

# INSTRUCTOR'S SOLUTIONS MANUAL

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## BUSINESS STATISTICS: A FIRST COURSE EIGHTH EDITION

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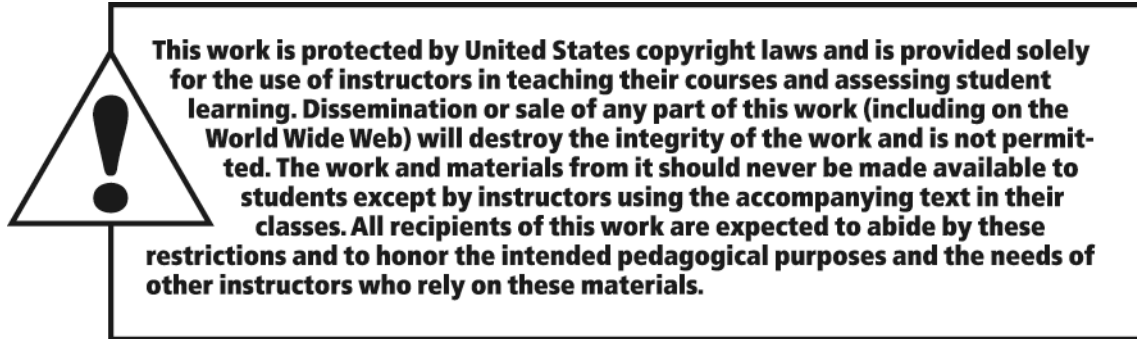
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# Teaching Tips

## Our Starting Point

Over a generation ago, advances in “data processing” led to new business opportunities as first centralized and then desktop computing proliferated. The Information Age was born. Computer science became much more than just an adjunct to a mathematics curriculum, and whole new fields of studies, such as computer information systems, emerged.

More recently, further advances in information technologies have combined with data analysis techniques to create new opportunities in what is more data *science* than data *processing* or *computer science*. The world of business statistics has grown larger, bumping into other disciplines. And, in a reprise of something that occurred a generation ago, new fields of study, this time with names such as informatics, data analytics, and decision science, have emerged.

This time of change makes what is taught in business statistics and how it is taught all the more critical. These new fields of study all share statistics as a foundation for further learning. We are accustomed to thinking about change, as seeking ways to continuously improve the teaching of business statistics have always guided our efforts. We actively participate in Decision Sciences Institute (DSI), American Statistical Association (ASA), and Making Statistics More Effective in Schools and Business (MSMESB) conferences. We use the ASA’s Guidelines for Assessment and Instruction (GAISE) reports and combine them with our experiences teaching business statistics to a diverse student body at several large universities.

What to teach and how to teach it are particularly significant questions to ask during a time of change. As an author team, we bring a unique collection of experiences that we believe helps us find the proper perspective in balancing the old and the new. Our lead author, David M. Levine, was the first educator, along with Mark L. Berenson, to create a business statistics textbook that discussed using statistical software and incorporated “computer output” as illustrations—just the first of many teaching and curricular innovations in his many years of teaching business statistics. Kathryn A. Szabat has provided statistical advice to various business and non-business communities. Her background in statistics and operations research and her experiences interacting with professionals in practice have guided her, as departmental chair, in developing a new, interdisciplinary academic department, Business Systems and Analytics, in response to the technology- and data-driven changes in business today. David F. Stephan, developed courses and teaching methods in computer information systems and digital media during the information revolution, creating, and then teaching in, one of the first personal computer *classrooms* in a large school of business along the way. Early in his career, he introduced spreadsheet

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applications to a business statistics faculty audience that included David Levine, an introduction that would eventually led to the inclusion of Microsoft Excel in this textbook. We also benefit from our many years teaching undergraduate and graduate business subjects and the diversity of interests and efforts of our past co-author, Timothy Krehbiel.

## Educational Philosophy

As in prior editions of *Business Statistics: A First Course*, we are guided by these key learning principles:

1. **Help students see the relevance of statistics to their own careers by providing examples drawn from the functional areas in which they may be specializing.** Students need a frame of reference when learning statistics, especially when statistics is not their major. That frame of reference for business students should be the functional areas of business, such as accounting, finance, information systems, management, and marketing. Each statistics topic needs to be presented in an applied context related to at least one of these functional areas. The focus in teaching each topic should be on its application in business, the interpretation of results, the evaluation of the assumptions, and the discussion of what should be done if the assumptions are violated.
2. **Emphasize interpretation of statistical results over mathematical computation.** Introductory business statistics courses should recognize the growing need to *interpret* statistical results that computerized processes create. This makes the interpretation of results more important than knowing how to execute the tedious hand calculations required to produce them.
3. **Give students ample practice in understanding how to apply statistics to business.** Both classroom examples and homework exercises should involve actual or realistic data as much as possible. Students should work with data sets, both small and large, and be encouraged to look beyond the statistical analysis of data to the interpretation of results in a managerial context.
4. **Familiarize students with how to use statistical software to assist business decision-making.** Introductory business statistics courses should recognize that programs with statistical functions are commonly found on a business decision maker's desktop computer. Integrating statistical software into all aspects of an introductory statistics course allows the course to focus on interpretation of results instead of computations (see point 2).
5. **Provide clear instructions to students for using statistical applications.** Books should explain clearly how to use programs such as Microsoft Excel, JMP, and Minitab, with the study of statistics, without having those instructions dominate the book or distract from the learning of statistical concepts.

## 4 Teaching Tips

### Getting Started: First Things First

In a time of change, you can never know exactly what knowledge and background students bring into an introductory business statistics classroom. Add that to the need to curb the fear factor about learning statistics that so many students begin with, and there's a lot to cover even before you teach your first statistical concept.

We created "First Things First" to meet this challenge. This unit sets the context for explaining what statistics is (not what students may think!) while ensuring that all students share an understanding of the forces that make learning business statistics critically important today. Especially designed for instructors teaching with course management tools, including those teaching hybrid or online courses, "Getting Started" has been developed to be posted online or otherwise distributed before the first class section.

We would argue that the most important class is the first class. First impressions are critically important. You have the opportunity to set the tone to create a new impression that the course will be important to the business education of your students. Make the following points:

- This course is not a math course.
- State that you will be learning analytical skills for making business decisions.
- Explain that the focus will be on how statistics can be used in the functional areas of business.

This book uses a systematic approach for meeting a business objective or solving a business problem. This approach goes across all the topics in the book and most importantly can be used as a framework in real world situations when students graduate. The approach has the acronym **DCOVA**, which stands for **Define, Collect, Organize, Visualize, and Analyze**.

- **Define** the business objective or problem to be solved and then define the variables to be studied.
- **Collect** the data from appropriate sources
- **Organize** the data
- **Visualize** the data by developing charts
- **Analyze** the data by using statistical methods to reach conclusions.

You can begin by emphasizing the importance of defining your objective or problem. Then, discuss the importance of operational definitions of variables to be considered and define variable, data, and statistics.

Just as computers are used not just in the computer course, students need to know that statistics is used not just in the statistics course. This leads you to a discussion of business analytics in which data is used to make decisions. Make the point that analytics should be part of the competitive strategy of every



organization especially since “big data”, meaning data collected in huge volumes at very fast rates, needs to be analyzed.

1. Inform the students that there is an Excel Guide, a JMP Guide, and a Minitab Guide at the end of each chapter. Strongly encourage or require students to read the Excel Guide and/or the JMP Guide or Minitab Guide at the end of this chapter so that they will be ready to use Excel and/or JMP or Minitab with this book.

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### Chapter 1

You need to continue the discussion of the Define task by establishing the types of variables. Mention the importance of having an operational definition for each variable. Be sure to discuss the different types carefully since the ability to distinguish between categorical and numerical variables will be crucial later in the course. Go over examples of each type of variable and have students provide examples of each type. Then, if you wish, you can cover the different measurement scales.

Then move on to the C of the DCOVA approach, collecting data. Mention the different sources of data and make sure to cover the fact that data often needs to be cleaned of errors. Then, you could spend some time discussing sampling, even if it is just using the table of random numbers to select a random sample. You may want to take a bit more time and discuss the types of survey sampling methods and issues involved with survey sampling results. The *Think About This* essay discusses the important issue of the use of Web-based surveys.

There is also a section on Data Cleaning that discusses the issues that occur in data collection. This is followed by a section on data formatting that includes the important concepts of stacking and unstacking variables and recoding variables. The last section discusses the types of errors that occur in surveys.

The chapter also introduces three continuing cases -- the *Managing Ashland MultiComm Services*, *CardioGood Fitness*, and *Clear Mountain State Student Surveys* that appear at the end of many chapters. The Digital cases are introduced in this chapter also. In these cases, students visit Web sites related to companies and issues raised in the Using Statistics scenarios that start each chapter. The goal of the Digital cases is for students to develop skills needed to identify misuses of statistical information. As would be the situation with many real world cases, in Digital cases, students often need to sift through claims and assorted information in order to discover the data most relevant to a case task. They will then have to examine whether the conclusions and claims are supported by the data. (Instructional tips for using the *Managing Ashland MultiComm Services*, and Digital cases and solutions to the *Managing Ashland MultiComm Service*, *CardioGood Fitness*, *Clear Mountain State Student Surveys*, and Digital cases are included in this *Instructor's Solutions Manual*.).

Make sure that students read the Excel Guide and/or JMP Guide or Minitab Guide at the end of each chapter. The *In-Depth Excel* instructions provide step-by-step instructions and live worksheets that automatically update when data changes. The *PHStat add-in* instructions provide instructions for using the PHStat add-in. *Analysis ToolPak* instructions provide instructions for using the Analysis ToolPak, the Excel add-in package that is included with many versions of Excel.

## Chapter 2

This chapter moves on to the organizing and visualizing steps of the DCOVA framework. If you are going to collect sample data to use in Chapters 2 and 3, you can illustrate sampling by conducting a survey of students in your class. Ask each student to collect his or her own personal data concerning the time it takes to get ready to go to class in the morning or the time it takes to get to school or home from school. First, ask the students to write down a definition of how they plan to measure this time. Then, collect the various answers and read them to the class. Then, a single definition could be provided (such as the time to get ready is the time measured from when you get out of bed to when you leave your home, recorded to the nearest minute). In the next class, select a random sample of students and use the data collected (depending on the sample size) in class when Chapters 2 and 3 are discussed. Then, move on to the Organize step that involves setting up your data in an Excel, JMP, Minitab, or Tableau. Show the summary worksheet and develop tables to help you prepare charts and analyze your data. Begin your discussion for categorical data with the example on p. 45 concerning the percentage of the time millennials use different devices for watching television and then if you wish, explain that you can sometimes organize the data into a two-way table that has one variable in the row and another in the column.

Continue with organizing data (but now for numerical data) by referring to the cost of a restaurant meal on p. 49. Show the simple ordered array and how a frequency distribution, percentage distribution, or cumulative distribution can summarize the raw data in a way that is more useful. Now you are ready to tackle the Visualize step. A good way of starting this part of the chapter is to display the following quote.

"A picture is worth a thousand words."

Students will almost certainly be familiar with Microsoft® Word and may have already used Excel to construct charts that they have pasted into Word documents. Now you will be using Excel or JMP or Minitab or Tableau to construct many different types of charts. Return to the data previously discussed on what devices millennials use to watch television and illustrate how a bar chart and pie chart can be constructed. Mention their advantages and disadvantages. A good example is to show the data on incomplete ATM transactions on p. 60 and how the Pareto chart enables you to focus on the vital few categories. If time permits, you can discuss the side-by-side bar chart for a contingency table.

To examine charts for numerical variables you can either use the restaurant data previously mentioned or data that you have collected from your class. You may want to begin with a simple stem-and-leaf display that both organizes the data and shows a bar type chart. Then move on to the histogram and the various polygons, pointing out the advantages and disadvantages of each.

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If time permits, you can discuss the scatter plot and the time-series plot for two numerical variables. Otherwise, you can wait until you get to regression analysis. Also, you may want to discuss how multidimensional tables allow you to see several variables simultaneously.

If the opportunity is available, we believe that it is worth the time to cover Section 2.9 on Pitfalls in Organizing and Visualizing Data. This is a topic that students very much enjoy since it allows for a great deal of classroom interaction. After discussing the fundamental principles of good graphs, try to illustrate the improper display shown in Figure 2.31. Ask students what is “bad” about this figure. Follow up with a homework assignment involving Problems 2.69 – 2.73 (*USA Today* is a great source).

You will find that the chapter review problems provide large data sets with numerous variables. Report writing exercises provide the opportunity for students to integrate written and/or oral presentation with the statistics they have learned.

The *Managing Ashland MultiComm Services* case enables students to examine the use of statistics in an actual business environment. The Digital case refers to the EndRun Financial Services and claims that have been made. The CardioGood Fitness case focuses on developing a customer profile for a market research team. The Choice *Is* Yours Follow-up expands on the chapter discussion of the mutual funds data. The Clear Mountain State Student Survey provides data collected from a sample of undergraduate students and a separate sample of graduate students.

The Excel Guide and the JMP and Minitab and Tableau Guides for this and the remaining chapters are organized according to the sections of the chapter. They are quite extensive since they cover both organizing and visualizing many different graphs. The Excel Guide includes instructions for In-Depth Excel, PHStat, and the Analysis ToolPak. Pick and allows you to choose the approaches that you prefer.

## Chapter 3

This chapter on descriptive numerical statistical measures represents the initial presentation of statistical symbols in the text. Students who need to review arithmetic and algebraic concepts may wish to refer to Appendix A for a quick review or to appropriate texts (see [www.pearson.com](http://www.pearson.com)) or videos ([www.videoaidedinstruction.com](http://www.videoaidedinstruction.com)). Once again, as with the tables and charts constructed for numerical data, it is useful to provide an interesting set of data for classroom discussion. If a sample of students was selected earlier in the semester and data concerning student time to get ready or commuting time were collected (see Chapters 1 and 2), use these data in developing the numerous descriptive summary measures in this chapter. (If they have not been developed, use other data for classroom illustration.)

Discussion of the chapter begins with the property of central tendency. We have found that almost all students are familiar with the arithmetic mean (which they know as the average) and most students are familiar with the median. A good way to begin is to compute the mean for your classroom example. Emphasize the effect of extreme values on the arithmetic mean and point out that the mean is like the center of a seesaw -- a balance point. Note that you will return to this concept later when you discuss the variance and the standard deviation. You might want to introduce summation notation at this point and express the arithmetic mean in formula notation as in Equation (3.1). (Alternatively, you could wait until you cover the variance and standard deviation.) A classroom example in which summation notation is reviewed is usually worthwhile. Remind the students again that Appendix A includes a review of arithmetic and algebra and summation notation [or refer them to other text sources such as those found at [www.pearson.com](http://www.pearson.com) or videos (see [www.videoaidedinstruction.com](http://www.videoaidedinstruction.com))].

The next statistic to compute is the median. Be sure to remind the students that the median as a measure of position must have all the values ranked in order from lowest to highest. Be sure to have the students compare the arithmetic mean to the median and explain that this tells us something about another property of data (skewness). Following the median, the mode can be briefly discussed. Once again, have the students compare this result to those of the arithmetic mean and median for your data set. If time permits, you can also discuss the geometric mean which is heavily used in finance.

The completion of the discussion of central tendency leads to the second characteristic of data, variability. Mention that all measures of variation have several things in common: (1) they can never be negative, (2) they will be equal to 0 when all values are the same, (3) they will be small when there isn't much variation, and (4) they will be large when there is a great deal of variation.

The first measure of variability to consider is the simplest one, the range. Be sure to point out that the range only provides information about the extremes, not about the distribution between the extremes.

Point out that the range lacks one important ingredient, the ability to take into account each data value. Bring up the idea of computing the differences around the mean, but then return to the fact that as

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the balance point of the seesaw, these differences add up to zero. At that point, ask the students what they can do mathematically to remove the negative sign for some of the values. Most likely, they will answer by telling you to square them (although someone may realize that the absolute value could be taken). Next, you may want to define the squared differences as a sum of squares. Now you need to have the students realize that the number of values being considered affects the magnitude of the sum of squared differences. Therefore, it makes sense to divide by the number of values and compute a measure called the variance. If a population is involved, you divide by  $N$ , the population size, but if you are using a sample, you divide by  $n - 1$ , to make the sample result a better estimate of the population variance. You can finish the development of variation by noting that since the variance is in squared units, you need to take the square root to compute the standard deviation.

Another measure of variation that can be discussed is the coefficient of variation. Be sure to illustrate the usefulness of this as a measure of relative variation by using an example in which two data sets have vastly different standard deviations, but also vastly different means. A good example is one that involves the volatility of stock prices. Point out that the variation of the price should be considered in the context of the magnitude of the arithmetic mean. By changing values in the data provided, students can observe how the mean, median, and standard deviation are affected.

The final measure of variation is the  $Z$  score. Point out that this provides a measure of variation in standard deviation units. You can also say that you will return to  $Z$  scores in Chapter 6 when the normal distribution will be discussed.

You are now ready to move on to the third characteristic of data, shape. Be sure to clearly define and illustrate both symmetric and skewed distributions by comparing the mean and median. You may also want to briefly mention the property of kurtosis which is the relative concentration of values in the center of the distribution as compared to the tails. This statistic is provided by Excel through an Excel function or the Analysis Toolpak and by JMP or Minitab. Once these three characteristics have been discussed, you are ready to show how they can be computed using Excel or JMP or Minitab.

Now that these measures are understood, you can further explore data by computing the quartiles, the interquartile range, the five number summary, and constructing a boxplot. You begin by determining the quartiles. Reference here can be made to the standardized exams that most students have taken, and the quantile scores that they have received (97th percentile, 48th percentile, 12th percentile, ..., etc.). Explain that the 1<sup>st</sup> and 3<sup>rd</sup> quartiles are merely two special quantiles -- the 25th and 75th, that unlike the median (the 2<sup>nd</sup> quartile), are not at the center of the distribution. Once the quartiles have been computed, the interquartile range can be determined. Mention that the interquartile range computes the variation in the center of the distribution as compared to the difference in the extremes computed by the range.

You can then discuss the five-number summary of minimum value, first quartile, median, third quartile, and maximum value. Then, you construct the boxplot. Present this plot from the perspective of serving as a tool for determining the location, variability, and symmetry of a distribution by visual inspection, and as a graphical tool for comparing the distribution of several groups. It is useful to display Figure 3.9 on page 142 that indicates the shape of the boxplot for four different distributions. Then, use PHStat or JMP or Minitab or Tableau to construct a boxplot. Note that you can construct the boxplot for a single group or for multiple groups.

If you desire, you can discuss descriptive measures for a population and introduce the empirical rule and the Chebyshev rule.

If time permits, and you have covered scatter plots in Chapter 2, you can briefly discuss the covariance and the coefficient of correlation as a measure of the strength of the association between two numerical variables. Point out that the coefficient of correlation has the advantage as compared to the covariance of being on a scale that goes from  $-1$  to  $+1$ . Figure 3.11 on p. 157 is useful in depicting scatter plots for different coefficients of correlation.

Once again, you will find that the chapter review problems provide large data sets with numerous variables.

The *Managing Ashland MultiComm Services* case enables students to examine the use of descriptive statistics in an actual business environment. The Digital case continues the evaluation of the EndRun Financial Services discussed in the Digital case in Chapter 2. The CardioGood Fitness case focuses on developing a customer profile for a market research team. More Descriptive Choices Follow-up expands on the discussion of the mutual funds data. The Clear Mountain State Student Survey provides data collected from a sample of undergraduate students and a separate sample of graduate students.

The Excel Guide for the chapter includes instructions on using different Excel functions to compute various statistics. Alternatively, you can use PHStat or the Analysis ToolPak to compute a list of statistics. PHStat can be used to construct a boxplot. Or you can use JMP or Minitab. The Tableau guide covers the five number summary and the boxplot

### Chapter 4

The chapter on probability represents a bridge between the descriptive statistics already covered and the topics of statistical inference and regression to be covered in subsequent chapters. In many traditional statistics courses, often a great deal of time is spent on probability topics that are of little direct applicability in basic statistics. The approach in this text is to cover only those topics that are of direct applicability in the remainder of the text.

You need to begin with a relatively concise discussion of some probability rules. Essentially, students really just need to know that (1) no probability can be negative, (2) no probability can be more than 1, and (3) the sum of the probabilities of a set of mutually exclusive events adds to 1.0. Students often understand the subject best if it is taught intuitively with a minimum of formulas, with an example that relates to a business application shown as a two-way contingency table (see the Using Statistics example). If desired, you can use In-Depth Excel or PHStat to compute probabilities from the contingency table.

Once these basic elements of probability have been discussed, if there is time and you desire, conditional probability and Bayes' theorem can be covered. The *Think About This* concerning email SPAM is a wonderful way of helping students realize the application of probability to everyday life. In addition, you may wish to spend a bit of time going over counting rules, especially if the binomial distribution will be covered in Chapter 5.

Be aware that in a one-semester course where time is particularly limited, these topics may be of marginal importance. The Digital case in this chapter extends the evaluation of the EndRun Financial Services to consider claims made about various probabilities. The CardioGood Fitness, More Descriptive Choices Follow-up, and Clear Mountain State Student Survey each involve developing contingency tables to be able to compute and interpret conditional and marginal probabilities.



## Chapter 5

Now that the basic principles of probability have been discussed, the probability distribution is developed and the expected value and variance (and standard deviation) are computed and interpreted. Given that a probability distribution has been defined, you can now discuss some specific distributions. Although every introductory course undoubtedly covers the normal distribution to be discussed in Chapter 6, the decision about whether to cover the binomial or Poisson distributions is a matter of personal choice and depends on whether the course is part of a two-course sequence.

If the binomial distribution is covered, an interesting way of developing the binomial formula is to follow the Using Statistics example that involves an accounting information system. Note, in this example, the value for  $p$  is 0.10. (It is best not to use an example with  $p = 0.50$  since this represents a special case). The discussion proceeds by asking how you could get three tagged order forms in a sample of 4. Usually a response will be elicited that provides three items of interest out of four selections in a particular order such as Tagged Tagged Not Tagged Tagged. Ask the class, what would be the probability of getting Tagged on the first selection? When someone responds 0.1, ask them how they found that answer and what would be the probability of getting Tagged on the second selection. When they answer 0.1 again, you will be able to make the point that in saying 0.1 again, they are assuming that the probability of Tagged stays constant from trial to trial. When you get to the third selection and the students respond 0.9, point out that this is a second assumption of the binomial distribution -- that only two outcomes are possible -- in this case Tagged and Not Tagged, and the sum of the probabilities of Tagged and Not Tagged must add to 1.0. Now you can compute the probability of three out of four in this order by multiplying  $(0.1)(0.1)(0.9)(0.1)$  to get 0.0036. Ask the class if this is the answer to the original question. Point out that this is just one way of getting three Tagged out of four selections in a specific order, and, that there are four ways to get three Tagged out of four selections. This leads to the development of the binomial formula Equation (5.4). You might want to do another example at this point that calls for adding several probabilities such as three or more Tagged, less than three Tagged, etc. Complete the discussion of the binomial distribution with the computation of the mean and standard deviation of the distribution. Be sure to point out that for samples greater than five, computations can become unwieldy and the student should use PHStat, an Excel function, the binomial tables (See the Online **Binomial.pdf** tables), JMP, or Minitab.

Once the binomial distribution has been covered, if time permits, other discrete probability distributions can be presented. If you cover the Poisson distribution, point out the distinction between the binomial and Poisson distributions. Note that the Poisson is based on an area of opportunity in which you are counting occurrences within an area such as time or space. Contrast this with the binomial distribution in which each value is classified as of interest or not of interest. Point out the equations for the mean and

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standard deviation of the Poisson distribution and indicate that the mean is equal to the variance. Since the computation of probabilities from these discrete probability distributions can become tedious for other than small sample sizes, it is important to discuss PHStat, an Excel function the Poisson tables (See the Online **Poisson.pdf** tables) or JMP or Minitab.

The *Managing Ashland MultiComm Services* case for this chapter relates to the binomial distribution. The Digital case involves the expected value and standard deviation of a probability distribution and applications of the covariance in finance.

## Chapter 6

Now that probability and probability distributions have been discussed in Chapters 4 and 5, you are ready to introduce the normal distribution. We recommend that you begin by mentioning some reasons that the normal distribution is so important and discuss several of its properties. We would also recommend that you do not show Equation (6.1) in class as it will just intimidate some students. You might begin by focusing on the fact that any normal distribution is defined by its mean and standard deviation and display Figure 6.3 on p. 234. Then, an example can be introduced and you can explain that if you subtracted the mean from a particular value, and divided by the standard deviation, the difference between the value and the mean would be expressed as a standardized normal or  $Z$  score that was discussed in Chapter 3. Next, use Table E.2, the cumulative normal distribution, to find probabilities under the normal curve. In the text, the cumulative normal distribution is used since this table is consistent with results provided by Excel, JMP, and Minitab. Make sure that all the students can find the appropriate area under the normal curve in their cumulative normal distribution tables. If anyone cannot, show them how to find the correct value. Be sure to remind the class that since the total area under the curve adds to 1.0, the word area is synonymous with the word probability. Once this has been accomplished, a good approach is to work through a series of examples with the class, having a different student explain how to find each answer. The example that will undoubtedly cause the most difficulty will be finding the values corresponding to known probabilities. Slowly go over the fact that in this type of example, the probability is known and the  $Z$  value needs to be determined, which is the opposite of what the student has done in previous examples. Also point out that in cases in which the unknown  $X$  value is below the mean, the negative sign must be assigned to the  $Z$  value. Once the normal distribution has been covered, you can use PHStat, or various Excel functions or JMP or Minitab to compute normal probabilities. You can also use the Visual Explorations in Statistics Normal distribution procedure on p. 239. This will be useful if you intend to use examples that explore the effect on the probabilities obtained by changing the  $X$  value, the population mean,  $\mu$ , or the standard deviation,  $\sigma$ . The *Think About This* essay provides a historical perspective of the application of the normal distribution.

If you have sufficient time in the course, the normal probability plot can be discussed. Be sure to note that all the data values need to be ranked in order from lowest to highest and that each value needs to be converted to a normal score. Again, you can either use PHStat to generate a normal probability plot, use Excel functions with Excel charts, or use JMP or Minitab.

The *Managing Ashland MultiComm Services* case for this chapter relates to the normal distribution. The Digital case involves the normal distribution and the normal probability plot. The CardioGood Fitness, More Descriptive Choices Follow-up, and Clear Mountain State Student Survey each involve developing normal probability plots.

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### Chapter 7

The coverage of the normal distribution in Chapter 6 flows into a discussion of sampling distributions. Point out the fact that the concept of the sampling distribution of a statistic is important for statistical inference. Make sure that students realize that problems in this section will find probabilities concerning the mean, not concerning individual values. It is helpful to display Figure 7.4 on p. 265 to show how the Central Limit Theorem applies to different shaped populations. A useful classroom or homework exercise involves using PHStat, Excel, or JMP or Minitab to form sampling distributions. This reinforces the concept of the Central Limit Theorem.

The *Managing Ashland MultiComm Services* case for this chapter relates to the sampling distribution of the mean. The Digital case also involves the sampling distribution of the mean.

You might want to have students experiment with using the Visual Explorations add-in workbook to explore sampling distributions. You can also use either Excel functions, the PHStat add-in, the Analysis ToolPak, or JMP or Minitab to develop sampling distribution simulations.

## Chapter 8

You should begin this chapter by reviewing the concept of the sampling distribution covered in Chapter 7. It is important that the students realize that (1) an interval estimate provides a range of values for the estimate of the population parameter, (2) you can never be sure that the interval developed does include the population parameter, and (3) the proportion of intervals that include the population parameter within the interval is equal to the confidence level.

Note that the Using Statistics example for this chapter, which refers to the Ricknel Home Centers is actually a case study that relates to every part of the chapter. This scenario is a good candidate for use as the classroom example demonstrating an application of statistics in accounting. It also enables you to use the DCOVA approach of Define, Collect, Organize, Visualize, and Analyze in the context of statistical inference.

When introducing the  $t$  distribution for the confidence interval estimate of the population mean, be sure to point out the differences between the  $t$  and normal distributions, the assumption of normality, and the robustness of the procedure. It is useful to display Table E.3 in class to illustrate how to find the critical  $t$  value. When developing the confidence interval for the proportion, remind the students that the normal distribution may be used here as an approximation to the binomial distribution as long as the assumption of normality is valid [when  $n\pi$  and  $n(1 - \pi)$  are at least 5].

Having covered confidence intervals, you can move on to sample size determination by turning the initial question of estimation around, and focusing on the sample size needed for a desired confidence level and width of the interval. In discussing sample size determination for the mean, be sure to focus on the need for an estimate of the standard deviation. When discussing sample size determination for the proportion, be sure to focus on the need for an estimate of the population proportion and the fact that a value of  $\pi = 0.5$  can be used in the absence of any other estimate.

Since the formulas for the confidence interval estimates and sample sizes discussed in this chapter are straightforward, using PHStat or In-Depth Excel can remove much of the tedious nature of these computations or you can use JMP or Minitab.

The *Managing Ashland MultiComm Services* case for this chapter involves developing various confidence intervals and interpreting the results in a marketing context. The Digital case also relates to confidence interval estimation. This chapter marks the first appearance of the Sure Value Convenience Store case which places the student in the role of someone working in the corporate office of a nationwide convenience store franchise. This case will appear in the next two chapters, Chapters 9 – 10. The CardioGood Fitness, More Descriptive Choices Follow-up, and Clear Mountain State Student Survey each involve developing confidence interval estimates.

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You can use either Excel functions, the PHStat add-in, or JMP or Minitab to construct confidence intervals for means and proportions and either Excel functions or the PHStat add-in to determine the sample size for means and proportions.

## Chapter 9

A good way to begin the chapter is to focus on the reasons that hypothesis testing is used. We believe that it is important for students to understand the logic of hypothesis testing before they delve into the details of computing test statistics and making decisions. If you begin with the Using Statistics example concerning the filling of cereal boxes, slowly develop the rationale for the null and alternative hypotheses. Ask the students what conclusion they would reach if a sample revealed a mean of 200 grams (They will all say that something is the matter) and if a sample revealed a mean of 367.99 grams (Almost all will say that the difference between the sample result and what the mean is supposed to be is so small that it must be due to chance). Be sure to make the point out that hypothesis testing allows you to take away the decision from a person's subjective judgment, and enables you to make a decision while at the same time quantifying the risks of different types of incorrect decisions. Be sure to go over the meaning of the Type I and Type II errors, and their associated probabilities  $\alpha$  and  $\beta$  along with the concept of statistical power.

Set up an example of a sampling distribution such as Figure 9.1 on p. 317, and show the regions of rejection and nonrejection. Explain that the sampling distribution and the test statistic involved will change depending on the characteristic being tested. Focus on the situation where  $\sigma$  is unknown if you have numerical data. Emphasize that  $\sigma$  is virtually never known. It is also useful at this point to introduce the concept of the  $p$ -value approach as an alternative to the classical hypothesis testing approach. Define the  $p$ -value and use the phrase given in the text “If the  $p$ -value is low,  $H_0$  must go.” and the rules for rejecting the null hypothesis and indicate that the  $p$ -value approach is a natural approach when using Excel or JMP or Minitab, since the  $p$ -value can be determined by using PHStat, Excel functions, the Analysis Toolpak, or JMP or Minitab.

Once the initial example of hypothesis testing has been developed, you need to focus on the differences between the tests used in various situations. The Chapter 9 summary table is useful for this since it presents a roadmap for determining which test is used in which circumstance. Be sure to point out that one-tail tests are used when the alternative hypothesis involved is directional (e.g.,  $\mu > 368$ ,  $\mu < 0.20$ ). Examine the effect on the results of changing the hypothesized mean or proportion.

The *Managing Ashland MultiComm Services* case, Digital case, and the Sure Value Convenience Store case each involves the use of the one-sample test of hypothesis for the mean.

You can use either Excel functions, the PHStat add-in, or JMP or Minitab to carry out the hypothesis tests for means and proportions.

## Chapter 10

This chapter discusses tests of hypothesis for the differences between two or more groups. The chapter begins with  $t$  tests for the difference between the means, then covers the  $Z$  test for the difference between two proportions, the  $F$  test for the ratio of two variances, and concludes with one-way ANOVA.

The first test of hypothesis covered is usually the test for the difference between the means of two groups for independent samples. Point out that the test statistic involves pooling of the sample variances from the two groups and assumes that the population variances are the same for the two groups. Students should be familiar with the  $t$  distribution, assuming that the confidence interval estimate for the mean has been previously covered. Point out that a stem-and-leaf display, a boxplot, or a normal probability plot can be used to evaluate the validity of the assumptions of the  $t$  test for a given set of data. This allows you to once again use the DCOVA approach of Define, Collect, Organize, Visualize, and Analyze to meet a business objective.

Once the  $t$  test has been discussed, you can use the Excel worksheets provided with the In-Depth Excel approach, PHStat, the Analysis Toolpak, or JMP or Minitab to determine the test statistic and  $p$ -value. Mention that if the variances are not equal, a separate variance  $t$  test can be conducted. The *Think About This* essay is a wonderful example of how the two-sample  $t$  test was used to solve a business problem that a student had after she graduated and had taken the introductory statistics course.

At this point, having covered the test for the difference between the means of two independent groups, if you have time in your course, you can discuss a test that examines differences in the means of two paired or matched groups. The key difference is that the focus in this test is on differences between the values in the two groups, since the data have been collected from matched pairs or repeated measurements on the same individuals or items. Once the paired  $t$  test has been discussed, the In-Depth Excel approach, PHStat, the Analysis Toolpak, or JMP or Minitab can be used to determine the test statistic and  $p$ -value.

You can continue the coverage of differences between two groups by testing for the difference between two proportions. Be sure to review the difference between numerical and categorical data emphasizing the categorical variable used here classifies each observation as of interest or not of interest. Make sure that the students realize that the test for the difference between two proportions follows the normal distribution. A good classroom example involves asking the students if they enjoy shopping for clothing and then classifying the yes and no responses by gender. Since there will often be a difference between males and females, you can then ask the class how we might go about determining whether the results are statistically significant.

The  $F$ -test for the variances can be covered next. Be sure to carefully explain that this distribution, unlike the normal and  $t$  distributions, is not symmetric and cannot have a negative value



since the statistic is the ratio of two variances. Remind the students that the larger variance is in the numerator. Be sure to mention that a boxplot of the two groups and normal probability plots can be used to determine the validity of the assumptions of the  $F$  test. This is particularly important here since this test is sensitive to non-normality in the two populations. The In-Depth Excel approach, PHStat, the Analysis Toolpak, or JMP or Minitab can be used to determine the test statistic and  $p$ -value.

If the one-way ANOVA  $F$  test for the difference between  $c$  means is to be covered in your course, a good way to start is to go back to the sum of squares concept that was originally covered when the variance and standard deviation were introduced in Section 3.2. Explain that in the one-way Analysis of Variance, the sum of squared differences around the overall mean can be divided into two other sums of squares that add up to the total sum of squares. One of these measures differences among the means of the groups and thus is called sum of squares among groups ( $SSA$ ), while the other measures the differences within the groups and is called the sum of squares within the groups ( $SSW$ ). Be sure to remind the students that, since the variance is a sum of squares divided by degrees of freedom, a variance among the groups and a variance within the groups can be computed by dividing each sum of squares by the corresponding degrees of freedom. Make the point that the terminology used in the Analysis of Variance for variance is Mean Square, so the variances computed are called  $MSA$ ,  $MSW$ , and  $MST$ . This will lead to the development of the  $F$  statistic as the ratio of two variances. A useful approach at this point when all formulas are defined, is to set up the ANOVA summary table. Try to minimize the focus on the computations by reminding students that the Analysis of Variance computations can be done using In-Depth Excel, PHStat, the Analysis Toolpak, or JMP or Minitab. It is also useful to show how to obtain the critical  $F$  value by either referring to Table E.5 or the Excel or JMP or Minitab results. Be sure to mention the assumptions of the Analysis of Variance and that the boxplot and normal probability plot can be used to evaluate the validity of these assumptions for a given set of data. Levene's test can be used to test for the equality of variances.

Once the Analysis of Variance has been covered, if time permits (which it may not in a one-semester course), you will want to determine which means are different. Although many approaches are available, this text uses the Tukey-Kramer procedure that involves the Studentized range statistic shown in Table E.7. Be sure that students compare each paired difference between the means to the critical range. Note that you can use In-Depth Excel, PHStat, or JMP or Minitab to compute Tukey-Kramer multiple comparisons.

Be aware that the *Managing Ashland MultiComm Services* case, since it contains both independent sample and matched sample aspects, involves all the sections of the chapter except the test for the difference between two proportions. The Digital case is based on two independent samples and on one-way ANOVA. The Sure Value Convenience Store case now involves a decision between two prices

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for coffee and also between four prices of coffee. The CardioGood Fitness, More Descriptive Choices Follow-up, and Clear Mountain State Student Survey each involve the determination of differences between two or more groups on both numerical and categorical variables.

You can use either Excel functions, the PHStat add-in, the Analysis ToolPak, or JMP or Minitab to carry out the hypothesis tests for the differences between means and variances for the paired  $t$  test, and one-way ANOVA. You can also use Excel functions, the PHStat add-in, or JMP or Minitab to carry out the hypothesis test for the differences between two proportions.

## Chapter 11

This chapter covers chi-square tests. The Using Statistics example concerning hotels relates to the first three sections of the chapter.

If you covered the  $Z$  test for the difference between two proportions in Chapter 10, you can return to the example you used there and point out that the chi-square test can be used as an alternative. A good classroom example involves asking the students if they enjoy shopping for clothing and then classifying the yes and no responses by gender. Since there will often be a difference between males and females, you can then ask the class how they might go about determining whether the results are statistically significant. The expected frequencies are computed by finding the mean proportion of items of interest (enjoying shopping) and items not of interest (not enjoying shopping) and multiplying by the sample sizes of males and females respectively. This leads to the computation of the test statistic. Once again as with the case of the normal,  $t$ , and  $F$  distribution, be sure to set up a picture of the chi-square distribution with its regions of rejection and non-rejection and critical values. In addition, go over the assumptions of the chi square test including the requirement for an expected frequency of at least five in each cell of the  $2 \times 2$  contingency table.

Now you are ready to extend the chi-square test to more than two groups. Be sure to discuss the fact that with more than two groups, the number of degrees of freedom will change and the requirements for minimum cell expected frequencies will be somewhat less restrictive. If you have time, you can develop the Marascuilo procedure to determine which groups differ.

The discussion of the chi-square test concludes with the test of independence in the  $r$  by  $c$  table. Be sure to go over the interpretation of the null and alternative hypotheses and how they differ from the situation in which there are only two rows.

The *Managing Ashland MultiComm Services* case extends the survey discussed in Chapter 8 to analyze data from contingency tables. The Digital case also involves analyzing various contingency tables. The Sure Value Convenience Store case and the CardioGood Fitness case now involve using the Kruskal-Wallis test instead of the one-way ANOVA, The More Descriptive Choices Follow-up and Clear Mountain State Student Survey cases involve both contingency tables and nonparametric tests.

You can use In-Depth Excel, PHStat, JMP, or Minitab for testing differences between the proportions and for tests of independence.

## Chapter 12

Regression analysis is probably the most widely used and misused statistical method in business and economics. In an era of easily available statistical and spreadsheet applications, we believe that the best approach is one that focuses on the interpretation of regression results obtained from such applications, the assumptions of regression, how those assumptions can be evaluated, and what can be done if they are violated. Although we also feel that might be useful for students to work out at least one *small* example with the aid of a hand calculator, we believe that there should be minimal focus on hand calculations.

A good way to begin the discussion of regression analysis is to focus on developing a model that can provide a better prediction of a variable of interest. The Using Statistics example, which forecasts sales for a clothing store, is useful for this purpose. You can extend the DCOVA approach discussed earlier by defining the business objective, discussing data collection, and data organization before moving on to the visualization and analysis in this chapter. Be sure to clearly define the dependent variable and the independent variable at this point.

Once the two types of variables have been defined, the example should be introduced. Explain the goal of the analysis and how regression can be useful. Follow this with a scatter plot of the two variables. Before developing the Least Squares method, review the straight-line formula and note that different notation is used in statistics for the intercept and the slope than in mathematics. At this point, you need to develop the concept of how the straight line that best fits the data can be found. One approach involves plotting several lines on a scatter plot and asking the students how they can determine which line fits the data better than any other. This usually leads to a criterion that minimizes the differences between the actual  $Y$  value and the value that would be predicted by the regression line. Remind the class that when you computed the mean in Chapter 3, you found out that the sum of the differences around the mean was equal to zero. Tell the class that the regression line in two dimensions is similar to the mean in one dimension, and that the differences between the actual  $Y$  value and the value that would be predicted by the regression line will sum to zero. Students at this point, having covered the variance, will usually tell you just to square the differences. At this juncture, you might want to substitute the regression equation for the predicted value, and tell the students that since you are minimizing a quantity, derivatives are used. We discourage you from doing the actual proof, but mentioning derivatives may help some students realize that the calculus they may have learned in mathematics courses is actually used to develop the theory behind the statistical method. The least-squares concepts discussed can be reinforced by using the Visual Explorations in Statistics Simple Linear Regression procedure on p. 493. This procedure produces a scatter plot with an unfitted line of regression and a floating control panel of controls with which to adjust the line. The spinner buttons can be used to change the values of the slope and  $Y$  intercept to

change the line of regression. As these values are changed, the difference from the minimum  $SSE$  changes.

The solution obtained from the Least Squares method allows you to find the slope and  $Y$  intercept. In this text, since the emphasis is on the interpretation of computer output, focus is now on finding the regression coefficients on the output shown in Figure 12.4 on p. 455. Once this has been done, carefully review the meaning of these regression coefficients in the problem involved. The coefficients can now be used to predict the  $Y$  value for a given  $X$  value. Be sure to discuss the problems that occur if you try to extrapolate beyond the range of the  $X$  variable. Now you can show how to use either the In-Depth Excel, the Analysis ToolPak, PHStat, JMP, or Minitab to obtain the regression output.

Tell the students that now you need to determine the usefulness of the regression model by subdividing the total variation in  $Y$  into two component parts, explained variation or regression sum of squares ( $SSR$ ) and unexplained variation or error sum of squares ( $SSE$ ). Once the sum of squares has been determined and the coefficient of determination  $r^2$  computed, be sure to focus on the interpretation. Having computed the error sum of squares ( $SSE$ ), the standard error of the estimate can be computed. Make the analogy that the standard error of the estimate has the same relationship to the regression line that the standard deviation had to the arithmetic mean.

The completion of this initial model development phase allows you to begin focusing on the validity of the model fitted. First, go over the assumptions and emphasize the fact that unless the assumptions are evaluated, a correct regression analysis has not been carried out. Reiterate the point that this is one of the things that people are most likely to do incorrectly when they carry out a regression analysis.

Once the assumptions have been discussed, you are ready to begin evaluating whether they are true for the model that has been fit. This leads into a discussion of residual analysis. Emphasize that Excel, JMP, or Minitab can be used to determine the residuals and that in determining whether there is a pattern in the residuals, you look for gross patterns that are obvious on the plot, *not* minor patterns that are not obvious. Be sure to note that the residual plot can also be used to evaluate the assumption of equal variance along with whether there is a pattern in the residuals over time if the data have been collected in sequential order. Point out that finding no pattern (i.e., a random pattern) means that the model fit is an appropriate one. However, it does not mean that other alternative models involving additional variables should not be considered. Mention also, that a normal probability plot of the residuals can be helpful in determining the validity of the normality assumption. If time permits, the discussion of the Anscombe data in Section 12.9 serves as a strong reinforcement of the importance of residual analysis.

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If time is available, you may wish to discuss the Durbin-Watson statistic for autocorrelation. Be sure to discuss how to find the critical values from the table of the  $D$  statistic and the fact that sometimes the results will be inconclusive.

Once the model fit has been found to be appropriate, inferences in regression can be made. First cover the  $t$  or  $F$  test for the slope by referring to the Excel, JMP, or Minitab results. Here, the  $p$ -value approach is usually beneficial. Then, if time permits, you can discuss the confidence interval estimate for the mean and the prediction interval for the individual value.

The *Managing Ashland MultiComm Services* case, the Digital case, and the Brynne Packaging case each involves a simple linear regression analysis of a set of data.

## Chapter 13

If time is available in the course, you can now move on to multiple regression. You should point out that Microsoft Excel, JMP, or Minitab needs to be used to perform the computations in multiple regression. Once you have the results, you need to focus on the interpretation of the regression coefficients and how the interpretation differs between simple linear regression and multiple regression. Mention the aspects of multiple regression that are similar in interpretation to those in simple regression -- prediction, residual analysis, coefficient of determination, and standard error of the estimate. If sufficient time is available, you can move on to the dummy variable model. With dummy variables, be sure to mention that the categories must be coded as 0 and 1. In addition, indicate the importance of determining whether there is an interaction between the dummy variable and the other independent variables. Further discussion can include interaction terms in regression models.

Both the *Managing Ashland MultiComm Services* case and the Digital case involve developing a multiple regression model that includes dummy variables.

To perform multiple regression, you can use In-Depth Excel, the Analysis ToolPak, PHStat, JMP, or Minitab.

## **Chapter 14**

This chapter on Business Analytics is new for this edition. If you are teaching a one semester course it is possible that you could integrate some of the descriptive analytics material in Section 14.1 into the discussion of tables and charts. However, a full discussion of the material in this chapter would be easier to accomplish in a two semester course or a separate course on business analytics.

You may wish to begin the chapter with a discussion of how analytics have become so important. This can be followed by mentioning the types of analytics followed by the difference between supervised learning and unsupervised learning. Then you can provide examples of the various graphs used in Section 14.2 such as dashboards, and bubble charts. Most of these graphs will require the use of software such as JMP.

Section 14.3 discusses regression trees. Regression trees are used when the dependent variable is numerical. With regression trees, the dependent variable is broken down according to values of the independent variables. With regression trees, you may want to use the same example that you may have used in Chapter 13 and then compare the results.

Section 14.4 discusses classification trees. Classification trees are used when the dependent variable is categorical. With classification trees, the dependent variable is broken down according to values of the independent variables.

Sections 14.5 on cluster analysis and 14.6 on multiple correspondence analysis and multidimensional scaling differ from all the other topics in the book in that they are focused on classifying objects into groups and/or interpreting how the objects differ. In cluster analysis, make sure to point out that different clustering criteria can lead to different results. In multidimensional scaling point out that it may be difficult to interpret the dimensions separating the objects even in two dimensions.



## CHAPTER 1

- 1.1 The type of beverage sold yields categorical or “qualitative” responses.
- 1.2 Business size represents a categorical variable because each size represents a particular category.
- 1.3 The time it takes to download a video from the Internet is a continuous numerical or “quantitative” variable because time can have any value from 0 to any reasonable unit of time
- 1.4
- (a) The number of cellphones is a numerical variable that is discrete because the outcome is a count.
  - (b) Monthly data usage is a numerical variable that is continuous because any value within a range of values can occur.
  - (c) Number of text messages exchanged per month is a numerical variable that is discrete because the outcome is a count.
  - (d) Voice usage per month is a numerical variable that is continuous because any value within a range of values can occur.
  - (e) Whether a cellphone is used for streaming video is a categorical variable because the answer can be only yes or no.
- 1.5
- (a) numerical, continuous
  - (b) numerical, discrete
  - (c) categorical
  - (d) categorical
- 1.6
- (a) Categorical
  - (b) Numerical, continuous
  - (c) Categorical
  - (d) Numerical, discrete
  - (e) Categorical
- 1.7
- (a) numerical, continuous \*
  - (b) categorical
  - (c) categorical
  - (d) numerical, discrete
- \*Some researchers consider money as a discrete numerical variable because it can be “counted.”
- 1.8
- (a) numerical, continuous \*
  - (b) numerical, discrete
  - (c) numerical, continuous \*
  - (d) categorical
- \*Some researchers consider money as a discrete numerical variable because it can be “counted.”
- 1.9
- (a) Income may be considered discrete if we “count” our money. It may be considered continuous if we “measure” our money; we are only limited by the way a country's monetary system treats its currency.
  - (b) The first format would provide more information because it includes a ratio scale value while the second measure would only include a range of values for each choice category.

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- 1.10 The underlying variable, ability of the students, may be continuous, but the measuring device, the test, does not have enough precision to distinguish between the two students.
- 1.11 (a) The population is “all working women from the metropolitan area.” A systematic or random sample could be taken of women from the metropolitan area. The director might wish to collect both numerical and categorical data.  
(b) Three categorical questions might be occupation, marital status, type of clothing. Numerical questions might be age, average monthly hours shopping for clothing, income.
- 1.12 (a) Data distributed by an organization or individual.  
(b) The American Community Survey is based on a sample.
- 1.13 The answer depends on the specific story.
- 1.14 The answer depends on the specific story.
- 1.15 The transportation engineers and planners should use primary data collected through an observational study of the driving characteristics of drivers over the course of a month.
- 1.16 The information presented there is based mainly on a mixture of data distributed by an organization and data collected by ongoing business activities.
- 1.17 (a) 001  
(b) 040  
(c) 902
- 1.18 Sample without replacement: Read from left to right in 3-digit sequences and continue unfinished sequences from end of row to beginning of next row.
- Row 05: 338 505 855 551 438 855 077 186 579 488 767 833 170  
Rows 05-06: 897  
Row 06: 340 033 648 847 204 334 639 193 639 411 095 924  
Rows 06-07: 707  
Row 07: 054 329 776 100 871 007 255 980 646 886 823 920 461  
Row 08: 893 829 380 900 796 959 453 410 181 277 660 908 887  
Rows 08-09: 237  
Row 09: 818 721 426 714 050 785 223 801 670 353 362 449  
Rows 09-10: 406  
Note: All sequences above 902 and duplicates are discarded.
- 1.19 (a) Row 29: 12 47 83 76 22 99 65 93 10 65 83 61 36 98 89 58 86 92 71  
Note: All sequences above 93 and all repeating sequences are discarded.  
(b) Row 29: 12 47 83 76 22 99 65 93 10 65 83 61 36 98 89 58 86  
Note: All sequences above 93 are discarded. Elements 65 and 83 are repeated.
- 1.20 A simple random sample would be less practical for personal interviews because of travel costs (unless interviewees are paid to attend a central interviewing location).
- 1.21 This is a probability sample because the selection is based on chance. It is not a simple random sample because A is more likely to be selected than B or C.

- 1.22 Here all members of the population are equally likely to be selected and the sample selection mechanism is based on chance. But not every sample of size 2 has the same chance of being selected. For example the sample “B and C” is impossible.
- 1.23 (a) Since a complete roster of full-time students exists, a simple random sample of 200 students could be taken. If student satisfaction with the quality of campus life randomly fluctuates across the student body, a systematic 1-in-20 sample could also be taken from the population frame. If student satisfaction with the quality of life may differ by gender and by experience/class level, a stratified sample using eight strata, female freshmen through female seniors and male freshmen through male seniors, could be selected. If student satisfaction with the quality of life is thought to fluctuate as much within clusters as between them, a cluster sample could be taken.
- (b) A simple random sample is one of the simplest to select. The population frame is the registrar’s file of 4,000 student names.
- (c) A systematic sample is easier to select by hand from the registrar’s records than a simple random sample, since an initial person at random is selected and then every 20th person thereafter would be sampled. The systematic sample would have the additional benefit that the alphabetic distribution of sampled students’ names would be more comparable to the alphabetic distribution of student names in the campus population.
- (d) If rosters by gender and class designations are readily available, a stratified sample should be taken. Since student satisfaction with the quality of life may indeed differ by gender and class level, the use of a stratified sampling design will not only ensure all strata are represented in the sample, it will also generate a more representative sample and produce estimates of the population parameter that have greater precision.
- (e) If all 4,000 full-time students reside in one of 10 on-campus residence halls which fully integrate students by gender and by class, a cluster sample should be taken. A cluster could be defined as an entire residence hall, and the students of a single randomly selected residence hall could be sampled. Since each dormitory has 400 students, a systematic sample of 200 students can then be selected from the chosen cluster of 400 students. Alternately, a cluster could be defined as a floor of one of the 10 dormitories. Suppose there are four floors in each dormitory with 100 students on each floor. Two floors could be randomly sampled to produce the required 200 student sample. Selection of an entire dormitory may make distribution and collection of the survey easier to accomplish. In contrast, if there is some variable other than gender or class that differs across dormitories, sampling by floor may produce a more representative sample.
- 1.24 (a)
- |         |      |      |      |      |      |      |      |      |      |      |
|---------|------|------|------|------|------|------|------|------|------|------|
| Row 16: | 2323 | 6737 | 5131 | 8888 | 1718 | 0654 | 6832 | 4647 | 6510 | 4877 |
| Row 17: | 4579 | 4269 | 2615 | 1308 | 2455 | 7830 | 5550 | 5852 | 5514 | 7182 |
| Row 18: | 0989 | 3205 | 0514 | 2256 | 8514 | 4642 | 7567 | 8896 | 2977 | 8822 |
| Row 19: | 5438 | 2745 | 9891 | 4991 | 4523 | 6847 | 9276 | 8646 | 1628 | 3554 |
| Row 20: | 9475 | 0899 | 2337 | 0892 | 0048 | 8033 | 6945 | 9826 | 9403 | 6858 |
| Row 21: | 7029 | 7341 | 3553 | 1403 | 3340 | 4205 | 0823 | 4144 | 1048 | 2949 |
| Row 22: | 8515 | 7479 | 5432 | 9792 | 6575 | 5760 | 0408 | 8112 | 2507 | 3742 |
| Row 23: | 1110 | 0023 | 4012 | 8607 | 4697 | 9664 | 4894 | 3928 | 7072 | 5815 |
| Row 24: | 3687 | 1507 | 7530 | 5925 | 7143 | 1738 | 1688 | 5625 | 8533 | 5041 |
| Row 25: | 2391 | 3483 | 5763 | 3081 | 6090 | 5169 | 0546 |      |      |      |
- Note: All sequences above 5000 are discarded. There were no repeating sequences.

