Insider's Guide
to Teaching
with the
Triola Statistics Series

Triola Statistics Series:

Elementary Statistics, 13th Edition
Elementary Statistics Using Excel, 6th Edition
Essentials of Statistics, 6th Edition
Elementary Statistics Using the TI-83/84 Calculator, 5th Edition
Biostatistics for the Biological and Health Sciences, 2nd Edition

Support Manual for
Adjuncts and Full-Time Professors

Mario F. Triola

Pearson

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Introduction

Dear Professor:

The Pearson team is delighted that you are using a book in the Triola Statistics Series. The author has personally visited many professors across the United States, and he is happy to see a wide range of extremely effective statistics courses. Some professors have many years of experience in teaching statistics, and they continue to improve their courses each year. Other professors are relatively new to teaching statistics. Some professors are adjuncts who do not teach on a full-time basis, and their contact with other teachers is minimal. In some cases, large sections are taught with teaching assistants who might be graduate students with little or no teaching experience. This *Insider's Guide to Teaching Statistics* is intended to provide some insight into effective teaching for such groups.

Please know that the recommendations and suggestions in this guide are not being made in an authoritarian spirit of "you *must* do it *this* way." The content of this guide should be tempered with personal teaching styles, individual course objectives, and individual student needs and goals.

In addition to teaching students fundamental concepts of statistics, the introductory statistics course is an excellent vehicle for doing much more than teaching course content. The introductory statistics course provides us with an ideal opportunity to foster student growth in these important areas:

Critical thinking

Technology usage

Public speaking

Working cooperatively in groups

This guide includes recommendations that are helpful in encouraging student growth in these important areas.

We hope that this guide is helpful, and any suggestions for improvement are most welcome. We sincerely wish you the best of luck!

II. How Should Statistics Be Taught?

One of the most important points to be made in this *Insider's Guide* is the basic approach to teaching the introductory statistics course. Here are some important principles:

1. The introductory statistics course should be taught in a way that is fundamentally different from the approach used in traditional mathematics courses. Arithmetic computations or algebraic manipulations are not nearly as important as the ability to *understand* results and to be able to *interpret* results in a meaningful way.

2. The introductory statistics course focuses on *real applications* instead of abstractions.

3. Textbooks in the Triola Statistics Series are full of real data. Examples, exercises, and test questions should involve students with real data as much as possible. Fabricated data have little use in the introductory statistics course.

4. There should not be a high priority placed on covering as many different topics as possible. It is much better to cover fewer topics well than to cover many topics poorly.

The following pages identify the GAISE recommendations. The author comments about the GAISE recommendations are designed to clarify the above points.

GAISE Recommendations

GAISE is an acronym for "Guidelines for Assessment and Instruction in Statistics Education." These guidelines are recommendations from a project sponsored by the American Statistical Association (ASA). Here are six GAISE recommendations for the teaching of introductory statistics:

1. **Emphasize statistical literacy and develop statistical thinking.**
2. **Use real data.**
3. **Stress conceptual understanding rather than mere knowledge of procedures.**
4. **Foster active learning in the classroom.**
5. **Use technology for developing conceptual understanding and analyzing data.**
6. **Use assessments to improve and evaluate student learning.**

The author enthusiastically supports these recommendations, and much of the content of this *Insider's Guide* is devoted to implementation of these recommendations. Here are some comments about the six recommendations.

1. **Emphasize statistical literacy and develop statistical thinking.**
The importance of sound sampling techniques should be introduced early and often throughout the introductory statistics course. Part of "literacy" is understanding the meaning of terms such as *simple random sample* and *voluntary response sample*. Statistical thinking is used when a student recognizes that results obtained from a poorly selected sample might be results without any real validity. For example, newspapers, magazines, television shows, and Internet sites often conduct surveys by asking people to respond to some question. However, the responses constitute a voluntary response sample, and students should know that any conclusions based on such a sample do not apply to the larger population. This is one simple example of the type of critical thinking that should be fostered throughout the course.

