer experience at the drive-thru depends on them,” says Marla. Some of the factors that affect a customers’ ability to complete their purchases within 90 seconds include restaurant staffing, equipment layout in the restaurant, training, and efficiency of the grill team, and frequency of customer arrivals to name a few. Also, customer order patterns also play a role. Some customers will just order drinks, while others seem to need enough food to feed an entire soccer team. And then there are the special orders. Obviously, there is plenty of room for variability here.

Yet that doesn’t stop the company from using statistical techniques to better understand the drive-thru action. In particular, McDonald’s utilizes numerical measures of the center and spread in the data and to help transform the data into useful information. In order for restaurant managers to achieve the goal in their own restaurants, they need training in proper restaurant and drive-thru operations. Hamburger University, McDonald’s training center located near Chicago, Illinois, satisfies that need. In the mock-up restaurant service lab, managers go through a “before and after” training scenario. In the “before” scenario, they run the restaurant for thirty minutes as if they were back in their home restaurants. Managers in the training class are assigned to be crew, customers, drive-thru cars, special needs guests (such as hearing impaired, indecisive, or clumsy), or observers. Statistical data about the operations, revenues, and service times are collected and analyzed. Without the right training, the restaurant’s operations usually start breaking down after 10–15 minutes. After debriefing and analyzing the data collected, the managers make suggestions for adjustments and head back to the service lab to try again. This time, the results usually come in well within standards. “When presented with the quantitative results, managers are pretty quick to make the connections between better operations, higher revenues, and happier customers,” Marla states.

When managers return to their respective restaurants, the training results and techniques are shared with staff who are charged with implementing the ideas locally. The results of the training eventually are measured when McDonald’s conducts a restaurant operations improvement process study, or ROIP. The goal is simple: improved operations. When the ROIP review is completed, statistical analyses are performed and managers are given their results. Depending on the results, decisions might be made that require additional financial resources, building construction, staff training, or reconfiguring layouts. Yet one thing is clear: statistics drive the decisions behind McDonald’s drive-thru service operations.

Discussion Questions:

1. After returning from the training session at Hamburger University, a McDonald’s store owner selected a random sample 362 of drive-thru customers and carefully measured the time it took from when a customer entered the McDonald’s property until the customer had received the order at the drive-thru window. These data are in the file called McDonald’s Drive-Thru Waiting Times. Note, the owner selected some customers during the breakfast period, others during lunch and others during dinner. For the overall sample, compute the key measures of central tendency. Based on these measures, what conclusion might the owner reach with respect to how well his store is doing in meeting the 90 second customer service goal? Discuss.

2. Referring to question 1, compute the key measures of central tendency for drive-thru times broken down by
a. Develop a scatter plot of these data. Determine which variable should be the dependent variable and which should be the independent variable.

b. Based on the scatter plot, what, if any, conclusions might the sales manager reach with respect to the relationship between sales and number of clerk hours worked? Do any stores stand out as being different? Discuss.

Computer Database Exercises

2-74. USA Today reported (Jefferson Graham, “Looks like the new iPod’s a hit,” September 19, 2005) that Apple had 74% of the digital music device market, according to researcher The NPD Group. The NPD Group provides global sales and marketing information that helps clients make more informed, fact-based decisions in order to optimize their businesses. The data in the file entitled Digital provide the brand of digital devices owned by a sample of consumers that would produce the market shares alluded to in the article. Produce a pie chart that represents the market shares obtained from the referenced sample. Indicate the market shares and the identity of those manufacturers in the pie chart.

2-75. The file Home-Prices contains information about single-family housing prices in 100 metropolitan areas in the United States.

a. Construct a frequency distribution and histogram of 1997 median single-family home prices. Use the $2^k/n$ guideline to determine the appropriate number of classes.

b. Construct a cumulative relative frequency distribution and ogive for 1997 median single-family home prices.

c. Repeat parts a and b but this time use half again as many class intervals as recommended by the $2^k/n$ guideline. What was the impact of using more class intervals?

2-76. Elliel’s Department Store tracks its inventory on a monthly basis. Monthly data for the years 1996–2000 are in the file called Elliels.

a. Construct a line chart showing the monthly inventory over the five years. Discuss what this graph implies about inventory.

b. Sum the monthly inventory figures for each year. Then present the sums in bar chart form. Discuss whether you think this is an appropriate graph to describe the inventory situation at Elliels.

2-77. The Energy Information Administration (EIA) surveys the price of diesel fuel. The EIA-888 is a survey of diesel fuel outlet prices from truck stops and service stations across the country. It produces estimates of national and regional prices. The diesel fuel prices that are released are used by the trucking industry to make rate adjustments in hauling contracts. The file entitled DieselS contains the average on-highway diesel prices for each of 53 weeks from September 27, 2004 to September 26, 2005.

a. Construct a histogram with 11 classes beginning at $1.85.

b. Are there any data points that are unusually larger than the rest of the data? In which classes do these points occur? What is the interpretation of this phenomenon?

2-78. The Energy Information Administration published a press release on September 26, 2005 (Paula Weir and Pedro Saavedra, “Two Multi-Phase Surveys That Combine Overlapping Sample Cycles at Phase 1”). The file entitled DieselS contains the average on-highway diesel prices for each of 53 weeks from September 27, 2004 to September 26, 2005. It also contains equivalent information for the state of California, recognized as having the highest national prices.

a. Construct a chart containing line plots for both the national average and California’s diesel prices. Describe the relationship between the diesel prices in California versus the national average.

b. In what week did the California average diesel price surpass $3.00 a gallon?

c. Determine the smallest and largest price paid in California for a gallon of diesel. At what weeks did these occur? Use this information to project when California gas prices might exceed $4.00, assuming a linear trend between California diesel prices and the week in which they occurred.