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- 1.24 (b) 089 189 289 389 489 589 689 789 889 989  
cont. 1089 1189 1289 1389 1489 1589 1689 1789 1889 1989  
2089 2189 2289 2389 2489 2589 2689 2789 2889 2989  
3089 3189 3289 3389 3489 3589 3689 3789 3889 3989  
4089 4189 4289 4389 4489 4589 4689 4789 4889 4989
- (c) With the single exception of invoice #0989, the invoices selected in the simple random sample are not the same as those selected in the systematic sample. It would be highly unlikely that a random process would select the same units as a systematic process.
- 1.25 (a) A stratified sample should be taken so that each of the three strata will be proportionately represented.
- (b) The number of observations in each of the three strata out of the total of 1,000 should reflect the proportion of the three categories in the customer database. For example,  $3,500/10,000 = 35\%$  so 35% of 1,000 = 350 customers should be selected from the prospective buyers; similarly  $4,500/10,000 = 45\%$  so 450 customers should be selected from the first time buyers, and  $2,000/10,000 = 20\%$  so 200 customers from the repeat buyers.
- (c) It is not simple random sampling because, unlike the simple random sampling, it ensures proportionate representation across the entire population.
- 1.26 (a) For the third value, Apple is spelled incorrectly. The twelfth value should be Blackberry not Blueberry. The fifteenth value, APPLE, may lead to an irregularity. The eighteenth value should be Samsung not Samsun.
- (b) This list contains 19 names, where one would expect to find 20 names.
- 1.27 Only the second value, 2.7MB, contains units and the eighth value, 1,079, might be confused with 1, 79.
- 1.28 (a) The times for each of the hotels would be arranged in separate columns.
- (b) The hotel names would be in one column and the times would be in a second column.
- 1.29 A recoded variable PriceLevel could be defined, assigning the value Budget for hotels with budget-priced rooms, Moderate for hotels with moderate-priced rooms, and Deluxe for hotels with deluxe-priced rooms.
- 1.30 Before accepting the results of a survey of college students, you might want to know, for example:  
Who funded the survey? Why was it conducted? What was the population from which the sample was selected? What sampling design was used? What mode of response was used: a personal interview, a telephone interview, or a mail survey? Were interviewers trained? Were survey questions field-tested? What questions were asked? Were they clear, accurate, unbiased, valid? What operational definition of “vast majority” was used? What was the response rate? What was the sample size?
- 1.31 (a) Possible coverage error: Only employees in a specific division of the company were sampled.
- (b) Possible nonresponse error: No attempt is made to contact nonrespondents to urge them to complete the evaluation of job satisfaction.
- (c) Possible sampling error: The sample statistics obtained from the sample will not be equal to the parameters of interest in the population.

- 1.31 cont. (d) Possible measurement error: Ambiguous wording in questions asked on the questionnaire.
- 1.32 Coverage error could result if bank executives are systematically excluded from the population thereby not allowing them to be part of any sample that is used to generate the results. This could lead to selection bias. Non-response error that results in non-response bias could result if not all bank executives who were selected for inclusion in the sample are contacted even after multiple attempts to do so. In this case, data that was desired and necessary for inclusion in the sample would then not be present. Sampling error reflects the variability in outcomes when taking different samples. Sampling error is unavoidable. One can obtain an impression of the size of the sampling error by creating interval estimates. Measurement error could arise if the bank executives self-report results or if the methods of reporting are not standardized, i.e. if questions are not asked in the same manner from respondent to respondent, or if those conducting the survey do not do so in a consistent manner.
- 1.33 We need the sample to be representative for the population, avoiding any coverage error that can cause selection bias. Assurance that all CEOs who have been selected as a part of the sample are contacted to provide the necessary information is necessary. This would minimize non-response bias. Sampling error reflects the variability in outcomes when taking different samples. Sampling error is unavoidable. One can obtain an impression of the size of the sampling error by creating interval estimates. Finally, the survey should be conducted in a systematic and consistent manner to minimize the possibility of measurement error.
- 1.34 Before accepting the results of the survey, you might want to know, for example:  
Who funded the survey? Why was it conducted? What was the population from which the sample was selected? What sampling design was used? What mode of response was used: a personal interview, a telephone interview, or a mail survey? Were interviewers trained? Were survey questions field-tested? What questions were asked? Were they clear, accurate, unbiased, valid? What was the response rate? What was the margin of error? What was the sample size? What frame was used?
- 1.35 A population contains all the items of interest whereas a sample contains only a portion of the items in the population.
- 1.36 A statistic is a summary measure describing a sample whereas a parameter is a summary measure describing an entire population.
- 1.37 Categorical random variables yield categorical responses such as yes or no answers. Numerical random variables yield numerical responses such as your height in inches.
- 1.38 Discrete random variables produce numerical responses that arise from a counting process. Continuous random variables produce numerical responses that arise from a measuring process.
- 1.39 Both nominal scaled and ordinal scaled variables are categorical variables but no ranking is implied in nominal scaled variable such as male or female while ranking is implied in ordinal scaled variable such as a student's grade of A, B, C, D and F.
- 1.40 Both interval scaled and ratio scaled variables are numerical variables in which the difference between measurements is meaningful but an interval scaled variable does not involve a true zero such as standardized exam scores while a ratio scaled variable involves a true zero such as height.

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- 1.41 Items or individuals in a probability sampling are selected based on known probabilities while items or individuals in a nonprobability samplings are selected without knowing their probabilities of selection.
- 1.42 Missing values are values that were not collected for a variable. Outliers are values that seem excessively different from most of the other values
- 1.43 In unstacked arrangements, separate numerical variables are created for each group in the data. For example, you might create a variable for the weights of men and a second variable for the weights of women. In stacked arrangements, a single numerical variable is paired with a categorical variable that represents the categories. For example, all weights would be in one variable, with a categorical variable indicating male or female.
- 1.44 Coverage error is error generated due to an improperly or inappropriately framed population which can result in a sample that may not be representative of the population that one wishes to study. Non-response error is error generated due to members of a chosen sample not being contacted even after repeated attempts so that information that should be provided is missing.
- 1.45 Sampling error results from the variability of outcomes of different samples. This sample to sample variation is inevitably connected to the sampling process. Measurement error is error that results from either self-reported data or data that is collected in an inconsistent manner by those who are responsible for collecting and summarizing the desired information.
- 1.46 Microsoft Excel:  
This product features a spreadsheet-based interface that allows users to organize, calculate, and organize data. Excel also contains many statistical functions to assist in the description of a dataset. Excel can be used to develop worksheets and workbooks to calculate a variety of statistics including introductory and advanced statistics. Excel also includes interactive tools to create graphs, charts, and pivot tables. Excel can be used to summarize data to better understand a population of interest, compare across groups, predict outcomes, and to develop forecasting models. These capabilities represent those that are generally relevant to the current course. Excel also includes many other statistical capabilities that can be further explored on the Microsoft Office Excel official website.
- Minitab 18:  
Minitab 18 has a comprehensive set of statistical methods including introductory and advanced statistical procedures. Minitab 18 features include basic descriptive statistical procedures, graph and chart creation, diagnostic tests, analysis of variance, regression, time series and forecasting analyses, nonparametric analyses, cross-tabulation, chi-square and related tests, and other statistical procedures. Minitab 18 utilizes a user friendly interface that allows one to quickly identify the appropriate procedure. The interface also allows one to easily export results including charts and graphs to facilitate the creation of presentations and reports. These Minitab 18 features would allow one to summarize data to better understand a population of interest, compare across groups, predict outcomes, and to develop forecasting models. These capabilities represent those that are generally relevant to the current course. Minitab 18 also includes many other statistical capabilities that can be further explored on the Minitab official website.

- 1.46 JMP:  
cont. JMP has a comprehensive set of statistical methods including introductory and advanced statistical procedures. JMP features include basic descriptive statistical procedures, graph and chart creation, diagnostic tests, analysis of variance, regression, time series and forecasting analyses, nonparametric analyses, cross-tabulation, chi-square and related tests, and other statistical procedures. JMP utilizes a user friendly interface that allows one to quickly identify the appropriate procedure. JMP also contains predictive analytic tools such as classification trees to classify data into groups. These JMP features would allow one to summarize data to better understand a population of interest, compare across groups, predict outcomes, and to develop forecasting models. These capabilities represent those that are generally relevant to the current course. JMP also includes many other statistical capabilities that can be further explored on the JMP official website.
- 1.47 (a) The population of interest include banking executives representing institutions of various sizes and U.S. geographic locations.  
(b) The collected sample includes 163 banking executives from institutions of various sizes and U.S. geographic locations.  
(c) A parameter of interest is the percentage of the population of banking executives that identify customer experience initiatives as an area where increased spending is expected.  
(d) A statistic used to the estimate the parameter in (c) is the percentage of the 163 banking executives included in the sample who identify customer experience initiatives as an area where increased spending is expected. In this case, the statistic is 55%.
- 1.48 The answers are based on an article titled “U.S. Satisfaction Still Running at Improved Level” and written by Lydia Saad (August 15, 2018). The article is located on the following site:  
[https://news.gallup.com/poll/240911/satisfaction-running-improved-level.aspx?g\\_source=link\\_NEWSV9&g\\_medium=NEWSFEED&g\\_campaign=item\\_&g\\_content=U.S.%2520Satisfaction%2520Still%2520Running%2520at%2520Improved%2520Level](https://news.gallup.com/poll/240911/satisfaction-running-improved-level.aspx?g_source=link_NEWSV9&g_medium=NEWSFEED&g_campaign=item_&g_content=U.S.%2520Satisfaction%2520Still%2520Running%2520at%2520Improved%2520Level)  
The population of interest includes all individuals aged 18 and older who live within the 50 U.S. states and the District of Columbia.  
The collected sample includes a random sample of 1,024 individuals aged 18 and older who live within the 50 U.S. states and the District of Columbia.  
A parameter of interest is the percentage of the population of individuals aged 18 and older and live within the 50 U.S. states and the District of Columbia who are satisfied with the direction of the U.S.  
A statistic used to the estimate the parameter in (c) is the percentage of the 1,024 individuals included in the sample. In this case, the statistic is 36%.
- 1.49 The answers were based on information obtained from the following site:  
<https://www.pwc.com/gx/en/ceo-survey/2017/pwc-ceo-20th-survey-report-2017.pdf>  
(a) The population of interest included CEOs representing a mix of industries from 79 countries.  
(b) The sample included 1,379 CEOs. The percentage of CEOs by continent were as follows: North America (11%), Western Europe (21%), Central and Eastern Europe (11%), Latin America (12%), Middle East and Africa (9%), and Asia Pacific (36%).  
(c) A parameter of interest would be the percentage of CEOs among the population of interest that believe social media could have a negative impact on the level of stakeholder trust in their industry over the next few years.

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- 1.49 cont. (d) The statistic used to estimate the parameter in (c) is the percentage of CEOs among the 1,379 CEOs included in the sample who believe social media could have a negative impact on the level of stakeholder trust in their industry over the next few years. In this case, the statistic is 87%.
- 1.50 (a) One variable collected with the American Community Survey is marital status with the following possible responses: now married, widowed, divorced, separated, and never married.  
(b) The variable in (a) represents a categorical variable.  
(c) Because the variable in (a) is a categorical, this question is not applicable. If one had chosen age in years from the American Community Survey as the variable, the answer to (c) would be discrete.
- 1.51 Answers will vary depending on the specific sample survey used. The below answers were based on the sample survey located at: <http://www.zarca.com/Online-Surveys-Non-Profit/association-salary-survey.html>  
(a) An example of a categorical variable included in the survey would be whether one had obtained an undergraduate degree with yes or no as possible answers.  
(b) An example of a numerical variable included in the survey would be the respondent's annual base salary for the past year.
- 1.52 (a) The population of interest consisted of 10,000 benefited employees of the University of Utah.  
(b) The sample consisted of 3,095 employees of the University of Utah.  
(c) Gender, marital status, and employment category represent categorical variables. Age in years, education level in years completed, and household income represent numerical variables.
- 1.53 (a) Key social media platforms used represents a categorical variable. The frequency of social media usage represents a discrete numerical variable. Demographics of key social media platform users represent categorical variables.  
(b) 1. Which of the following is your preferred social media platform: YouTube, Facebook, or Twitter?  
2. What time of the day do you spend the most amount of time using social media: morning, afternoon, or evening?  
3. Please indicate your ethnicity?  
4. Which of the following do you most often use to access social media: mobile device, laptop computer, desktop computer, other device?  
5. Please indicate whether you are a home owner: Yes or No?  
(c) 1. For the past week, how many hours did you spend using social media?  
2. Please indicate your current age in years.  
3. What was your annual income this past year?  
4. Currently, how many friends have you accepted on Facebook?  
5. Currently, how many twitter followers do you have?



## Chapter 2 Solutions

2.1 (a)

Category	Frequency	Percentage
A	13	26%
B	28	56%
C	9	18%

(b) Category “B” is the majority.

2.2 (a) Table frequencies for all student responses

	Student Major Categories			
Gender	A	C	M	Totals
Male	14	9	2	25
Female	6	6	3	15
Totals	20	15	5	40

(b) Table percentages based on overall student responses

	Student Major Categories			
Gender	A	C	M	Totals
Male	35.0%	22.5%	5.0%	62.5%
Female	15.0%	15.0%	7.5%	37.5%
Totals	50.0%	37.5%	12.5%	100.0%

Table based on row percentages

	Student Major Categories			
Gender	A	C	M	Totals
Male	56.0%	36.0%	8.0%	100.0%
Female	40.0%	40.0%	20.0%	100.0%
Totals	50.0%	37.5%	12.5%	100.0%

Table based on column percentages

	Student Major Categories			
Gender	A	C	M	Totals
Male	70.0%	60.0%	40.0%	62.5%
Female	30.0%	40.0%	60.0%	37.5%
Totals	100.0%	100.0%	100.0%	100.0%

2.3 (a) You can conclude that in 2011 Android, iOS, and OtherOS dominated the market in 2011. In 2012, 2013, 2014, and 2015 Android and iOS dominated the market. Android has increased its market share from 49.2% in 2011 to 80.7% in 2016. iOS has seen a slight decrease in market share from 18.8% in 2011 to 17.7% in 2016. OtherOS market share has declined from 19.8% in 2011 to 0.2% in 2016. Blackberry has also seen a significant decrease from 10.3% in 2011 to 0.2% in 2016. Microsoft reached its highest market share in 2013 with 3.3% and its lowest in 2015 and 2016 with 1.1%.

(b) iOS decreased its market share from 18.8% in 2011 to 17.7% in 2016. Android’s market share has increased from 2011 to 2016 while Microsoft, Blackberry, and OtherOS have all lost market share.

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2.4 (a)

Category	Total	Percentages
Bank Account or Service	202	9.330%
Consumer Loan	132	6.097%
Credit Card	175	8.083%
Credit Reporting	581	26.836%
Debt Collection	486	22.448%
Mortgage	442	20.416%
Student Loan	75	3.464%
Other	72	3.326%
Grand Total	2165	

(b) There are more complaints for credit reporting, debt collection, and mortgage than the other categories. These categories account for about 70% of all the complaints.

(c)

Company	Total	Percentage
Bank of America	42	3.64%
Capital One	93	8.07%
Citibank	59	5.12%
Ditech Financial	31	2.69%
Equifax	217	18.82%
Experian	177	15.35%
JPMorgan	128	11.10%
Nationstar Mortgage	39	3.38%
Navient	38	3.30%
Ocwen	41	3.56%
Synchrony	43	3.73%
Trans-Union	168	14.57%
Wells Fargo	77	6.68%
Grand Total	1153	

(d) Equifax, Trans-Union, and Experian, all of which are credit score companies, have the most complaints.

2.5 The respondents from the sample of companies included in the survey indicated that they would be most likely to use business analytics within the next five years with more than half planning to use this technology. Slightly less than half of the respondents plan to use machine language technology and only 21% of the respondents planning to use self-learning robots. Nearly half of the respondents had no plans to use self-learning robots. It could be concluded that business analytics will likely be the most impactful technology within the next five years followed by machine language technology and self-learning robots.

- 2.6 The largest sources of electricity in the United States are coal followed by natural gas. Nuclear energy is the third most used source of energy. Hydroelectric and Renewable sources other than hydroelectric and solar are about the same followed by Other gas, Petroleum coke and liquids, and Other.

- 2.7 (a)

Technologies	Frequency	Percentage
Wearable technology	9	10.00%
Blockchain technology	9	10.00%
Artificial Intelligence	17	18.89%
Iot: retail insurance	23	25.56%
Iot: commercial insurance	5	5.56%
Social media	27	30.00%
Grand Total	90	

- (b) Professionals expect to be using Social media and Iot: retail insurance technologies the most over the next year followed by Artificial Intelligence. Professionals do not expect to be using Wearable, Blockchain, and Iot: commercial insurance technologies much over the next year.

- 2.8 (a) Table of row percentages:

OVERLOADED	GENDER		Total
	Male	Female	
Yes	44.08%	55.92%	100.00%
No	53.54%	46.46%	100.00%
Total	51.64%	48.36%	100.00%

Table of column percentages:

OVERLOADED	GENDER		Total
	Male	Female	
Yes	17.07%	23.13%	20.00%
No	82.93%	76.87%	80.00%
Total	100.00%	100.00%	100.00%

Table of total percentages:

OVERLOADED	GENDER		Total
	Male	Female	
Yes	8.82%	11.18%	20.00%
No	42.83%	37.17%	80.00%
Total	51.64%	48.36%	100.00%

- (b) Approximately the same percentages of males and females as a percentage of the total number of people surveyed feel overloaded with too much information. As percentages of those who do and do not feel overloaded, the genders differ mildly. However, four times as many people do not feel overloaded at work than those that do.

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2.9 (a)

Column Percentage

CATEGORY	OUTCOME		Total
	Successful	Not Successful	
Film & Video	36.02%	36.81%	36.51%
Games	15.44%	18.24%	17.19%
Music	40.20%	24.38%	30.34%
Technology	8.34%	20.56%	15.96%
Total	100.00%	100.00%	100.00%

Row Percentages

CATEGORY	OUTCOME		Total
	Successful	Not Successful	
Film & Video	37.15%	62.85%	100.00%
Games	33.84%	66.16%	100.00%
Music	49.91%	50.09%	100.00%
Technology	19.69%	80.31%	100.00%
Total	37.67%	62.33%	100.00%

Total Percentages

CATEGORY	OUTCOME		Total
	Successful	Not Successful	
Film & Video	13.57%	22.95%	36.51%
Games	5.82%	11.37%	17.19%
Music	15.14%	15.20%	30.34%
Technology	3.14%	12.82%	15.96%
Total	37.67%	62.33%	100.00%

- (b) The row percentages are most informative because they provide a percentage of successful projects within each category which allows one to compare across categories.
- (c) Music kick starter projects were the most successful with approximately 50% of the projects succeeding compared to less than 20% of the Technology projects. The Film & Video and Games categories had success rates in between the Music and Technology categories, with success rates of 37% and 34% respectively.

2.10 Approximately 11.7% of the total people surveyed answered window tinting as their preferred luxury upgrade. A higher percentage of women than men prefer window tinting as a luxury upgrade.

2.11 Ordered array: 63 64 68 71 75 88 94

2.12 Ordered array: 73 78 78 78 85 88 91

- 2.13 (a)  $(166 + 100)/591 * 100 = 45.01\%$   
 (b)  $(124 + 77)/591 * 100 = 34.01\%$   
 (c)  $(59 + 65)/591 * 100 = 20.98\%$   
 (d) 45% of the incidents took fewer than 2 days and 66% of the incidents were detected in less than 8 days. 79% of the incidents were detected in less than 31 days.

2.14  $\frac{216,000 - 61,000}{6} = 33,333.33$  so choose 40,000 as interval width

- (a) \$60,000 – under \$100,000; \$100,000 – under \$140,000; \$140,000 – under \$180,000; \$180,000 – under \$220,000; \$220,000 – under \$260,000; \$260,000 – under \$300,000  
 (b) \$40,000  
 (c)  $\frac{60,000 + 100,000}{2} = 80,000$  similarly, the remaining class midpoints are \$120,000; \$160,000; \$200,000; \$240,000; \$280,000

- 2.15 (a) 

222.67	262.50	262.67	276.40	278.00	290.83	292.87
298.00	318.67	324.33	332.93	345.09	346.70	380.67
398.55	418.14	422.45	423.50	429.00	441.00	492.71
505.77	539.68	571.50	585.20	696.33	718.50	726.40
789.20	878.20					

  
 (b)

NBA Cost		
Cost \$	Frequency	Percentage
200 but less than 300	8	27%
300 but less than 400	7	23%
400 but less than 500	6	20%
500 but less than 600	4	13%
600 but less than 700	1	3%
700 but less than 800	3	10%
800 but less than 900	1	3%
Total	30	100%

- (c) 70% of the costs to attend a NBA basketball game are between \$200 and \$500 with 27% of the costs between \$200 and \$300. Three teams or 10% of the NBA teams have costs between \$700 and \$800.

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2.16 (a)

Electricity Costs		
Electricity Costs	Frequency	Percentage
\$80 but less than \$100	4	8%
\$100 but less than \$120	7	14%
\$120 but less than \$140	9	18%
\$140 but less than \$160	13	26%
\$160 but less than \$180	9	18%
\$180 but less than \$200	5	10%
\$200 but less than \$220	3	6%

(b)

Electricity Costs	Frequency	Percentage	Cumulative %
\$ 99	4	8.00%	8.00%
\$119	7	14.00%	22.00%
\$139	9	18.00%	40.00%
\$159	13	26.00%	66.00%
\$179	9	18.00%	84.00%
\$199	5	10.00%	94.00%
\$219	3	6.00%	100.00%

(c) The majority of utility charges are clustered between \$120 and \$180.

2.17 (a)

Commuting Time (minutes)	Frequency	Percentage
200 but less than 230	12	40%
230 but less than 260	9	30%
260 but less than 290	4	13%
290 but less than 320	3	10%
320 but less than 350	1	3%
350 but less than 380	1	3%
	<b>30</b>	<b>100%</b>

(b)

Commuting Time (minutes)	Frequency	Percentage	Cumulative %
200 but less than 230	12	40%	40%
230 but less than 260	9	30%	70%
260 but less than 290	4	13%	83%
290 but less than 320	3	10%	93%
320 but less than 350	1	3%	97%
350 but less than 380	1	3%	100%
	<b>30</b>	<b>100%</b>	

- 2.17 (c) The majority of commuters living in or near cities spend from 200 up to 230 minutes commuting each week. 70% of commuters spend from 200 up to 260 minutes commuting each week.

- 2.18 (a), (b)

Credit Score	Frequency	Percent (%)	Cumulative Percent (%)
560 – under 580	4	0.16	0.16
580 – under 600	24	0.93	1.09
600 – under 620	68	2.65	3.74
620 – under 640	290	11.28	15.02
640 – under 660	548	21.32	36.34
660 – under 680	560	21.79	58.13
680 – under 700	507	19.73	77.86
700 – under 720	378	14.71	92.57
720 – under 740	168	6.54	99.11
740 – under 760	22	0.86	99.96
760 – under 780	1	0.04	100.00

- (c) The average credit scores are concentrated between 620 and 720.

- 2.19 (a), (b)

Bin	Frequency	Percentage	Cumulative %
-0.00350 but less than -0.00201	13	13.00%	13.00%
-0.00200 but less than -0.00051	26	26.00%	39.00%
-0.00050 but less than 0.00099	32	32.00%	71.00%
0.00100 but less than 0.00249	20	20.00%	91.00%
0.00250 but less than 0.00399	8	8.00%	99.00%
0.004 but less than 0.00549	1	1.00%	100.00%

- (c) Yes, the steel mill is doing a good job at meeting the requirement as there is only one steel part out of a sample of 100 that is as much as 0.005 inches longer than the specified requirement.

- 2.20 (a), (b)

Time in Seconds	Frequency	Percent (%)
5 – under 10	8	16%
10 – under 15	8	30%
15 – under 20	8	36%
20 – under 25	8	12%
25 – under 30	8	6%

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2.20 (b)  
cont.

Time in Seconds	Percentage Less Than
5	0
10	16
15	46
20	82
25	94
30	100

(c) The target is being met since 82% of the calls are being answered in less than 20 seconds

2.21 (a)

Call Duration (seconds)	Frequency	Percentage
60 up to 119	7	14%
120 up to 179	12	24%
180 up to 239	11	22%
240 up to 299	11	22%
300 up to 359	4	8%
360 up to 419	3	6%
420 and longer	2	4%
	50	100%

(b)

Call Duration (seconds)	Frequency	Percentage	Cumulative %
60 up to 119	7	14%	14%
120 up to 179	12	24%	38%
180 up to 239	11	22%	60%
240 up to 299	11	22%	82%
300 up to 359	4	8%	90%
360 up to 419	3	6%	96%
420 and longer	2	4%	100%
	50	100%	

(c) The call center's target of call duration less than 240 seconds is only met for 60% of the calls in this data set.

2.22 (a), (b) Manufacturer A:

Bin Cell	Frequency	Percentage	Cumulative Pctage.
6,500 but less than 7,500	3	7.50%	7.50%
7,500 but less than 8,500	5	12.50%	20.00%
8,500 but less than 9,500	20	50.00%	70.00%
9,500 but less than 10,500	9	22.50%	92.50%
10,500 but less than 11,500	3	7.50%	100.00%



- 2.22 (a), (b) Manufacturer B:  
cont.

Bin Cell	Frequency	Percentage	Cumulative Pctage.
7,500 but less than 8,500	2	5.00%	5.00%
8,500 but less than 9,500	8	20.00%	25.00%
9,500 but less than 10,500	16	40.00%	65.00%
10,500 but less than 11,500	9	22.50%	87.50%
11,500 but less than 12,500	5	12.50%	100.00%

- (c) Manufacturer B produces bulbs with longer lives than Manufacturer A. The cumulative percentage for Manufacturer B shows 65% of its bulbs lasted less than 10,500 hours, contrasted with 70% of Manufacturer A's bulbs, which lasted less than 9,500 hours. None of Manufacturer A's bulbs lasted more than 11,499 hours, but 12.5% of Manufacturer B's bulbs lasted between 11,500 and 12,499 hours. At the same time, 7.5% of Manufacturer A's bulbs lasted less than 7,500 hours, whereas all of Manufacturer B's bulbs lasted at least 7,500 hours

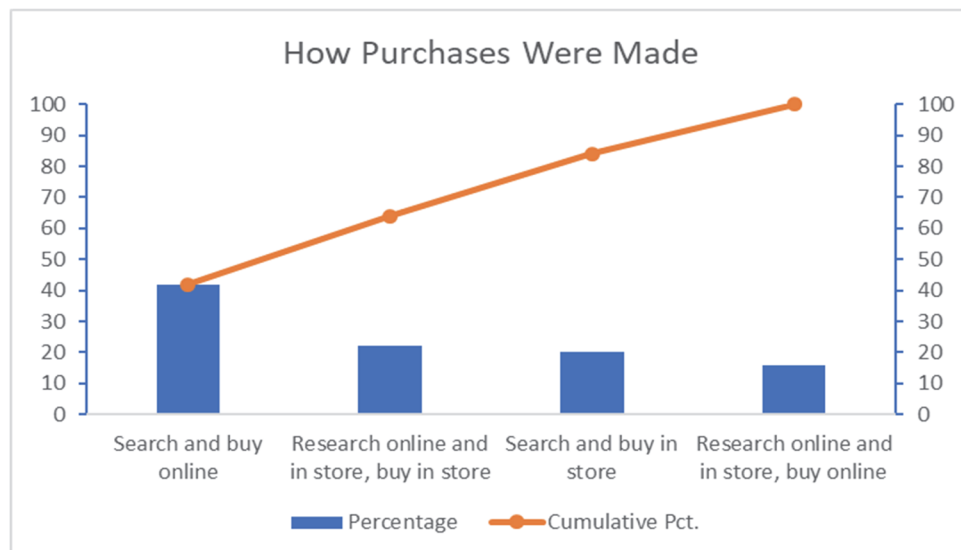
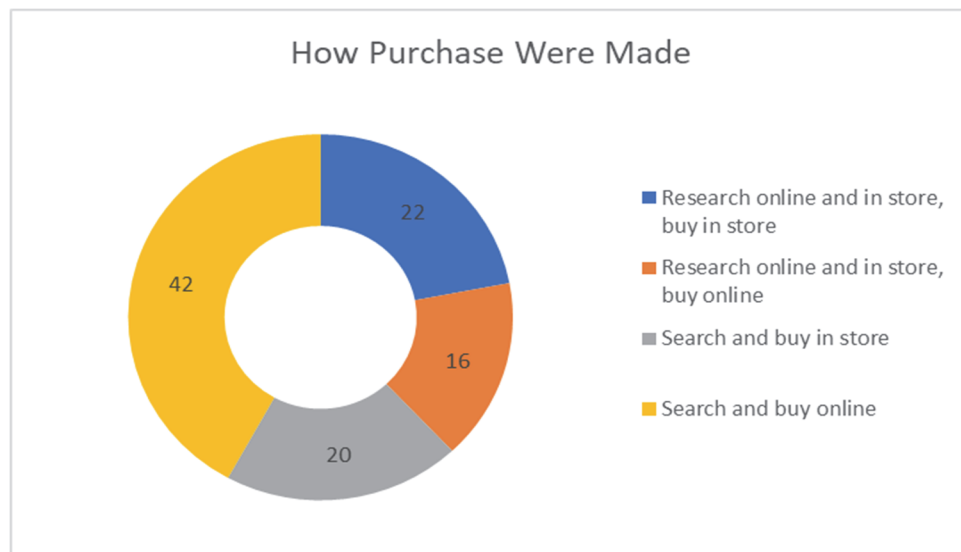
- 2.23 (a)

Amount of Soft Drink	Frequency	Percentage
1.850 – 1.899	1	2%
1.900 – 1.949	5	10%
1.950 – 1.999	18	36%
2.000 – 2.049	19	38%
2.050 – 2.099	6	12%
2.100 – 2.149	1	2%

Amount of Soft Drink	Frequency Less Than	Percentage Less Than
1.899	1	2%
1.949	6	12%
1.999	24	48%
2.049	43	86%
2.099	49	98%
2.149	50	100%

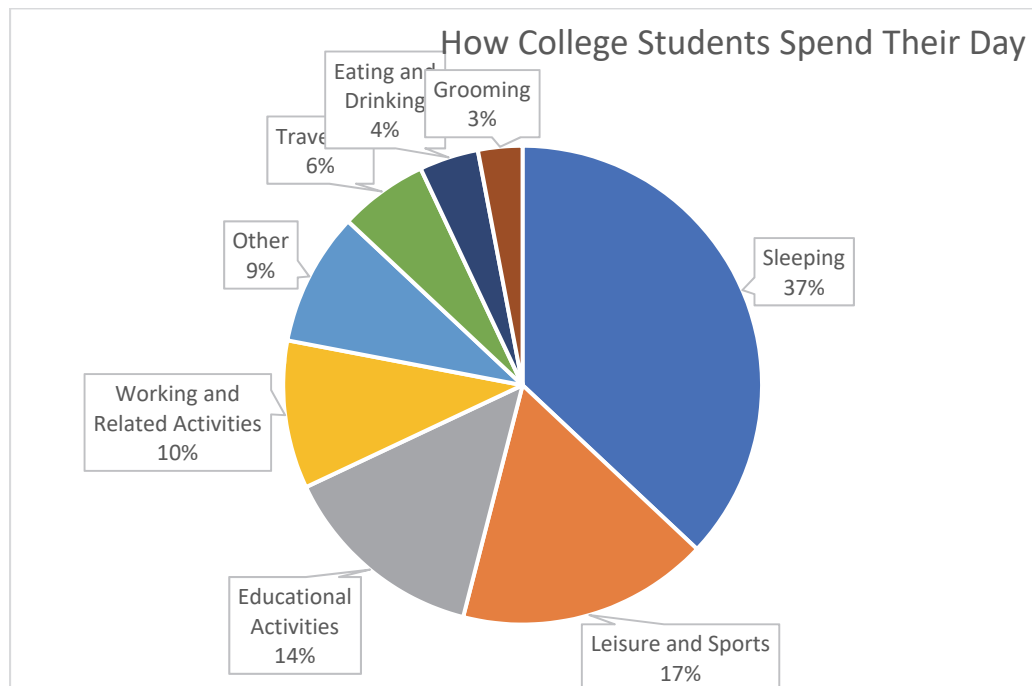
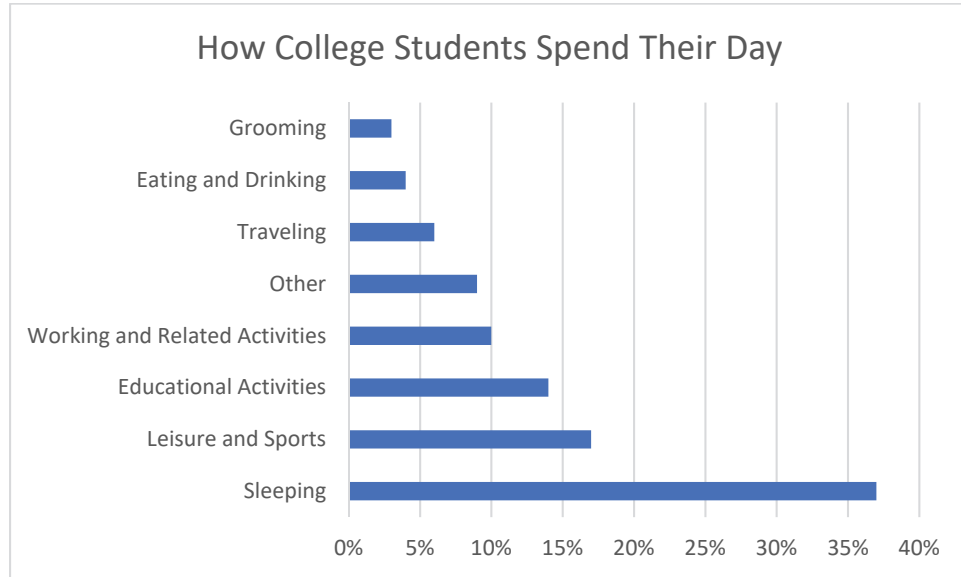
- (b) The amount of soft drink filled in the two liter bottles is most concentrated in two intervals on either side of the two-liter mark, from 1.950 to 1.999 and from 2.000 to 2.049 liters. Almost three-fourths of the 50 bottles sampled contained between 1.950 liters and 2.049 liters.

2.24 (a)

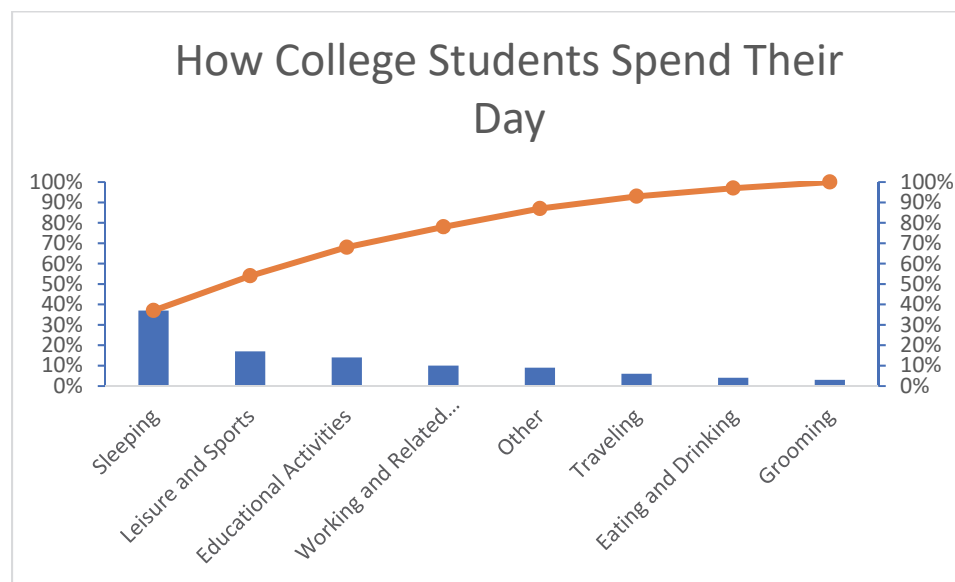


- 2.24 (b) The Pareto chart is best for portraying these data because it not only sorts the frequencies in descending order but also provides the cumulative line on the same chart.
- (c) You can conclude that searching and buying online was the highest category and the other three were equally likely.

2.25 (a)

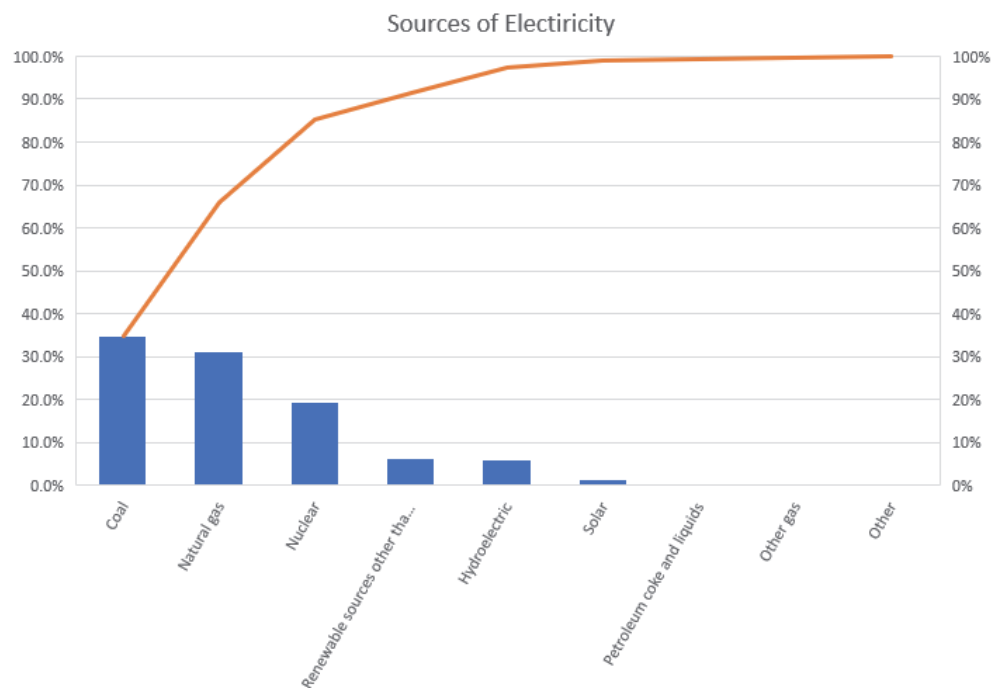


2.25 (a)  
cont.



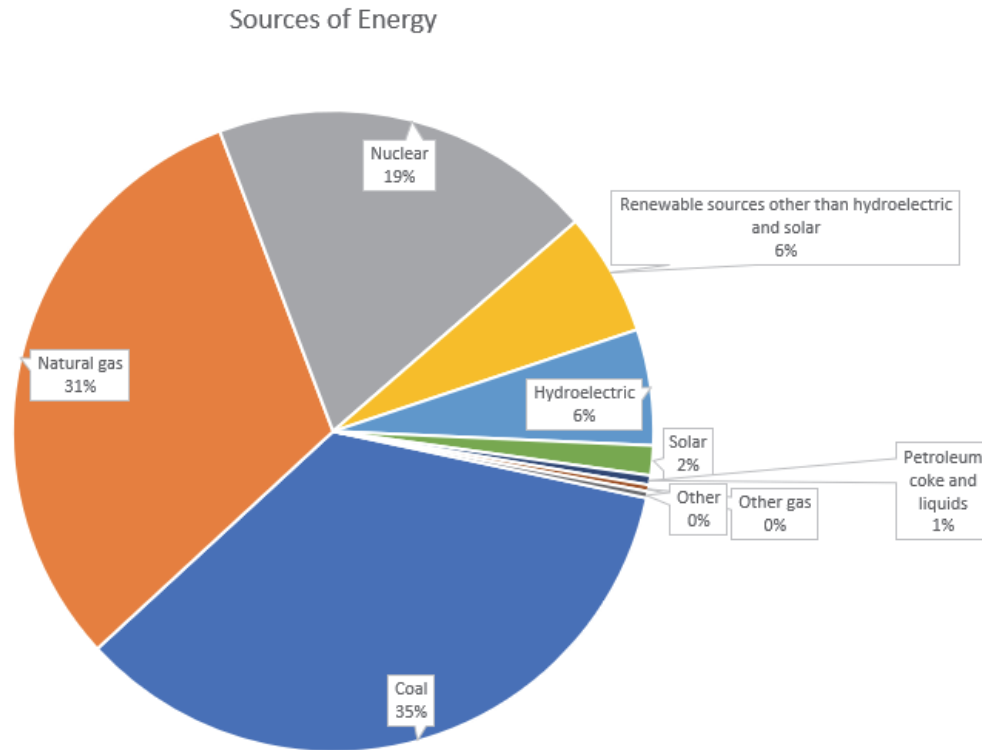
- (b) The Pareto diagram is better than the pie chart or the bar chart because it not only sorts the frequencies in descending order, it also provides the cumulative polygon on the same scale.
- (c) From the Pareto diagram it is obvious that more than 50% of their day is spent sleeping and taking part in leisure and sports.

2.26 (a)



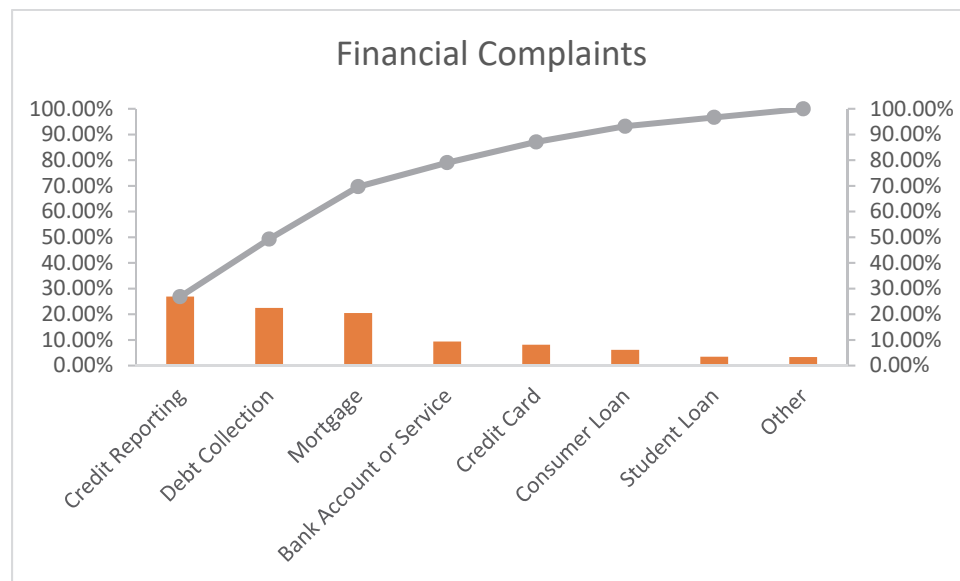
- (b)  $34.8\% + 19.4\% + 31.1\% = 85.3\%$

2.26 (c)  
cont.



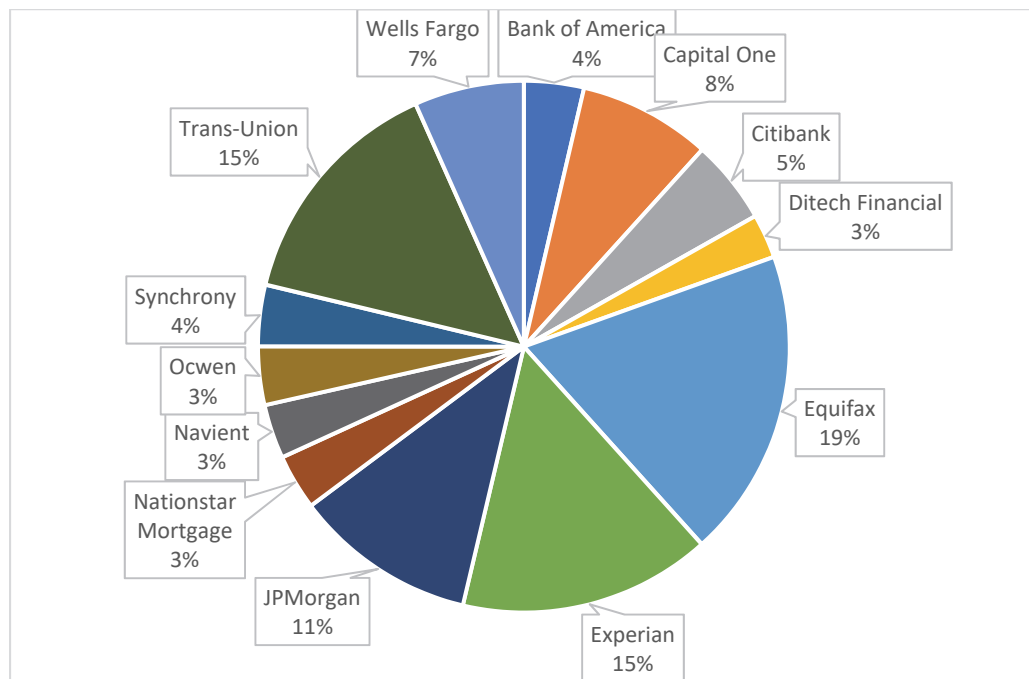
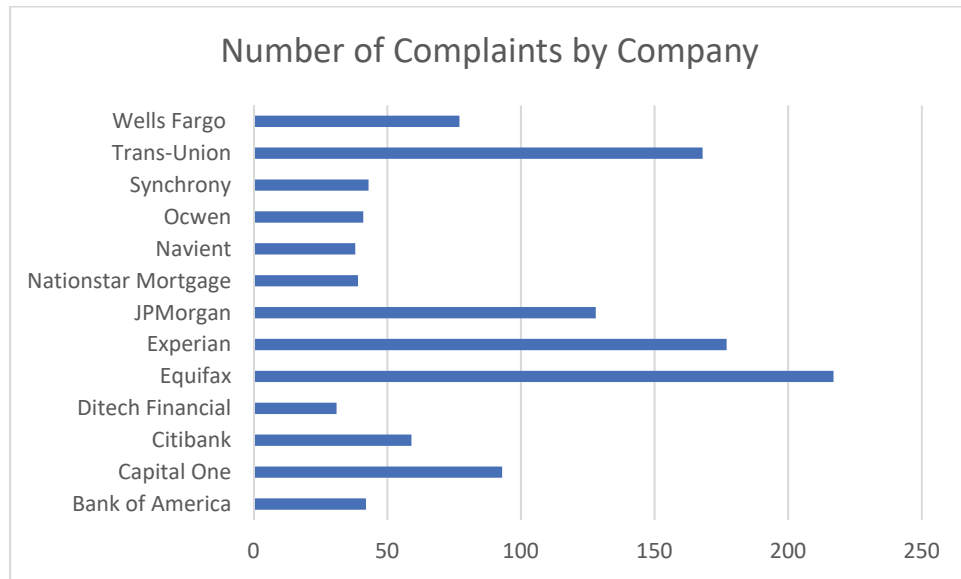
(d) The Pareto diagram is better than the pie chart because it not only sorts the frequencies in descending order, it also provides the cumulative polygon on the same scale.

2.27 (a)



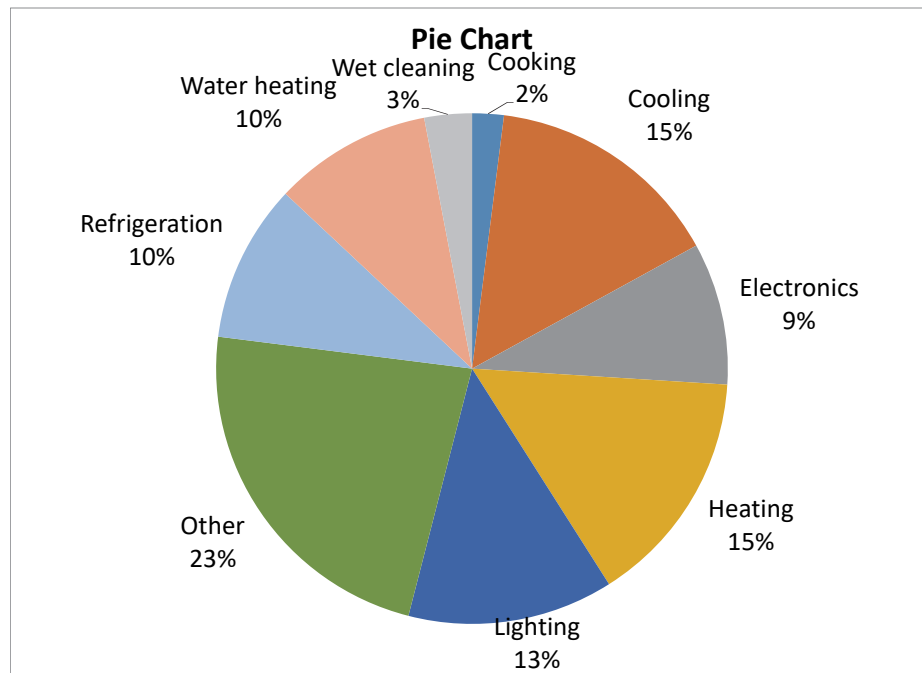
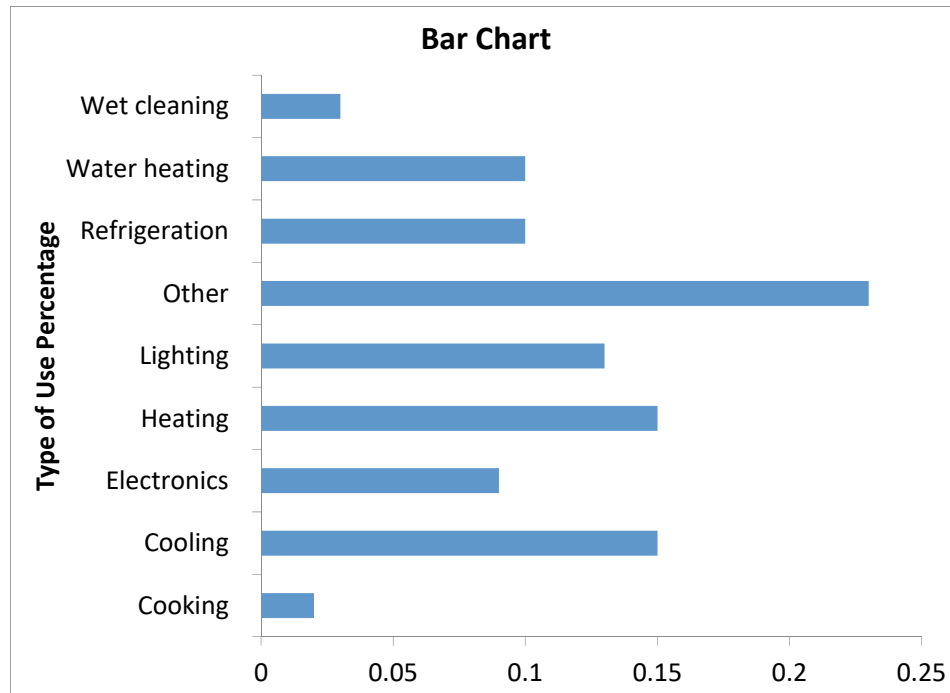
(b) The “vital few” reasons for the categories of complaints are “Credit Reporting”, “Debt Collection”, and “Mortgage” which account for 70% of the complaints. The remaining are the “trivial many” which make up 30% of the complaints.

2.27 (c)  
cont.



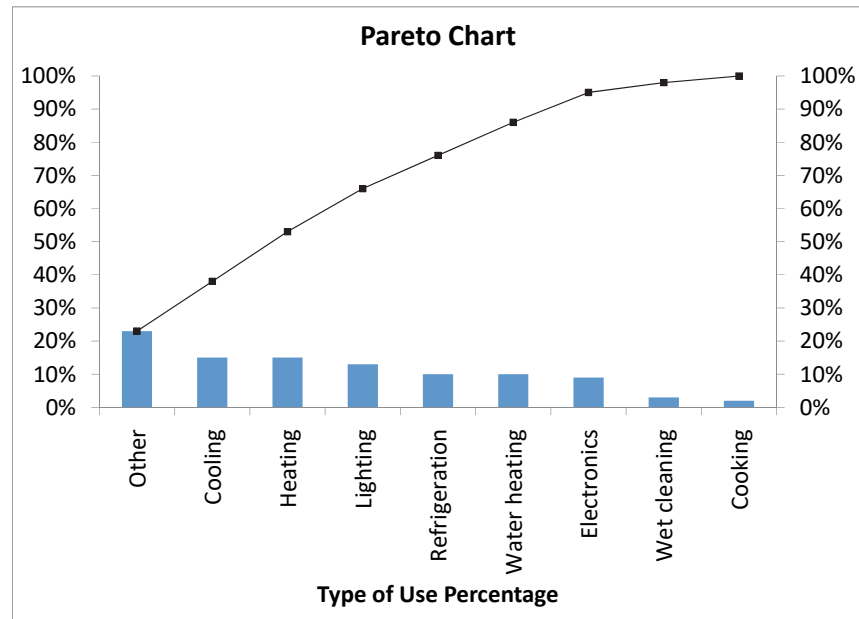
- (d) The Pareto diagram is better than the pie chart and bar chart because it allows you to see which companies account for most of the complaints.