In teaching the introductory statistics course, it is not important to memorize formulas or the detailed mechanics of statistical methods. It is not important to be able to reproduce the formula for the standard deviation s, and it is not so important to be able to do the arithmetic required for manually computing values of standard deviations. Instead, it is important to *understand* what the standard deviation s measures. On a very basic level, it is important for students to know quite well that s is a measure of *variation*. It is *really* important that students develop an ability to *understand* and *interpret* values of the standard deviation s. The empirical rule and Chebyshev's theorem are commonly presented as tools that help students understand and interpret s, but the author recommends skipping those two topics and focusing instead on the *range rule of thumb* presented in the book. It is easy to apply, and students generally understand it quite well, so it becomes a very effective tool that can help students understand and interpret values of standard deviations. This topic will be discussed further when measures of variation are discussed later in this guide. But this topic is excellent for making the point that we should emphasize statistical literacy and develop statistical thinking.

When teaching an introductory calculus course, the author might give a test question that asks students to write the definition of the derivative of a function $f(x)$, and he might ask students to compute the derivative of $f(x) = x^2$ while showing all of the steps involved. Calculus students should know the definition of the derivative and they should be able to apply it. However, the author would never ask statistics students to write the formula for the standard deviation or to calculate the standard deviation of a list of values while showing all work. Instead, the author prefers to ask questions that test *understanding*. Here are examples of good and bad test questions:

Bad test question: Write the formulas for the mean and standard deviation *s,* then compute the mean and standard deviation of the values 23.7, 11.2, 43.5, 77.2, 49.0, 27.3, and show all work.

Good test question: Listed below are weights (in grams) of newly minted quarters. (a) Find the mean. (b) Find the standard deviation. (c) In the context of the given weights, is a weight of 5.23 g *significantly low*? Explain your choice. (d) What is an adverse consequence of minting quarters with weights that vary too much?

5.71 5.71 5.59 5.61 5.63

When students find the mean $\bar{x}$ = 5.650 g and standard deviation of s = 0.057 g, they should be encouraged to use some technology, such as a TI-83 Plus or TI-84 Plus calculator. There is little to be gained by requiring that such statistics be calculated manually. A good answer to part (c) of the preceding question is the statement that yes, a weight of 5.23 g would be significantly low because it is more than two standard deviations away from the mean. One of several good answers to part (d) would be a statement that if weights of minted quarters vary too much, vending machines will reject too many valid coins. Part (d) is designed to emphasize the point that methods of statistics have real, important, and meaningful applications instead of being abstract concepts that might not have any real applications.

2. Use real data

George Cobb is a leader in statistics education. He wrote an article about evaluating introductory statistics textbooks (see "Introductory Textbooks: A Framework for evaluation", *Journal of the American Statistical Association*, Vol. 82, No. 397) and he included the following statement:

"Are the Data Sets Real or Fake? Not that many years ago, all it took was this first question to dispatch most books to the morgue. Fortunately, that is changing. It is true that there are still books on the market whose examples have been bled white of vital detail, but it is now easier to shun them. I hope that soon we will have seen the last of the infamous XYZ Corporation and Hospitals A, B, C, ..."

In the 13th edition of *Elementary Statistics*, 94% of the examples involve real data, and 92% of the exercises involve real data. With real data, students see how statistical concepts have meaningful applications. It is very likely that they will encounter data from the discipline that they might be considering as a major.

3. Stress conceptual understanding rather than mere knowledge of procedures

A good illustration of this point can be seen in the data from eruptions of the Old Faithful geyser and data from actual low temperatures and forecast temperatures:

Duration (sec)	240	120	178	234	235	269	255	220
Interval After (min)	92	65	72	94	83	94	101	87

Actual low (°F)	54	54	55	60	64
Low forecast five days earlier (°F)	56	57	59	56	64

When discussing correlation/regression, we might present the top table and ask if there is a correlation between the duration of an eruption and the time interval after the eruption to the next eruption. When discussing matched data, we might present the bottom table given above, and we might ask if the differences between the actual and forecast temperatures are from a population with a mean of 0. But instead of focusing too much on the details of the computations involved, we should stress the fundamental difference between the two sets of data summarized in the preceding tables. Students should learn how to ask the best questions. Given the top Old Faithful table, students should see that the issue is one of a *relationship* between the two variables. Given the bottom temperature table, students should see that a key element is the list of *differences* between the actual and forecast temperatures, and a mean difference equal to zero is evidence that the forecast temperatures are accurate. It's not the structure of paired data that determines the method that is most appropriate; it is the *context* of the data.