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Yet that doesn’t stop the company from using statistical techniques to better understand the drive-thru action. In particular, McDonald’s utilizes graphical techniques to display data and to help transform the data into useful information. In order for restaurant managers to achieve the goal in their own restaurants, they need training in proper restaurant and drive-thru operations. Hamburger University, McDonald’s training center located near Chicago, Illinois, satisfies that need. In the mock-up restaurant service lab, managers go through a “before and after” training scenario. In the “before scenario,” they run the restaurant for thirty minutes as if they were back in their home restaurants. Managers in the training class are assigned to be crew, customers, drive-thru cars, special needs guests (such as hearing impaired, indecisive, or clumsy), or observers. Statistical data about the operations, revenues, and service times are collected and analyzed. Without the right training, the restaurant’s operations usually start breaking down after 10–15 minutes. After debriefing and analyzing the data collected, the managers make suggestions for adjustments and head back to the service lab to try again. This time, the results usually come in well within standards. “When presented with the quantitative results, managers are pretty quick to make the connections between better operations, higher revenues, and happier customers,” Marla states.

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**Discussion Questions:**

1. After returning from the training session at Hamburger University, a McDonald’s store owner selected a random sample of 362 drive-thru customers and carefully measured the time it took from when a customer entered the McDonald’s property until the customer had received the order at the drive-thru window. These data are in the file called *McDonald’s Drive-Thru Waiting Times*. Note, the owner selected some customers during the breakfast period, others during lunch and others during dinner. Construct any appropriate graphs and charts that will effectively display these drive-thru data. Prepare a short discussion indicating the conclusions that this store owner might reach after reviewing the graphs and charts you have prepared.

2. Referring to question 1, suppose the manager comes away with the conclusion that his store is not meeting the 90 second customer service goal. As a result he plans to dig deeper into the problem by collecting more data from the drive-thru process. Discuss what other measures you would suggest the manager collect. Discuss how these data could be of potential value in helping the store owner understand his problem.

3. Visit a local McDonald’s that has a drive-thru facility. Randomly sample 20 drive-thru customers and collect the following data:
   a. the total time from arrival on the property to departure from the drive-thru window.
   b. the time from when customers place the order until they receive their order and exit the drive-thru process.
   c. the number of cars in the line when the sampled vehicle enters the drive-thru process.

Using the data that you have collected, construct appropriate graphs and charts to describe these data. Write a short report discussing the data.

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**CASE 2.1**

**Server Downtime**

After getting outstanding grades in high school and scoring very high on his ACT and SAT tests, Clayton Haney had his choice of colleges but wanted to follow his parents legacy and enrolled at Northwestern University. Clayton soon learned that there is a big difference between getting high grades in high school and being a good student. While he was recognized as being quite bright and very quick to pick up on things, he had never learned how to study. As a result,
after slightly more than two years at Northwestern, Clayton was asked to try his luck at another university. To the chagrin of his parents, Clayton decided that college was not for him.

After short stints working for a computer manufacturer and as a manager for a Blockbuster video store, Clayton landed a job working for the EDS company. EDS contracts to support information technology implementation and application for companies in the United States and throughout the world. Clayton had to train himself in virtually all aspects of personal computers and local area networks and was assigned to work for a client in the Chicago area.

Clayton’s first assignment was to research the downtime on one of the client’s primary network servers. He was asked to study the downtime data for the month of April and to make a short presentation to the company’s management. The downtime data are in a file called `Server Downtime`. These data are also shown in Table C-2.1-A. Although Clayton is very good at solving computer problems, he has had no training or experience in analyzing data, so he is going to need some help.

Required Tasks:

a. Construct a frequency distribution showing the number of times during the month that the server was down for each downtime cause category.

b. Develop a bar chart that displays the data from the frequency distribution in part a.

c. Develop a histogram that displays the downtime data.

d. Develop a pie chart that breaks down the percentage of total downtime that is attributed to each downtime cause during the month.

e. Prepare a short written report that discusses the downtime data. Make sure you merge the graphs and charts into the report.

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### CASE 2.2

**Yakima Apples, Inc.**

As a rule, Julie Fredrick preferred to work in the field rather than do “office” work in her capacity as a midlevel manager with Yakima Apples, Inc., a large grower and processor of apples in the state of Washington. However, after just leaving a staff meeting where she was asked to prepare a report of apple consumption in the United States, Julie was actually looking forward to spending some time at her computer “crunching some numbers.” Arden Golchein, senior marketing manager, indicated that he would e-mail her a data file that contained apple consumption data from 1970 through 2002 and told her that he wanted a very nice report using graphs, charts, and tables to describe apple consumption.

When she got to her desk, the e-mail was waiting and she saved the file under the name `Yakima Apples`. These data are also shown in Table C-2.2-A. Julie had done quite a bit of descriptive analysis in her previous job with the Washington State Department of Agriculture, so she had several ideas for types of graphs and tables that she might construct. She began by creating a list of the tasks that she thought would be needed.

Required Tasks:

a. Construct a line chart showing the total annual consumption of apples.

b. Construct one line chart that shows two things: the annual consumption of fresh apples and the annual consumption of processed apples.

c. Construct a line chart that shows the annual consumption for each type of processed apples.

d. Construct a histogram for the total annual consumption of apples.

e. Write a short report that discusses the historical pattern of apple consumption. The report will include all pertinent charts and graphs.