2.28 (a)



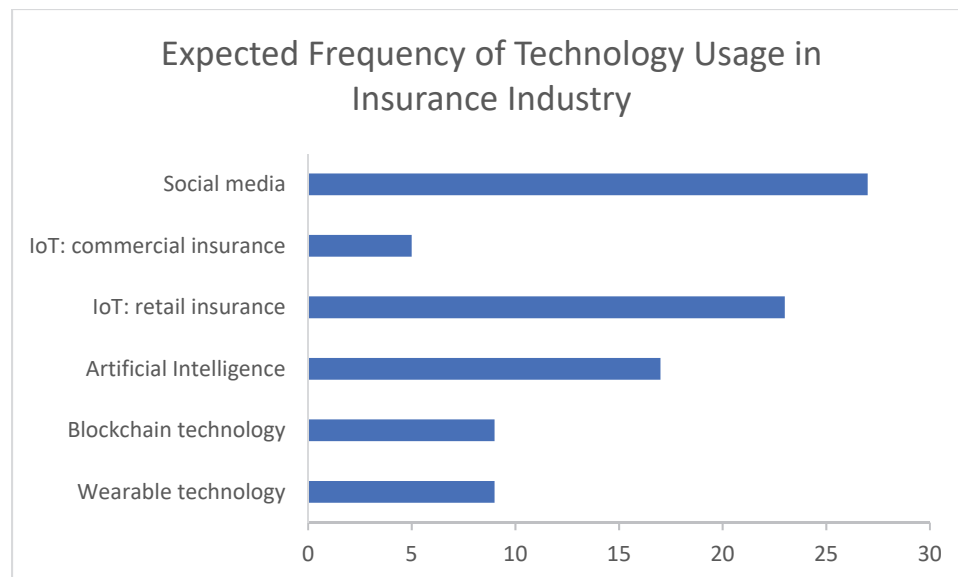
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2.28 (a)  
cont.



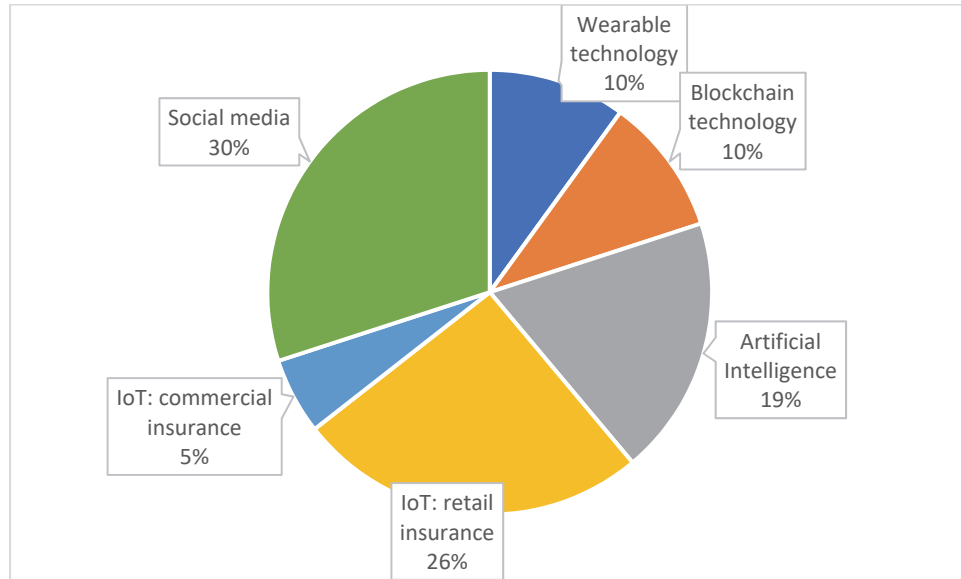
- (b) The Pareto diagram is better than the pie chart and bar chart because it not only sorts the frequencies in descending order; it also provides the cumulative polygon on the same scale.
- (c) Other, cooling, heating and lighting accounted for 66% of the residential electricity consumption in the United States.

2.29 (a)



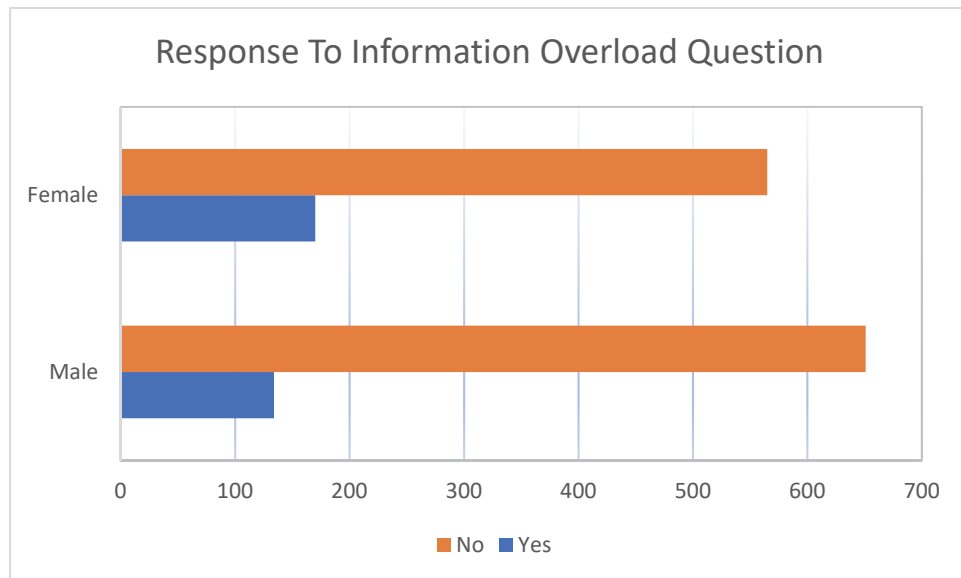


2.29 (a)  
cont.



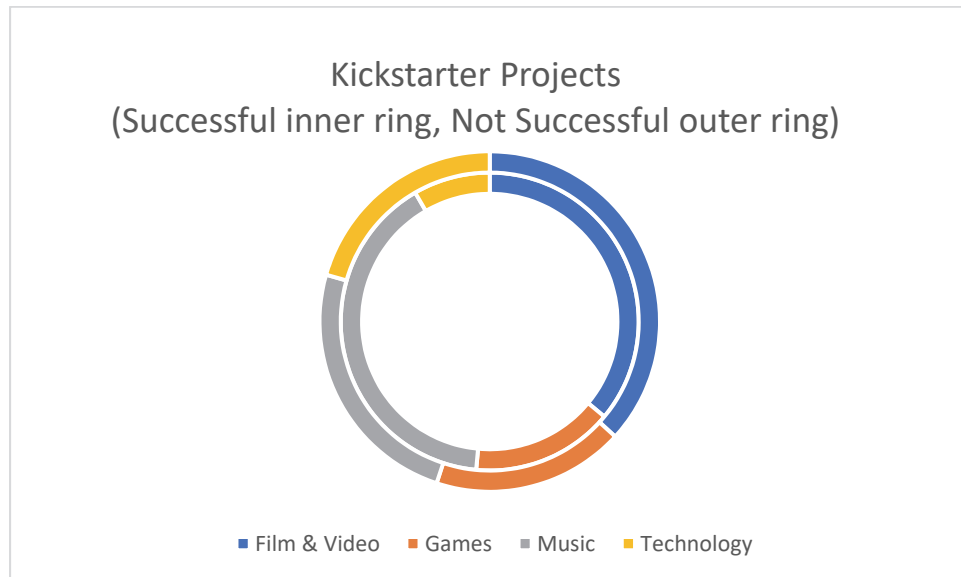
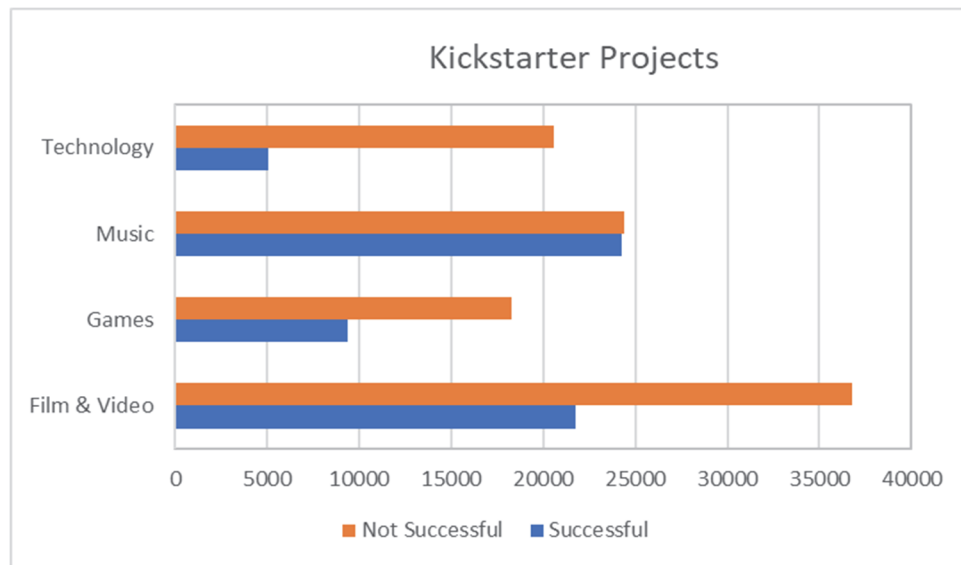
(b) Insurance professionals expect Social Media, AI, and IOT retail insurance to be most used in the insurance industry in the coming year.

2.30 (a)



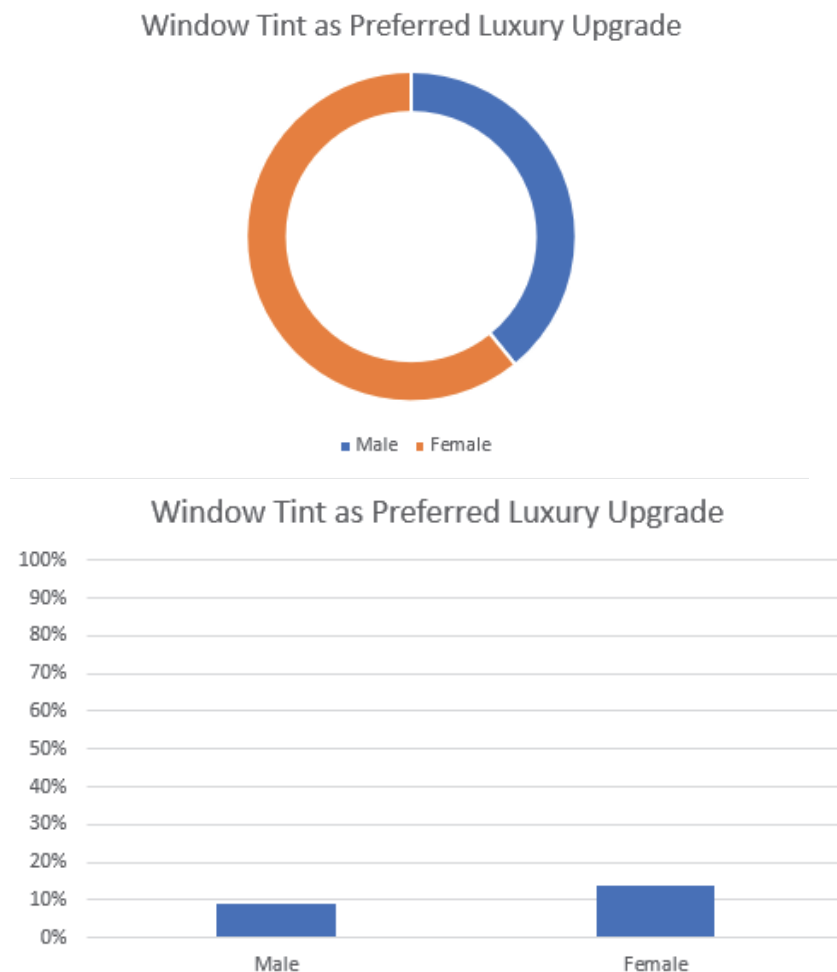
(b) Females are more likely to be overloaded with information.

2.31 (a)



(b) Of the successful kickstarter projects, music projects make up the largest part.

2.32 (a)



(b) A more females then men prefer window tint as a luxury upgrade.

2.33

Stem-and-leaf of Finance Scores	
5	34
6	9
7	4
9	38

2.34 Ordered array: 50 74 74 76 81 89 92

2.35 (a) Ordered array: 9.1 9.4 9.7 10.0 10.2 10.2 10.3 10.8 11.1 11.2  
 11.5 11.5 11.6 11.6 11.7 11.7 11.7 12.2 12.2 12.3  
 12.4 12.8 12.9 13.0 13.2

(b) The stem-and-leaf display conveys more information than the ordered array. We can more readily determine the arrangement of the data from the stem-and-leaf display than we can from the ordered array. We can also obtain a sense of the distribution of the data from the stem-and-leaf display.

(c) The most likely gasoline purchase is between 11 and 11.7 gallons.

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2.35 (d) Yes, the third row is the most frequently occurring stem in the display and it is located in the center of the distribution.

2.36 (a)

Stem Unit	100
2	2 6 6 8 8 9
3	0 2 2 3 5 5 8
4	0 2 2 2 3 4 9
5	1 4 7 9
6	
7	0 2 3 9
8	8

(b) The results are concentrated between \$220 and \$490.

2.37 (a) Download Speed 4.5 7.1 10.3 10.8 11.2 16.7 20.8 22.7 24.0  
Upload Speed 3.0 3.8 6.0 6.2 6.4 9.1 11.1 13.2 14.3

(b) Download Speeds: Stem unit :1

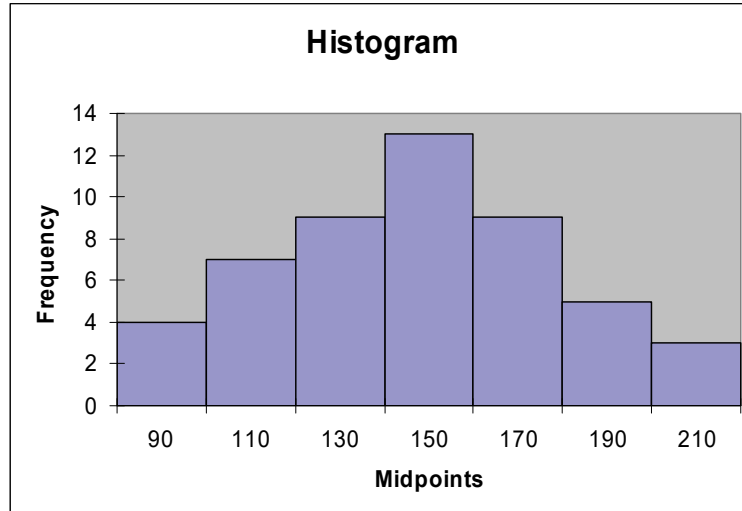
4	5
5	
6	
7	1
8	
9	
10	38
11	2
12	
13	
14	
15	
16	7
17	
18	
19	
20	8
21	
22	7
23	
24	0

- 2.37 (b) Upload Speeds: Stem unit 1  
cont.

3	08
4	
5	
6	024
7	
8	
9	1
10	
11	1
12	
13	2
14	3

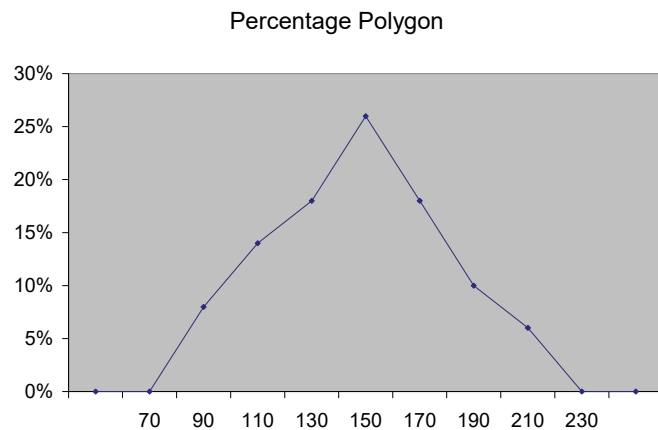
- (b) The stem-and-leaf display conveys more information than the ordered array. We can more readily determine the arrangement of the data from the stem-and-leaf display than we can from the ordered array. We can also obtain a sense of the distribution of the data from the stem-and-leaf display.
- (c) Download speeds are concentrated around 10 mbs and Upload speeds are concentrated around 6 mbs.

- 2.38 (a)

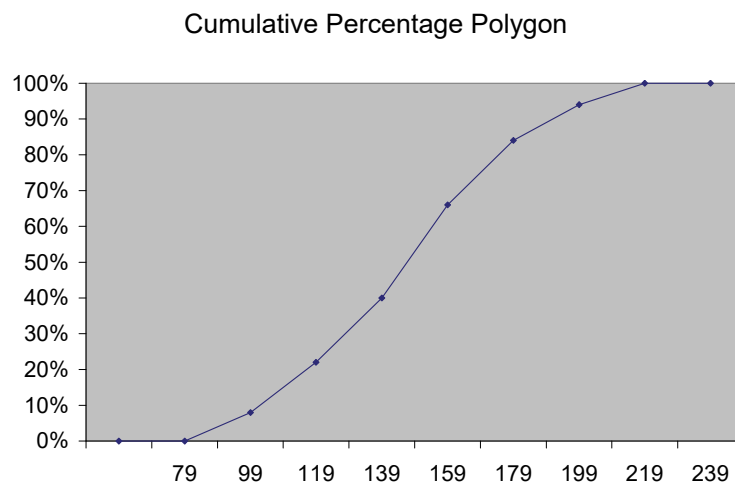


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2.38 (a)  
cont.



(b)

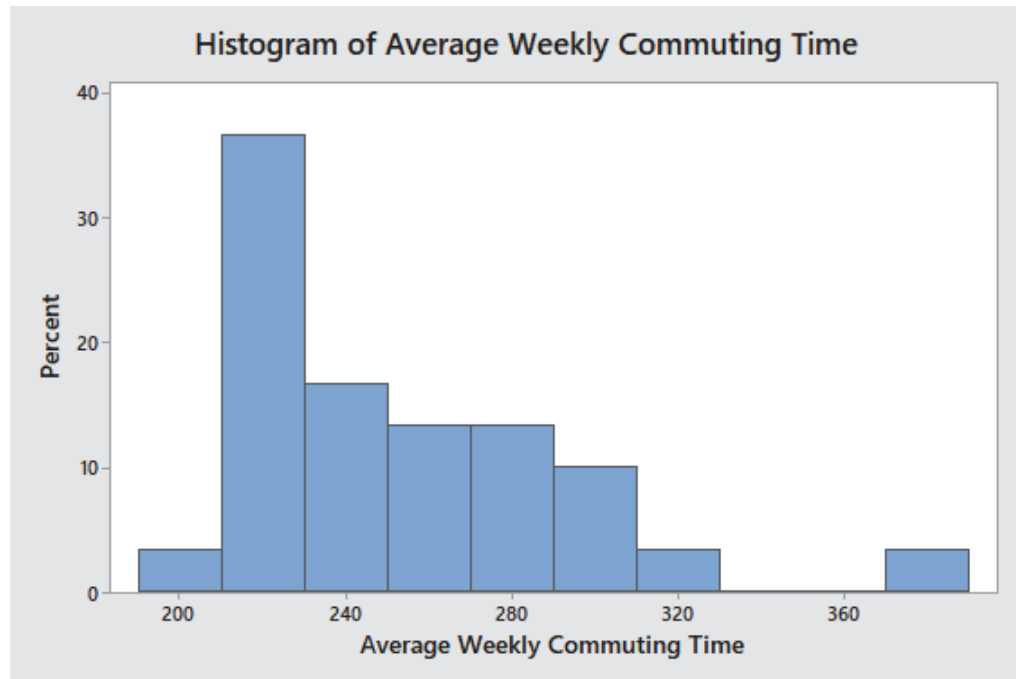


(c) The majority of utility charges are clustered between \$120 and \$180.

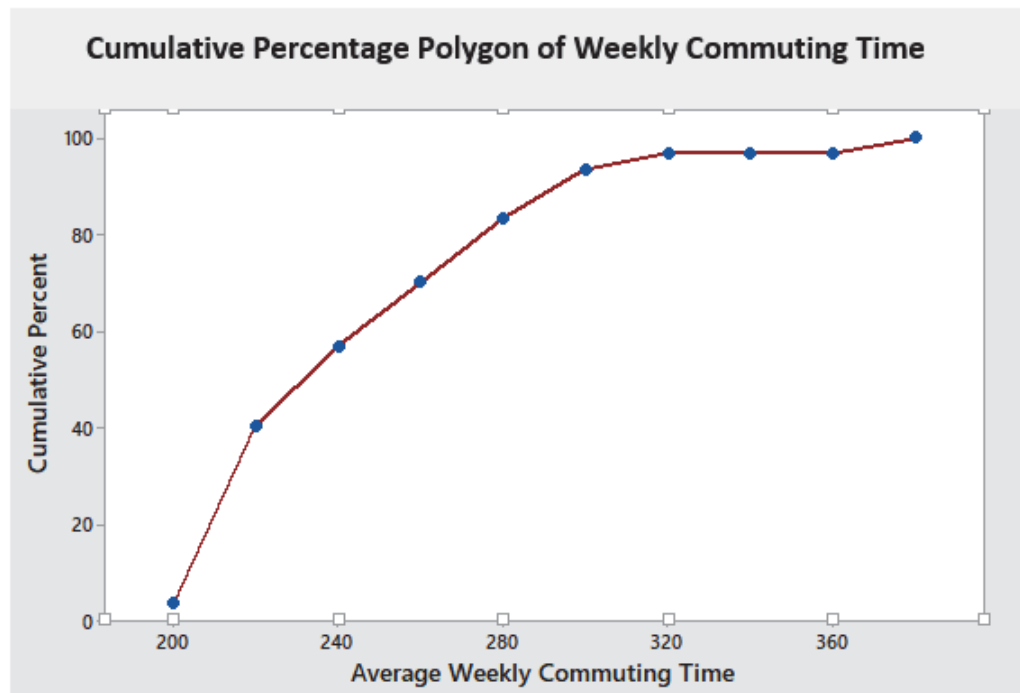
2.39 The cost of attending a baseball game is concentrated around \$65 with twelve teams at that cost. Four teams have costs of \$85 and one team has the highest cost of \$115.

2.40 Property taxes on a \$176K home seem concentrated between \$700 and \$2,200 and also between \$3,200 and \$3,700.

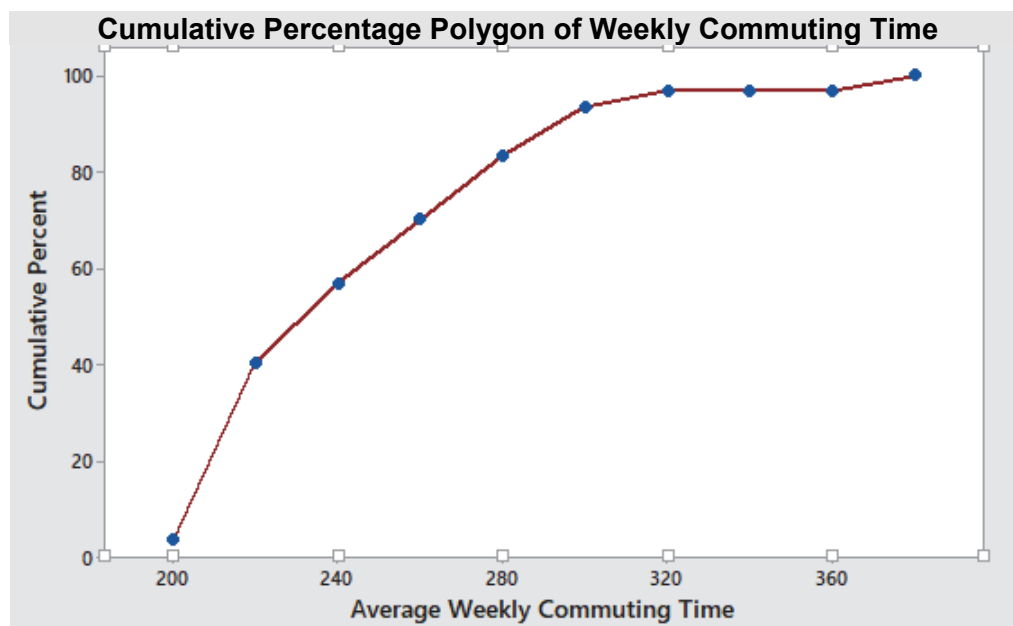
2.41 (a)



(b)

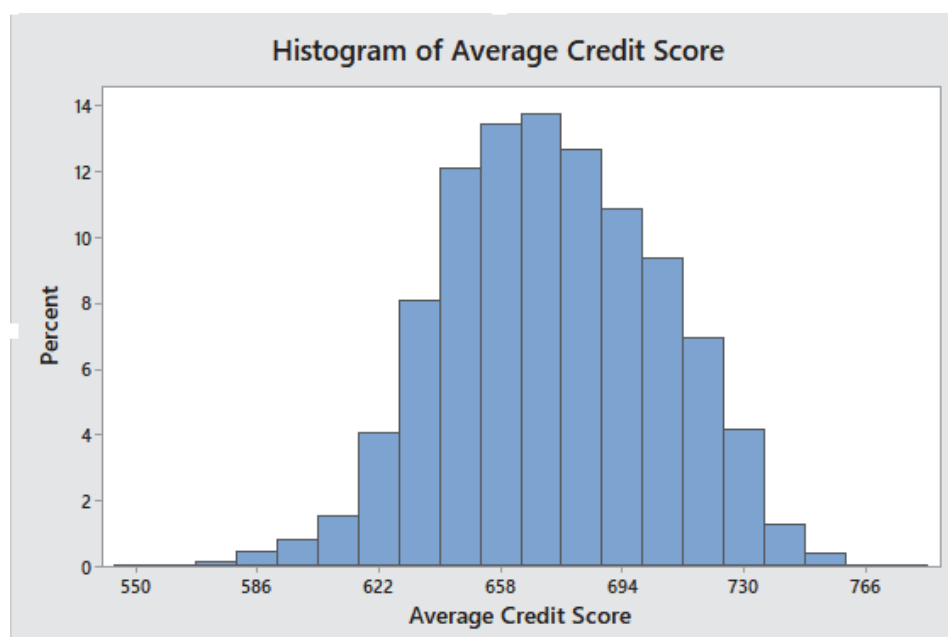


2.41 (b)  
cont.



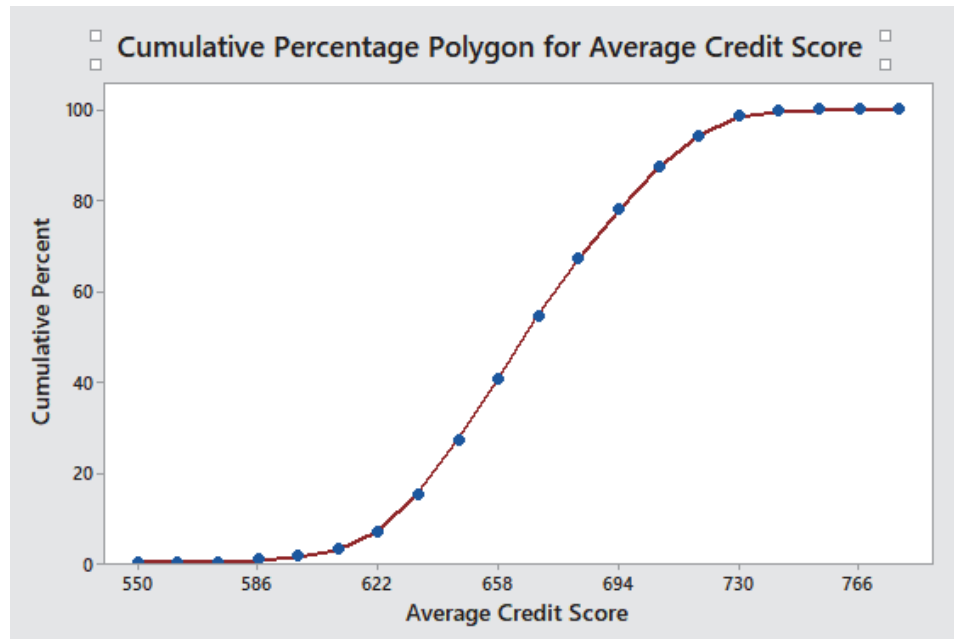
- (c) The majority of Americans living in cities spend an average of 280 minutes or less commuting each week. Approximately 38% spend between 210 and 230 minutes commuting each week with a small percentage commuting spending between 370 to 380 minutes commuting each week.

2.42 (a)



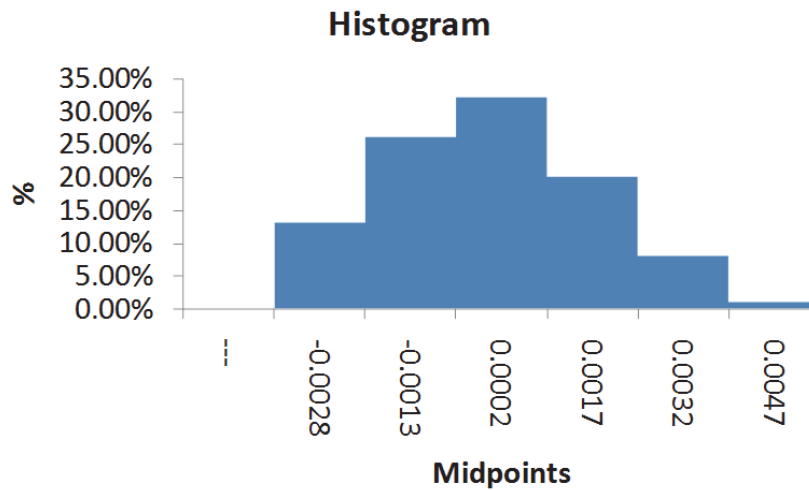


2.42 (b)  
cont.



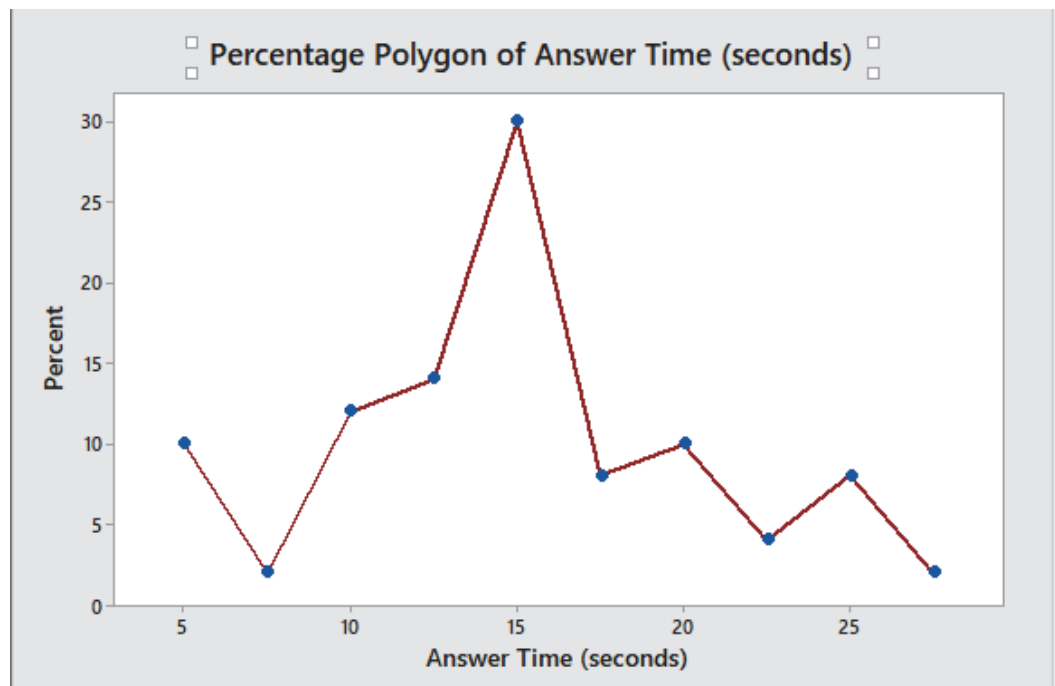
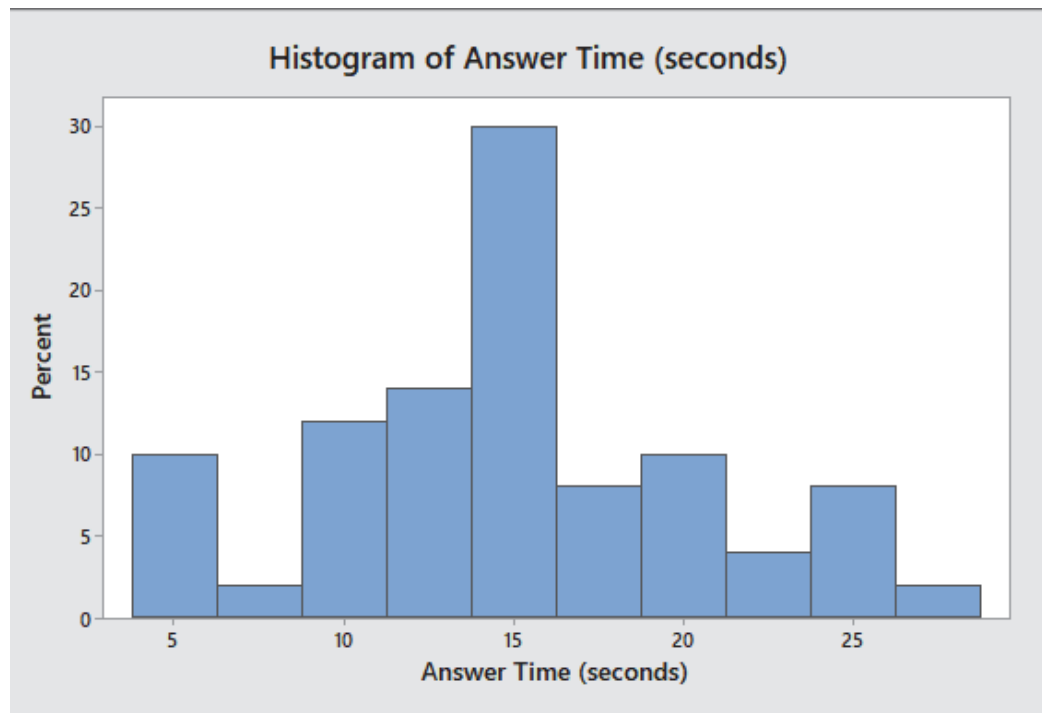
(c) The average credit scores are concentrated between 622 and 730.

2.43 (a)

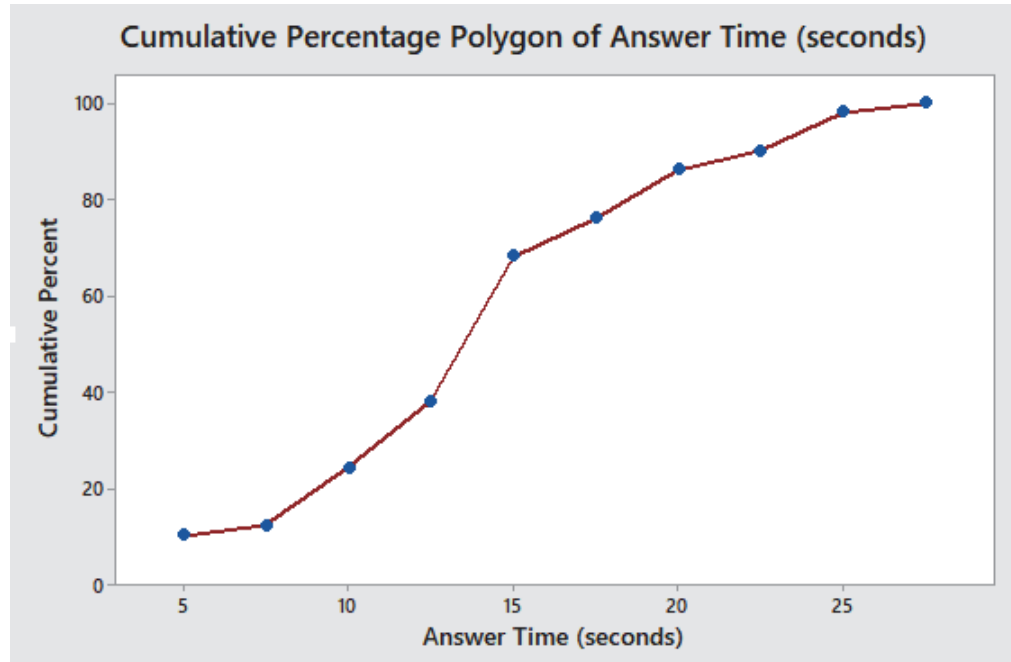


(b) Yes, the steel mill is doing a good job at meeting the requirement as there is only one steel part out of a sample of 100 that is as much as 0.005 inches longer than the specified requirement.

2.44 (a)

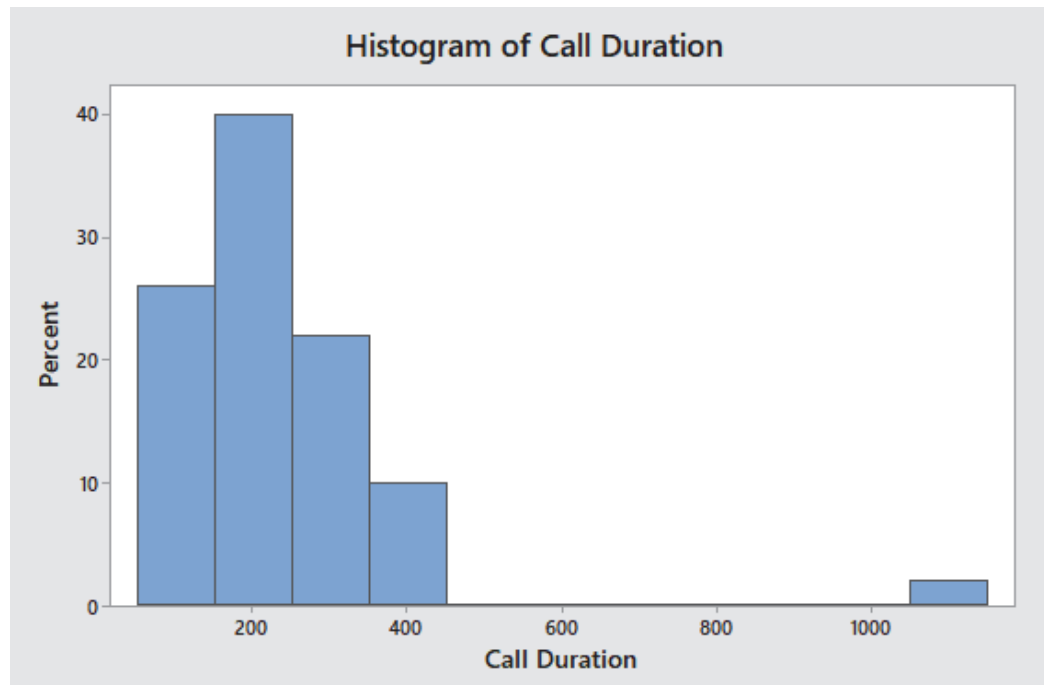


2.44 (b)  
cont.

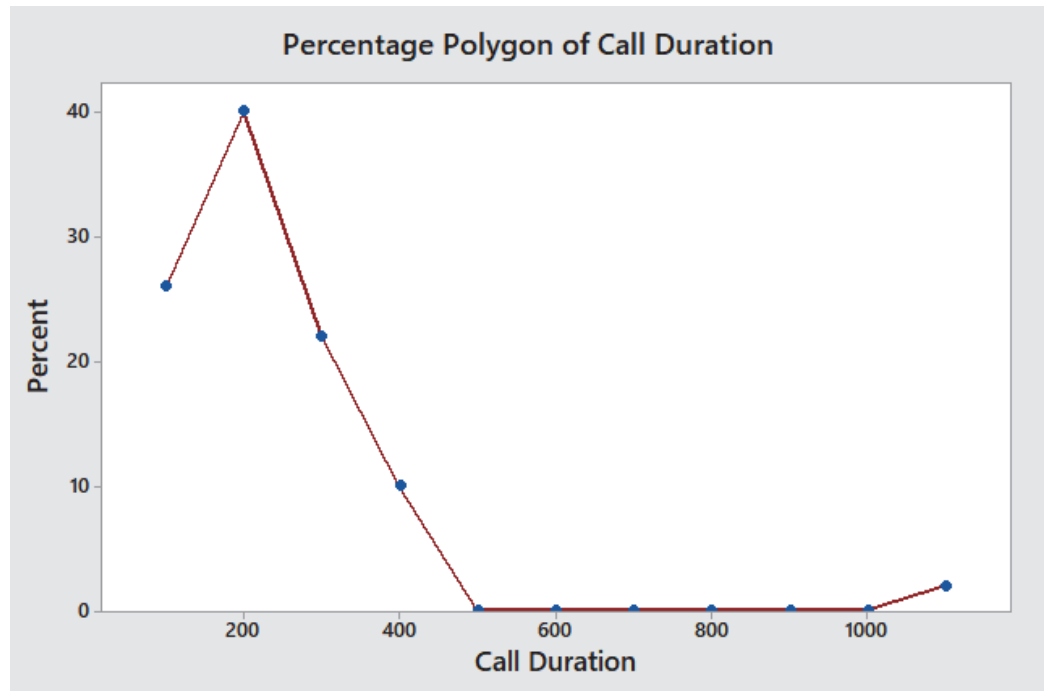


(c) The target is being met since 82% of the calls are being answered in less than 20 seconds.

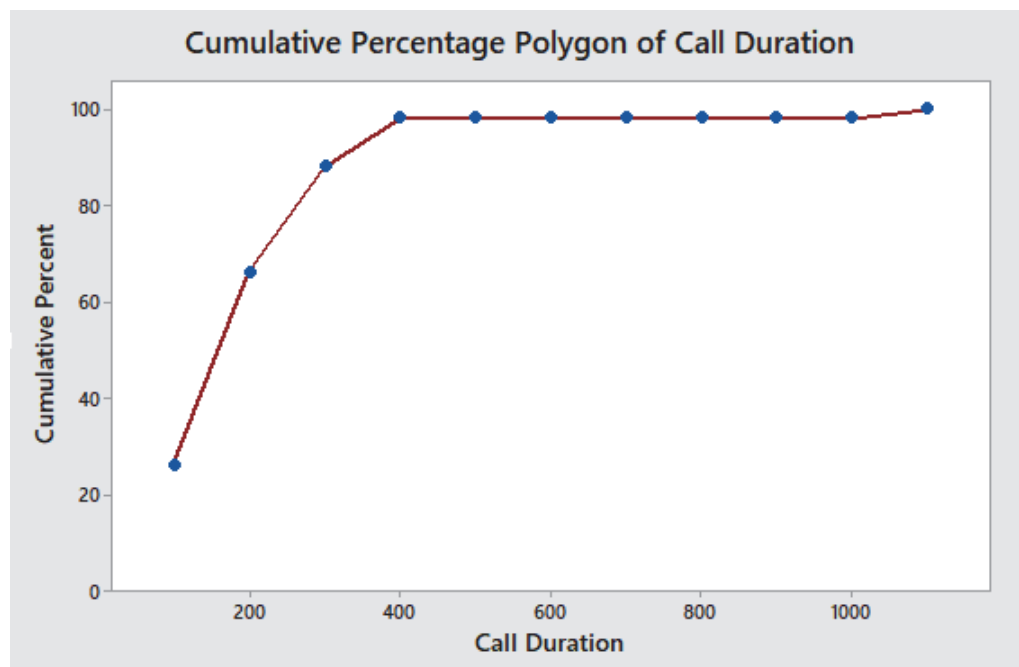
2.45 (a)



2.45 (a)  
cont.

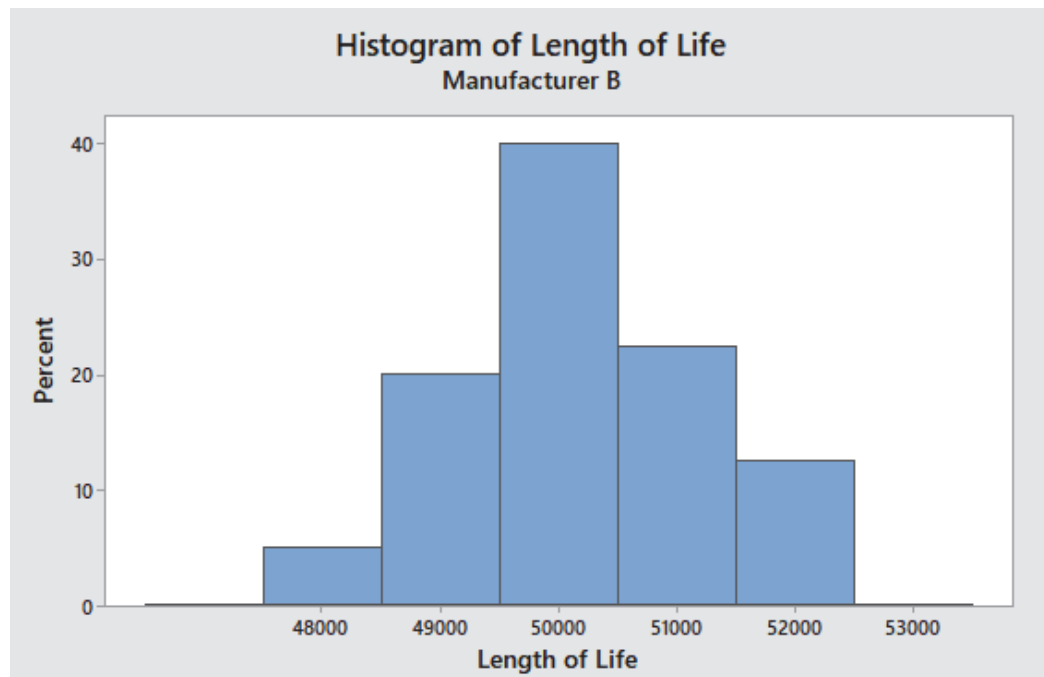
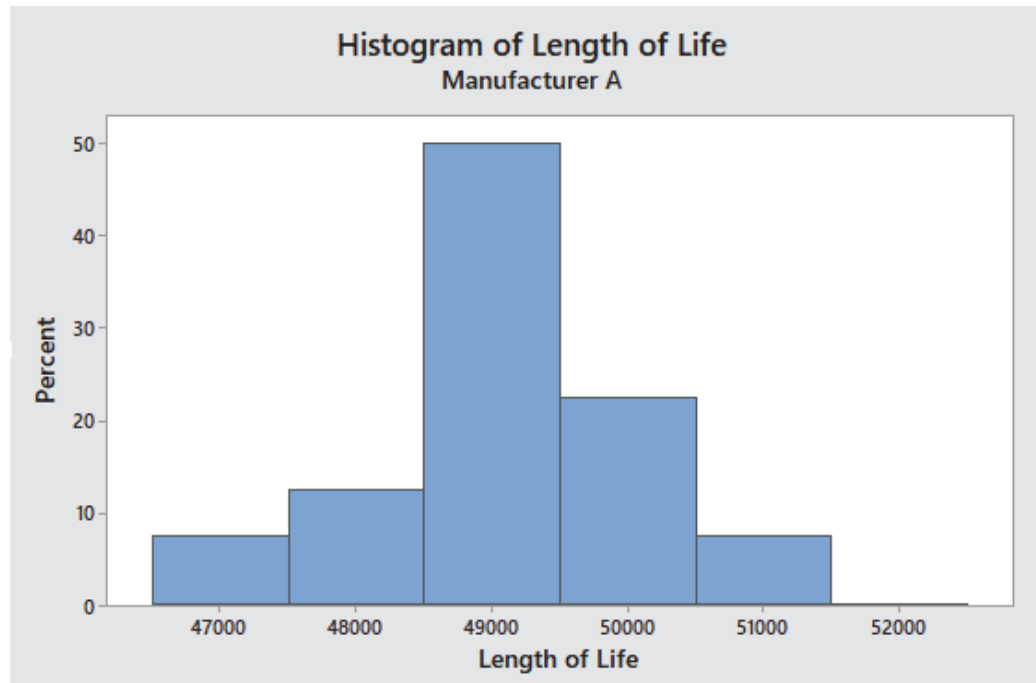


(b)

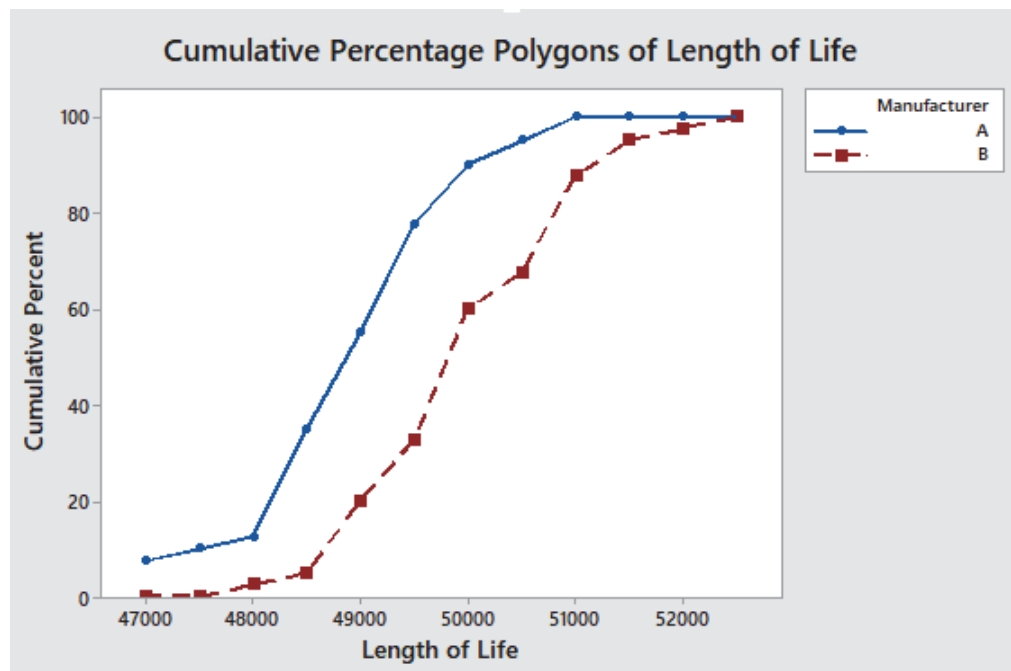
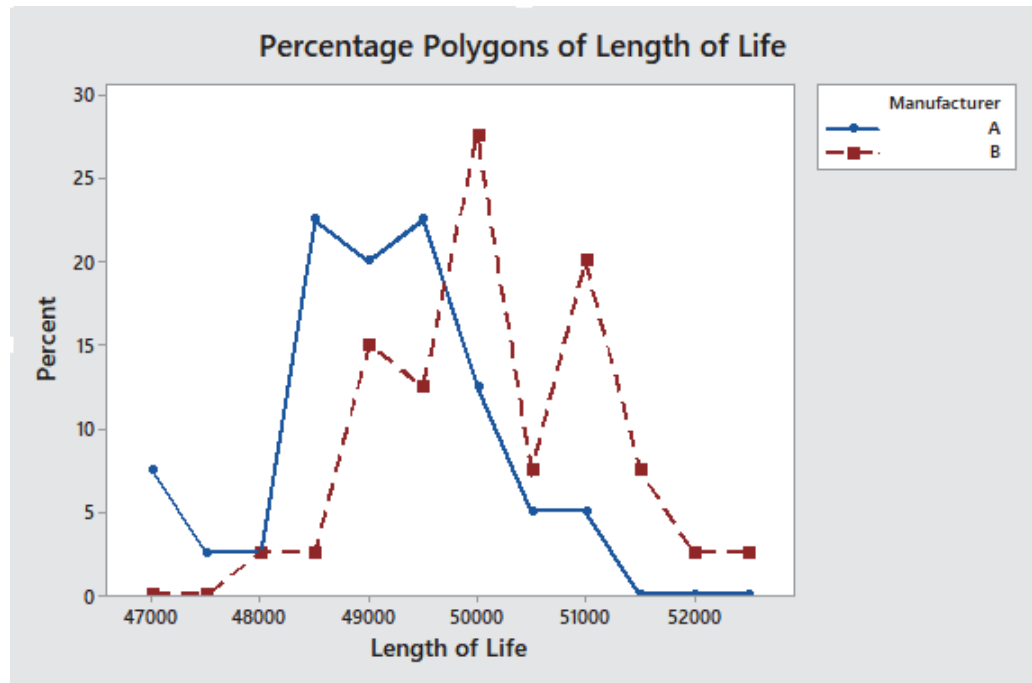


(c) The call center's target of call duration less than 240 seconds is only met for 60% of the calls in this data set.

2.46 (a)

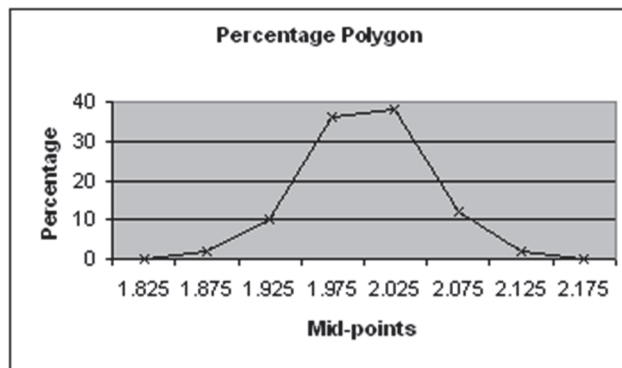
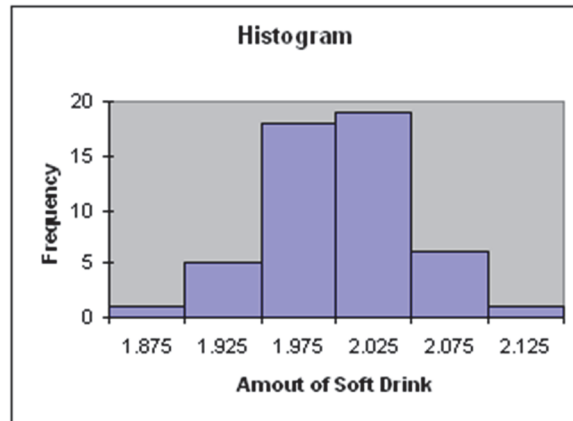


2.46 (b)  
cont.