4. Foster active learning in the classroom

Here is a saying that is so true when considered in the context of teaching an introductory statistics course:

Tell me something, and I will forget.
Show me and I will remember.
Involve me, and I will learn.

If you want your students to have a learning experience that will affect them for their entire lives, *involve* them with active learning. *Elementary Statistics,* 13th Edition, has Cooperative Group Activities at the end of each chapter, except for Chapter 15.

Some statistics professors believe that the entire course should be based on activities, and some other statistics professors do not include any activities at all. Somewhere between these extremes is a balance that allows active involvement along with enough time for teaching concepts using traditional methods.

Recommendation: If you do no activities at all, begin with just one or two activities to see how well they work. Then, assuming that all goes well, include more activities in future courses.

5. Use technology for developing conceptual understanding and analyzing data

Many statistics professors teach an effective course by allowing students to use any one of a variety of different scientific calculators. The author recommends that a specific technology be used. Triola statistics books include displays from Statdisk, Minitab, Excel, the TI-83/84 Plus calculator, and StatCrunch. There are also supplements for SPSS and SAS.

The author's personal preference is to require that each student have a TI-83 Plus or TI-84 Plus calculator, and that each student also do several software projects using Statdisk. However, choosing a technology to be used for an introductory statistics course is a complex decision that must take several factors into account. Some colleges have adopted a decision to use Excel because so many students use Excel in their work after graduation. Some colleges avoid Excel because its statistics functions are not as good as they should be. Some colleges use Minitab, and the latest release includes features that make it a perfectly good choice. Some statistics professors prefer to require TI-83/84 Plus calculators because they can do so much statistical number crunching and they can be used in class and on tests. Some statistics professors would like to require TI-83/84 Plus calculators, but are reluctant to do so because of the calculator's cost. The author had that same concern the first time that he required those calculators, so he announced that any student could sell him their calculator at the end of the course. At the end of that semester, *no* students wanted to give up their calculators. Their desire to keep their calculators instead of turning them in for cash was a strong indication about how they perceived the usefulness of those calculators.

Statdisk Statdisk is a free and easy-to-use software package designed specifically for the Triola Statistics Series textbooks. The latest version of Statdisk is one that the author is proud to have as a major and important supplement. Because Statdisk can do almost all of the functions described in the textbook, it can be used as the technology in the introductory statistics course. If another technology, such as Excel or SPSS, is used as the primary technology, it would be really helpful to have students use Statdisk as a supplement to the main technology being used. By getting results from Statdisk along with results from another technology, students are more likely to confirm that their results are correct.

Technology for New Approaches While the technology has the ability to do the statistics number crunching, it should also be used to explore concepts and new approaches. When considering the effects of an outlier, for example, a hypothesis test could be conducted with the outlier included and again with the outlier excluded. Probability can be better studied with simulations. Bootstrap resampling techniques can sometimes be used when traditional methods should not be used. For ideas about how to include technology, see the Technology Project at the end of each chapter in the Triola textbook

6. Use assessments to improve and evaluate student learning

Traditional tests and quizzes are one important method of assessment, but there are others. The author favors the use of activities and at least one major project. The author favors a capstone group project conducted near the end of the course. Students can work together in groups of four (more or less), and each group should conduct a project that involves the planning of an experiment or a method for collecting data in an observational study. After collecting original data, the group will make an inference by using the methods learned in the course.

A group presentation should involve each member speaking for at least one or two minutes. A computer display should also be included, along with a brief written report. Assessment is an important component of such a project. How do you assess the work of individual members that participate in a group project? Here is one method that the author found to be effective: Survey each group member and ask him or her to assess the work done by the other group members. For example, ask each group member to submit a separate form for each of the other group members, and that form should include an assessment of the other team members' work, such as "was a major contributor to the project," "did an average amount of work on the project," "did some but little work on the project," or "did not participate in any meaningful way." Students are quite honest about the work of their peers, and they are generally quite satisfied with this process of assessment.

The author favors four or five tests given during the semester, along with a comprehensive final examination. Activities and projects should also be part of the assessment plan.

III. Selecting a Technology

Here are the technologies commonly used in introductory statistics courses:

- **Statdisk**
- **Minitab**
- **Excel**
- **TI-83 Plus or TI-84 Plus calculator**
- **Any scientific calculator**
- **StatCrunch**
- **SPSS**
- **JMP**
- **Other: Fathom, Statistica, R, Stata, . . .**

There is no technology that is universally best for all statistics courses. The technology that is selected should reflect the needs and facilities of individual colleges.