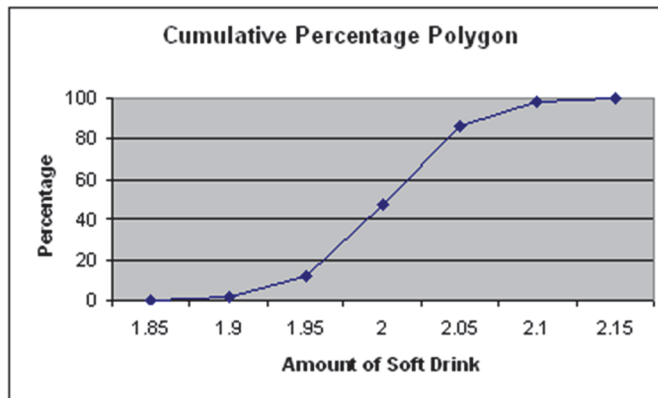
(c) Manufacturer B produces bulbs with longer lives than Manufacturer A

2.47 (a)



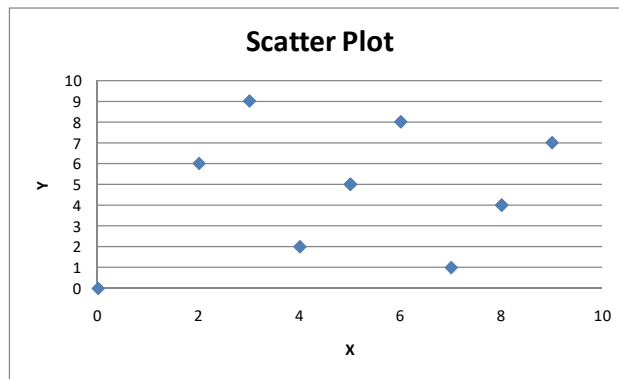
(b)

Amount of Soft Drink	Frequency Less Than	Percentage Less Than
1.899	1	2%
1.949	6	12
1.999	24	48
2.049	43	86
2.099	49	98
2.149	50	100



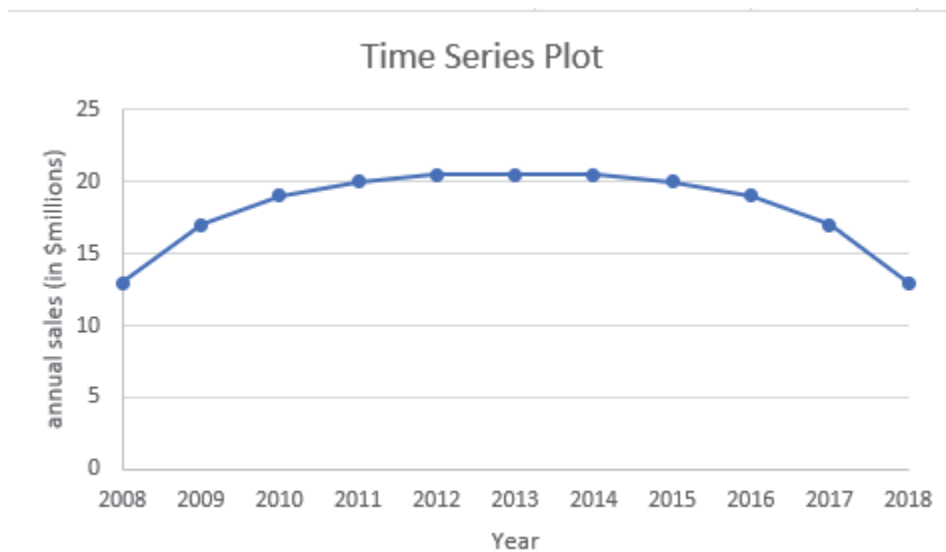
(c) The amount of soft drink filled in the two liter bottles is most concentrated in two intervals on either side of the two-liter mark, from 1.950 to 1.999 and from 2.000 to 2.049 liters. Almost three-fourths of the 50 bottles sampled contained between 1.950 liters and 2.049 liters.

2.48 (a)



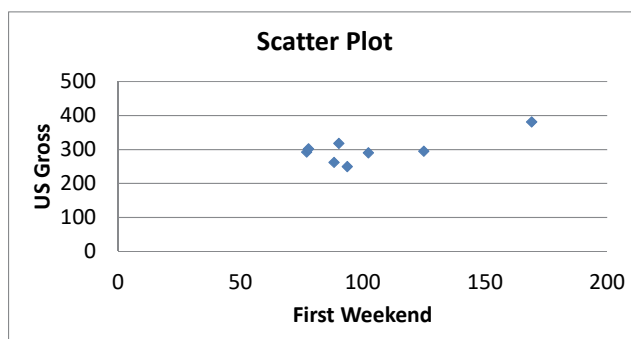
(b) There is no relationship between  $X$  and  $Y$ .

2.49 (a)



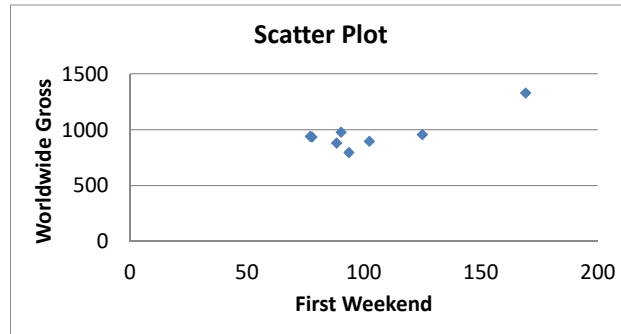
(b) Annual sales appear to be increasing in the earlier years before 2011, remain flat from 2012 to 2014 and then start to decline after 2014.

2.50 (a)



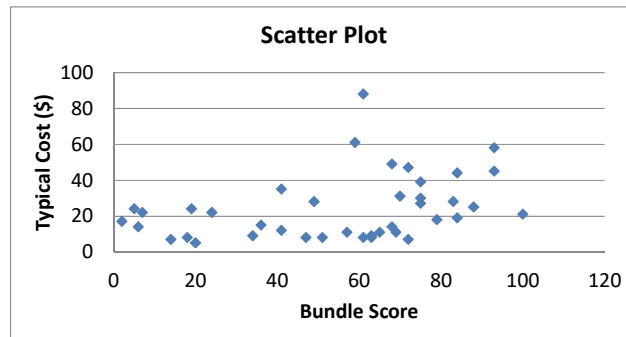


2.50 (b)  
cont.



(c) There appears to be a linear relationship between the first weekend gross and either the U.S. gross or the worldwide gross of Harry Potter movies. However, this relationship is greatly affected by the results of the last movie, *Deathly Hallows, Part II*.

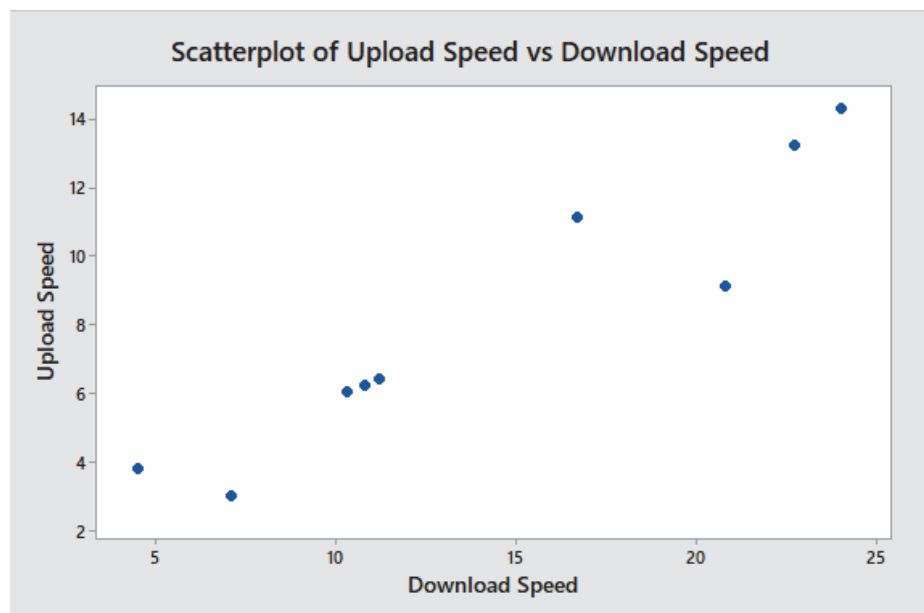
2.51 (a)



(b) There appears to be a positive relationship between Bundle score and typical cost.

2.52 (a) There appears to be a positive relationship between the download speed and the upload speed.

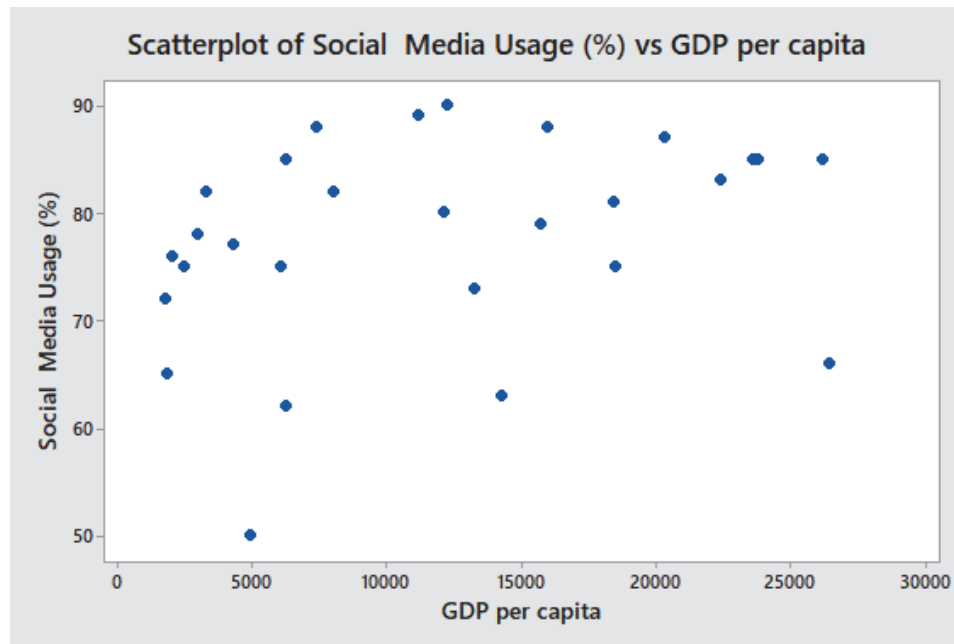
(b)



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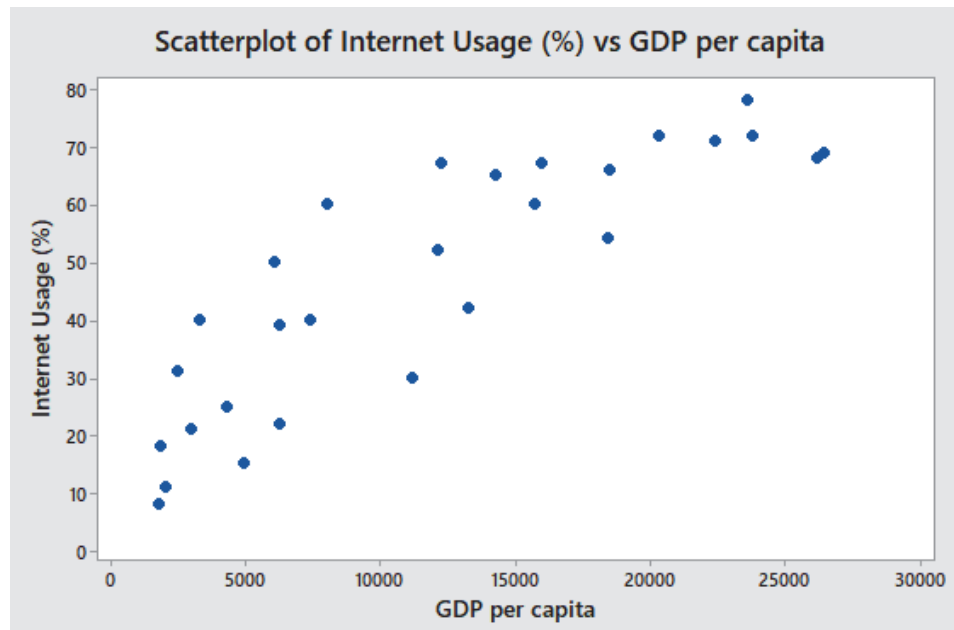
2.52 (c) Yes, this is borne out by the data  
cont.

2.53 (a)



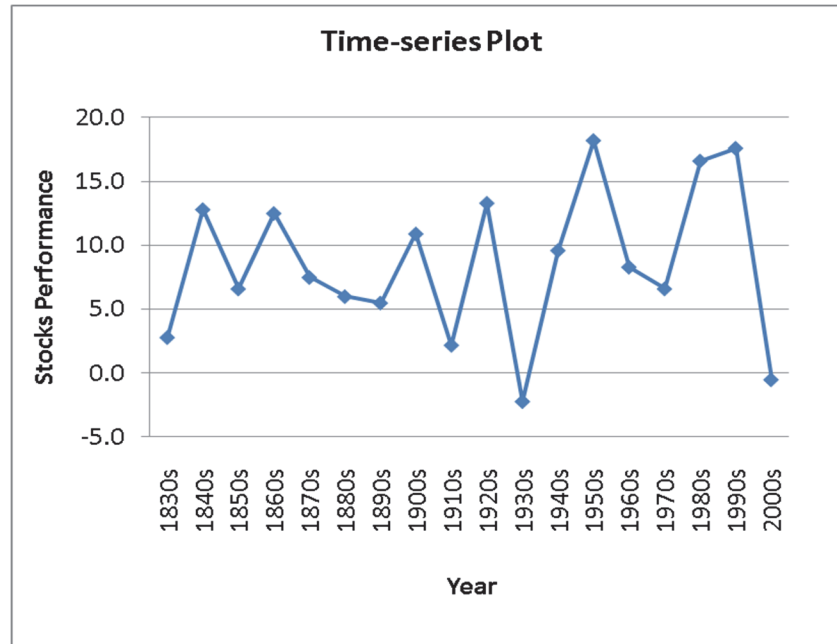
(b) There does not appear to be a relationship between GDP and social media usage.

(c)



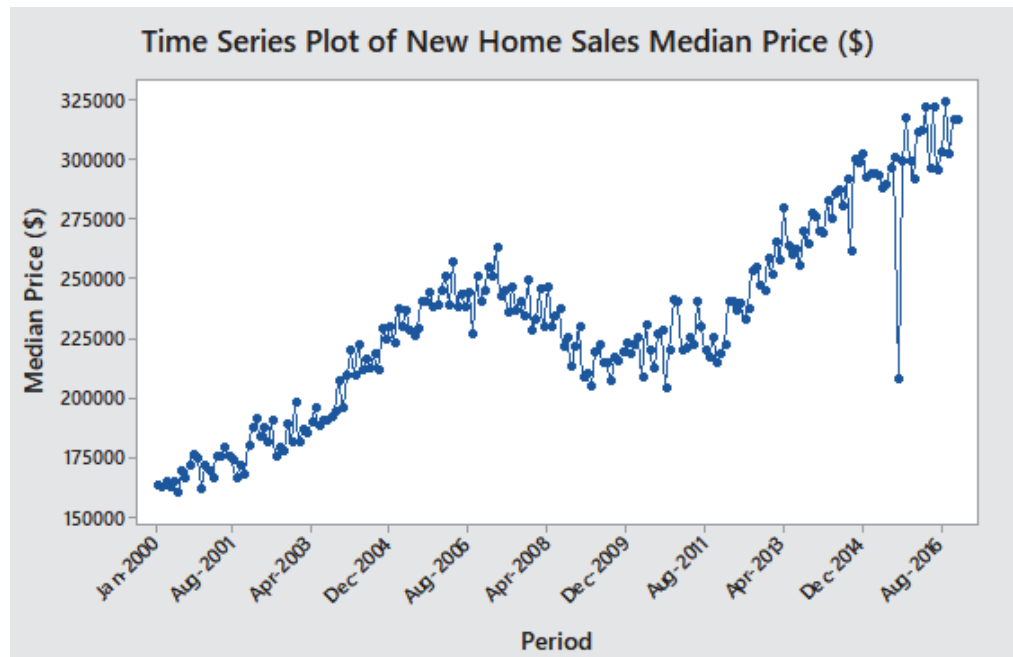
(d) There is a positive relationship between GDP and internet usage.

2.54 (a) Excel output:



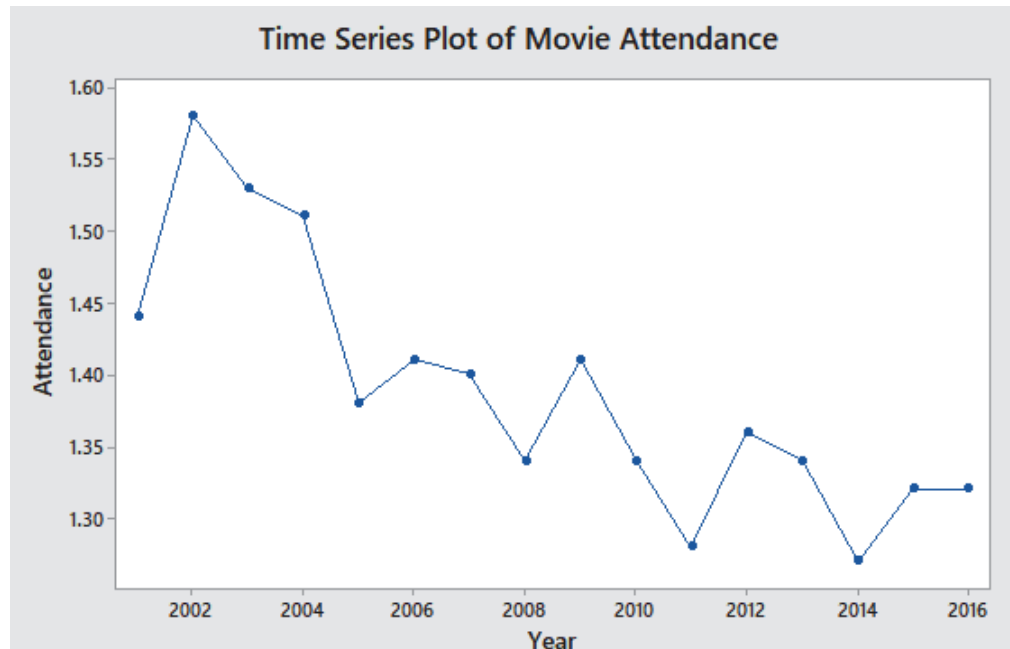
(b) There is a great deal of variation in the returns from decade to decade. Most of the returns are between 5% and 15%. The 1950s, 1980s, and 1990s had exceptionally high returns, and only the 1930s and 2000s had negative returns.

2.55 (a)



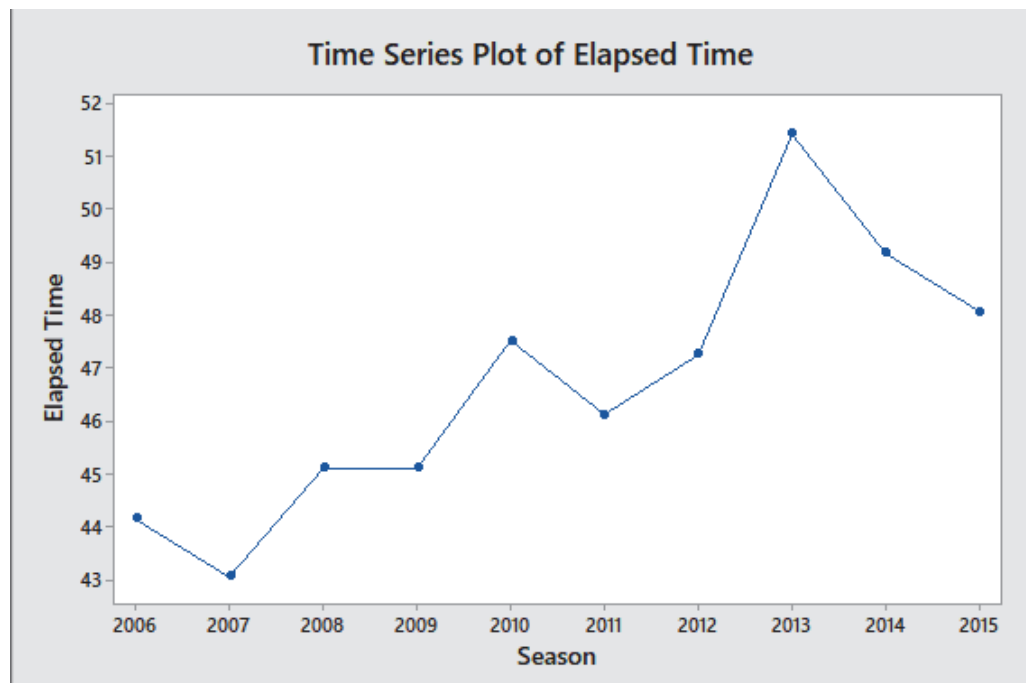
(b) There is an upward trend in home sales price until 2006. Prices decline or remain flat from 2006 – 2011. From 2011 – 2016 there is an upward trend in median price of new home sales. There is a huge drop in median prices in September 2015. This should be investigated further and may be just an error in the data file.

2.56 (a)

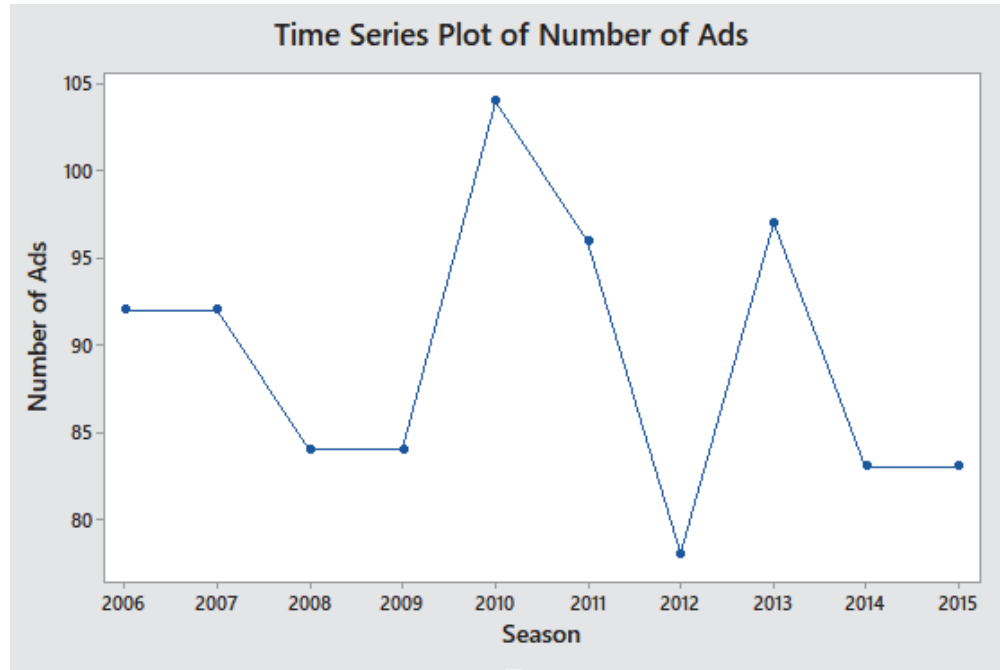


- (b) There was a decline in movie attendance from 2001 to 2016. During that time, movie attendance increased from 2001 to 2002 but then by 2016 decreased to a level below 2001.

2.57 (a)



2.57 (a)  
cont.



- (b) There does not appear to be a pattern present in the number of Ads ran between the opening kickoff and the final whistle over the years from 2006 to 2015.
- (c) The total elapse run time (in minutes) of commercials increased from 2007 to 2013 followed by a declined in 2014 and 2015.

2.58 (a) Pivot Table in terms of %

Count of Type Type	Star Rating					Grand Total
	One	Two	Three	Four	Five	
<b>Growth</b>	<b>5.43%</b>	<b>17.12%</b>	<b>27.35%</b>	<b>11.27%</b>	<b>2.71%</b>	<b>63.88%</b>
Large	3.76%	7.72%	13.57%	5.43%	1.67%	32.15%
Mid-Cap	1.25%	5.43%	7.52%	3.13%	0.63%	17.96%
Small	0.42%	3.97%	6.26%	2.71%	0.42%	13.78%
<b>Value</b>	<b>2.92%</b>	<b>10.65%</b>	<b>13.99%</b>	<b>7.31%</b>	<b>1.25%</b>	<b>36.12%</b>
Large	2.09%	6.68%	9.19%	3.97%	1.25%	23.18%
Mid-Cap	0.63%	2.09%	2.71%	1.04%	0.00%	6.47%
Small	0.21%	1.88%	2.09%	2.30%	0.00%	6.48%
<b>Grand Total</b>	<b>8.35%</b>	<b>27.77%</b>	<b>41.34%</b>	<b>18.58%</b>	<b>3.97%</b>	<b>100.00%</b>

- (b) The growth and value funds have similar patterns in terms of star rating and type. Both growth and value funds have more funds with a rating of three. Very few funds have ratings of five.

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2.58 (c) Pivot Table in terms of Average Three-Year Return  
cont.

Count of Type Type	Star Rating					Grand Total
	One	Two	Three	Four	Five	
<b>Growth</b>	<b>5.41</b>	<b>7.04</b>	<b>8.94</b>	<b>10.14</b>	<b>12.83</b>	<b>8.51</b>
Large	6.97	9.43	10.62	11.83	14.25	10.30
Mid-Cap	2.27	5.07	7.93	8.77	11.22	6.93
Small	0.78	5.09	6.52	8.35	9.53	6.39
<b>Value</b>	<b>4.43</b>	<b>5.49</b>	<b>7.29</b>	<b>8.34</b>	<b>10.23</b>	<b>6.84</b>
Large	5.23	6.05	7.58	8.85	10.23	7.29
Mid-Cap	2.79	5.77	7.32	9.26	–	6.69
Small	1.33	3.20	5.93	7.04	–	5.39
<b>Grand Total</b>	<b>5.07</b>	<b>6.45</b>	<b>8.38</b>	<b>9.43</b>	<b>12.01</b>	<b>7.91</b>

(d) There are 65 large cap growth funds with a rating of three. Their average three year return is 10.62.

2.59 (a) Pivot table of tallies in terms of counts:

Count of Star Rating		Column Labels					
Row Labels		Five	Four	Three	Two	One	Grand Total
Large		14	45	109	69	28	265
Low		8	24	50	25	9	116
Average		3	20	55	40	11	129
High		3	1	4	4	8	20
MidCap		3	20	49	36	9	117
Low		2	11	7	5	1	26
Average		1	9	34	15	3	62
High				8	16	5	29
Small		2	24	40	28	3	97
Low		1	3		1		5
Average			13	15	5		33
High		1	8	25	22	3	59
Grand Total		19	89	198	133	40	479

Pivot table of tallies in terms of % of grand total:

Count of Star Rating		Column Labels					
Row Labels		Five	Four	Three	Two	One	Grand Total
☐ Large		2.92%	9.39%	22.76%	14.41%	5.85%	55.32%
Low		1.67%	5.01%	10.44%	5.22%	1.88%	24.22%
Average		0.63%	4.18%	11.48%	8.35%	2.30%	26.93%
High		0.63%	0.21%	0.84%	0.84%	1.67%	4.18%
☐ MidCap		0.63%	4.18%	10.23%	7.52%	1.88%	24.43%
Low		0.42%	2.30%	1.46%	1.04%	0.21%	5.43%
Average		0.21%	1.88%	7.10%	3.13%	0.63%	12.94%
High		0.00%	0.00%	1.67%	3.34%	1.04%	6.05%
☐ Small		0.42%	5.01%	8.35%	5.85%	0.63%	20.25%
Low		0.21%	0.63%	0.00%	0.21%	0.00%	1.04%
Average		0.00%	2.71%	3.13%	1.04%	0.00%	6.89%
High		0.21%	1.67%	5.22%	4.59%	0.63%	12.32%
Grand Total		3.97%	18.58%	41.34%	27.77%	8.35%	100.00%

- 2.59 (b) For the large-cap funds, the three-star rating category had the highest percentage of funds, followed by two-star, four-star, one-star, and five-star. Very few large-cap funds had ratings of five. This pattern was also seen with the mid-cap funds as a group. The same pattern was observed with the small-cap funds. However, the pattern was more subtle in that the differences in percentage were less in many cases.

Within the large-cap fund category, the highest percentage of funds were in the average-risk category followed by the low-risk and high-risk categories. Within the mid-cap category, the highest percentage of funds were in the average-risk category followed by the high and low risk categories. Within the small-cap category, the highest percentage of funds were in the high-risk category followed by the average and low risk categories.

(c)

Average of 3YrReturn		Column Labels					
Row Labels		Five	Four	Three	Two	One	Grand Total
Large		12.53	10.57	9.39	7.86	6.35	9.04
Low		12.36	9.91	8.57	7.59	6.94	8.77
Average		10.73	11.35	10.00	7.75	7.03	9.27
High		14.80	10.92	11.36	10.68	4.76	9.07
MidCap		11.22	8.89	7.77	5.27	2.44	6.87
Low		11.74	9.02	8.48	7.13	3.90	8.52
Average		10.18	8.73	7.40	5.74	0.72	6.91
High				8.73	4.24	3.18	5.29
Small		9.53	7.75	6.38	4.48	0.96	6.07
Low		9.09	5.98		7.60		6.92
Average			7.73	6.61	2.85		6.48
High		9.96	8.44	6.24	4.71	0.96	5.76
Grand Total		12.01	9.43	8.38	6.45	5.07	7.91

- (d) There are four high-risk large-cap funds with a three-star rating. Their average three-year return is 11.36.

2.60 (a)

Count of Type Type	Star Rating					Grand Total
	One	Two	Three	Four	Five	
<b>Growth</b>	<b>5.43%</b>	<b>17.12%</b>	<b>27.35%</b>	<b>11.27%</b>	<b>2.71%</b>	<b>63.88%</b>
Large	1.25%	2.09%	4.80%	3.55%	1.46%	13.15%
Mid-Cap	1.67%	7.72%	15.87%	6.05%	0.42%	31.73%
Small	2.51%	7.31%	6.68%	1.67%	0.84%	19.00%
<b>Value</b>	<b>2.92%</b>	<b>10.65%</b>	<b>13.99%</b>	<b>7.31%</b>	<b>1.25%</b>	<b>36.12%</b>
Large	0.84%	4.38%	7.10%	4.38%	0.84%	17.54%
Mid-Cap	1.25%	4.80%	5.85%	2.71%	0.42%	15.03%
Small	0.84%	1.46%	1.04%	0.21%	0.00%	3.55%
<b>Grand Total</b>	<b>8.35%</b>	<b>27.77%</b>	<b>41.34%</b>	<b>18.58%</b>	<b>3.96%</b>	<b>100.00%</b>

- (b) Patterns of star rating conditioned on risk:  
 For the growth funds as a group, most are rated as three-star, followed by two-star, four-star, one-star, and five-star. The pattern of star rating is different among the various risk growth funds.  
 For the value funds as a group, most are rated as three-star, followed by two-star, four-star, one-star and five-star. Among the high-risk value funds, more are two-star than three-star.  
 Most of the growth funds are rated as average-risk, followed by high-risk and then low-risk. The pattern is not the same among all the rating categories.

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- 2.60 (b) Most of the value funds are rated as low-risk, followed by average-risk and then high-risk. The pattern is the same among the three-star, four-star, and five-star value funds. Among the one-star and two-star funds, there are more average risk funds than low risk funds.

(c)

Count of Type Type	Star Rating					Grand Total
	One	Two	Three	Four	Five	
<b>Growth</b>	<b>5.41</b>	<b>7.04</b>	<b>8.94</b>	<b>10.14</b>	<b>12.83</b>	<b>8.51</b>
Large	7.53	8.60	9.89	10.29	12.64	9.87
Mid-Cap	6.17	7.99	9.28	10.43	11.96	9.06
Small	3.83	5.59	7.45	8.76	13.59	6.64
<b>Value</b>	<b>4.43</b>	<b>5.49</b>	<b>7.29</b>	<b>8.34</b>	<b>10.23</b>	<b>6.84</b>
Large	5.29	7.00	7.66	8.57	10.74	7.76
Mid-Cap	5.01	4.98	6.97	7.96	9.23	6.41
Small	2.71	2.63	6.53	8.39	—	4.13
<b>Grand Total</b>	<b>5.07</b>	<b>6.45</b>	<b>8.38</b>	<b>9.43</b>	<b>12.01</b>	<b>7.91</b>

The three-year returns for growth funds is higher than for value funds. The return is higher for funds with higher ratings than lower ratings. This pattern holds for the growth funds for each risk level. For the low risk and average risk value funds, the return is lowest for the funds with a two-star rating.

- (d) There are 32 growth funds with high risk with a rating of three. These funds have an average three-year return of 7.45.

- 2.61 (a) Pivot table of tallies in terms of counts:

Row Labels	Five	Four	Three	Two	One	Grand Total
<b>Growth</b>	<b>13</b>	<b>54</b>	<b>131</b>	<b>82</b>	<b>26</b>	<b>306</b>
<b>Large</b>	<b>8</b>	<b>26</b>	<b>65</b>	<b>37</b>	<b>18</b>	<b>154</b>
High	3	1	3	4	6	17
Average	1	16	43	25	6	91
Low	4	9	19	8	6	46
<b>MidCap</b>	<b>3</b>	<b>15</b>	<b>36</b>	<b>26</b>	<b>6</b>	<b>86</b>
High			8	13	4	25
Average	1	7	24	11	2	45
Low	2	8	4	2		16
<b>Small</b>	<b>2</b>	<b>13</b>	<b>30</b>	<b>19</b>	<b>2</b>	<b>66</b>
High	1	7	21	18	2	49
Average		6	9	1		16
Low	1					1
<b>Value</b>	<b>6</b>	<b>35</b>	<b>67</b>	<b>51</b>	<b>14</b>	<b>173</b>
<b>Large</b>	<b>6</b>	<b>19</b>	<b>44</b>	<b>32</b>	<b>10</b>	<b>111</b>
High			1		2	3
Average	2	4	12	15	5	38
Low	4	15	31	17	3	70
<b>MidCap</b>		<b>5</b>	<b>13</b>	<b>10</b>	<b>3</b>	<b>31</b>
High				3	1	4
Average		2	10	4	1	17
Low		3	3	3	1	10
<b>Small</b>		<b>11</b>	<b>10</b>	<b>9</b>	<b>1</b>	<b>31</b>
High		1	4	4	1	10
Average		7	6	4		17
Low		3		1		4
<b>Grand Total</b>	<b>19</b>	<b>89</b>	<b>198</b>	<b>133</b>	<b>40</b>	<b>479</b>



- 2.61 (a) Pivot table of tallies in terms of % of grand total:  
cont.

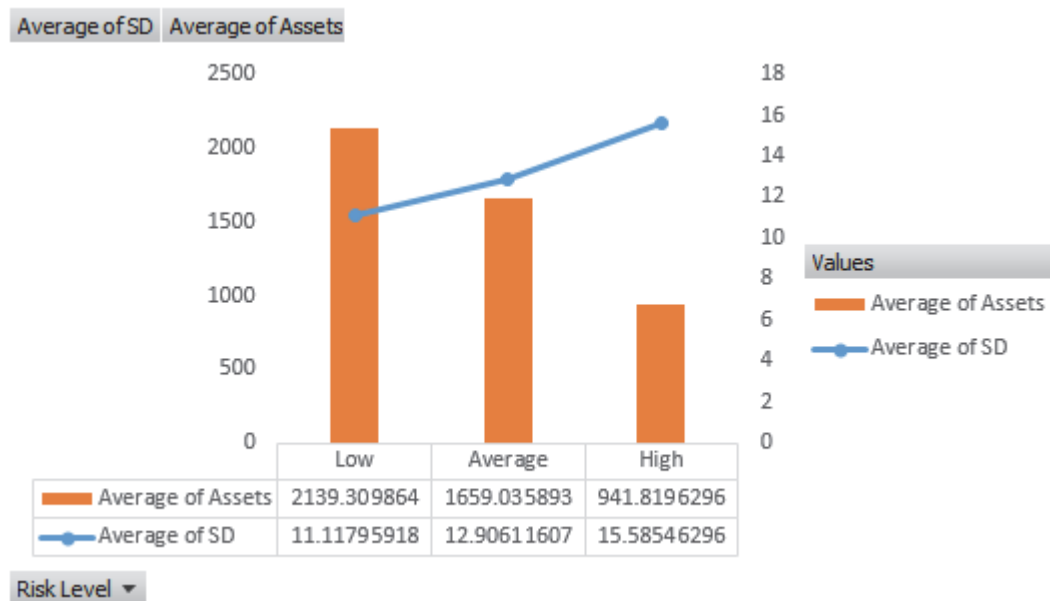
Count of Star Rating		Column Labels <span>⌵</span>					
Row Labels	<span>⌵</span> Five	Four	Three	Two	One	Grand Total	
<span>⌵</span> Growth		2.71%	11.27%	27.35%	17.12%	5.43%	63.88%
<span>⌵</span> Large		1.67%	5.43%	13.57%	7.72%	3.76%	32.15%
High		0.63%	0.21%	0.63%	0.84%	1.25%	3.55%
Average		0.21%	3.34%	8.98%	5.22%	1.25%	19.00%
Low		0.84%	1.88%	3.97%	1.67%	1.25%	9.60%
<span>⌵</span> MidCap		0.63%	3.13%	7.52%	5.43%	1.25%	17.95%
High		0.00%	0.00%	1.67%	2.71%	0.84%	5.22%
Average		0.21%	1.46%	5.01%	2.30%	0.42%	9.39%
Low		0.42%	1.67%	0.84%	0.42%	0.00%	3.34%
<span>⌵</span> Small		0.42%	2.71%	6.26%	3.97%	0.42%	13.78%
High		0.21%	1.46%	4.38%	3.76%	0.42%	10.23%
Average		0.00%	1.25%	1.88%	0.21%	0.00%	3.34%
Low		0.21%	0.00%	0.00%	0.00%	0.00%	0.21%
<span>⌵</span> Value		1.25%	7.31%	13.99%	10.65%	2.92%	36.12%
<span>⌵</span> Large		1.25%	3.97%	9.19%	6.68%	2.09%	23.17%
High		0.00%	0.00%	0.21%	0.00%	0.42%	0.63%
Average		0.42%	0.84%	2.51%	3.13%	1.04%	7.93%
Low		0.84%	3.13%	6.47%	3.55%	0.63%	14.61%
<span>⌵</span> MidCap		0.00%	1.04%	2.71%	2.09%	0.63%	6.47%
High		0.00%	0.00%	0.00%	0.63%	0.21%	0.84%
Average		0.00%	0.42%	2.09%	0.84%	0.21%	3.55%
Low		0.00%	0.63%	0.63%	0.63%	0.21%	2.09%
<span>⌵</span> Small		0.00%	2.30%	2.09%	1.88%	0.21%	6.47%
High		0.00%	0.21%	0.84%	0.84%	0.21%	2.09%
Average		0.00%	1.46%	1.25%	0.84%	0.00%	3.55%
Low		0.00%	0.63%	0.00%	0.21%	0.00%	0.84%
Grand Total		3.97%	18.58%	41.34%	27.77%	8.35%	100.00%

- (b) For growth funds, most are rated as three-star followed by two-star, four-star, one-star and five-star. Among the growth funds, large-cap and mid-cap had the same pattern of star-rating as observed for growth funds in general. Small-cap growth funds had the same pattern with the exception of having the same the number of funds rated as one-star and five-star. The pattern of star-rating is different among the various risk levels within the large-cap, mid-cap and small-cap growth funds.
- For value funds, most are rated as three-star followed by two-star, four-star, one-star, and five-star. Among the value funds, the pattern is the same for large-cap and mid-cap funds. Small-cap value funds have a different pattern. The pattern of star-rating is different among the various risk levels within the large-cap, mid-cap and small-cap funds.
- (c) The tables in 2.58 through 2.60 are easier to interpret because they contain fewer fields. The table in 2.61 tallies star rating across three fields: market type, market cap, and risk level. Problems 2.58 through 2.60 tally star rating across two fields.
- (d) Problem 2.60 reveals that most value funds are rated as low-risk followed by average-risk and high-risk. Problem 2.61 reveals that this is only the case among large-cap value funds. Most mid-cap value funds are rated as average-risk followed by low-risk and high-risk. Most small-cap value funds are rated as average-risk followed by high-risk and low-risk. Problem 2.61 also reveals that among small-cap funds rated as average-risk, most are rated as four-star, followed by three-star and two-star. Because Problem 2.61 includes four fields compared to three fields included in problems 2.58 through 2.60, additional patterns can be observed.

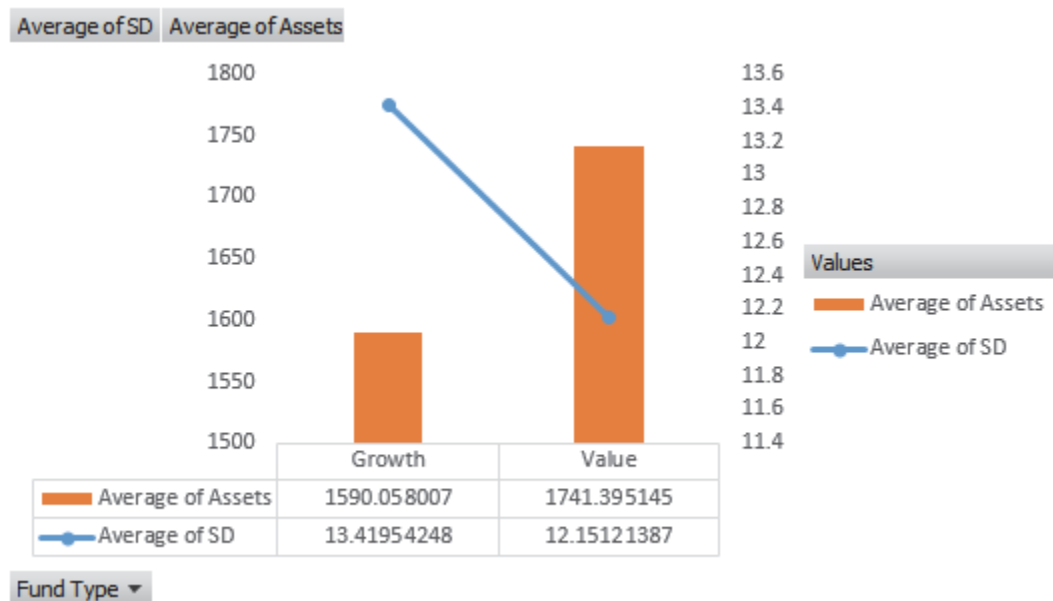
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2.62 The fund with the highest five-year return of 15.72 is a large cap growth fund that has a four-star rating and low risk.

2.63 (a)



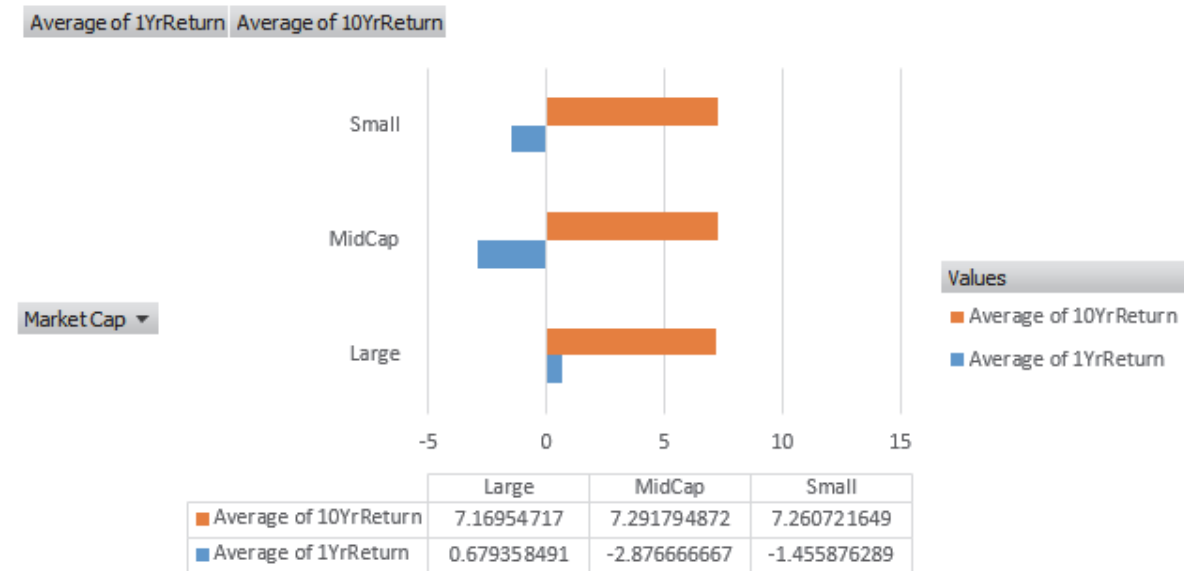
(b)



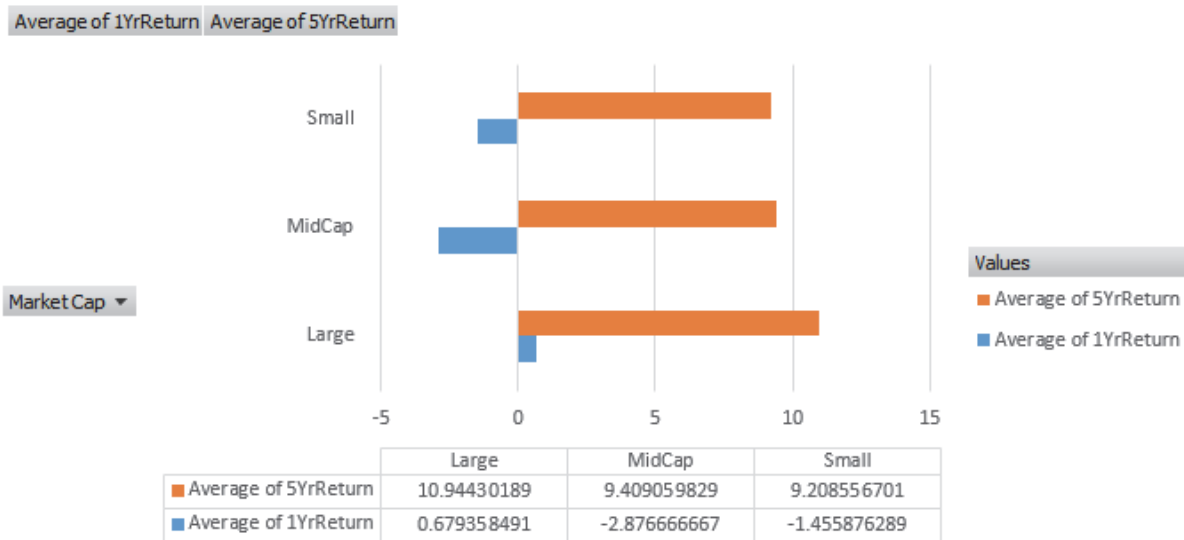
(c) The results from (a) reveal that the average of SD increases as the risk level increases while average of assets decreases as risk level increases. The results from (b) reveal that the average of SD is higher for growth funds compared to value funds. The patterns suggest that value funds are likely to be associated with less risk because the average of SD was lower among value funds and low risk funds.

2.64 Funds 479, 471, 347, 443, and 477 have the lowest five-year return.

2.65 (a)



(b)

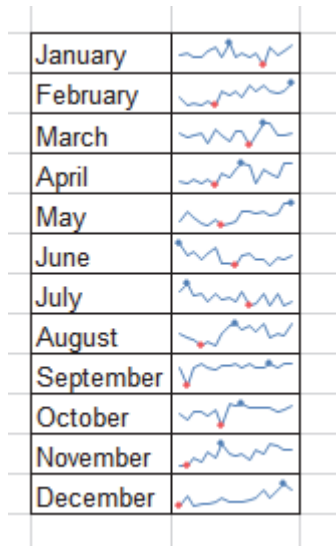


- (c) For the 1-year versus 10-year return chart, the 10-year returns are much higher than the 1-year returns with similar 5-year returns near 7 percent for all three market cap categories. For the 1-year versus 5-year chart, the returns are all higher for the 5-year returns compared to the 1-year returns. The 5-year returns are higher than the 10-year returns. The large-cap 5-year return is higher than the mid-cap and small 5-year returns.
- (d) Because the average 5-year returns were all higher than the 10-year returns for all market cap categories, one can conclude that the returns were lower in years 6 through 10. Without annual data, one cannot conclude that this was due to consistent lower returns across the years or the result of one or two years with lower returns.

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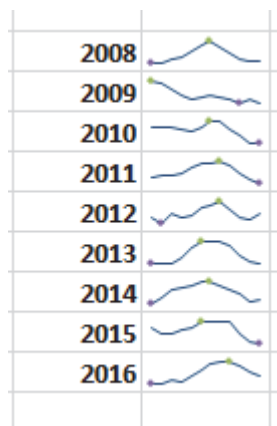
- 2.66 The five funds with the lowest five-year return have (1) midcap growth, average risk, one-star rating, (2) midcap growth, high risk, two-star rating, (3) large value, average risk, two-star rating, (4) midcap growth, high risk, one-star rating, and (5) small value, average risk, two-star rating.

- 2.67 (a)



- (b) The sparklines reveal that a general trend upward in home prices during the months of February, May, November, and December and they have remained steady in September after a jump from a low in 2001.
- (c) In the Time-series plot one can see an upward trend in home sales price until 2006. Prices decline or remain flat from 2006 – 2011. From 2011 – 2016 there is an upward trend in median price of new home sales. With the exception of one year, the September home prices are fairly stable. This could be an error in the data.

- 2.68 (a)

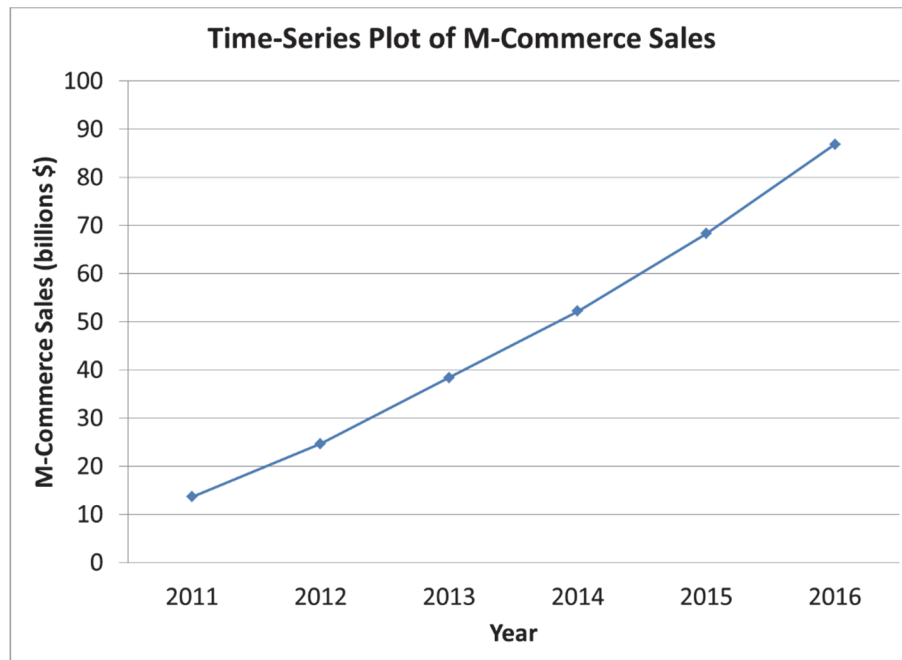
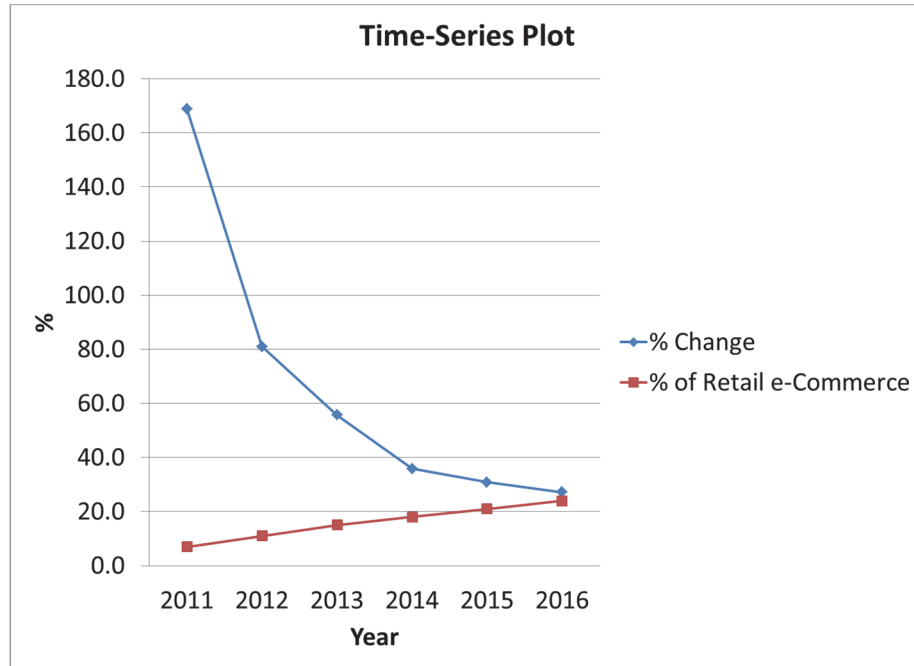


- (b) There has been a decline in the price of natural gas over time. However, there is no pattern within the years. For some years, the price is higher in the beginning of the year. For other years, the price is higher in the latter part of the year. Sometimes, there is little variation within the year.

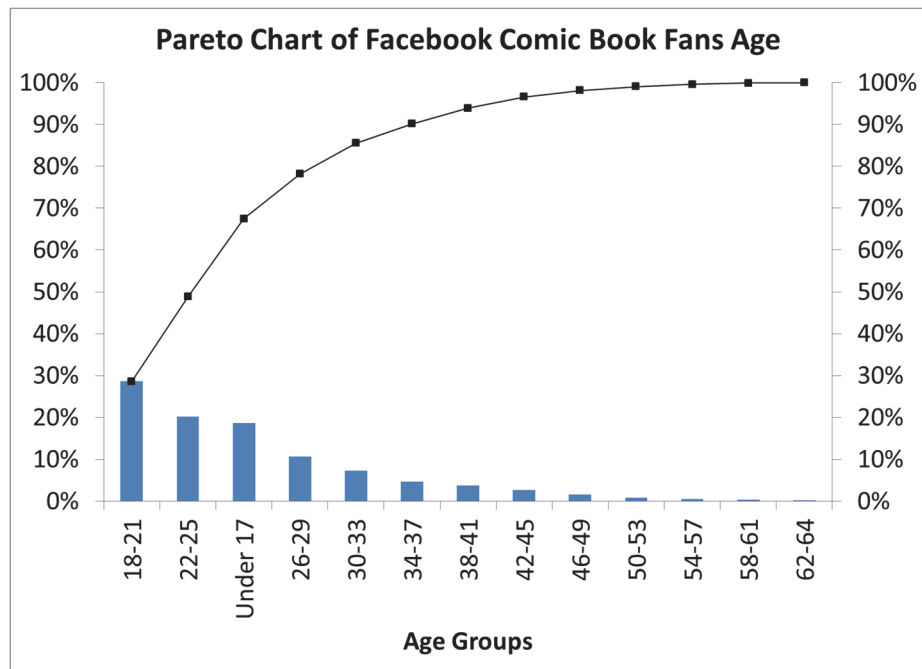
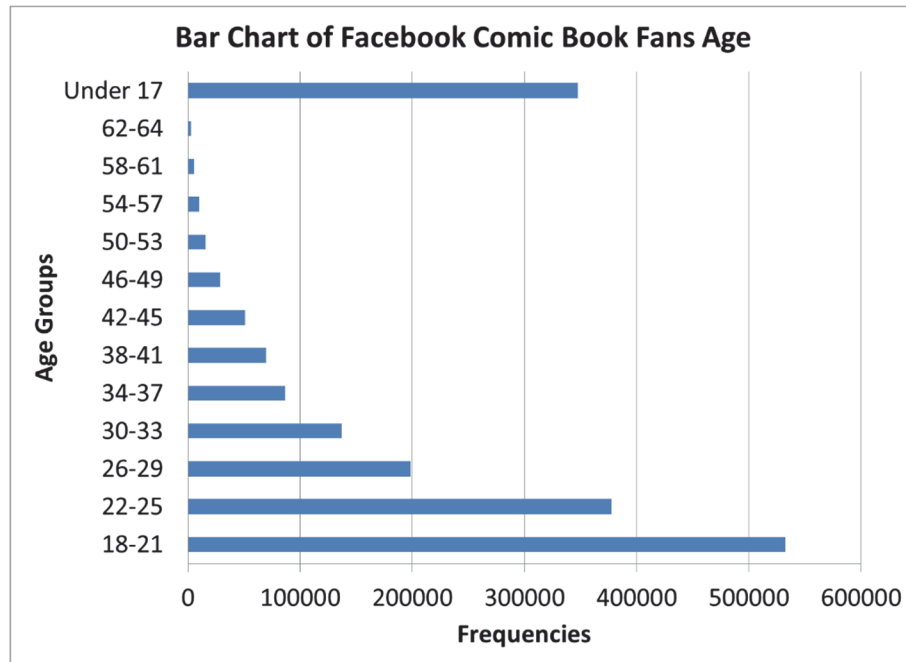
- 2.69 Student project answers will vary

- 2.70 Student project answers will vary

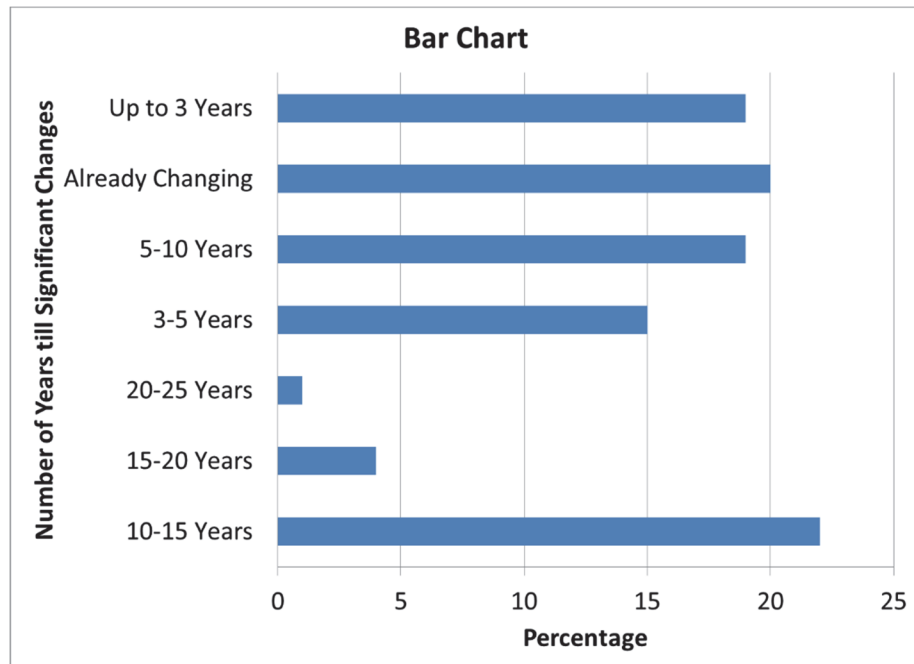
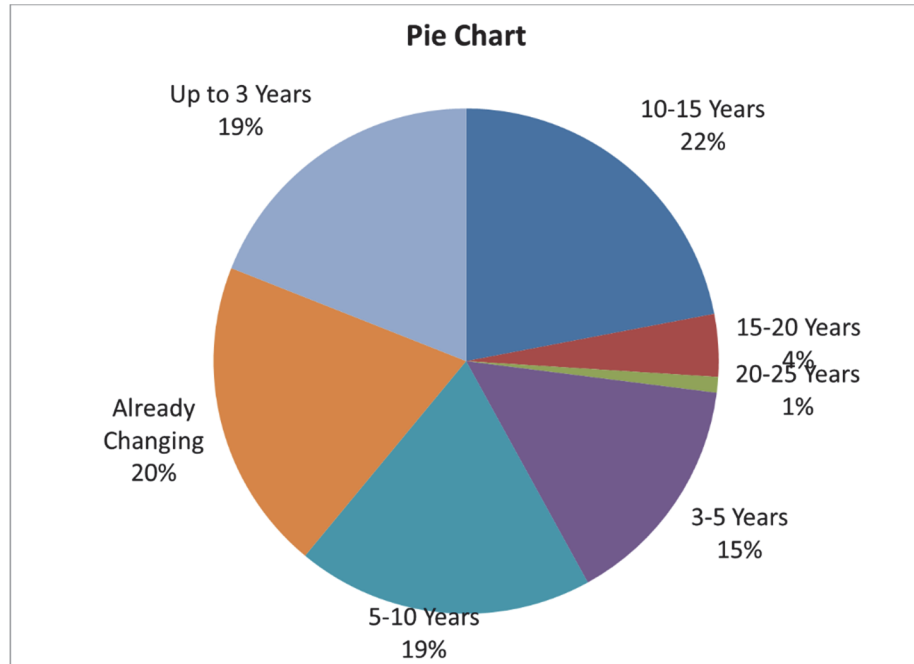
- 2.71 (a) There is a title.  
 (b) None of the axes are labeled.  
 (c)



- 2.72 (a) There is a title.  
 (b) The simplest possible visualization is not used.  
 (c)

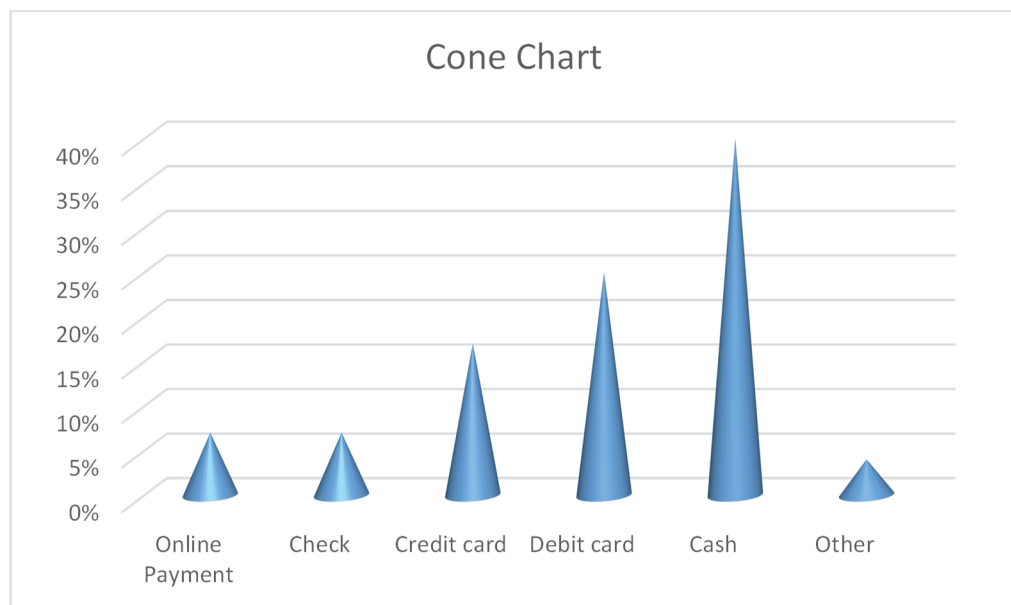
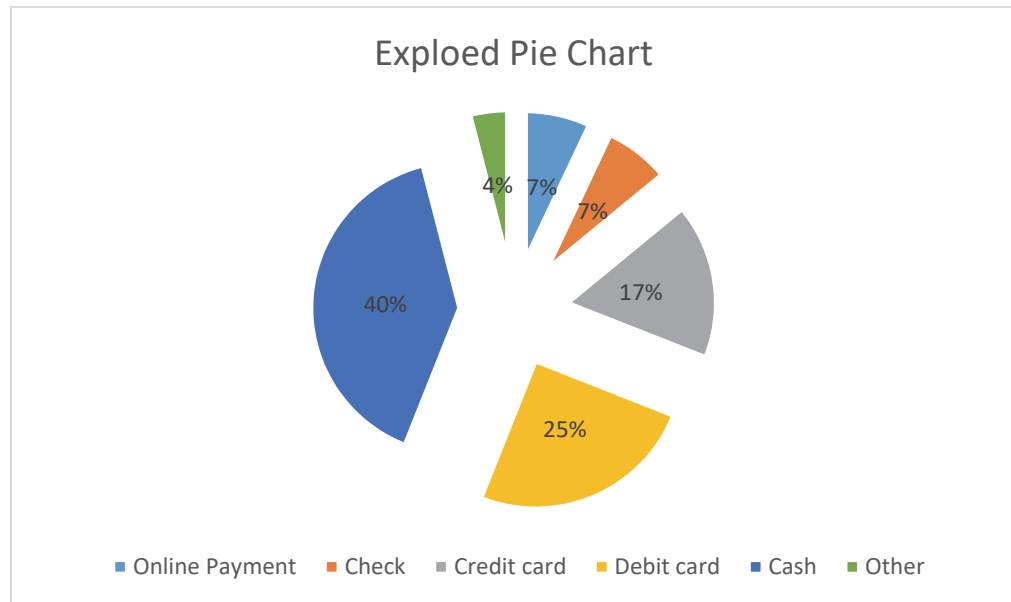


- 2.73 (a) None.  
 (b) The use of chartjunk.  
 (c)



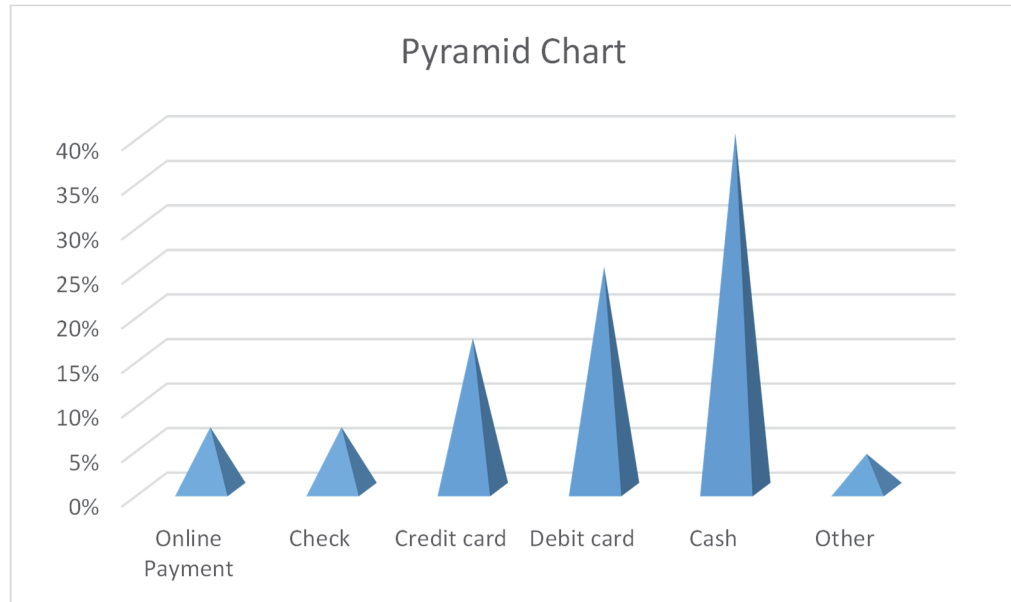
- 2.74 Answers will vary depending on selection of source.

2.75 (a)



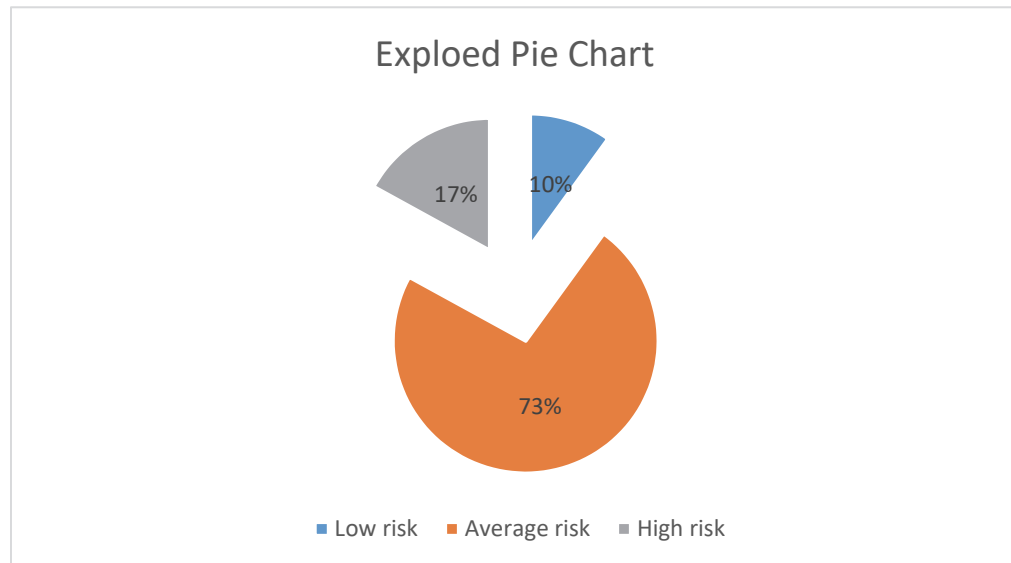


2.75 (a)  
cont.

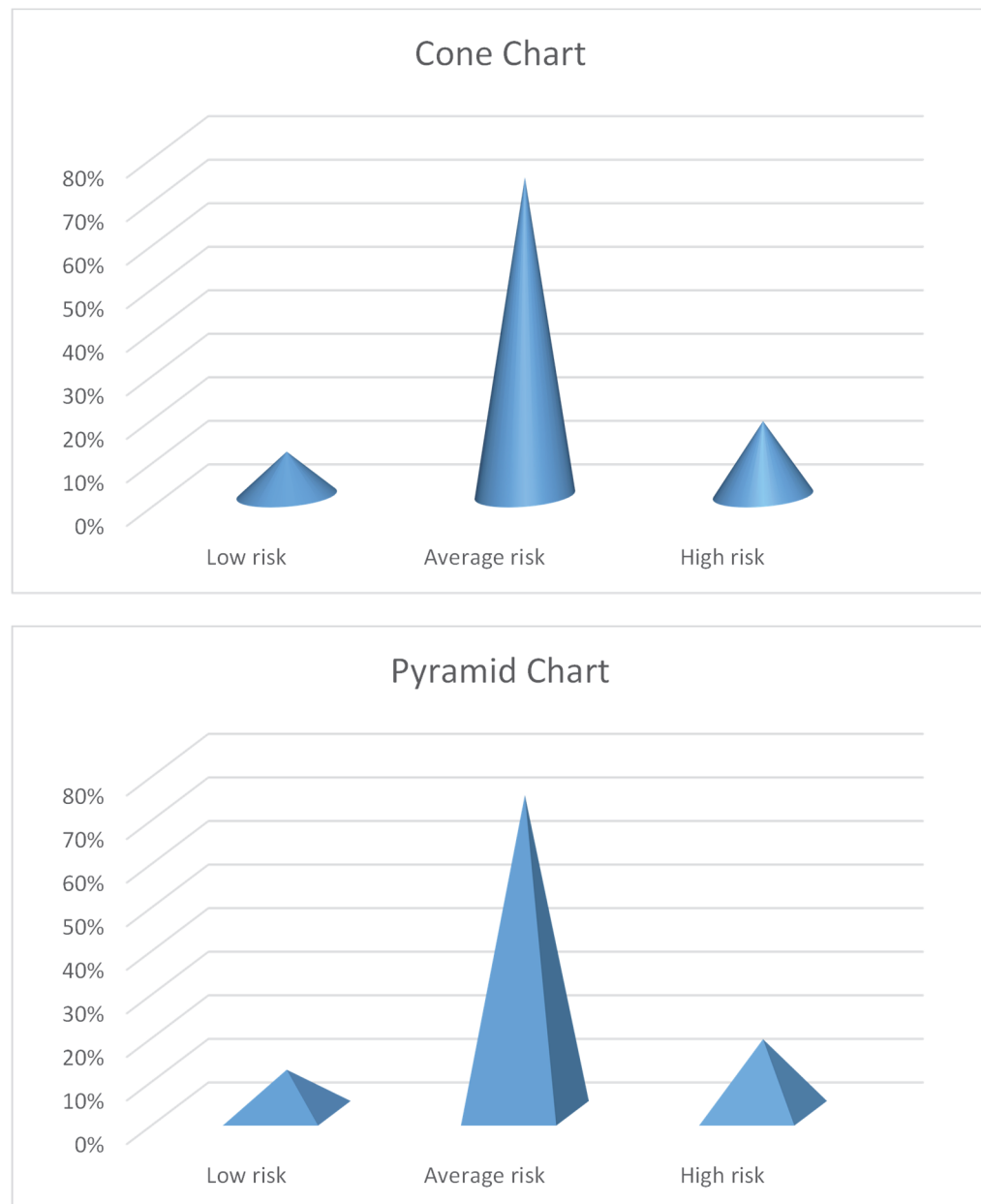


(b) The bar chart and the pie chart should be preferred over the exploded pie chart, doughnut chart, the cone chart and the pyramid chart since the former set is simpler and easier to interpret.

2.76 (a)



2.76 (a)  
cont.

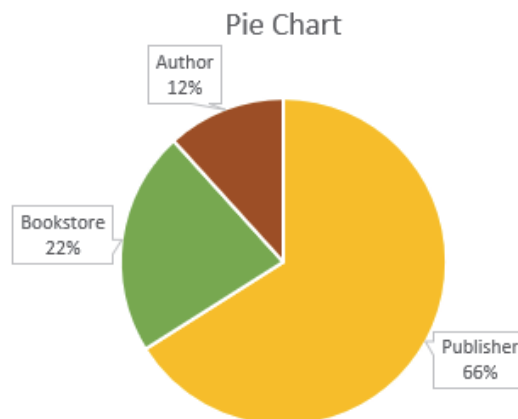


(b) The bar chart and the pie chart should be preferred over the exploded pie chart, doughnut chart, the cone chart and the pyramid chart since the former set is simpler and easier to interpret.

2.77 A histogram uses bars to represent each class while a polygon uses a single point. The histogram should be used for only one group, while several polygons can be plotted on a single graph.

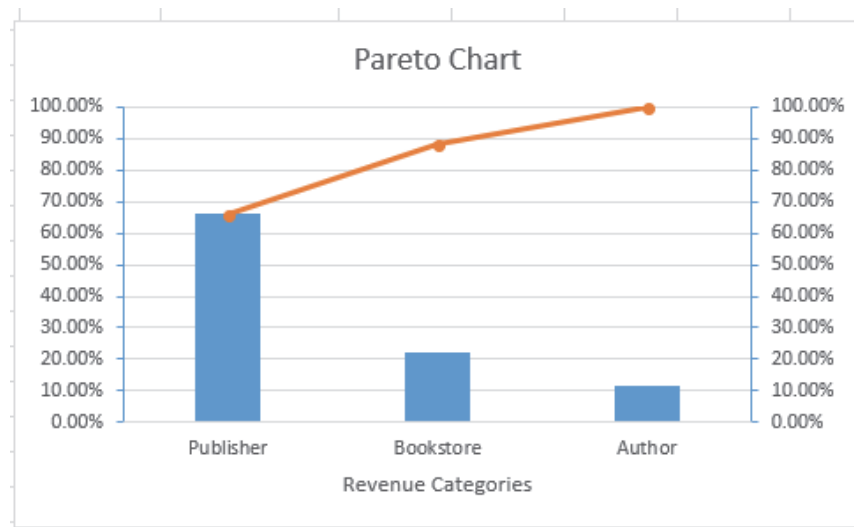
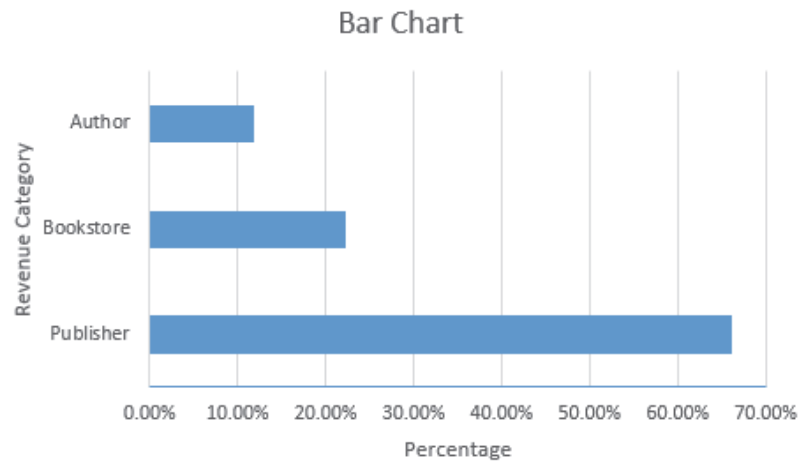
2.78 A summary table allows one to determine the frequency or percentage of occurrences in each category.

- 2.79 A bar chart is useful for comparing categories. A pie chart is useful when examining the portion of the whole that is in each category. A Pareto diagram is useful in focusing on the categories that make up most of the frequencies or percentages.
- 2.80 The bar chart for categorical data is plotted with the categories on the vertical axis and the frequencies or percentages on the horizontal axis. In addition, there is a separation between categories. The histogram is plotted with the class grouping on the horizontal axis and the frequencies or percentages on the vertical axis. This allows one to more easily determine the distribution of the data. In addition, there are no gaps between classes in the histogram.
- 2.81 A time-series plot is a type of scatter diagram with time on the x-axis.
- 2.82 Because the categories are arranged according to frequency or importance, it allows the user to focus attention on the categories that have the greatest frequency or importance.
- 2.83 Percentage breakdowns according to the total percentage, the row percentage, and/or the column percentage allow the interpretation of data in a two-way contingency table from several different perspectives.
- 2.84 A contingency table contains information on two categorical variables whereas a multidimensional table can display information on more than two categorical variables.
- 2.85 The multidimensional PivotTable can reveal additional patterns that cannot be seen in the contingency table. One can also change the statistic displayed and compute descriptive statistics which can add insight into the data.
- 2.86 In a PivotTable in Excel, double-clicking a cell drills down and causes Excel to display the underlying data in a new worksheet to enable you to then observe the data for patterns. In Excel, a slicer is a panel of clickable buttons that appears superimposed over a worksheet to enable you to work with many variables at once in a way that avoids creating an overly complex multidimensional contingency table that would be hard to comprehend and interpret.
- 2.87 Sparklines are compact time-series visualizations of numerical variables. Sparklines can also be used to plot time-series data using smaller time units than a time-series plot to reveal patterns that the time-series plot may not.
- 2.88 (a)

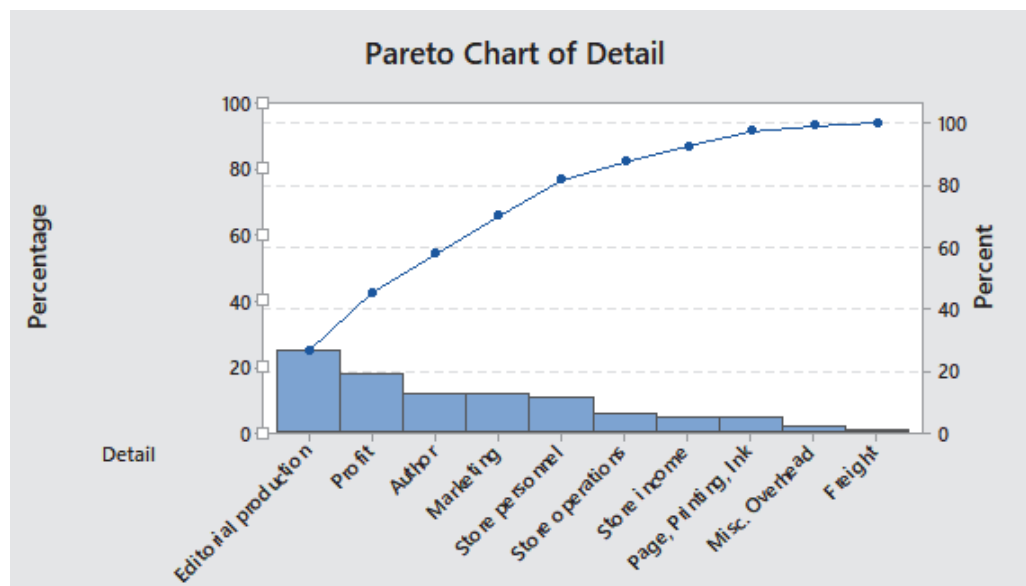


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2.88 (a)  
cont.

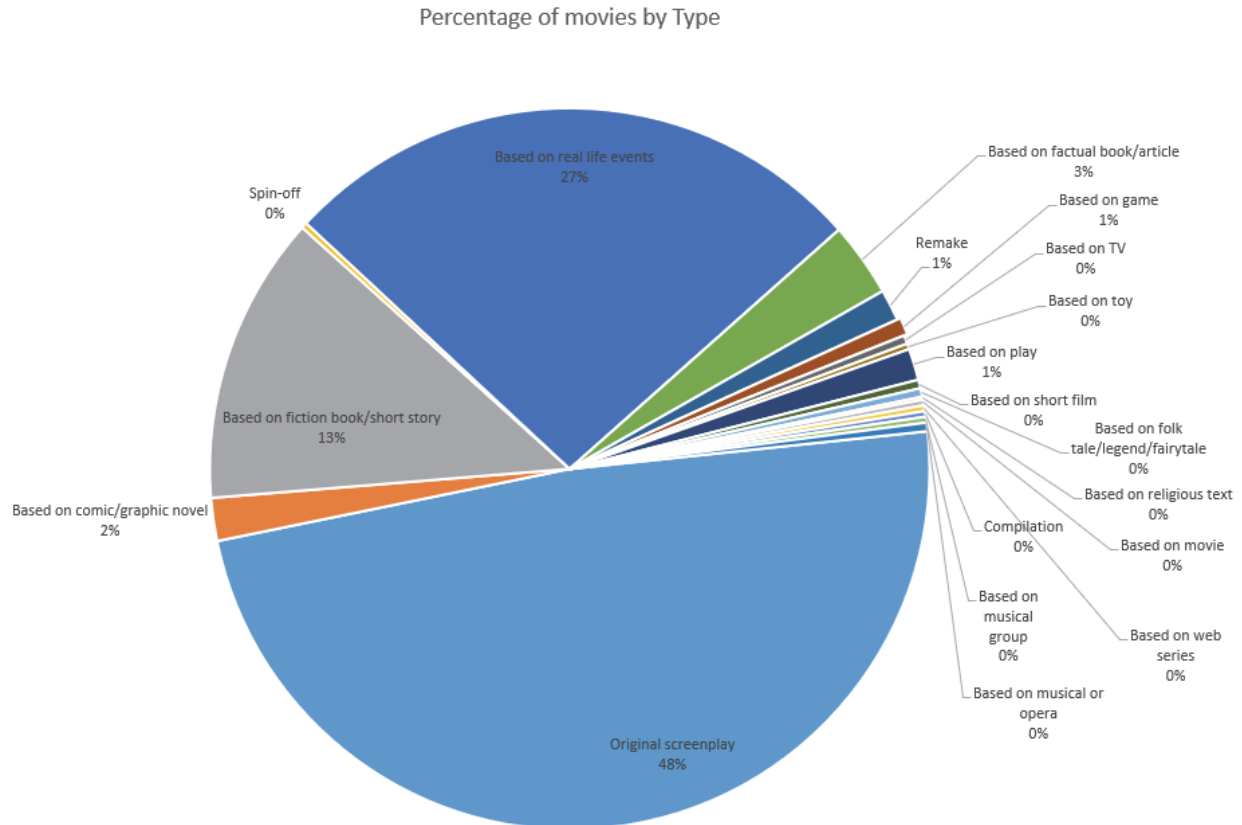


(b)

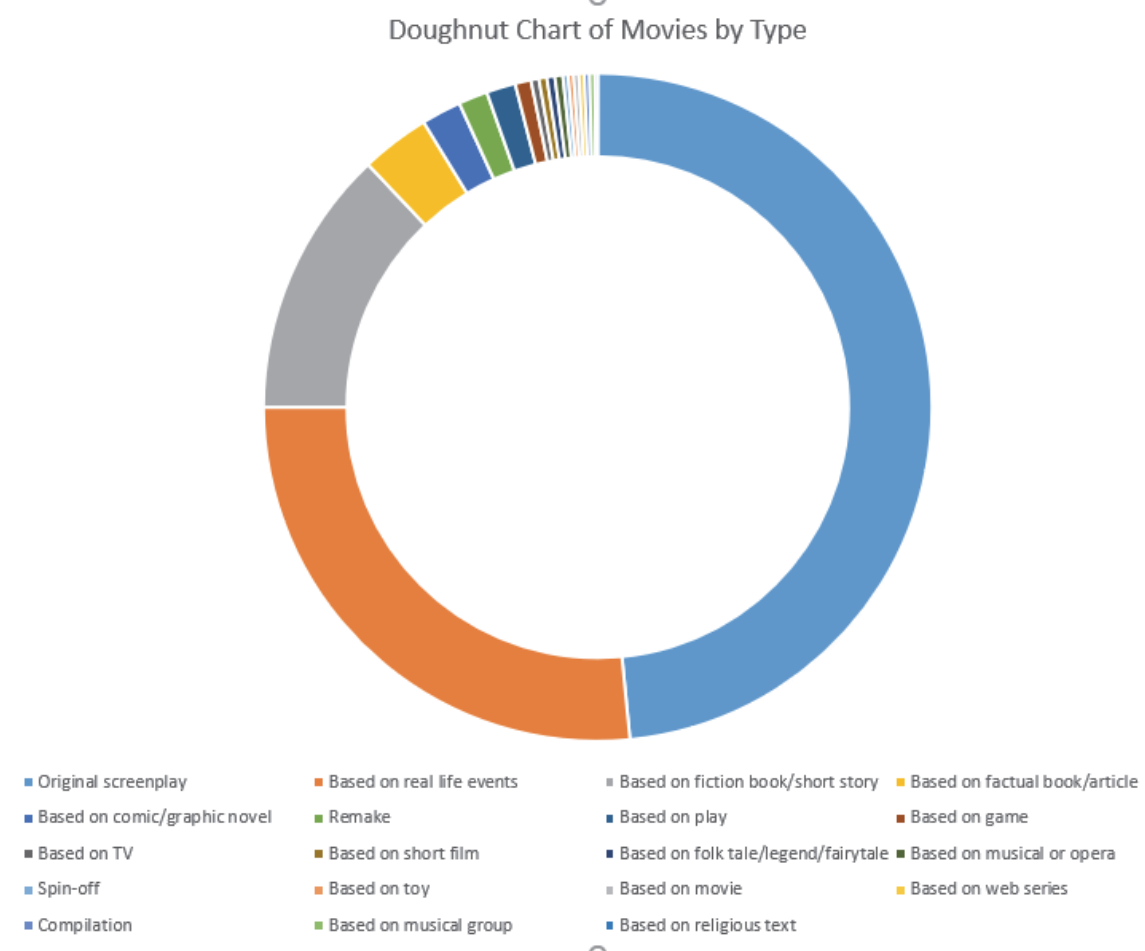


2.88 (c) The publisher gets the largest portion (66.06%) of the revenue. 24.93% is editorial production manufacturing costs. The publisher's marketing accounts for the next largest share of the revenue, at 11.6%. Author and bookstore personnel each account for around 11 to 12% of the revenue, whereas the publisher and bookstore profit and income account for more than 26% of the revenue. Yes, the bookstore gets almost twice the revenue of the authors.

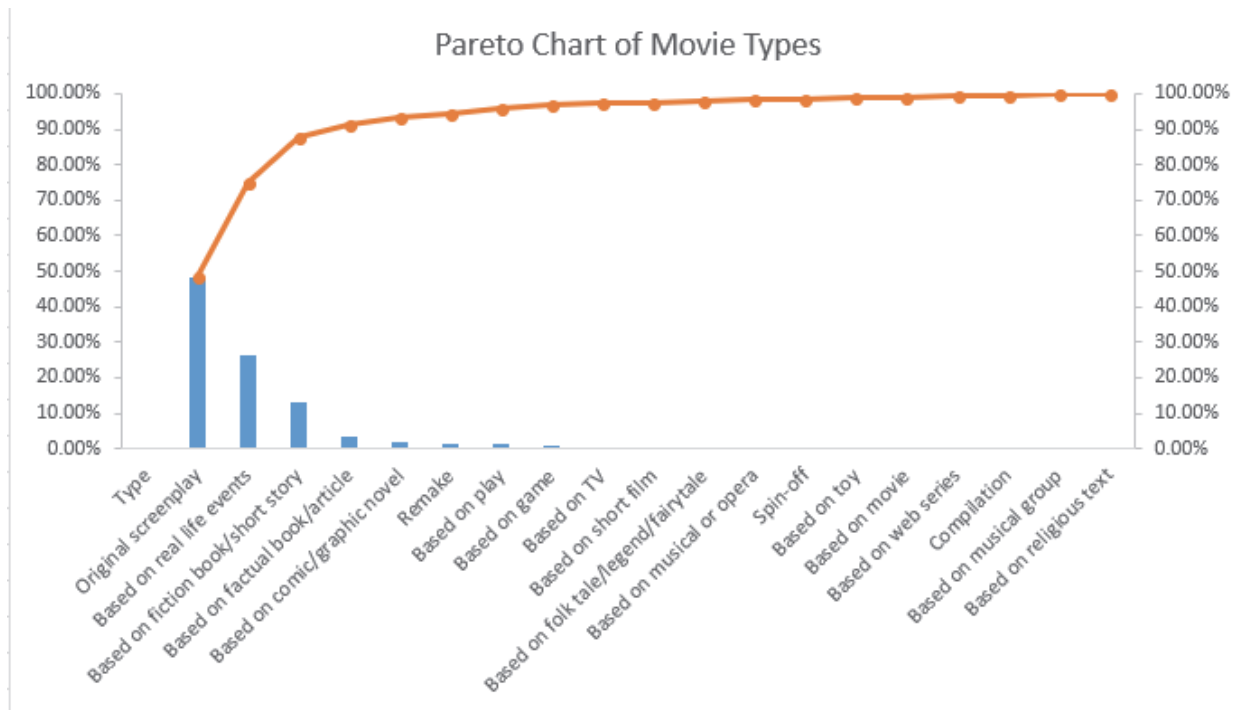
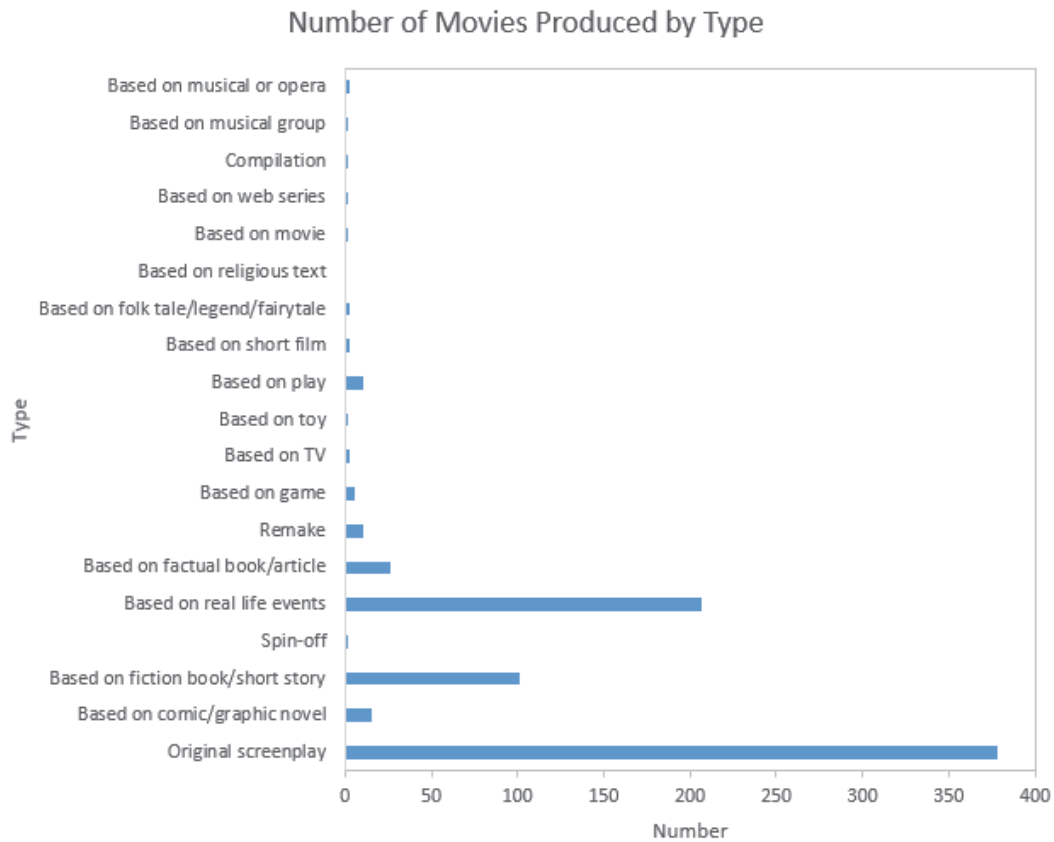
2.89 (a) Number of Movies



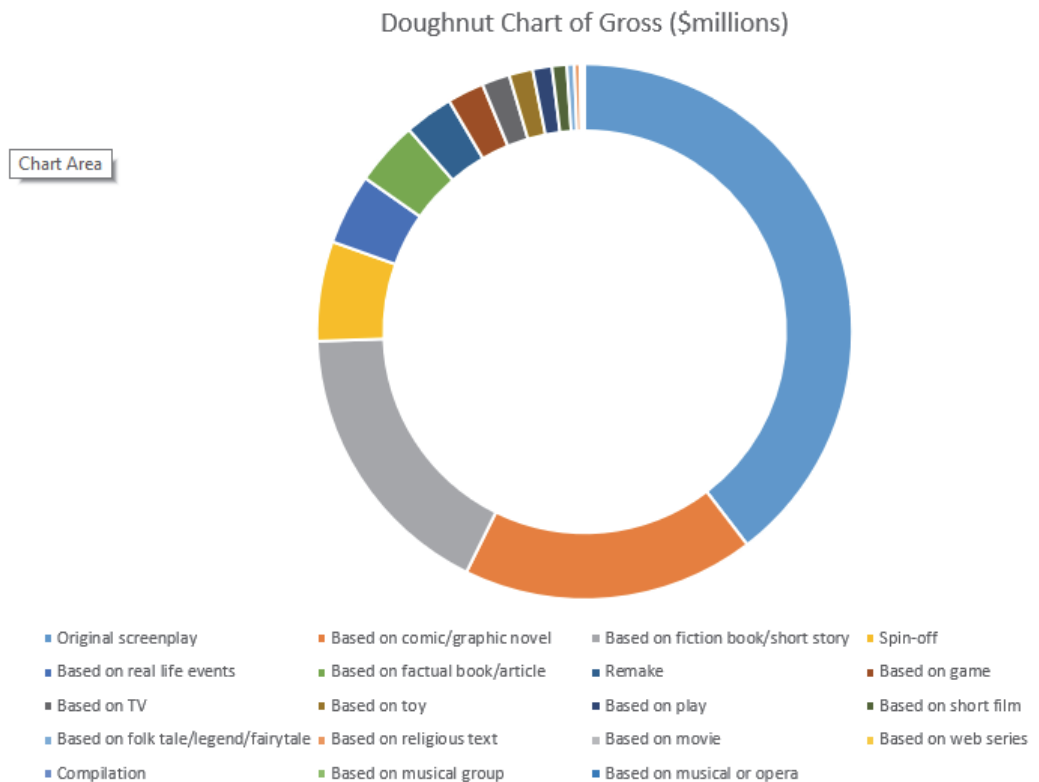
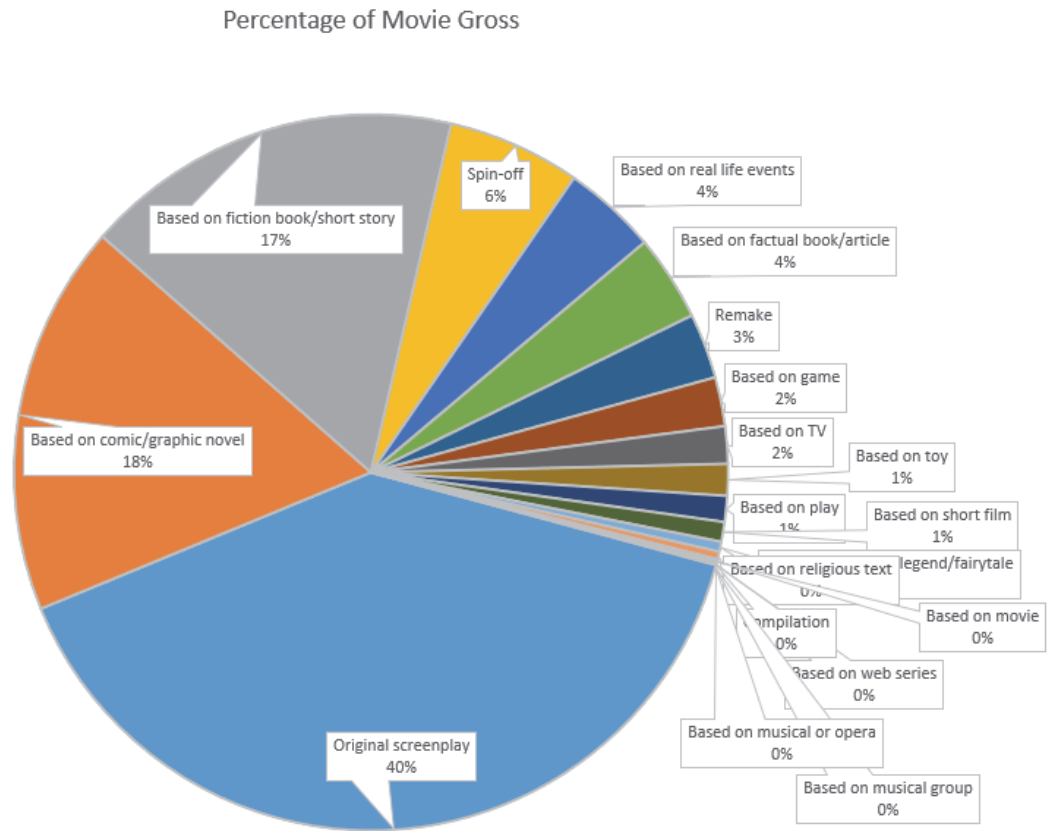
2.89 (a)  
cont.



2.89 (a)  
cont.

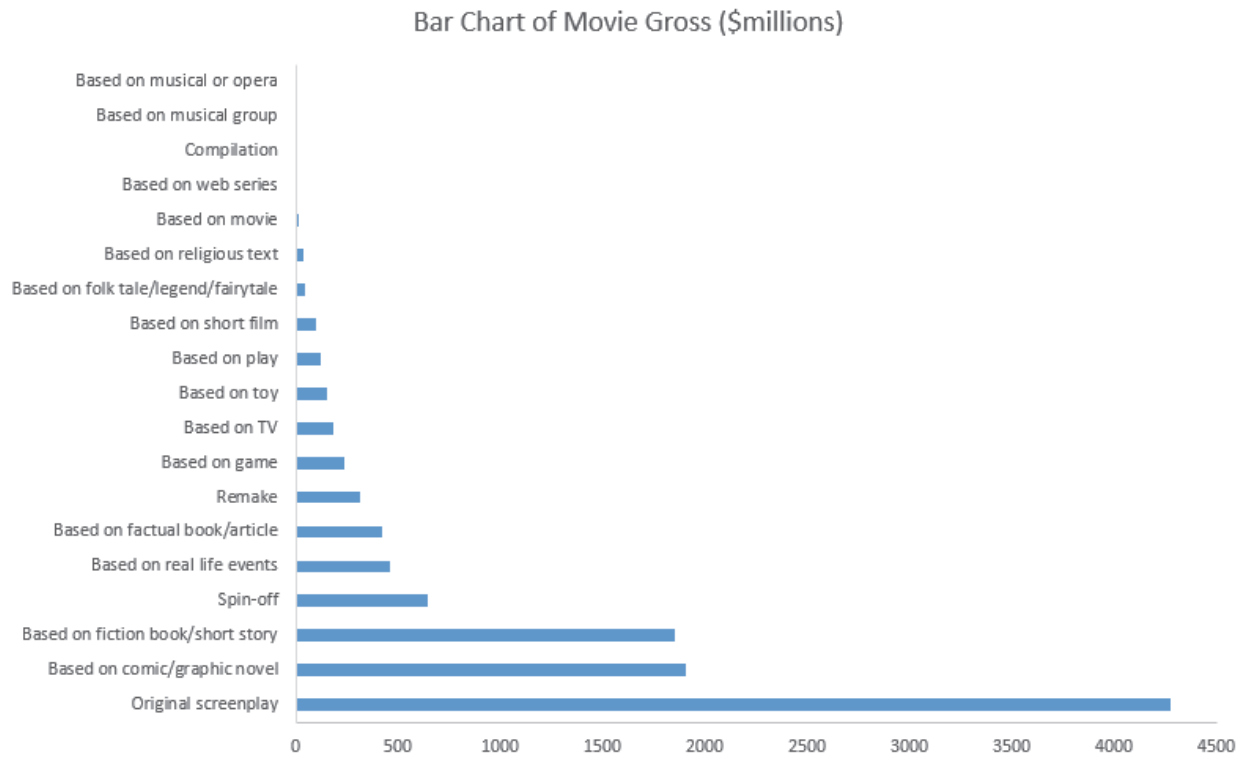


2.89 (a) Gross  
cont.

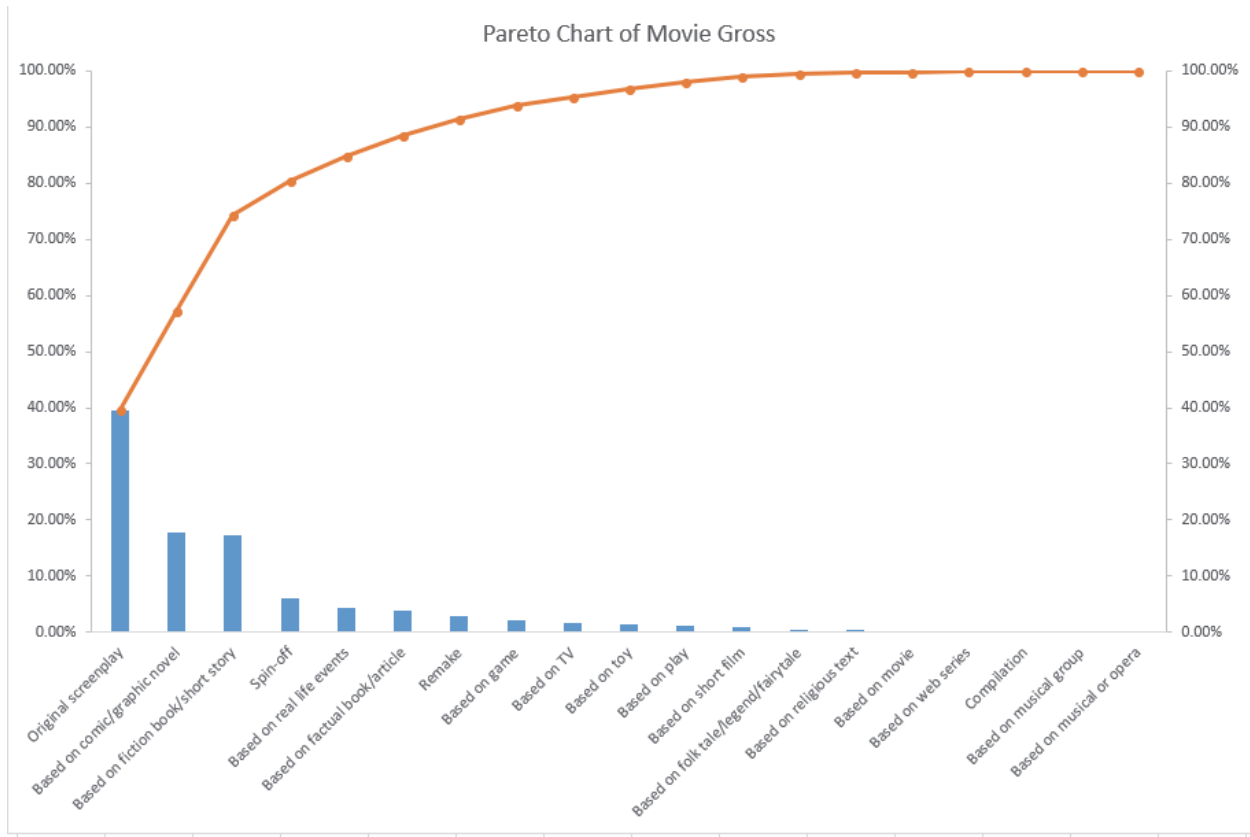




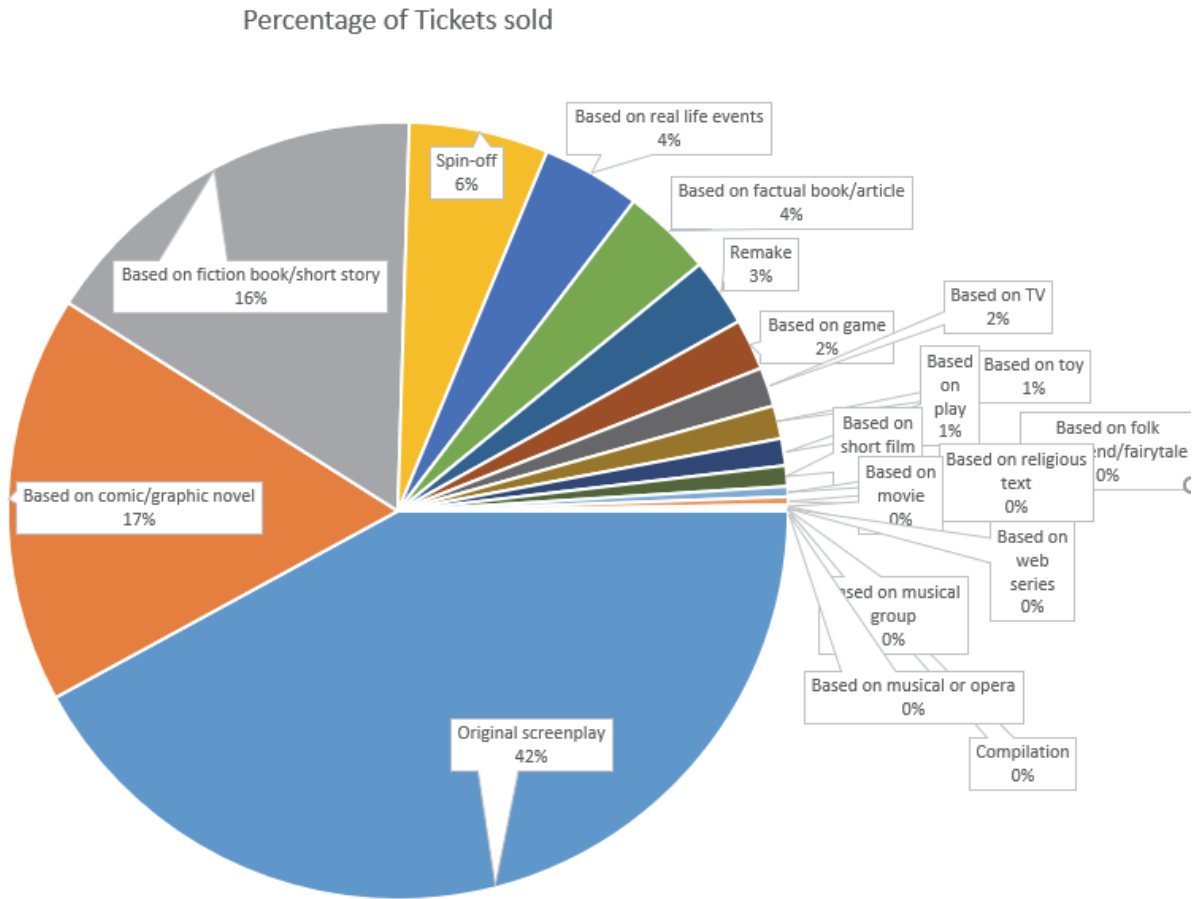
2.89 (a) Gross  
cont.