Recommendations for Using Technology

Keep in mind that the following recommendations are from the author, they are not given in an authoritarian spirit of "you must do it this way," and you should carefully consider the special needs of your students.

The author recommends that instead of allowing students to use "any" scientific calculator, all students should use a specific statistical software package or a TI-83 Plus or TI-84 Plus calculator. If a TI-83 Plus or TI-84 Plus calculator is required, the author recommends that students do at least a few simple projects using statistical software on a computer. The author's personal preference is to require that each student have either a TI-83 Plus calculator or a TI-84 Plus calculator, as well as utilize Statdisk (free at www.statdisk.org) for several different projects. However, the author's personal preferences are not universally suitable for all colleges. See comments about individual technologies below.

The author recommends that instead of using the Appendix A tables in the textbook, students use a statistical software package or TI-83/84 Plus calculator to find critical values and/or *P*-values. The author recommends that the *P*-value method of testing hypotheses be emphasized (although there is some value in learning the critical value method as well).

The author recommends that technology be used not only for routine statistical functions, but also for other methods made available by technology, such as simulations and bootstrap resampling. For example, use simulations as a way to conduct a few hypothesis tests, so that students can see hypothesis testing from a different perspective.

Statdisk Statdisk is a free statistical software package designed to supplement the Triola Statistics Series textbooks. It can be downloaded from www.statdisk.org. Statdisk is very easy to use, and it can be used with almost every major procedure in the textbook. The data sets from Appendix B in the textbook are already stored in Statdisk, so they can be easily accessed.

Advantages of using Statdisk:

- It is free. (It can be downloaded from www.statdisk.org.)
- It is very easy to use.
- It can be used for almost every major procedure in the textbook.
- Because it is designed specifically for the textbook, it is consistent with the procedures in the textbook.
- Statdisk can be used by students in conjunction with another technology to verify their results.

Helpful supplements for Statdisk users:

- *Statdisk Student Laboratory Manual and Workbook*
- Statdisk help site: help.statdisk.org

Minitab Minitab is a rich and powerful statistical software package that is used by many colleges and businesses. It was once expensive, but there are now inexpensive options available for students, such as a 6-month rental for $29.99. Minitab is particularly attractive if the statistics classes are held in a computer lab, with each student having immediate access to Minitab.

Advantages of using Minitab:

- It can be inexpensive. Students can rent Minitab for a semester at a cost of $29.99 for 6-months.
- Minitab is a professional and commercial statistical software package, and it has an extensive list of functions.

Helpful supplements for Minitab users:

- The Appendix B data sets are available as Minitab worksheets and they can be downloaded from www.TriolaStats.com.
- *Minitab Manual*, which is a supplement to the textbook.

Excel Excel is a spreadsheet program used extensively by businesses and other organizations. Many statistics professors choose Excel because they believe that they are helping their students to learn technical skills that will be very helpful when they enter the working world. Because Excel is included as part of many Microsoft packages, it is essentially free for many students. *Caution*: Excel is known to have some statistical shortcomings, so be sure to use some type of guide so that you know when Excel itself can be used and when an "add-in" (supplement) must be used instead. The Triola Statistics Series includes an Excel version: *Elementary Statistics Using Excel*. This textbook provides detailed step-by-step instructions for using Excel's statistical functions.

Advantages of using Excel:

- It is essentially free for many students.
- Students learn Excel, which will likely help them in their future employment.

Helpful supplements for Excel users:

- XLSTAT (an Excel add-in available from the publisher) adds important statistical functions, and it correctly handles cases that Excel handles incorrectly.
- The Appendix B data sets are available in an Excel format and they can be downloaded from www.TriolaStats.com.
- *Excel Student Laboratory and Manual*, which is a separate supplement to the textbook.

TI-83 Plus or TI-84 Plus Calculator Either a TI-83 Plus calculator or a TI-84 Plus calculator can be used. As of this writing, TI-83 Plus calculators are less expensive, selling for around $80. The cost can be reduced through rental programs or buyback programs. Some colleges have a program for providing free calculators to students who cannot afford them. The Triola Statistics Series includes a TI-83/84 Plus version: *Elementary Statistics Using the TI-83/84 Plus Calculator*. This textbook provides detailed step-by-step instructions for using the TI-83/84 plus statistical functions.