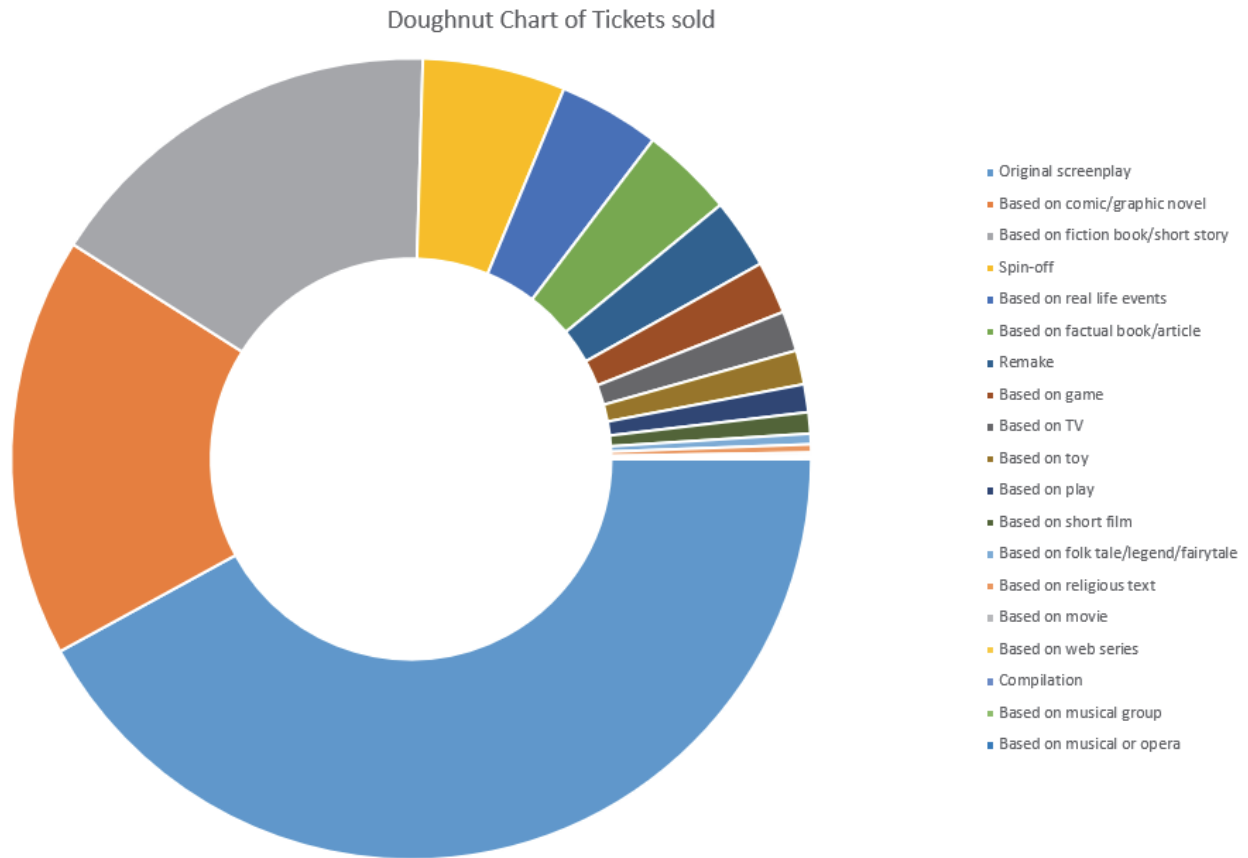
2.89 (a) Tickets Sold  
cont.



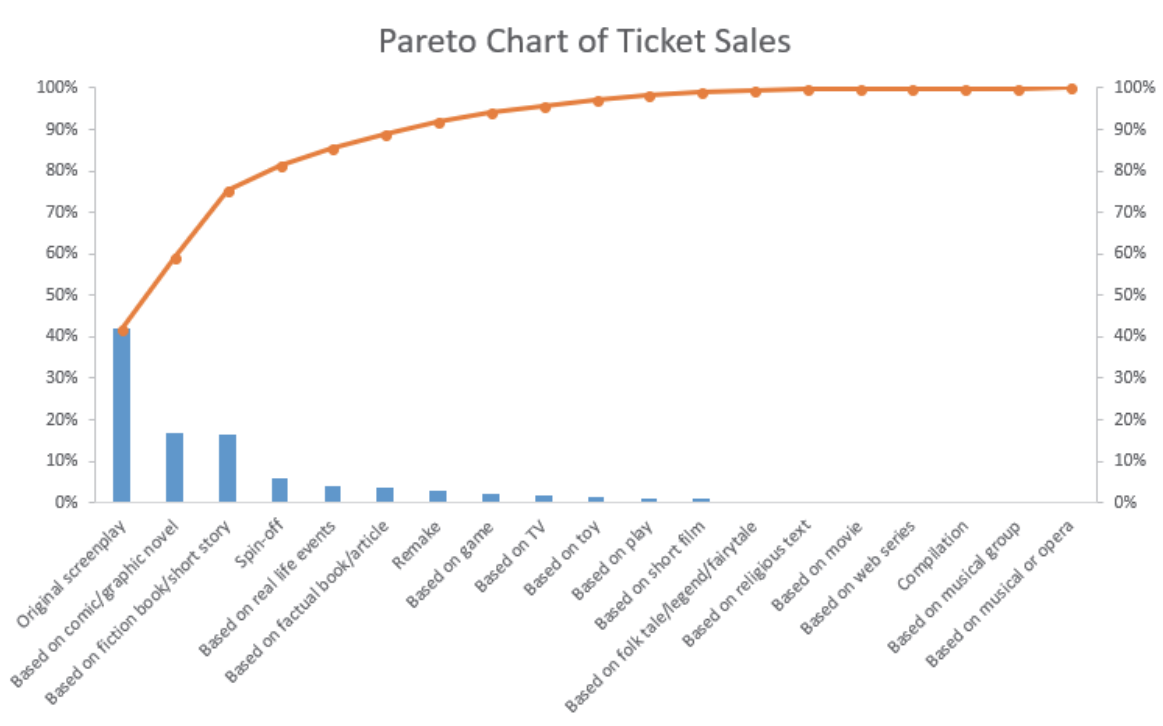
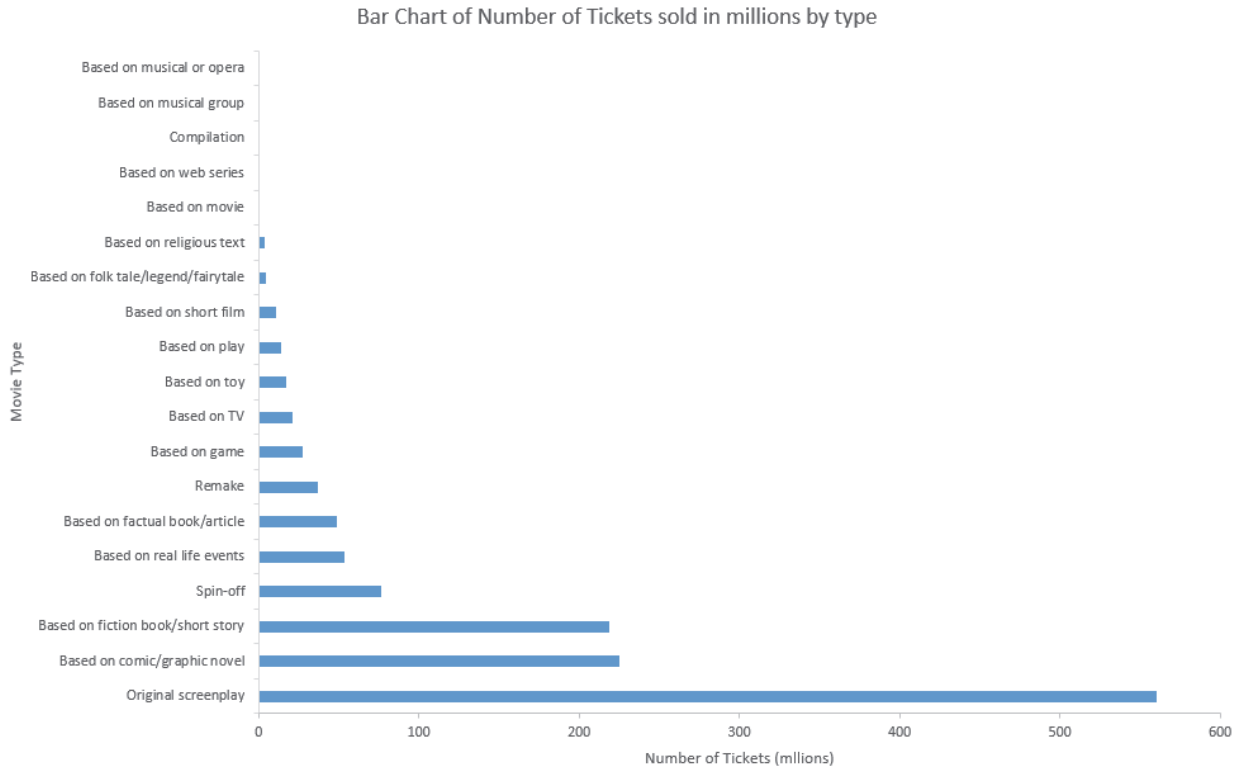
2.89 (a) Tickets Sold  
cont.



2.89 (a) Tickets Sold  
cont.



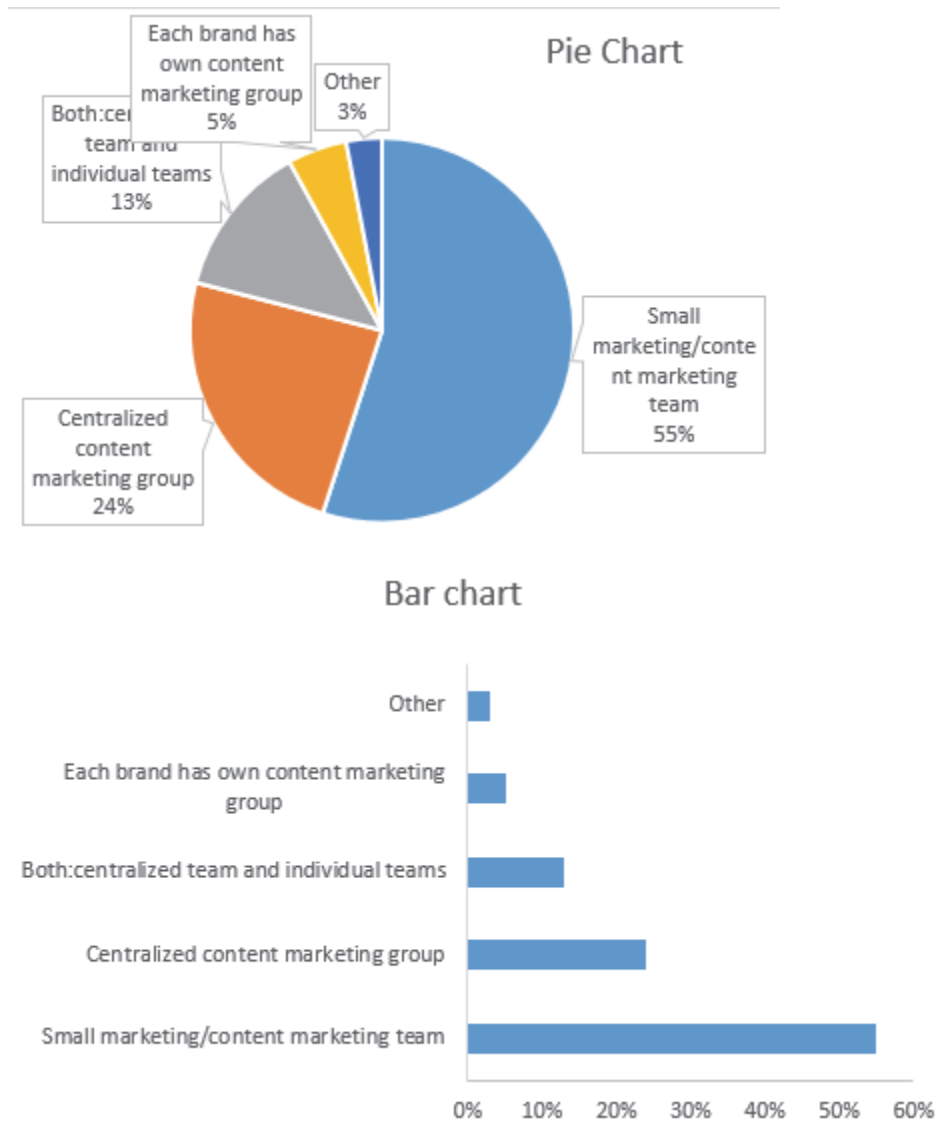
2.89 (a) Tickets Sold  
cont.



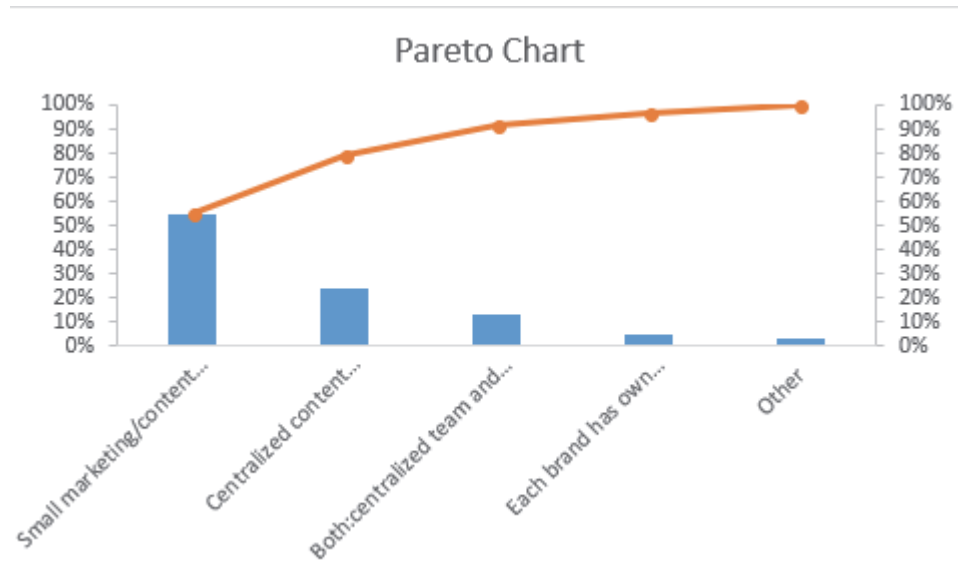
## 98 Chapter 2: Organizing and Visualizing Variables

2.89 (b) cont. Based on the Pareto chart for the number of movies, “Original screenplay”, “Based on real life events” and “Based on fiction/short story” are the “vital few” and capture about 88% of the market share. According to the Pareto chart for gross (in \$millions), “Original screenplay”, “Based on fiction book/short story” and “Based on comic/graphic novel” are the “vital few” and capture about 74% of the market share. According to the Pareto chart for number of tickets sold (in millions), “Original screenplay”, “Based on fiction book/short story” and “Based on comic/graphic novel” are the “vital few” and capture about 75% of the market share.

2.90 (a)

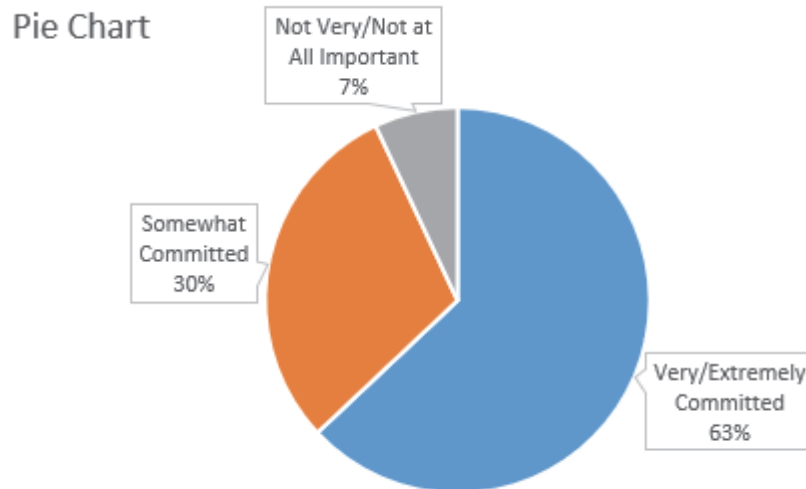


2.90 (a)  
cont.

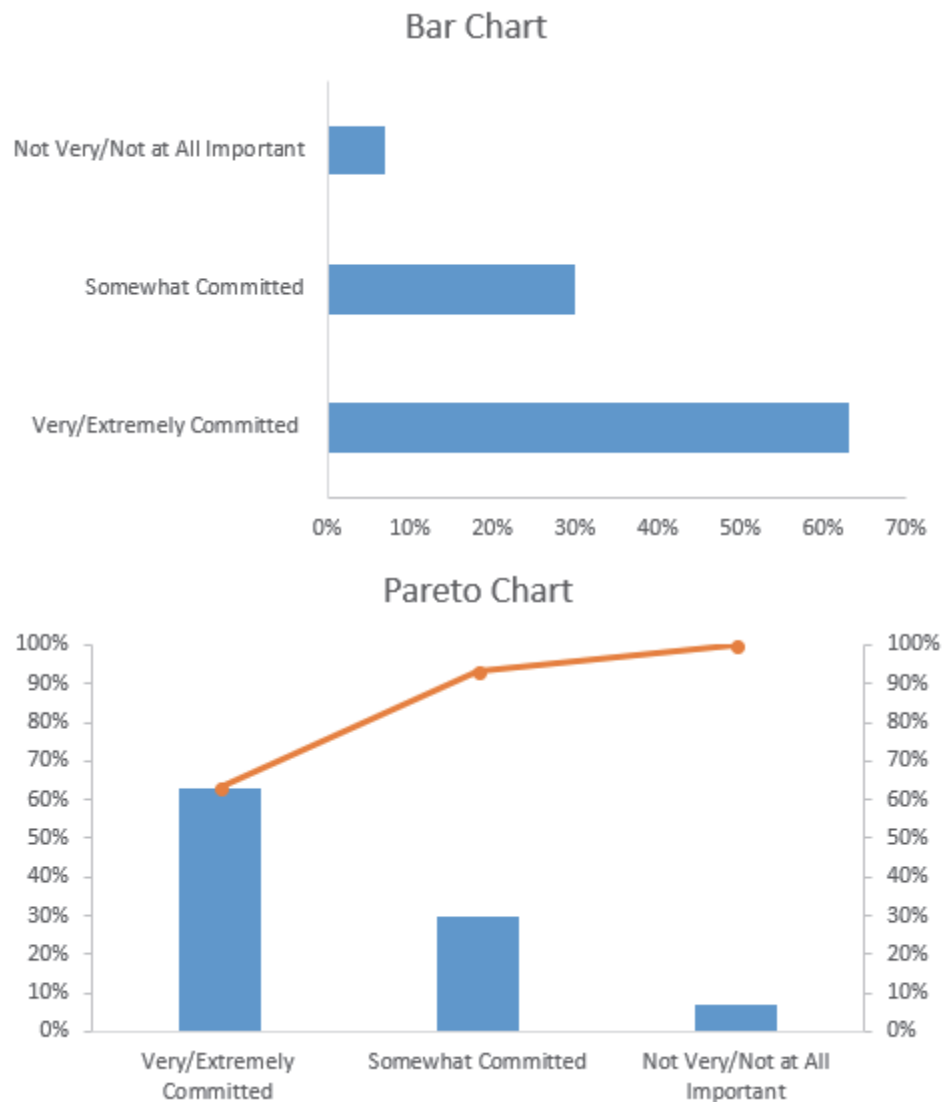


(b) The pie chart or the Pareto chart would be best. The pie chart would allow you to see each category as part of the whole, while the Pareto chart would enable you to see that Small marketing/content marketing team is the dominant category.

(c)



2.90 (c)  
cont.



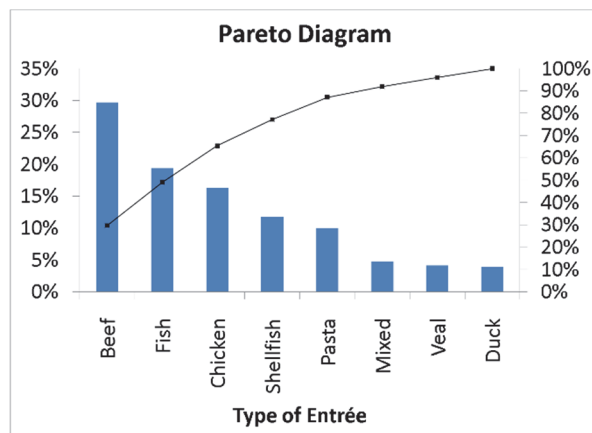
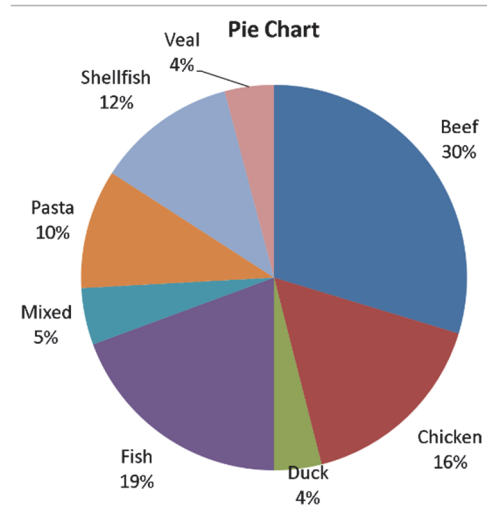
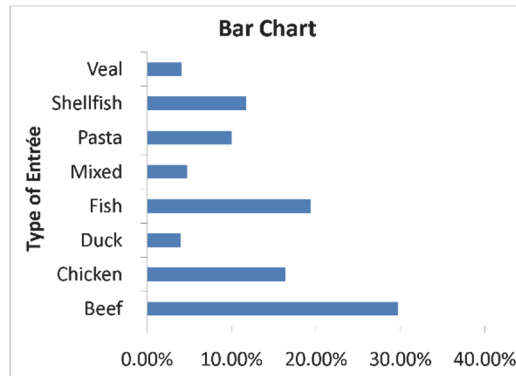
- (d) The pie chart or the Pareto chart would be best. The pie chart would allow you to see each category as part of the whole while the Pareto chart would enable you to see that very committed to content marketing is the dominant category.
- (e) Most organizations have a small marketing/content marketing team and are very committed to content marketing.



2.91 (a)

Type of Entrée	%	Number S
Beef	29.68%	187
Chicken	16.35%	103
Mixed	4.76%	30
Duck	3.97%	25
Fish	19.37%	122
Pasta	10.00%	63
Shellfish	11.75%	74
Veal	4.13%	26
Total	100.00%	630

(b)



- (c) The Pareto diagram has the advantage of offering the cumulative percentage view of the categories and, hence, enables the viewer to separate the "vital few" from the "trivial many".
- (d) Beef and fish account for nearly 50% of all entrees ordered by weekend patrons of a continental restaurant. When chicken is included, nearly two-thirds of the entrees are accounted for.

2.92 (a)

Dessert Ordered	Gender		Total
	Male	Female	
Yes	66%	34%	100%
No	<u>48%</u>	<u>52%</u>	<u>100%</u>
Total	52%	48%	100%

Dessert Ordered	Gender		Total
	Male	Female	
Yes	29%	34%	100%
No	<u>71%</u>	<u>52%</u>	<u>100%</u>
Total	100%	48%	100%

Dessert Ordered	Gender		Total
	Male	Female	
Yes	15%	8%	23%
No	<u>37%</u>	<u>40%</u>	<u>77%</u>
Total	52%	48%	100%

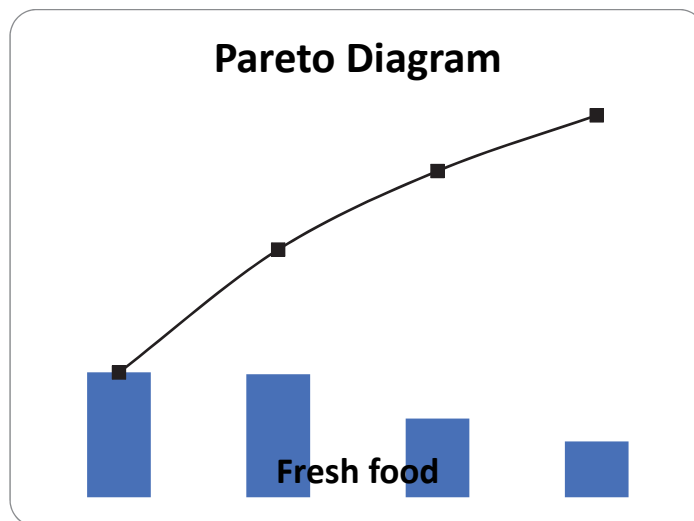
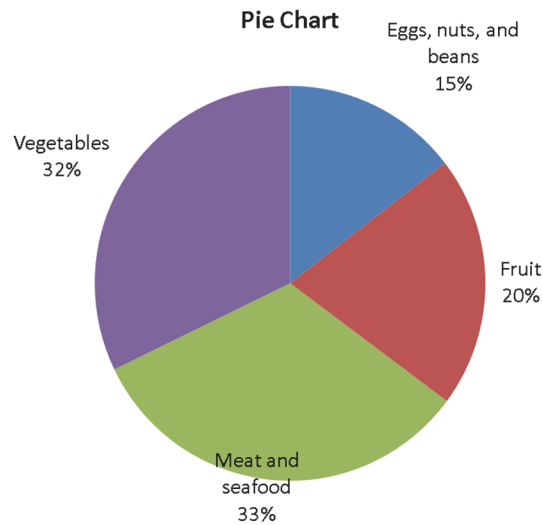
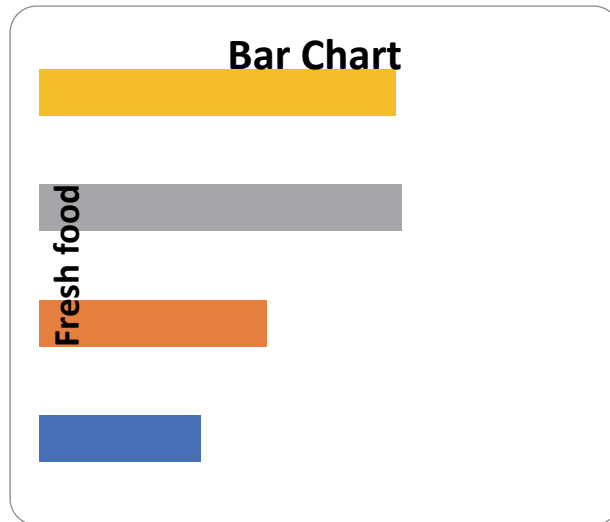
Dessert Ordered	Gender		Total
	Male	Female	
Yes	52%	48%	100%
No	<u>25%</u>	<u>75%</u>	<u>100%</u>
Total	31%	69%	100%

Dessert Ordered	Gender		Total
	Male	Female	
Yes	38%	16%	23%
No	<u>62%</u>	<u>84%</u>	<u>77%</u>
Total	100%	100%	100%

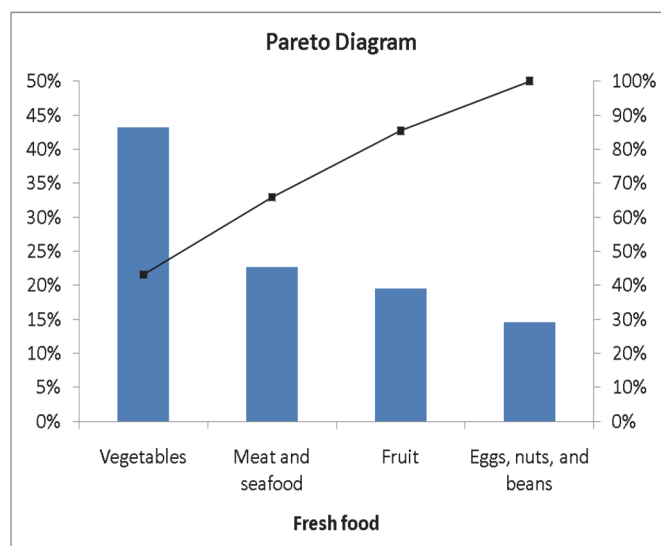
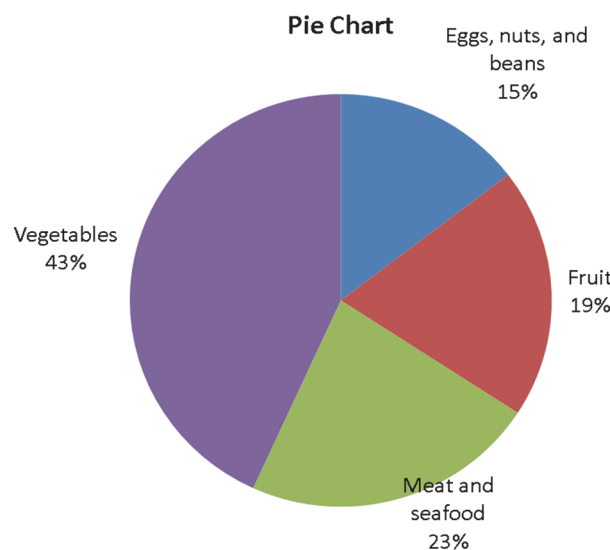
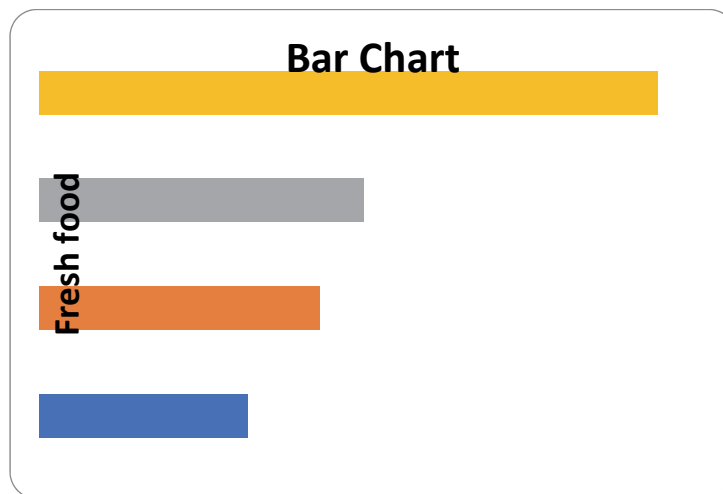
Dessert Ordered	Gender		Total
	Male	Female	
Yes	11.75%	10.79%	22.54%
No	<u>19.52%</u>	<u>57.94%</u>	<u>77.46%</u>
Total	31.27%	68.73%	100%

- (b) If the owner is interested in finding out the percentage of males and females who order dessert or the percentage of those who order a beef entrée and a dessert among all patrons, the table of total percentages is most informative. If the owner is interested in the effect of gender on ordering of dessert or the effect of ordering a beef entrée on the ordering of dessert, the table of column percentages will be most informative. Because dessert is usually ordered after the main entrée, and the owner has no direct control over the gender of patrons, the table of row percentages is not very useful here.
- (c) 29% of the men ordered desserts, compared to 17 of the women; men are almost twice as likely to order dessert as women. Almost 38% of the patrons ordering a beef entrée ordered dessert, compared to 16% of patrons ordering all other entrées. Patrons ordering beef are more than 2.3 times as likely to order dessert as patrons ordering any other entrée.

2.93 (a) United States Fresh Food Consumed:

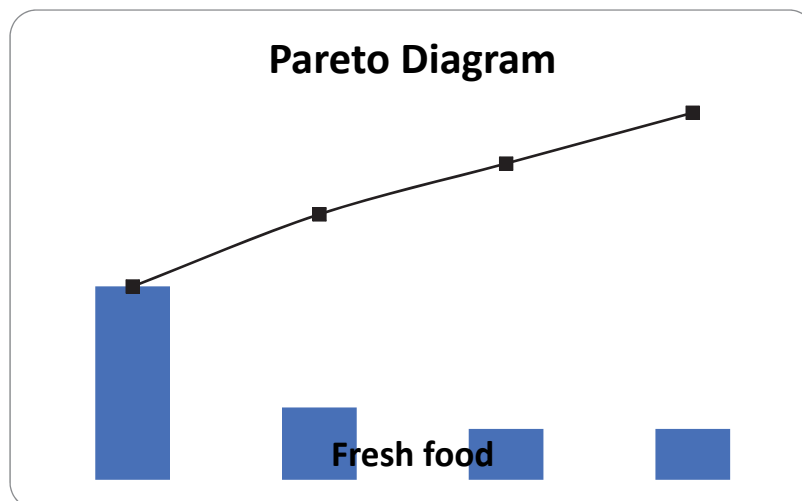
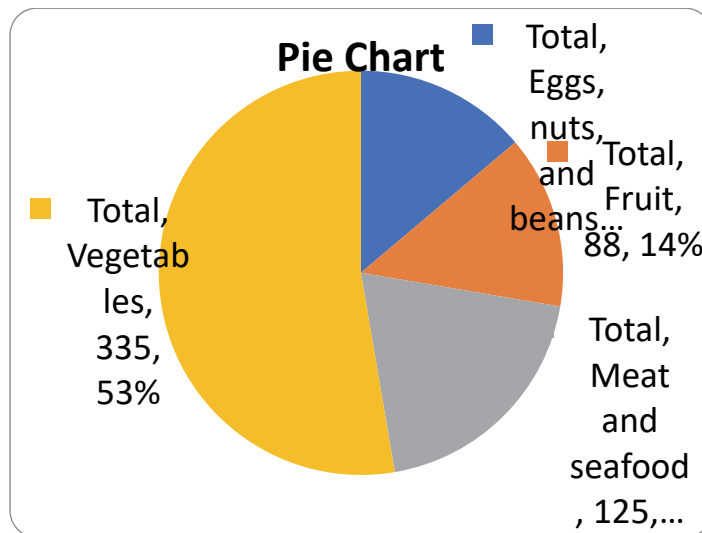
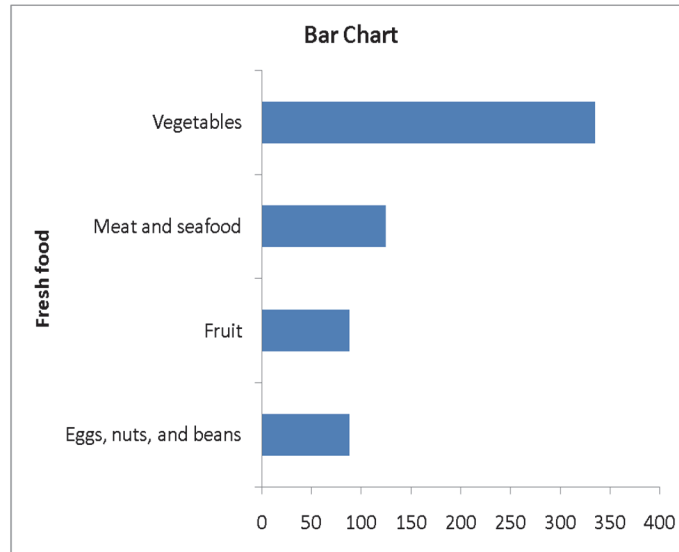


2.93 (a) Japan Fresh Food Consumed:  
cont.

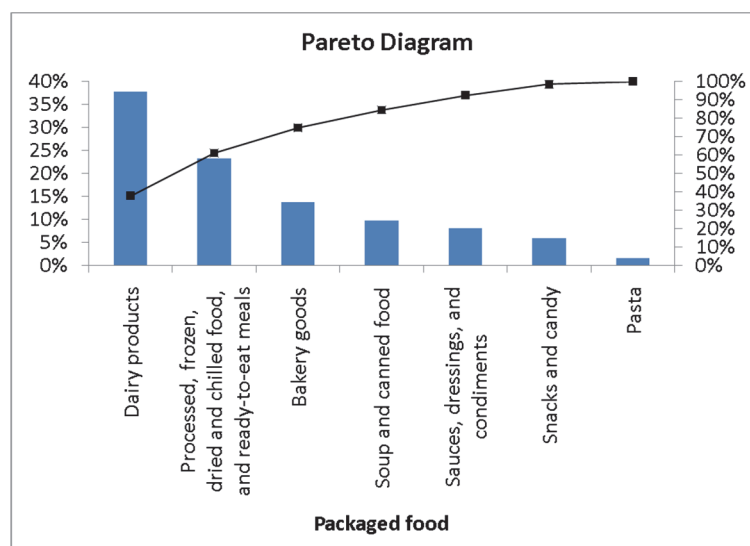
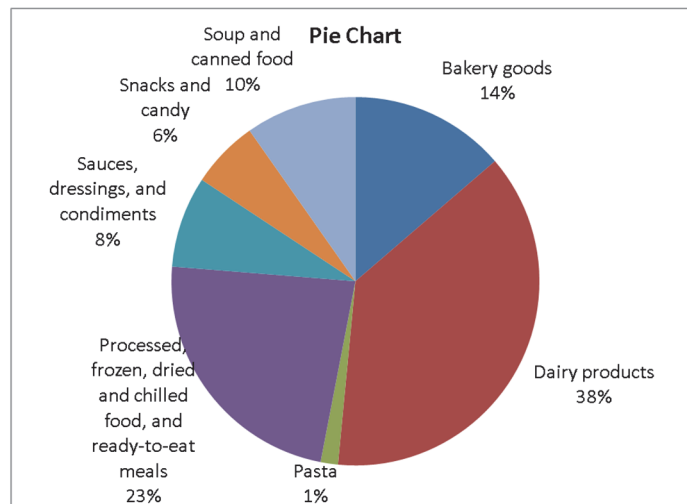
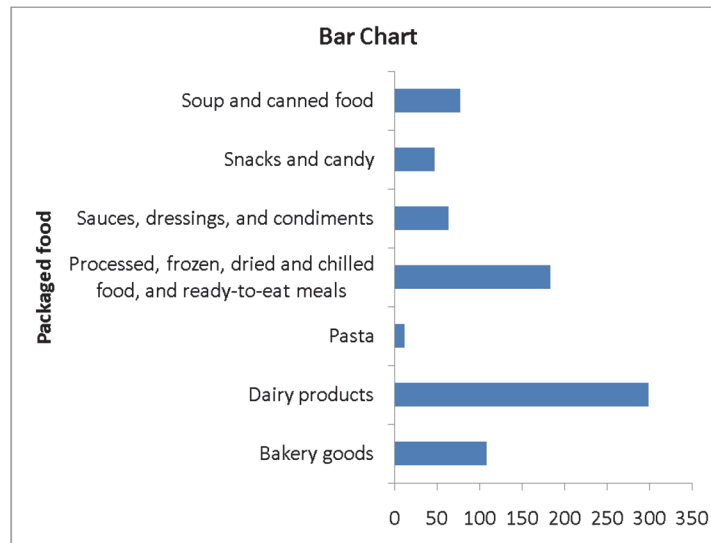


2.93  
cont.

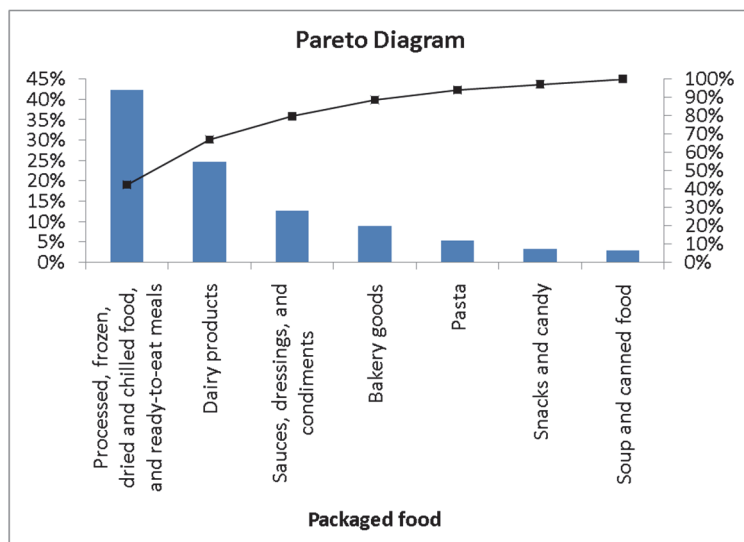
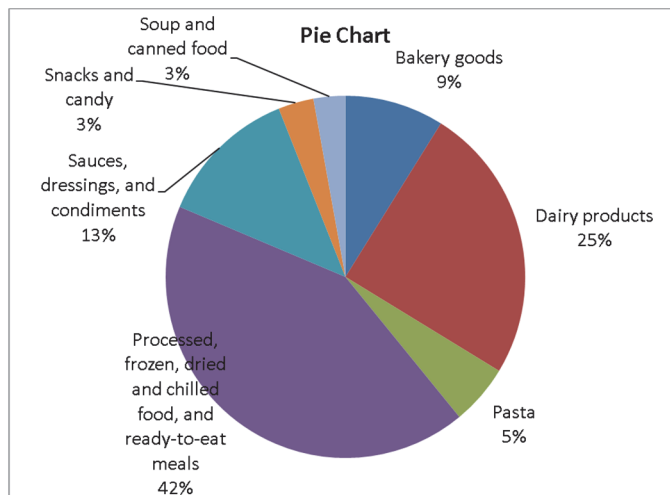
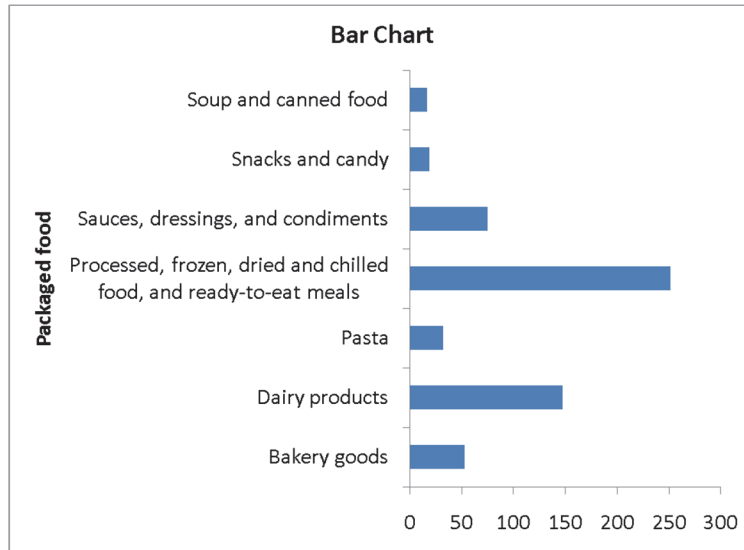
(a) **Russia Fresh Food Consumed:**

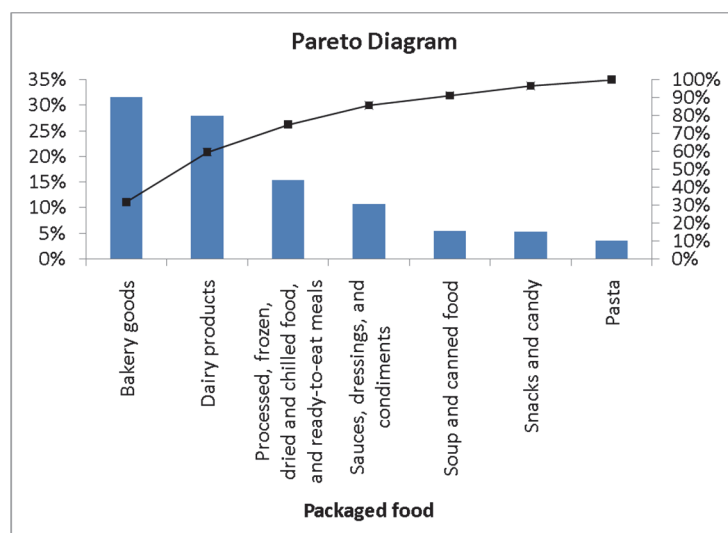
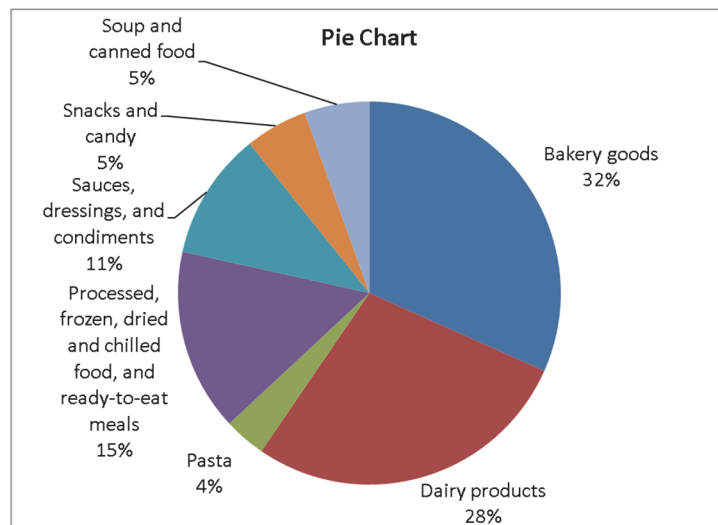
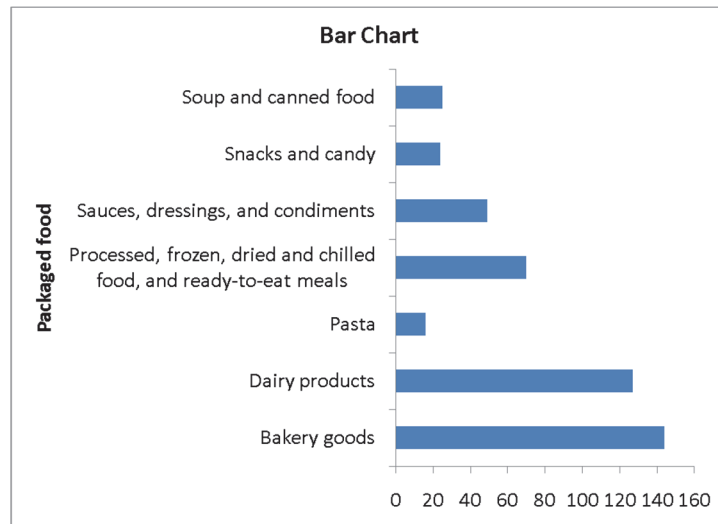


2.93 (b) United States Packaged Food Consumed:  
cont.



2.93 (b) Japan Packaged Food Consumed:  
cont.



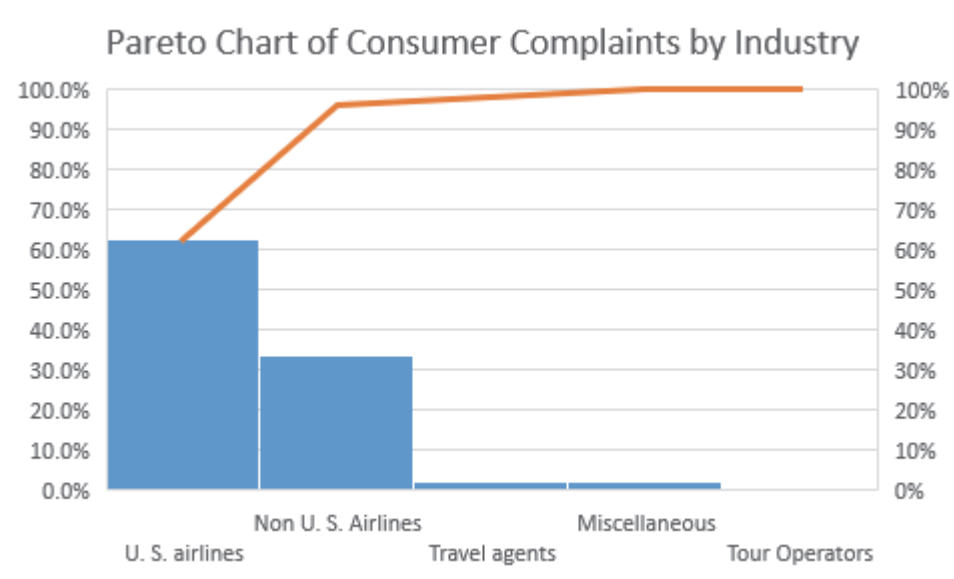
2.93 (b) Russian Packaged Food Consumed:  
cont.



- 2.93 (c) The fresh food consumption patterns between Japanese and Russians are quite similar with vegetables taking up the largest share followed by meats and seafood while Americans consume about the same amount of meats and seafood, and vegetables. Among the three countries, vegetables, and meats and seafood constitute more than 60% of the fresh food consumption.

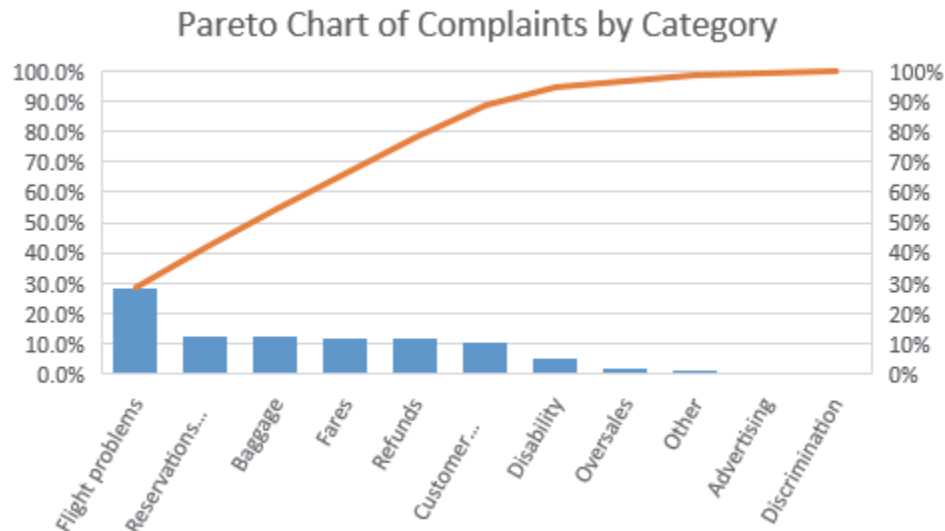
For Americans, dairy products, and processed, frozen, dried and chilled food and ready-to-eat meals make up slightly more than 60% of the packaged food consumption. For Japanese, processed, frozen, dried and chilled food, and ready-to-eat meals, and dairy products constitute more than 60% of their packaged food consumption. For the Russians, bakery goods and dairy products take up 60% of the share of their package food consumption.

- 2.94 (a)



Most complaints were against U.S. airlines.

- (b)

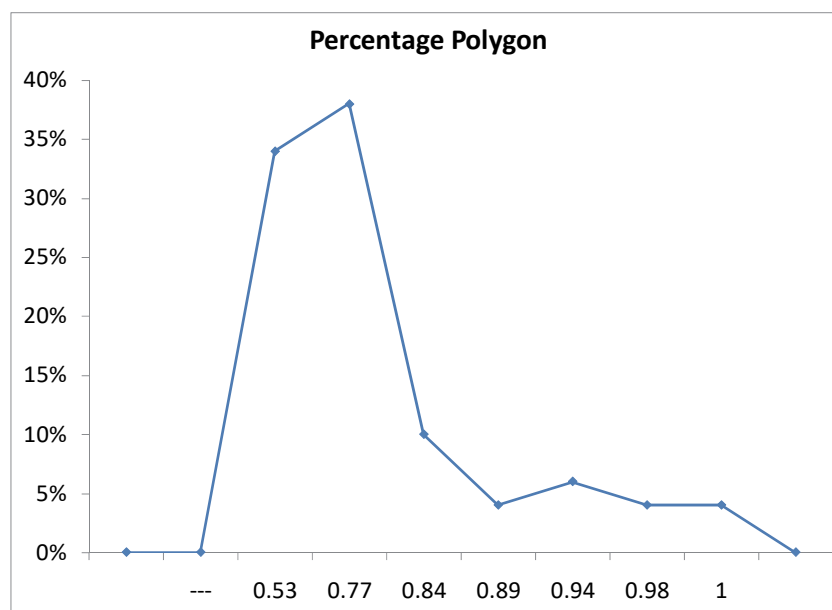
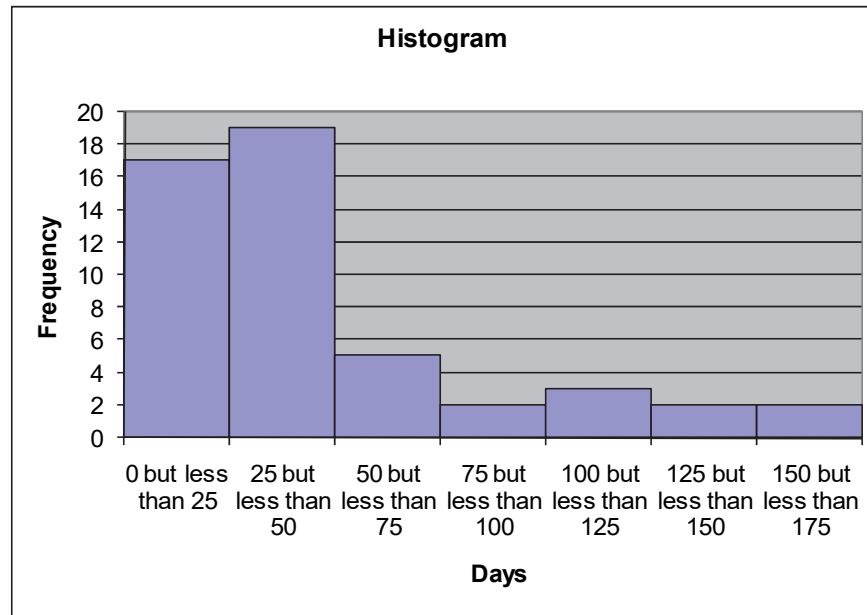


More of the complaints were due to flight problems.

2.95 (a)

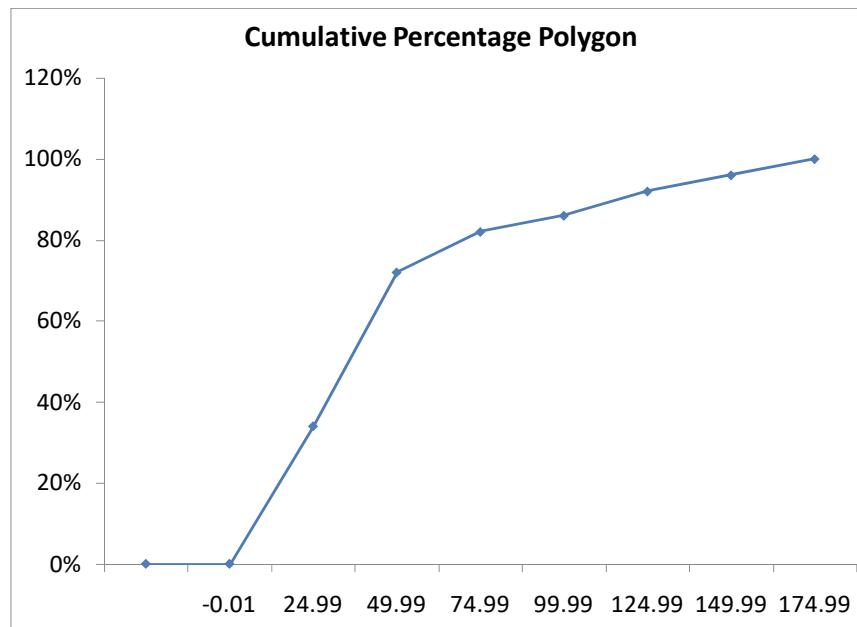
<i>Range</i>	<i>Frequency</i>	<i>Percentage</i>
0 but less than 25	17	34%
25 but less than 50	19	38%
50 but less than 75	5	10%
75 but less than 100	2	4%
100 but less than 125	3	6%
125 but less than 150	2	4%
150 but less than 175	2	4%

2.95 (b)



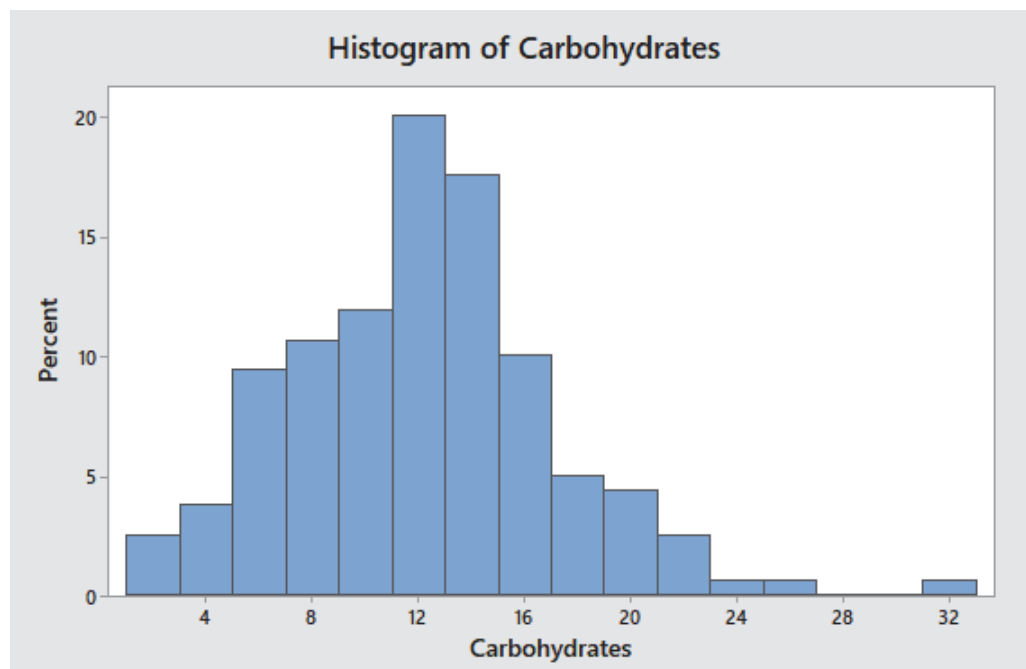
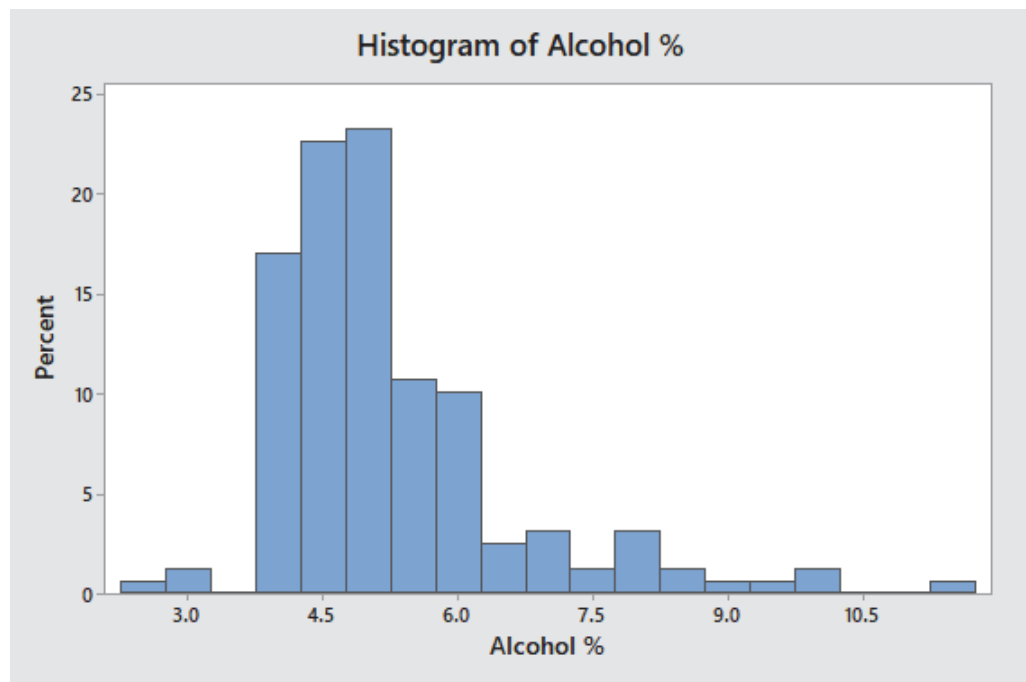
2.95 (c)  
cont.

<b>Range</b>	<b>Cumulative %</b>
0 but less than 25	34%
25 but less than 50	72%
50 but less than 75	82%
75 but less than 100	86%
100 but less than 125	92%
125 but less than 150	96%
150 but less than 175	100%

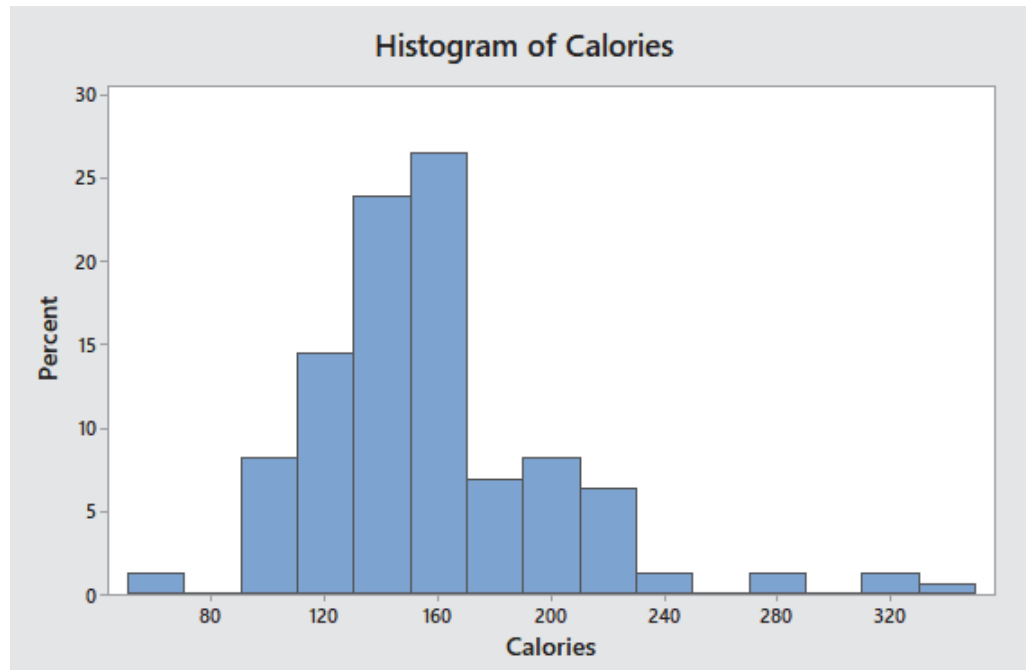


- (d) You should tell the president of the company that over half of the complaints are resolved within a month, but point out that some complaints take as long as three or four months to settle.

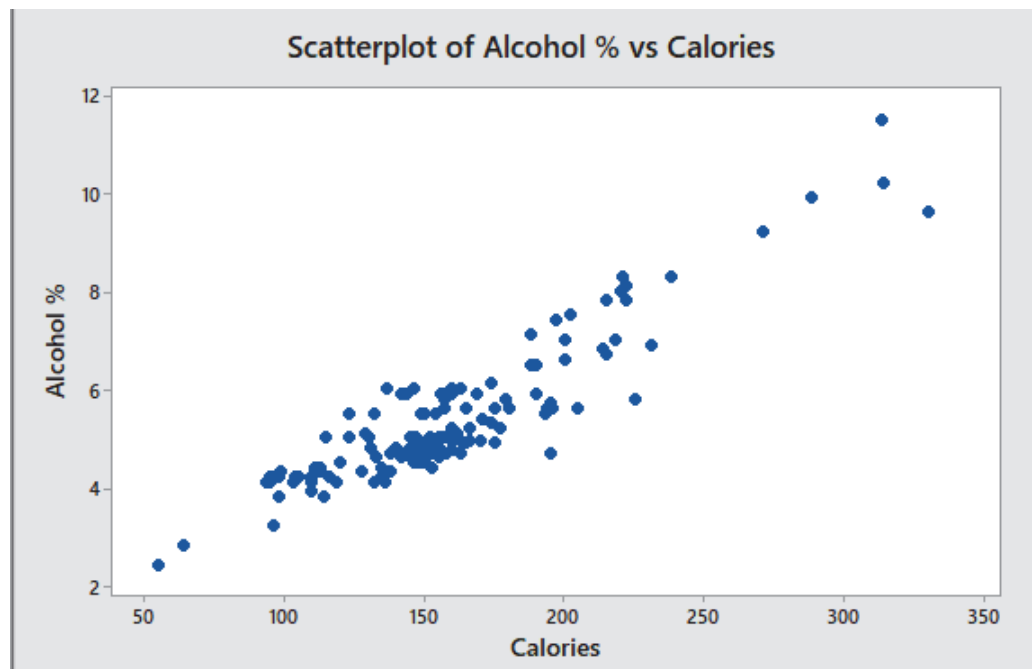
2.96 (a)



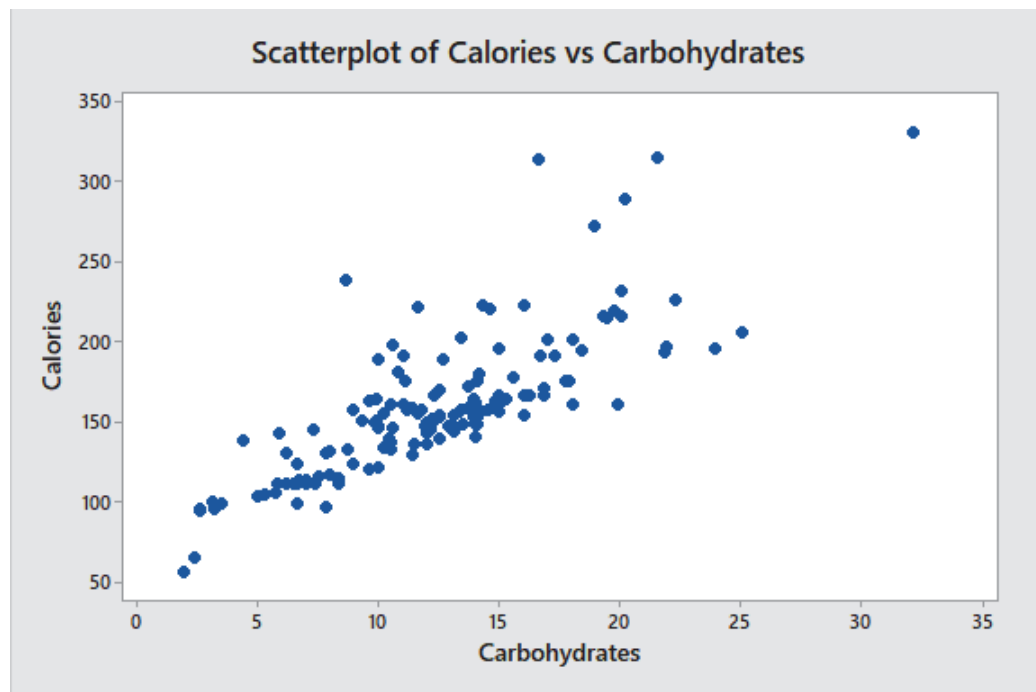
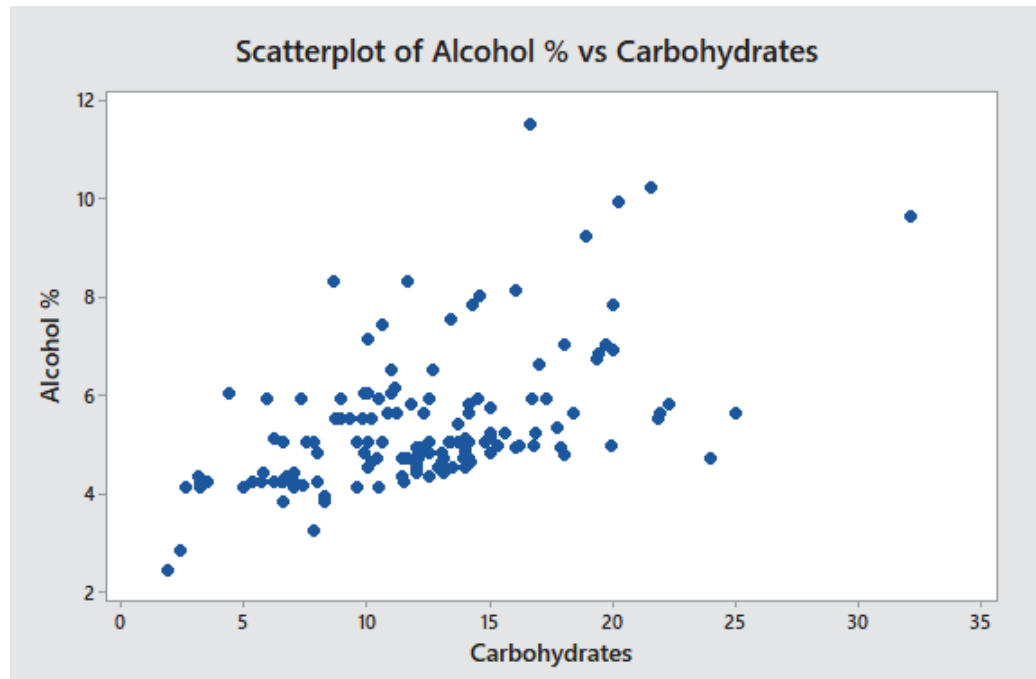
2.96 (a)  
cont.



(b)



2.96 (b)  
cont.

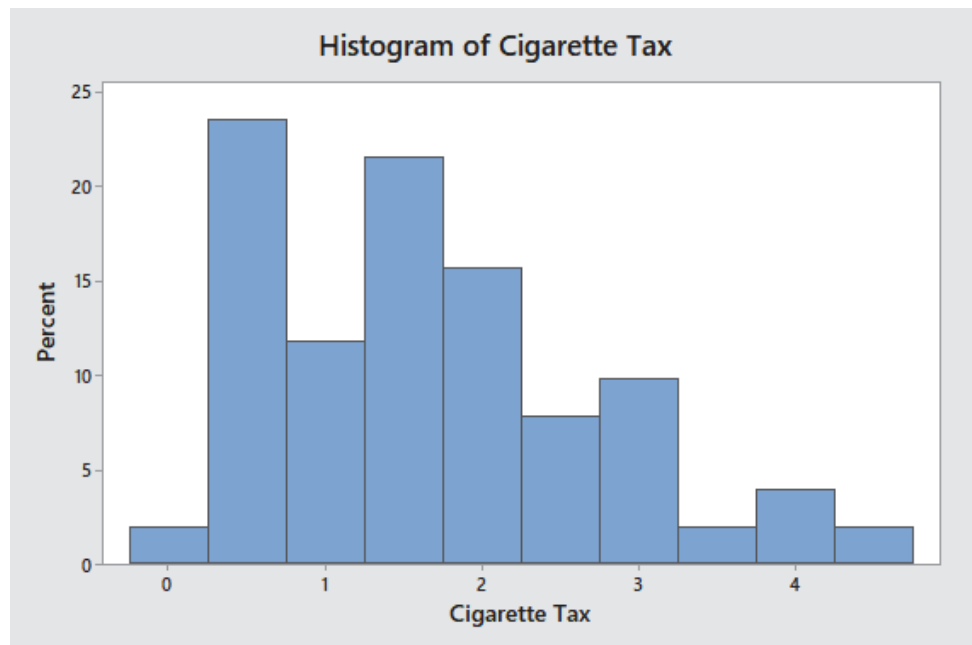


- 2.96 (c) cont. The alcohol percentage is concentrated between 4% and 6%, with more between 4% and 5%. The calories are concentrated between 140 and 160. The carbohydrates are concentrated between 12 and 15. There are outliers in the percentage of alcohol in both tails. There are a few beers with alcohol content as high as around 11.5%. There are a few beers with calorie content as high as around 320 and carbohydrates as high as 32. There is a positive relationship between percentage of alcohol and calories and between calories and carbohydrates, and positive relationship between percentage alcohol and carbohydrates.

2.97 (a)

0.17	0.3	0.37	0.44	0.45	0.57	0.57	0.6	0.6	0.62	0.64
0.675	0.68	0.84	0.995	1.03	1.08	1.15	1.2	1.29	1.32	1.339
1.36	1.41	1.53	1.6	1.6	1.66	1.7	1.7	1.78	1.8	1.98
2	2	2	2	2	2.5	2.52	2.6	2.7	2.87	3.025
3.04	3.08	3.2	3.51	3.75	3.9	4.35				

(b)



- (c) Most of the states have a Cigarette Tax between \$0.50 and \$2. Five percent of the states have a cigarette tax of at least \$3.5.

2.98 (a)

**Stem-and-leaf of One-Year CD N = 52**

```

7  0  0001111
11 0  2223
15 0  4555
17 0  67
17 0
26 1  000000001
26 1  223333
20 1  4555
16 1  66666667777777
2  1  8
1  2  0

```

*Leaf Unit = 0.1***Stem-and-leaf of Five-Year CD N = 52**

```

2  0  23
6  0  4555
8  0  67
8  0
11 1  001
13 1  23
16 1  445
24 1  66667777
26 1  88
26 2  00111
21 2  2222333333333333
6  2  444445

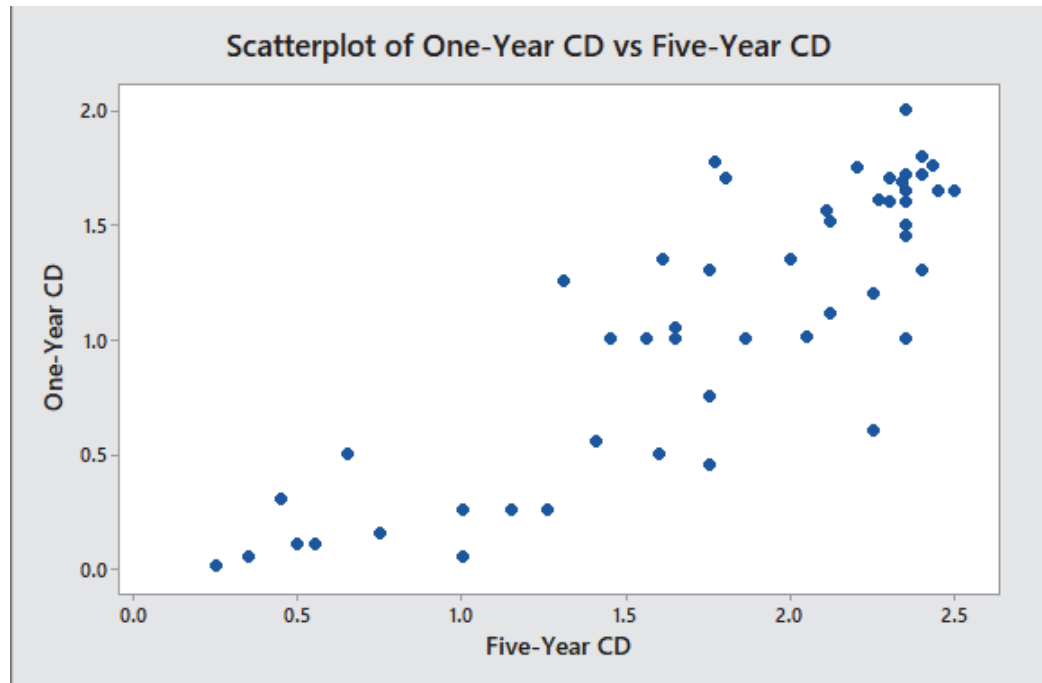
```

*Leaf Unit = 0.1*

- (b) The yield of one-year CDs shows that most values are at least 1.0. The yield of five-year CDs shows that most values are at least 1.6.



2.98 (c)  
cont.



(d) There appears to be a positive relationship between the yield of the one-year CD and the five-year CD.

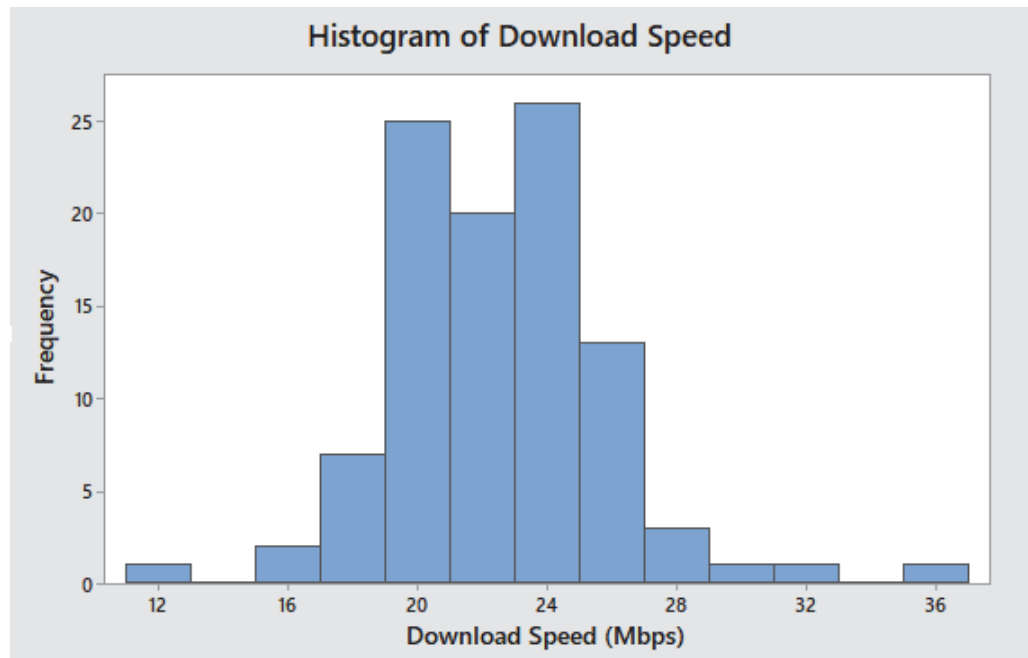
2.99 (a)

Download Speed (Mbps)	Frequency	Percentage
12 but less than 14	1	1.0%
14 but less than 16	1	1.0%
16 but less than 18	1	1.0%
18 but less than 20	19	19.0%
20 but less than 22	22	22.0%
22 but less than 24	22	22.0%
24 but less than 26	23	23.0%
26 but less than 28	7	7.0%
28 but less than 30	2	2.0%
30 but less than 32	0	0.0%
32 but less than 34	1	1.0%
34 but less than 36	0	0.0%
36 but less than 38	1	1.0%

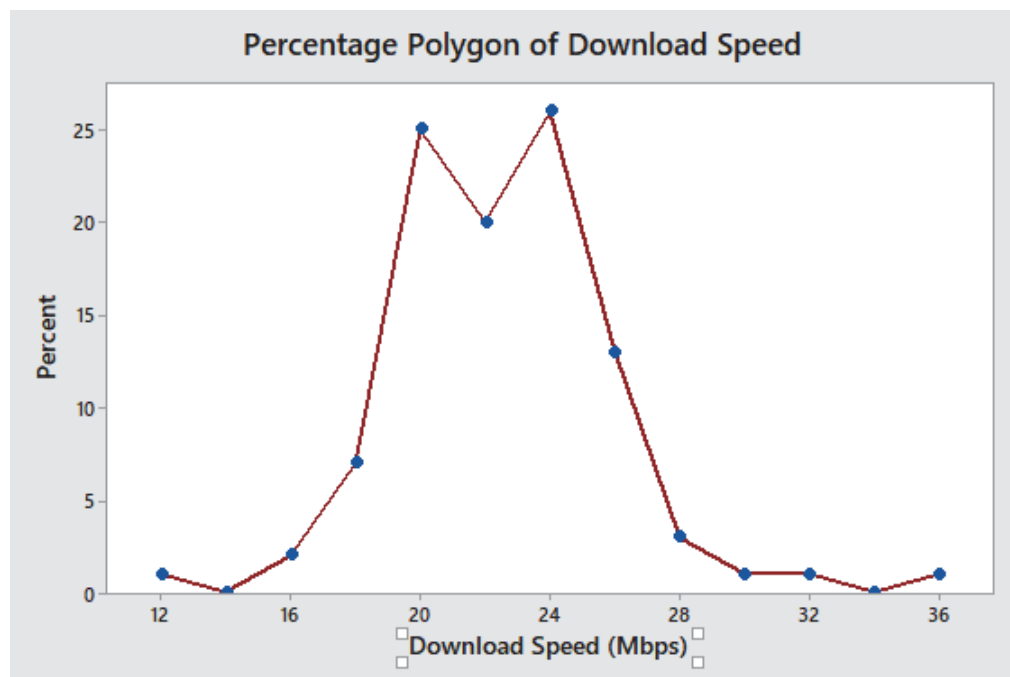
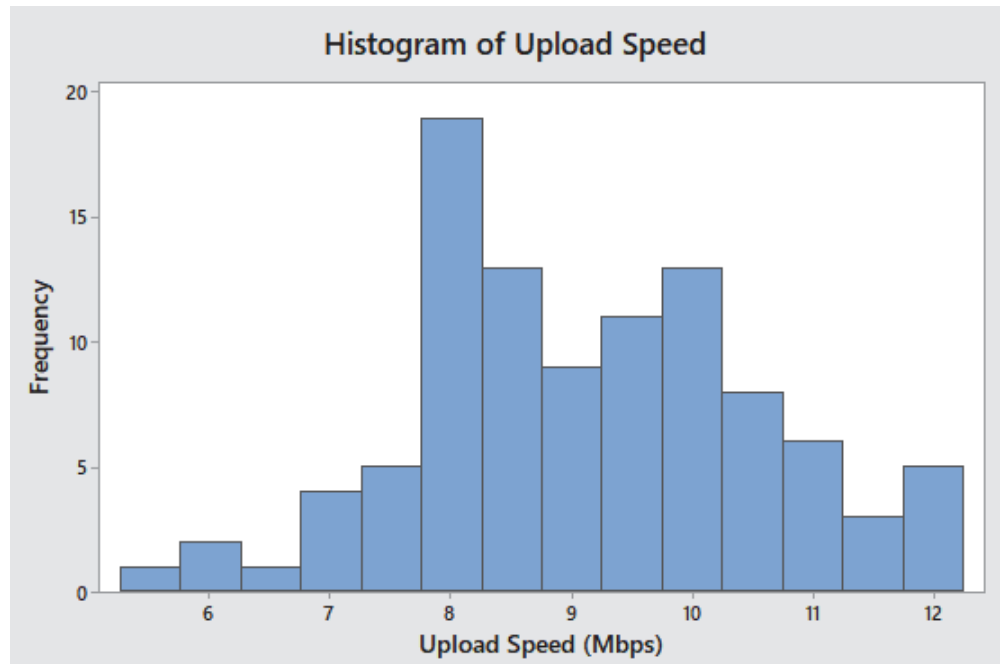
2.99 (a)  
cont.

Upload Speed (Mbps)	Frequency	Percentage
5 but less than 6	1	1.0%
6 but less than 7	4	4.0%
7 but less than 8	19	19.0%
8 but less than 9	23	23.0%
9 but less than 10	27	27.0%
10 but less than 11	14	14.0%
11 but less than 12	9	9.0%
12 but less than 13	3	3.0%

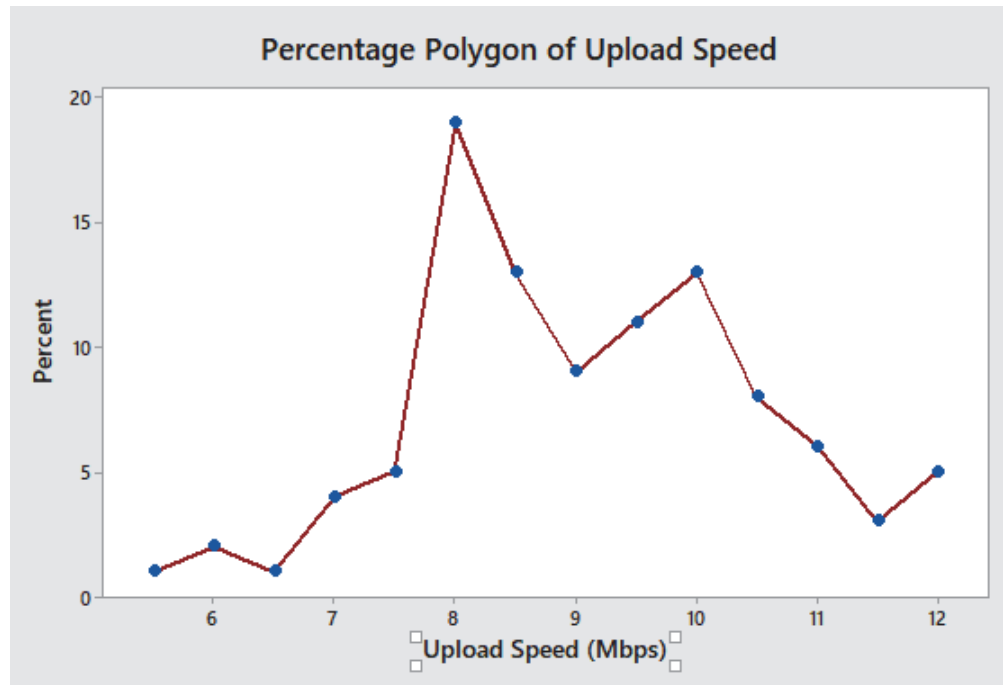
(b)



2.99 (b)  
cont.



2.99 (b)  
cont.

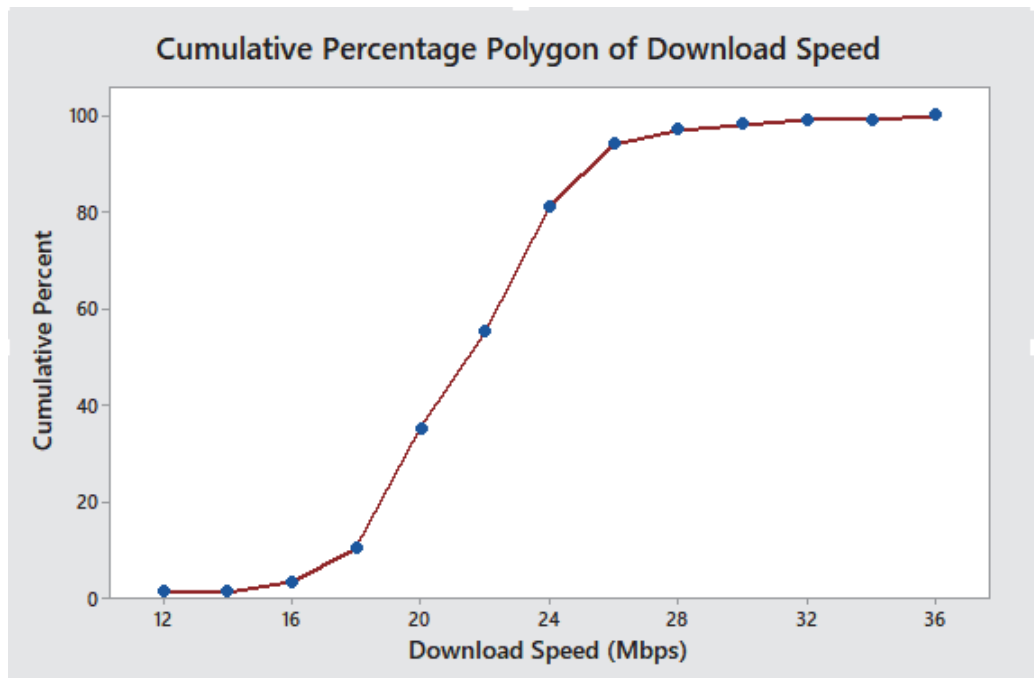


(c)

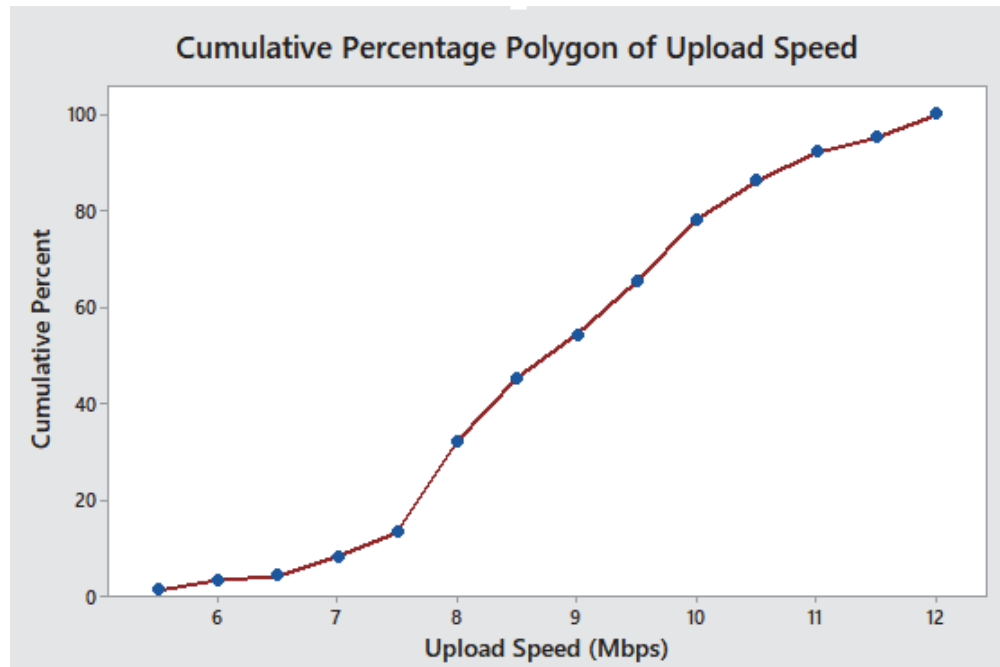
Download Speed (Mbps)	Frequency	Percentage	Cumulative Percentage
12 but less than 14	1	1.0%	1.0%
14 but less than 16	1	1.0%	2.0%
16 but less than 18	1	1.0%	3.0%
18 but less than 20	19	19.0%	22.0%
20 but less than 22	22	22.0%	44.0%
22 but less than 24	22	22.0%	66.0%
24 but less than 26	23	23.0%	89.0%
26 but less than 28	7	7.0%	96.0%
28 but less than 30	2	2.0%	98.0%
30 but less than 32	0	0.0%	98.0%
32 but less than 34	1	1.0%	99.0%
34 but less than 36	0	0.0%	99.0%
36 but less than 38	1	1.0%	100.0%

2.99 (c)  
cont.

Upload Speed (Mbps)	Frequency	Percentage	Cumulative Percentage
5 but less than 6	1	1.0%	1.0%
6 but less than 7	4	4.0%	5.0%
7 but less than 8	19	19.0%	24.0%
8 but less than 9	23	23.0%	47.0%
9 but less than 10	27	27.0%	74.0%
10 but less than 11	14	14.0%	88.0%
11 but less than 12	9	9.0%	97.0%
12 but less than 13	3	3.0%	100.0%

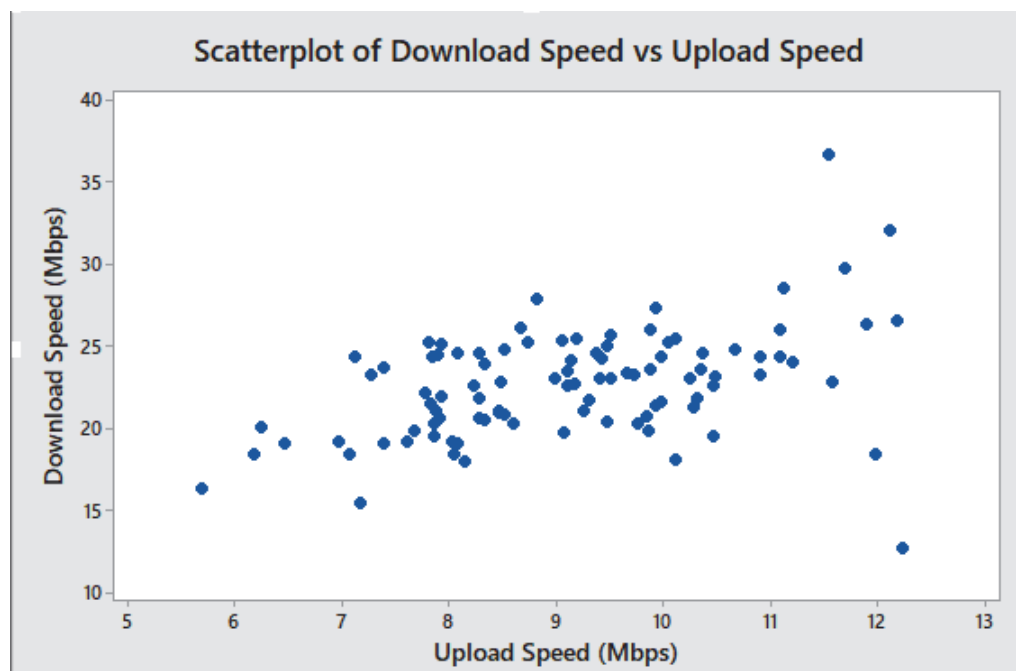


2.99 (c)  
cont.



(d) Most cities have an average download speed between 18 Mbps and 26 Mbps. Most cities have an average upload speed between 7 Mbps and 11 Mbps.

(e)



(f) There appears to be a positive relationship between download speed and upload speed.

2.100 (a)

**Frequencies (Boston)**

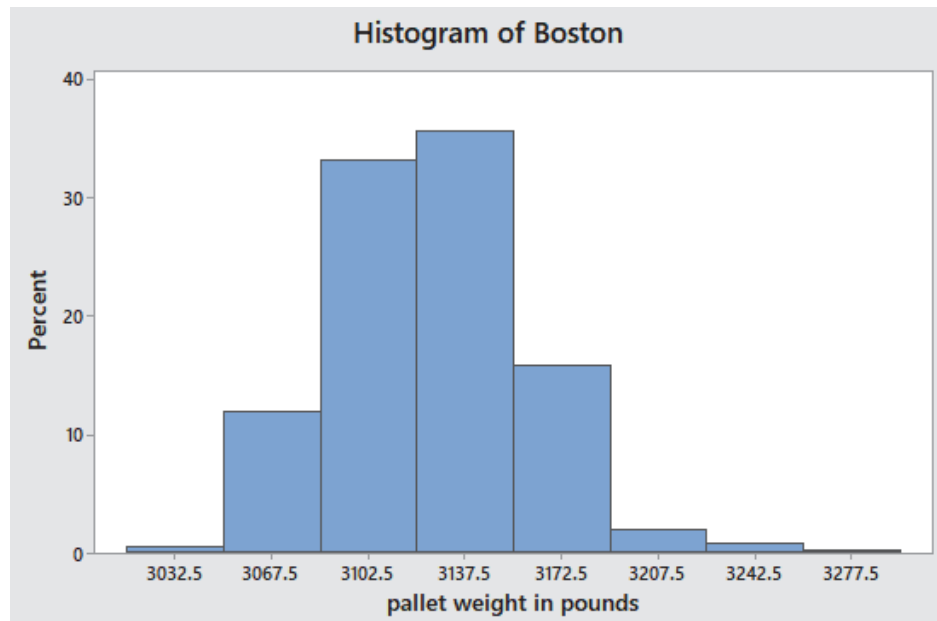
<i>Weight (Boston)</i>	<i>Frequency</i>	<i>Percentage</i>
3015 but less than 3050	2	0.54%
3050 but less than 3085	44	11.96%
3085 but less than 3120	122	33.15%
3120 but less than 3155	131	35.60%
3155 but less than 3190	58	15.76%
3190 but less than 3225	7	1.90%
3225 but less than 3260	3	0.82%
3260 but less than 3295	1	0.27%

(b)

**Frequencies (Vermont)**

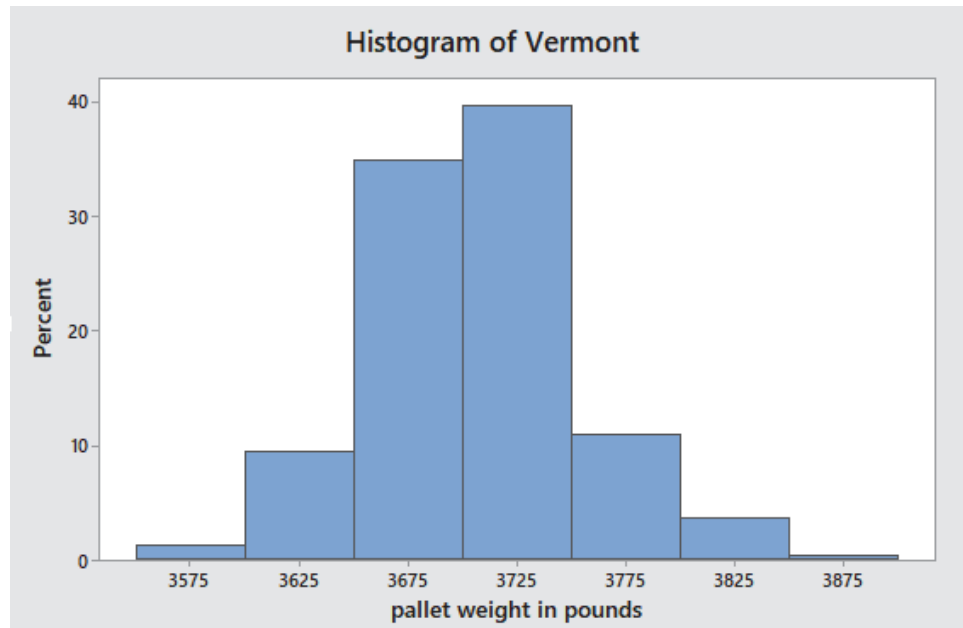
<i>Weight (Vermont)</i>	<i>Frequency</i>	<i>Percentage</i>
3550 but less than 3600	4	1.21%
3600 but less than 3650	31	9.39%
3650 but less than 3700	115	34.85%
3700 but less than 3750	131	39.70%
3750 but less than 3800	36	10.91%
3800 but less than 3850	12	3.64%
3850 but less than 3900	1	0.30%

(c)



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2.100 (c)  
cont.



- (d) 0.54% of the “Boston” shingles pallets are underweight while 0.27% are overweight.  
1.21% of the “Vermont” shingles pallets are underweight while 3.94% are overweight.

2.101 (a)

Two-Star Hotel		
Average Room Price (Canadian Dollar)	frequency	percentage
24 but less than 44	8	13.8%
44 but less than 64	5	8.6%
64 but less than 84	6	10.3%
84 but less than 104	10	17.2%
104 but less than 124	8	13.8%
124 but less than 144	11	19.0%
144 but less than 164	5	8.6%
164 but less than 184	5	8.6%
Total	58	100%

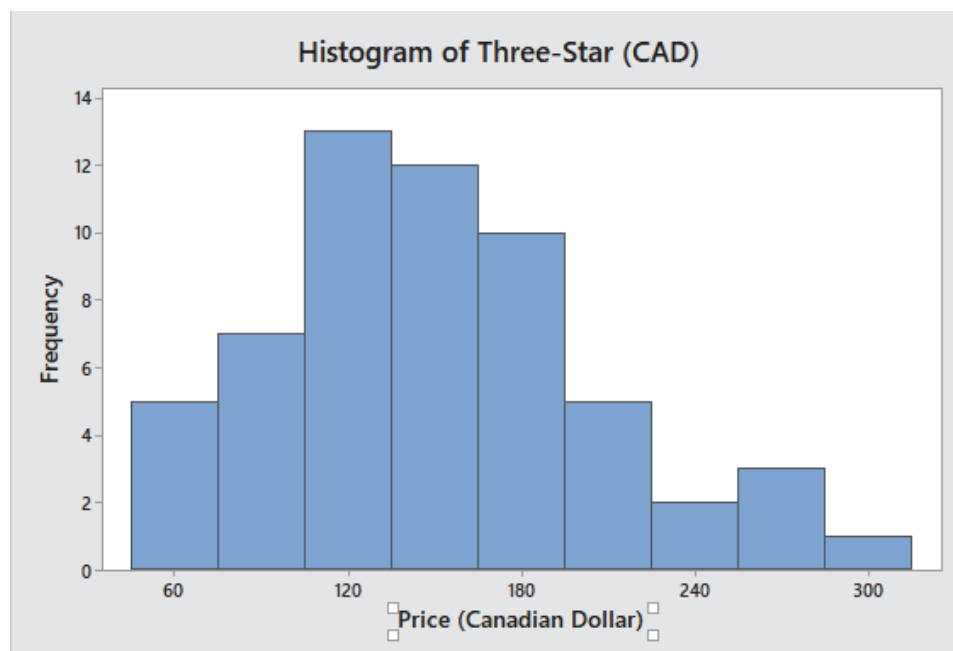
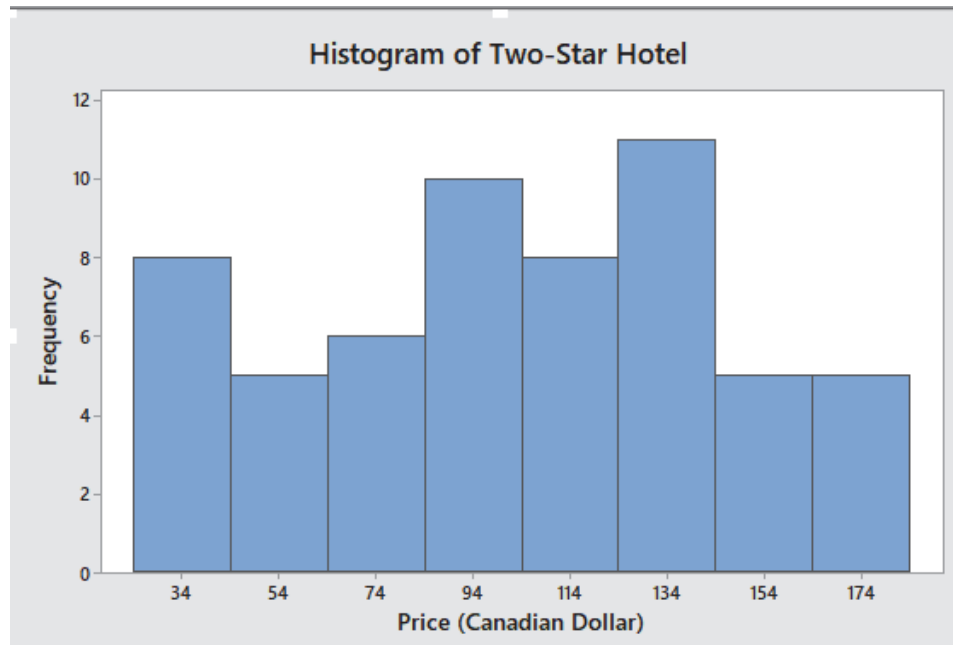


2.101 (a)  
cont.

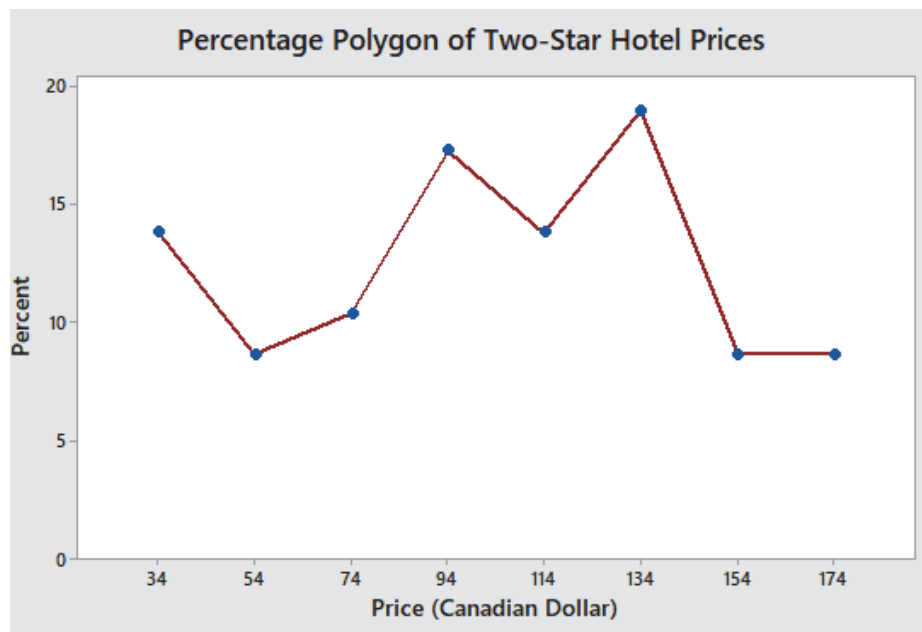
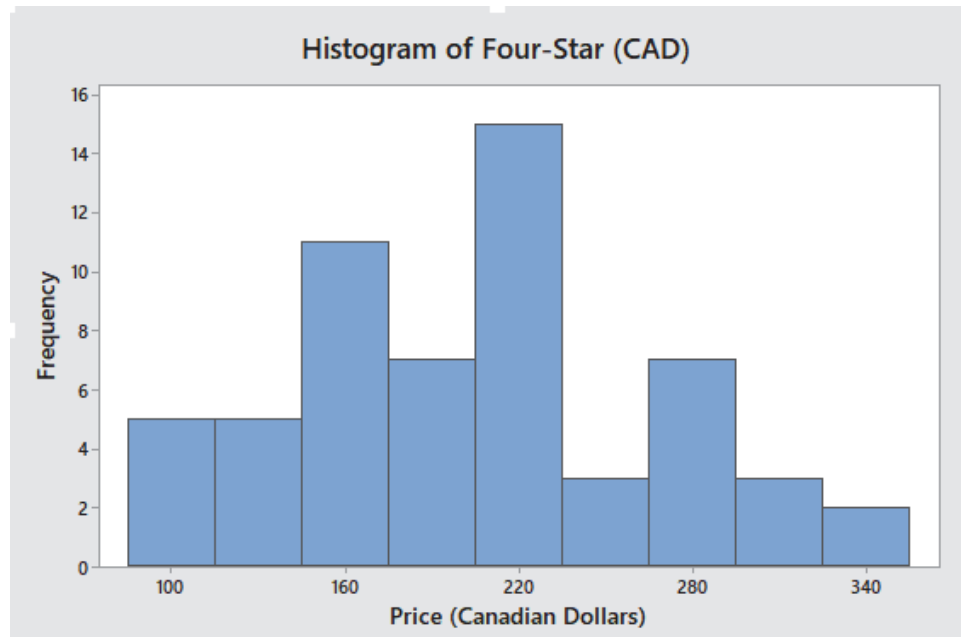
Three-Star Hotel		
Average Room Price (Canadian Dollar)	frequency	percentage
45 but less than 75	5	8.6%
75 but less than 105	7	12.1%
105 but less than 135	13	22.4%
135 but less than 165	12	20.7%
165 but less than 195	10	17.2%
195 but less than 225	5	8.6%
225 but less than 255	2	3.4%
255 but less than 285	3	5.2%
285 but less than 315	1	1.7%
Total	58	100%

Four-Star Hotel		
Average Room Price (Canadian Dollar)	frequency	percentage
85 but less than 115	5	8.6%
115 but less than 145	5	8.6%
145 but less than 175	11	19.0%
175 but less than 205	7	12.1%
205 but less than 235	15	25.9%
235 but less than 265	3	5.2%
265 but less than 295	7	12.1%
295 but less than 325	3	5.2%
325 but less than 355	2	3.4%
Total	58	100.0%

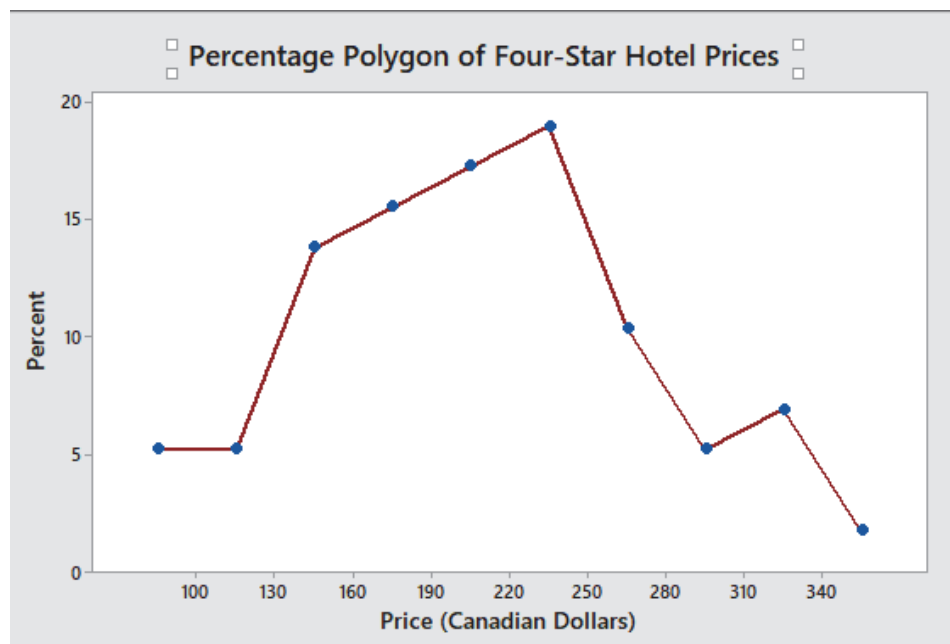
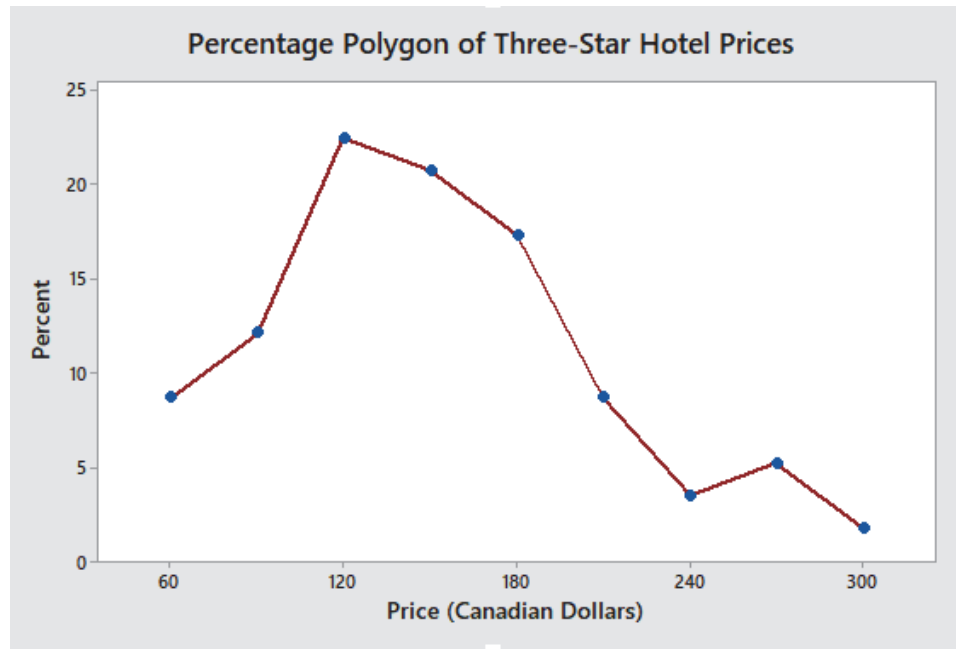
2.101 (b)  
cont.