Advantages of requiring a TI-83/84 Plus calculator:

- Every student has the calculator in class, so the calculator can be used in class and on tests.
- The calculator has an extensive list of statistical functions, so it is quite powerful.
- The calculator allows analysis of either summary data or original lists of sample data.

Helpful supplements for the TI-83/84 calculator:

- The data sets from Appendix B in the textbook can be downloaded and imported into the TI-83/84 Plus calculator. Download from: www.TriolaStats.com. This enables more realistic class examples and test questions, because students can work with large data sets without manually keying in long lists of data.
- The website www.TriolaStats.com includes programs that can be downloaded to the calculator, allowing more statistical functions to be executed.
- *Graphing Calculator Manual for the TI-83 Plus, TI-84 Plus, and the TI-89*, which is a separate supplement to the textbook.

StatCrunch StatCrunch is an Internet-based statistics software package that costs about $12 (or $5 when bundled with the textbook). It is user-friendly and generally allows students to use either summary statistics or lists of original data.

Advantages of requiring StatCrunch:

- It is Internet-based, so there is no need to install it on your own computer.
- StatCrunch is integrated into MyStatLab.

SPSS SPSS is relatively inexpensive if it can be bundled with the textbook. SPSS typically requires original lists of sample values, so summary statistics cannot be used. SPSS is generally more difficult to use than the preceding technologies.

Advantages of requiring SPSS:

- SPSS is widely used in social sciences, so some students may encounter it in their future coursework and careers.

Helpful supplements for SPSS users:

- The Appendix B data sets are available in an SPSS format. They can be downloaded from the website www.TriolaStats.com.
- *SPSS Student Laboratory and Manual*, which is a separate printed supplement to the textbook.

JMP (from SAS) JMP has a relatively inexpensive student version, or it might be available through bundling with the textbook. JMP typically requires original lists of sample values, so summary statistics cannot be used.

Helpful supplements for JMP users:

- The Appendix B data sets are available in a JMP format. They can be downloaded from the website www.TriolaStats.com.

IV. Getting Started with Statdisk

Overview

Statdisk is a statistics software package designed to augment Triola Statistics Series textbooks. Statdisk is extremely easy to use, it is free for students using a Triola textbook, and it can be used with almost every major statistics method in the textbook. Statdisk also includes all Appendix B data sets.

The Guidelines for Assessment and Instruction in Statistics Education (GAISE) Project was funded by the American Statistical Association, and it includes this recommendation: *Use technology for developing concepts and analyzing data.* In addition to teaching the content of statistics, we can help our students by strengthening important technology skills. The author's personal recommendation is to select a specific technology instead of having students use a variety of different scientific calculators. The most common choices in introductory statistics courses are Excel, the TI-83/84 Plus calculator, Minitab, or Statdisk.

The author strongly recommends Statdisk as a technology that could be used alone or as a supplement to Excel, the TI-83/84 Plus calculator, Minitab, or any other technology. Consider taking five minutes to download Statdisk and try it.

Working With Statdisk

1. **Download and install Statdisk (for Windows or macOS)**
   Download Statdisk from **www.Statdisk.org**. Open the downloaded Statdisk file and follow the installation directions.