2.101 (b)  
cont.

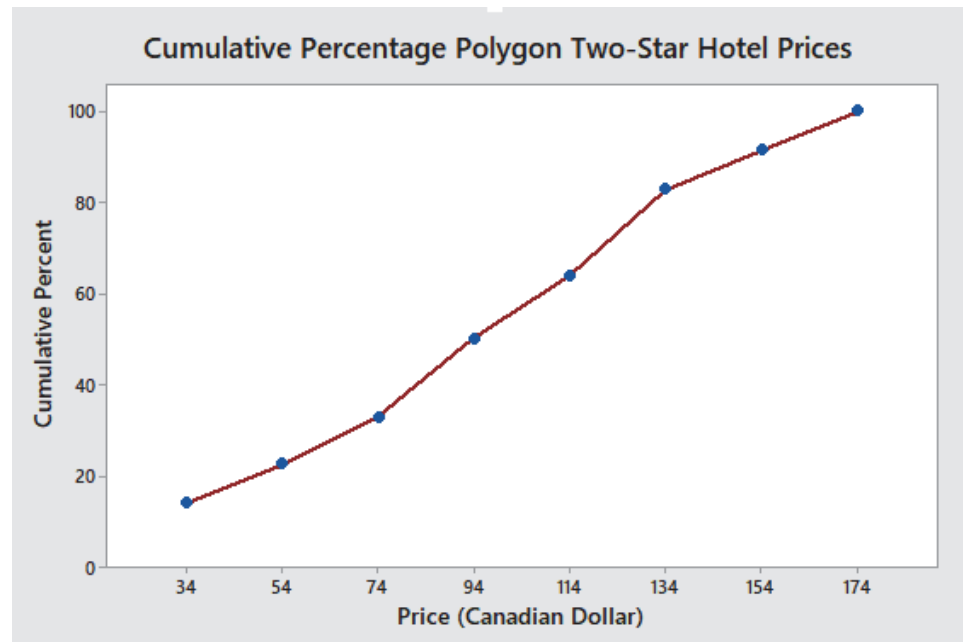


2.101 (b)  
cont.



2.101 (c)  
cont.

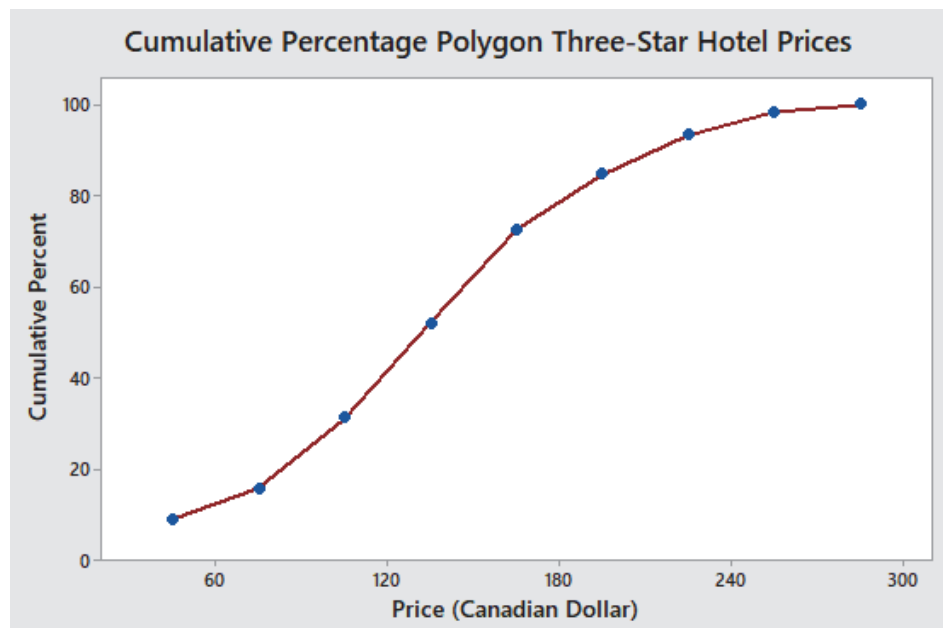
Two-Star Hotel	
Average Room Price (Canadian Dollar)	cumulative percentage
24 but less than 44	13.8%
44 but less than 64	22.4%
64 but less than 84	32.8%
84 but less than 104	50.0%
104 but less than 124	63.8%
124 but less than 144	82.8%
144 but less than 164	91.4%
164 but less than 184	100.0%



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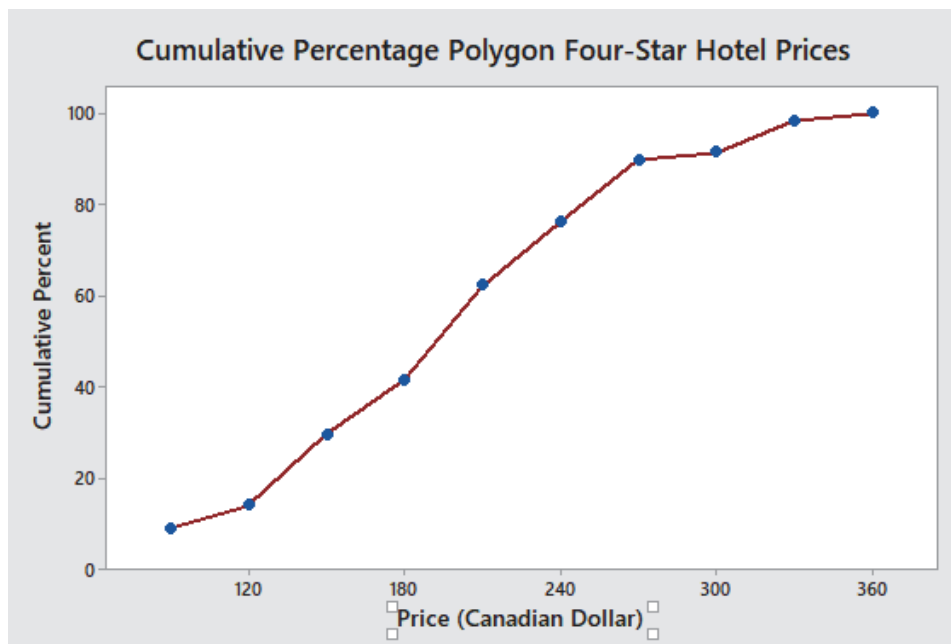
2.101 (c)  
cont.

Three-Star Hotel	
Average Room Price (Canadian Dollar)	cumulative percentage
45 but less than 75	8.6%
75 but less than 105	20.7%
105 but less than 135	43.1%
135 but less than 165	63.8%
165 but less than 195	81.0%
195 but less than 225	89.7%
225 but less than 255	93.1%
255 but less than 285	98.3%
285 but less than 315	100.0%



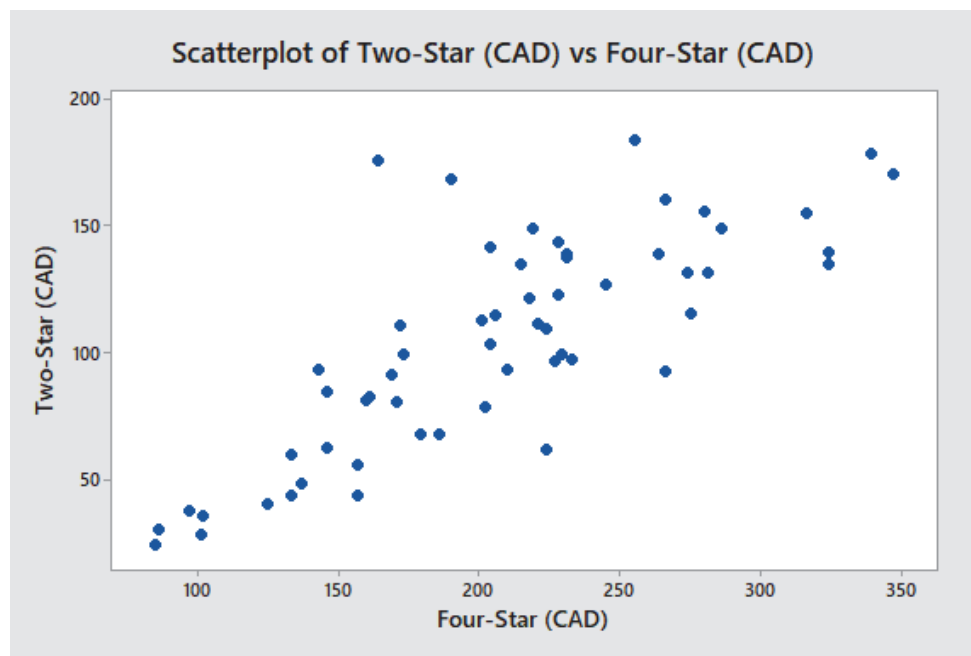
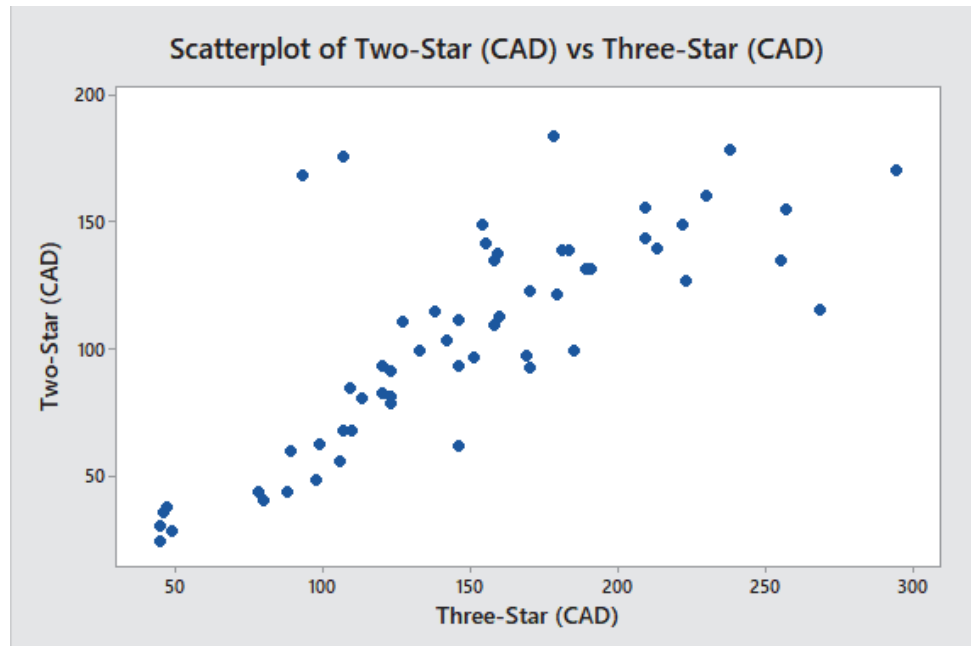
2.101 (c)  
cont.

Four-Star Hotel	
Average Room Price (Canadian Dollar)	cumulative percentage
85 but less than 115	8.6%
115 but less than 145	17.2%
145 but less than 175	36.2%
175 but less than 205	48.3%
205 but less than 235	74.1%
235 but less than 265	79.3%
265 but less than 295	91.4%
295 but less than 325	96.6%
325 but less than 355	100.0%



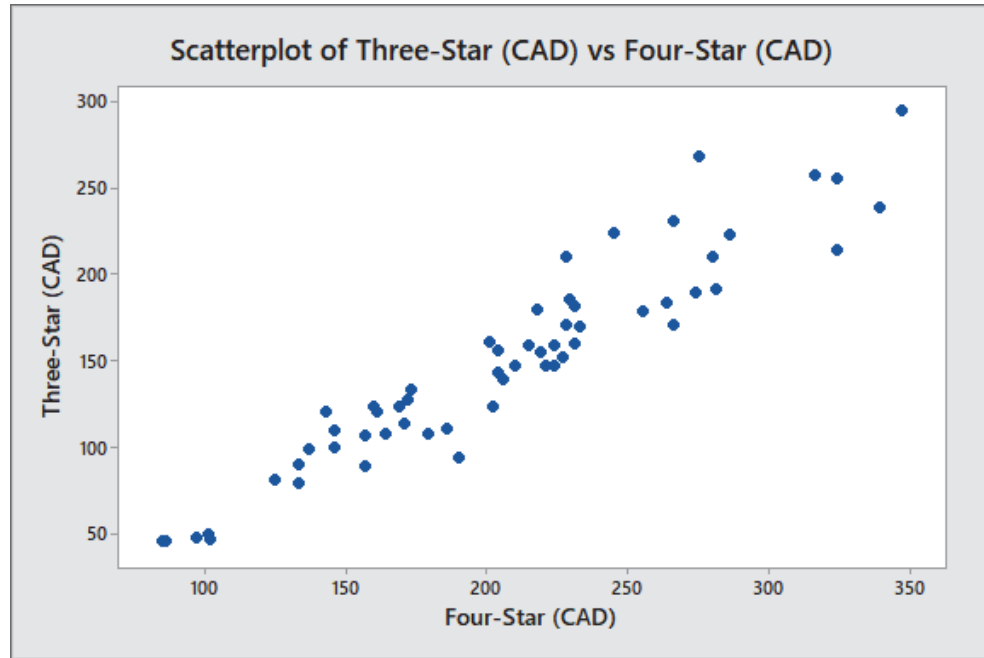
- (d) About 90% of two-star hotels have an average room price below 164 Canadian dollars. The majority of two-star hotels have room prices between 84 and 144 Canadian dollars. Approximately 93% of three-star hotels have an average room price below 255 Canadian dollars and 90% of four-star hotels have an average room price below 295 Canadian dollars. The majority of three-star hotels have room prices between 105 and 195 Canadian dollars. The majority of four-star hotels have room prices from 145 to 235 Canadian dollars.

2.101 (e)  
cont.





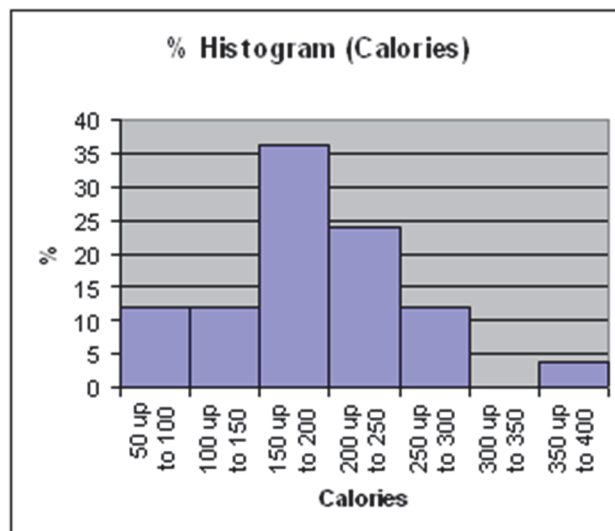
2.101 (e)  
cont.



- (f) The relationship of the price between two-star and three-star, three-star and four-star, and two-star and four-star hotels are all positive.

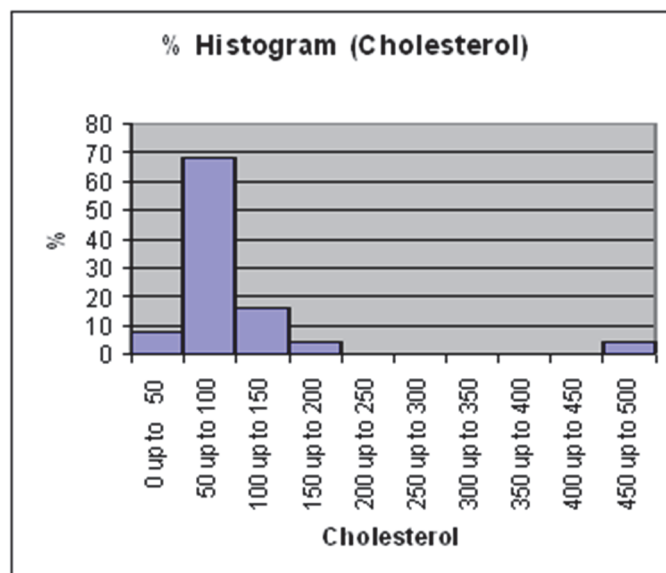
2.102 (a)

<b>Calories</b>	<b>Frequency</b>	<b>Percentage</b>	<b>Percentage Less Than</b>
50 up to 100	3	12%	12%
100 up to 150	3	12	24
150 up to 200	9	36	60
200 up to 250	6	24	84
250 up to 300	3	12	96
300 up to 350	0	0	96
350 up to 400	1	4	100



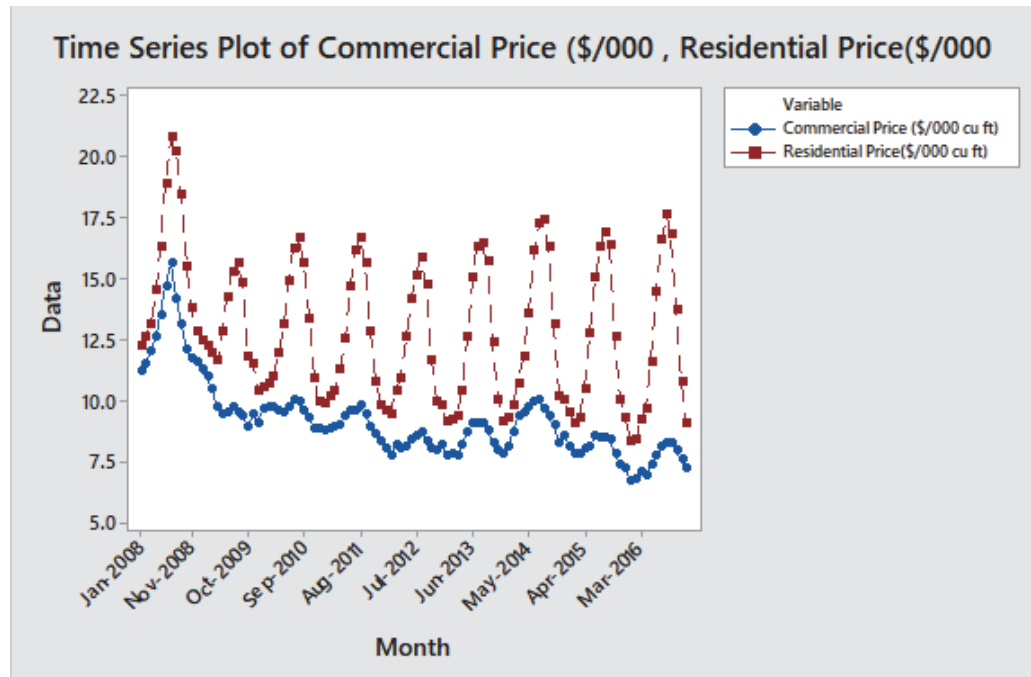
2.102 (b)  
cont.

<b>Cholesterol</b>	<b>Frequency</b>	<b>Percentage</b>	<b>Percentage Less Than</b>
0 up to 50	2	8	8%
50 up to 100	17	68	76
100 up to 150	4	16	92
150 up to 200	1	4	96
200 up to 250	0	0	96
250 up to 300	0	0	96
300 up to 350	0	0	96
350 up to 400	0	0	96
400 up to 450	0	0	96
450 up to 500	1	4	100



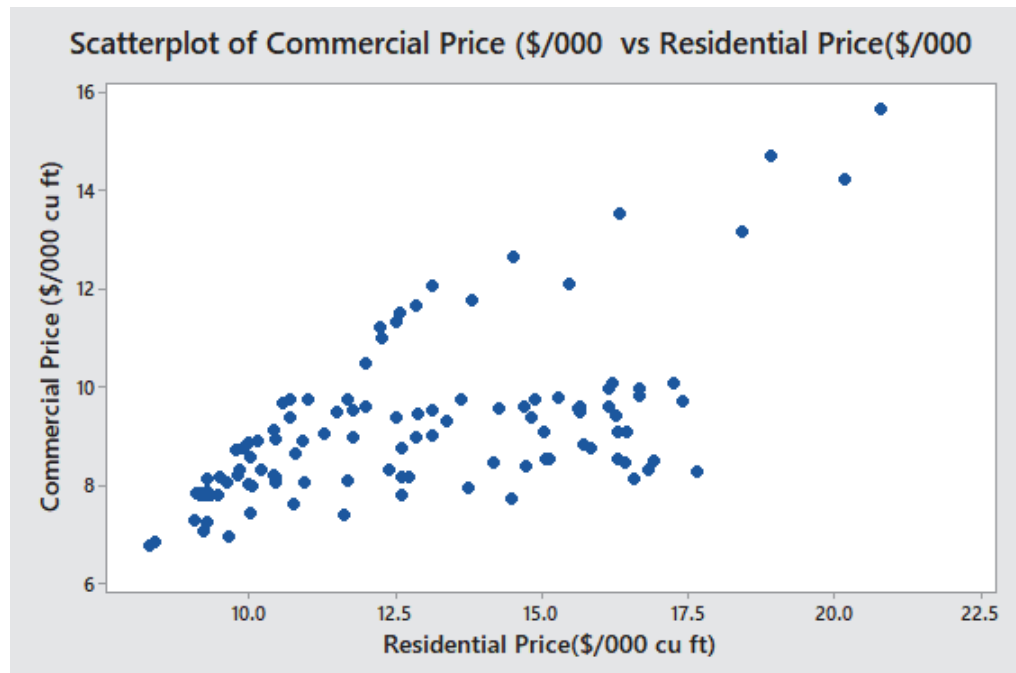
- (c) The sampled fresh red meats, poultry, and fish vary from 98 to 397 calories per serving, with the highest concentration between 150 to 200 calories. One protein source, spareribs, with 397 calories, is more than 100 calories above the next highest caloric food. The protein content of the sampled foods varies from 16 to 33 grams, with 68% of the data values falling between 24 and 32 grams. Spareribs and fried liver are both very different from other foods sampled—the former on calories and the latter on cholesterol content.

2.103 (a)



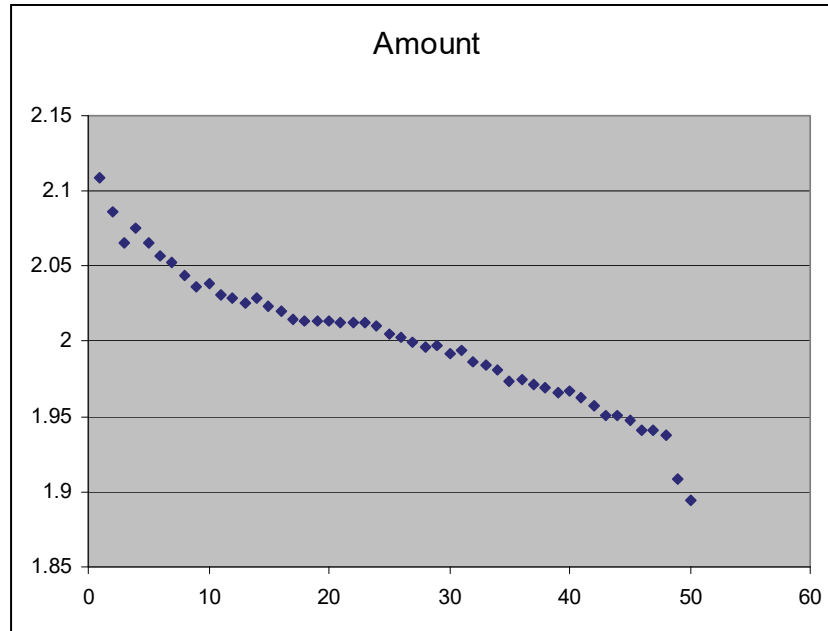
(b) The commercial average price was highest in the summer of 2008 and has since declined. The residential average price of gasoline in the United States is higher in the summer in general.

(c)



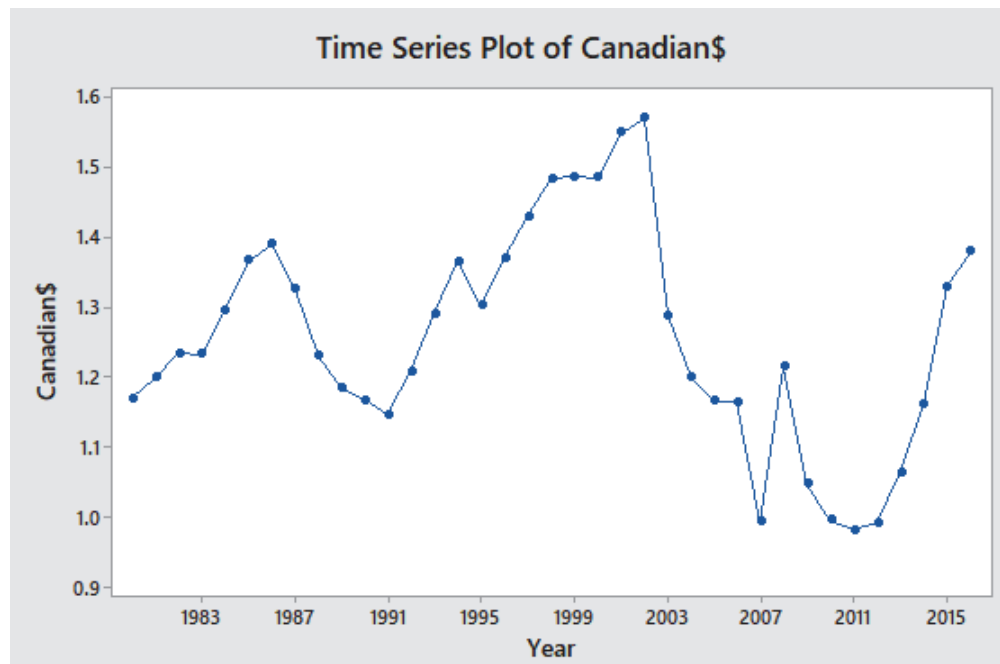
(d) There appears to be a slight positive relationship between the commercial price and residential price.

2.104 (a)

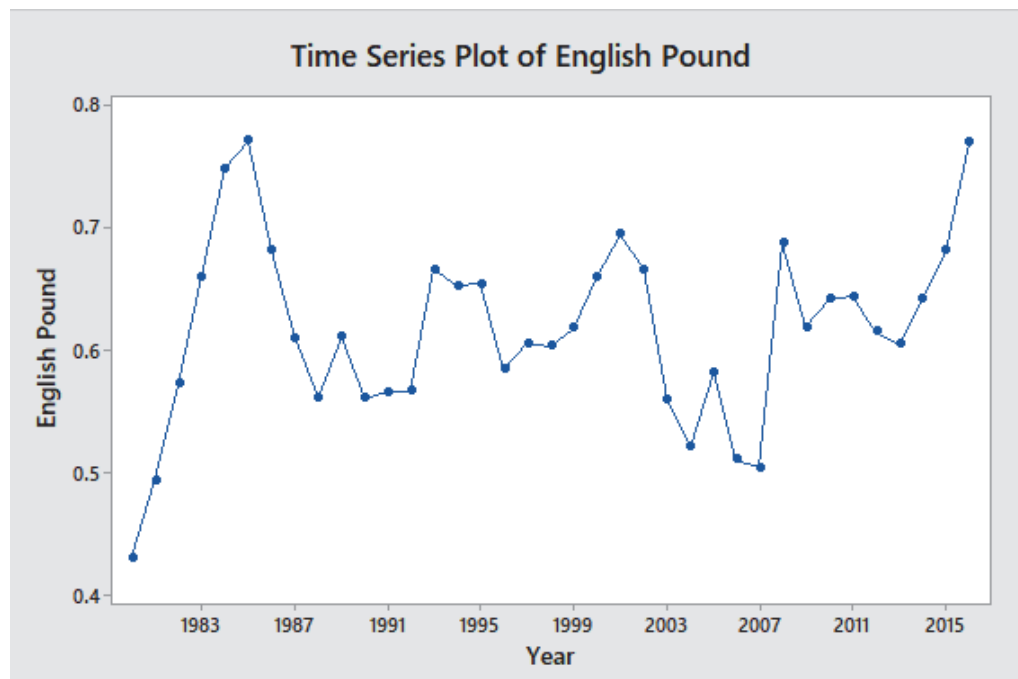
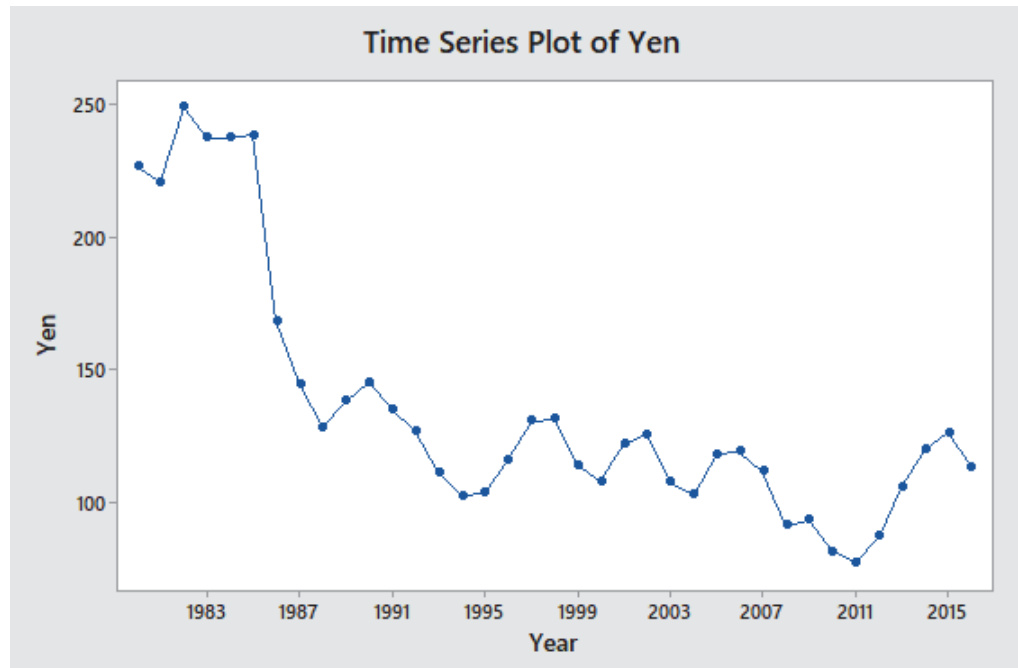


- (b) There is a downward trend in the amount filled.
- (c) The amount filled in the next bottle will most likely be below 1.894 liter.
- (d) The scatter plot of the amount of soft drink filled against time reveals the trend of the data, whereas a histogram only provides information on the distribution of the data.

2.105 (a)

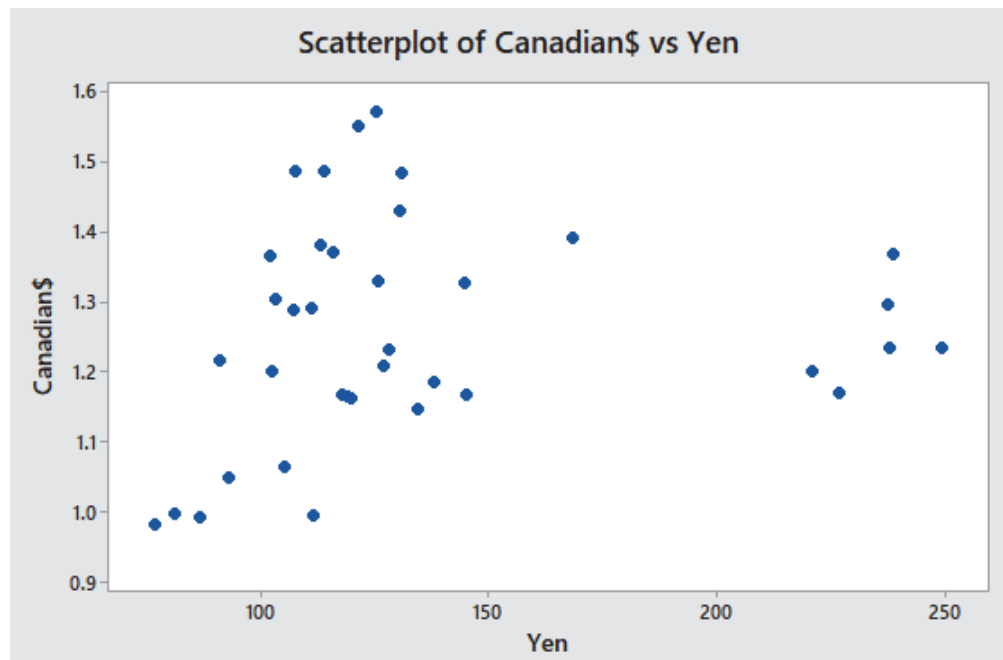
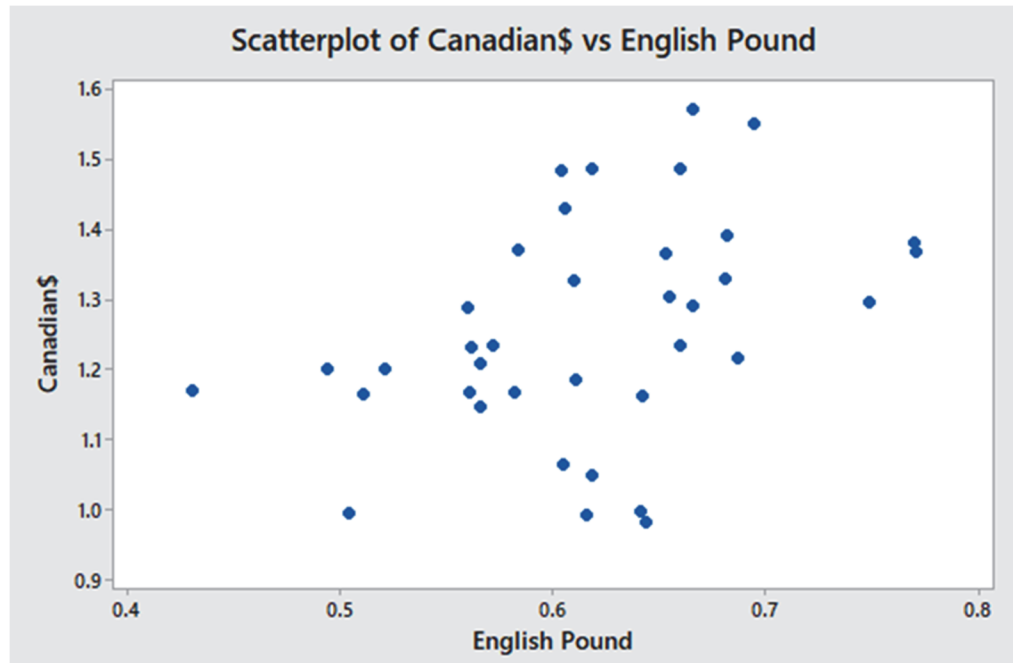


2.105 (a)  
cont.

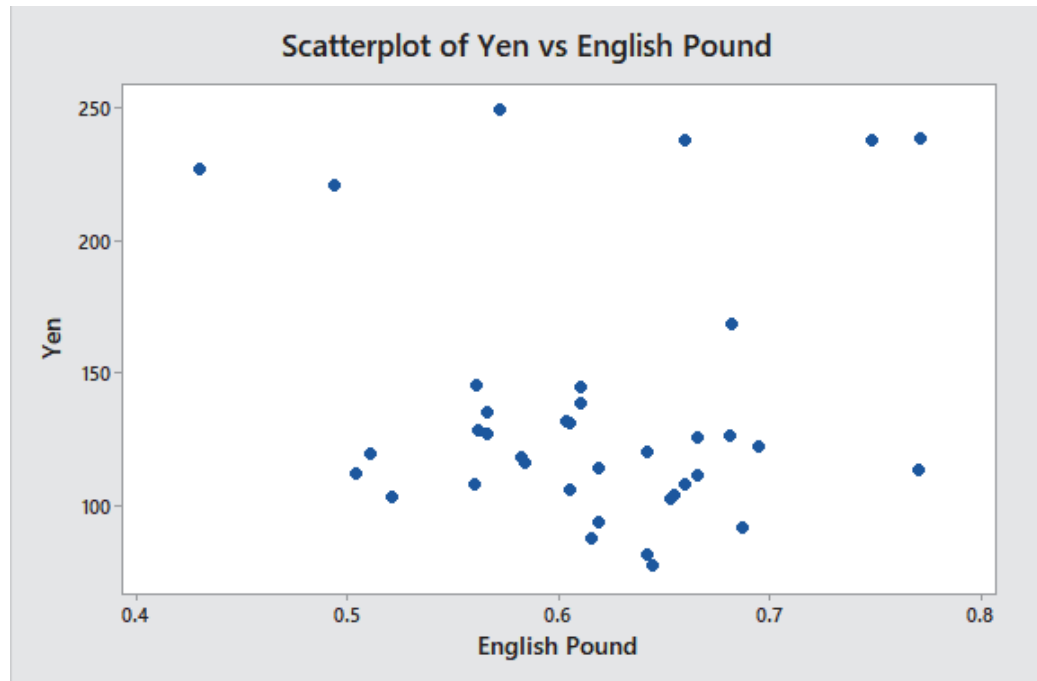


- (b) The Japanese yen had depreciated against the U.S. dollar since 1982 while the Canadian dollar appreciated gradually from 1980 to 1987 and from 1991 to 2002 and then started to depreciate until 2011. The English pound to U.S. dollar's exchange rate has been quite stable since 1983.
- (c) The U.S. dollar has appreciated against the Japanese yen since 1980 and appreciated against the Canadian dollar since 2002 in general while the exchange rate against the English pound has been stable in general.

2.105 (d)  
cont.



2.105 (d)  
cont.

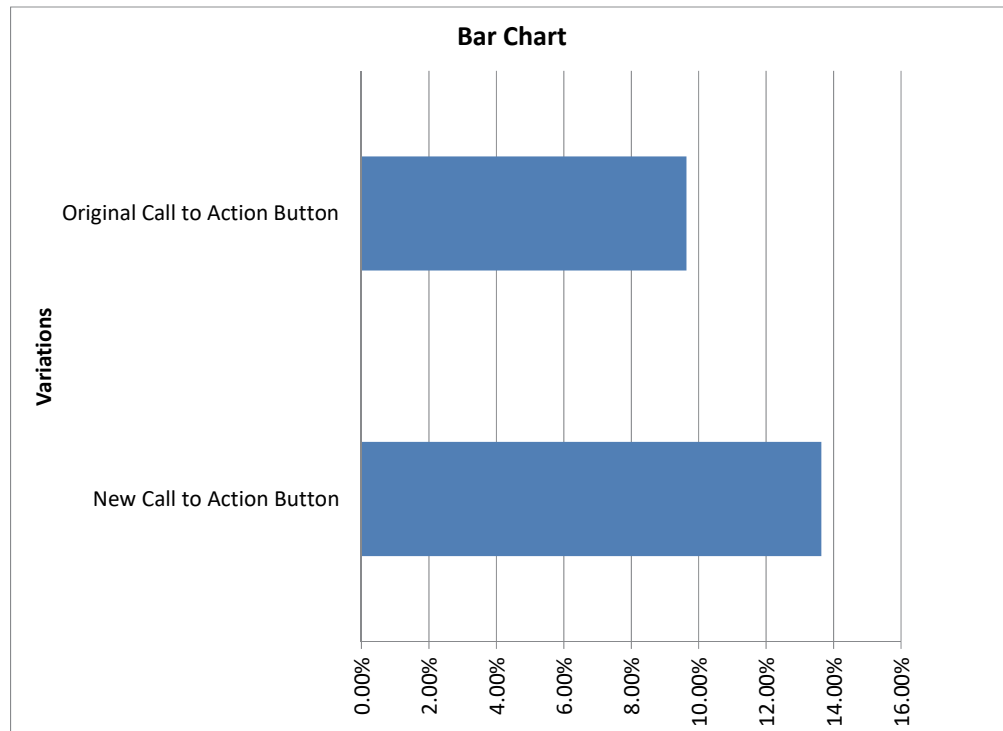


- (e) There is not any obvious relationship between the Canadian dollar and Japanese yen in terms of the U.S. dollar nor any relationship between the Japanese yen and English pound. There is a slightly positive relationship between the Canadian dollar and English pound.

2.106 (a)

Variations	Percentage of Download
Original Call to Action Button	9.64%
New Call to Action Button	13.64%

2.106 (b)  
cont.



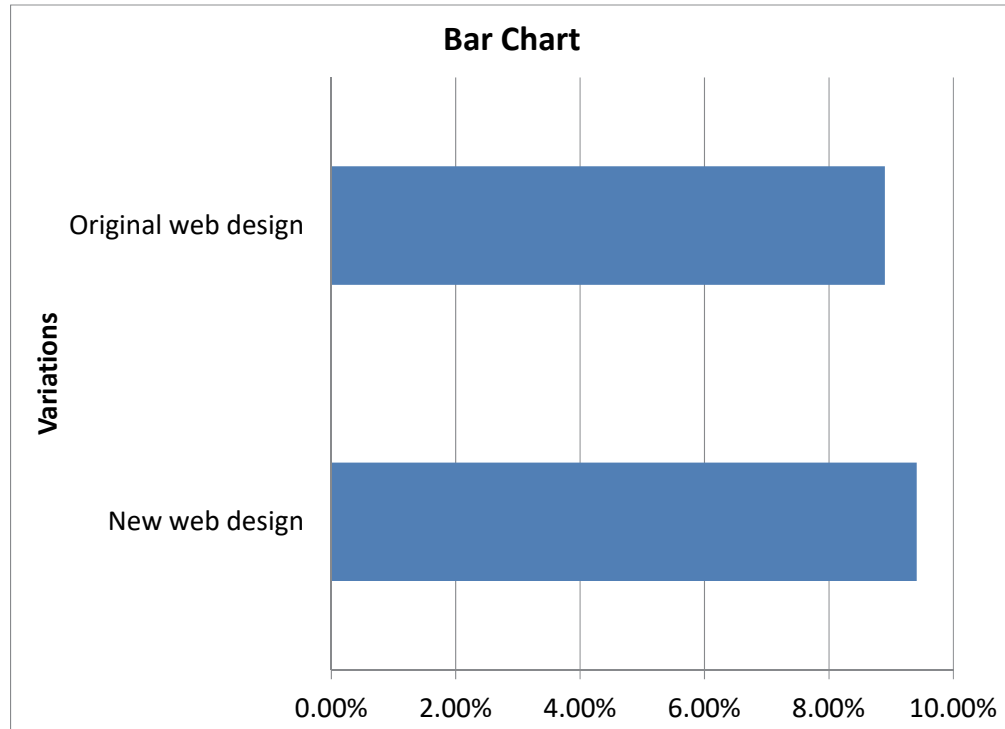
(c) The New Call to Action Button has a higher percentage of downloads at 13.64% when compared to the Original Call to Action Button with a 9.64% of downloads.

(d)

Variations	Percentage of Downloads
Original web design	8.90%
New web design	9.41%



2.106 (e)  
cont.



- (f) The New web design has only a slightly higher percentage of downloads at 9.41% when compared to the Original web design with an 8.90% of downloads.
- (g) The New web design is only slightly more successful than the Original web design while the New Call to Action Button is much more successful than the Original Call to Action Button with about 41% higher percentage of downloads.
- (h)

Call to Action Button	Web Design	Percentage of Downloads
Old	Old	8.30%
New	Old	13.70%
Old	New	9.50%
New	New	17.00%

- (i) The combination of the New Call to Action Button and the New web design results in slightly more than twice as high a percentage of downloads than the combination of the Old Call to Action Button and Old web design.
- (j) The New web design is only slightly more successful than the Original web design while the New Call to Action Button is much more successful than the Original Call to Action Button with about 41% higher percentage of downloads. However, the combination of the New Call to Action Button and New web design results in more than twice as high a percentage of downloads than the combination of the Old Call to Action Button and Old web design.

2.107 Class project – answers will vary depending on student responses.

2.108 Class project – answers will vary depending on student responses.

- 2.109 A descriptive analysis of the weight of the pallets of the Boston shingles revealed that the average weight was 3124.2 pounds with a standard deviation of 34.7. The average weight of 3124.2 pounds was 74.2 pounds above the expected minimum weight of 3,050 pounds. An analysis of the Vermont shingles revealed that the average weight was 3704.0 pounds with a standard deviation of 46.7. The average weight of 3704.0 pounds was 104 pounds above the expected minimum weight of 3,600 pounds. The below table includes a number of descriptive statistics for the two shingle types.

### Descriptive Statistics: Boston, Vermont

#### Statistics

Variable	N	N*	Mean	SE Mean	StDev	Minimum	Q1	Median	Q3	Maximum	Skewness
Boston	368	0	3124.2	1.81	34.7	3044.0	3098.0	3122.0	3146.0	3266.0	0.53
Vermont	330	38	3704.0	2.57	46.7	3566.0	3670.0	3704.0	3732.0	3856.0	0.29

A frequency distribution of the Boston shingles revealed that 0.54% of the pallets were underweight and 0.27% were overweight. A frequency distribution of the Vermont shingles revealed that 1.21% of the shingles were underweight and 3.94% were overweight. The complete results are provided in the below frequency distributions.

#### Frequencies (Boston)

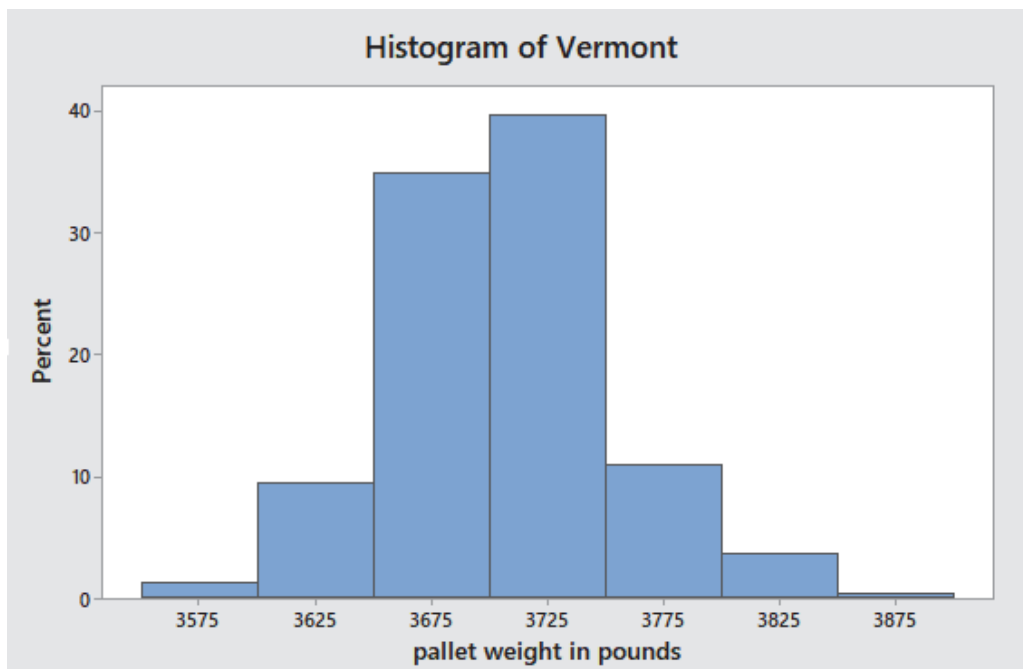
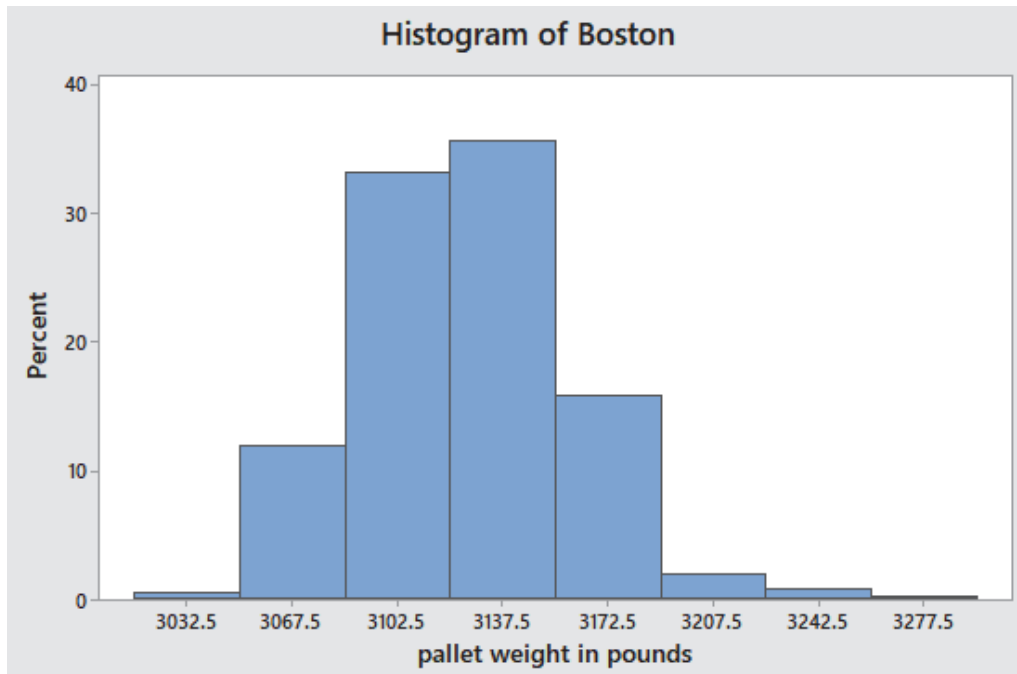
Weight (Boston)	Frequency	Percentage
3015 but less than 3050	2	0.54%
3050 but less than 3085	44	11.96%
3085 but less than 3120	122	33.15%
3120 but less than 3155	131	35.60%
3155 but less than 3190	58	15.76%
3190 but less than 3225	7	1.90%
3225 but less than 3260	3	0.82%
3260 but less than 3295	1	0.27%

#### Frequencies (Vermont)

Weight (Vermont)	Frequency	Percentage
3550 but less than 3600	4	1.21%
3600 but less than 3650	31	9.39%
3650 but less than 3700	115	34.85%
3700 but less than 3750	131	39.70%
3750 but less than 3800	36	10.91%
3800 but less than 3850	12	3.64%
3850 but less than 3900	1	0.30%

Histogram graphs of the Boston shingles and the Vermont shingles, shown below, revealed that the weights of the pallets appeared to be consistent with a normal distribution. In both cases, there was slight right skewness with the Boston shingles having slightly more right skewness than the Vermont shingles.

2.109  
cont.



The results of the above analyses reveal that both shingle types generally met pallet weight expectations with less than 1% of the Boston shingles weighing outside of the expected parameters and just over 5% of the Vermont shingles weighing outside of the expected parameters. The results suggest that the manufacturer should consider implementation of parameter compliance strategies for the Vermont shingles.