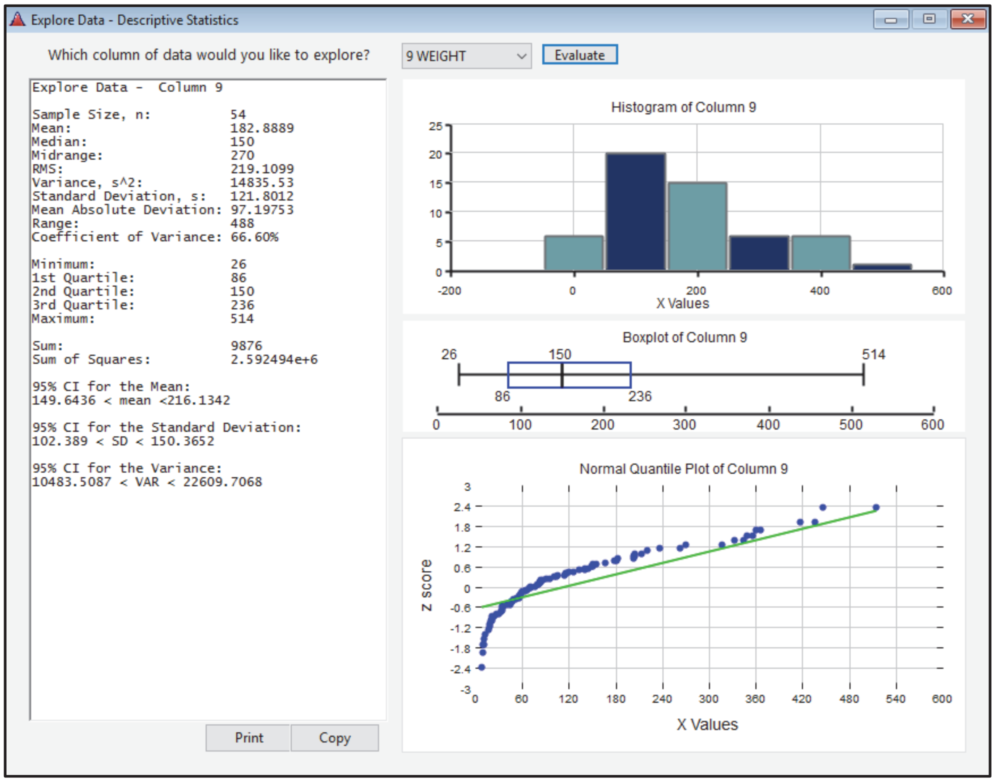
2. **Open a Data Set**
   Open Statdisk and select **Data Sets** in the top menu bar. Select *Elementary Statistics*, 13th Edition from the dropdown menu and then select data set **9 - Bear Measurements** from the submenu. The data set is loaded into the Statdisk Sample Editor. Note that the bear weight data (WEIGHT) are in column 9.

3. **Explore Data**
   Select **Data** in the top menu and then select **Explore Data – Descriptive Statistics** from the dropdown menu. In the dialog box, select column **9 Weight**, and then click **Evaluate**. The results are displayed, including descriptive statistics, confidence intervals, a histogram, boxplot, and normal quantile plot. See the display on the following page.

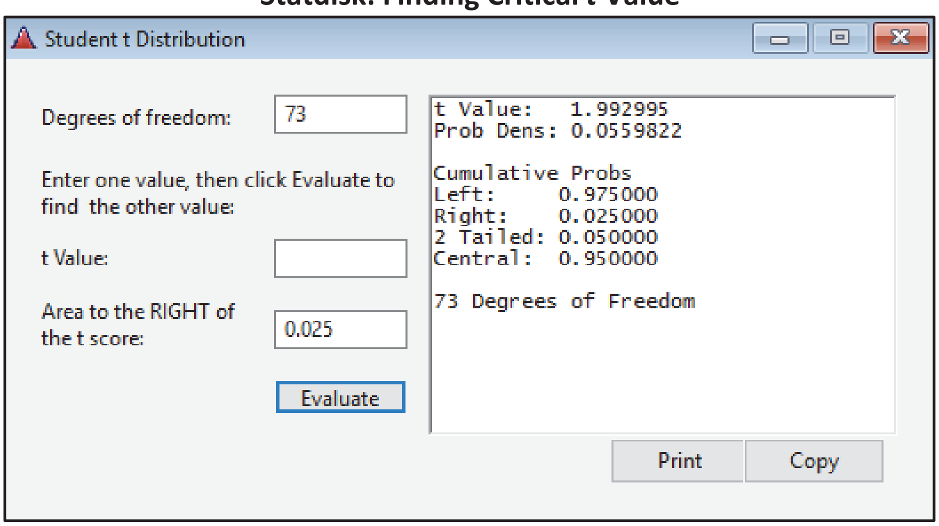
4. Probability Distributions

Ready to throw away your printed tables? Click **Analysis** in the top menu, select **Probability Distributions** from the dropdown menu, and then select any of the listed distributions and see how easy it is to get values or areas. For example, try finding the *t* value corresponding to 73 degrees of freedom and with an area of 0.025 to its right. See the display on the bottom of the following page showing that the *t* value is 1.992995. *No more problems with the limitations of printed tables!!!*

Statdisk Results from Weights of Bears

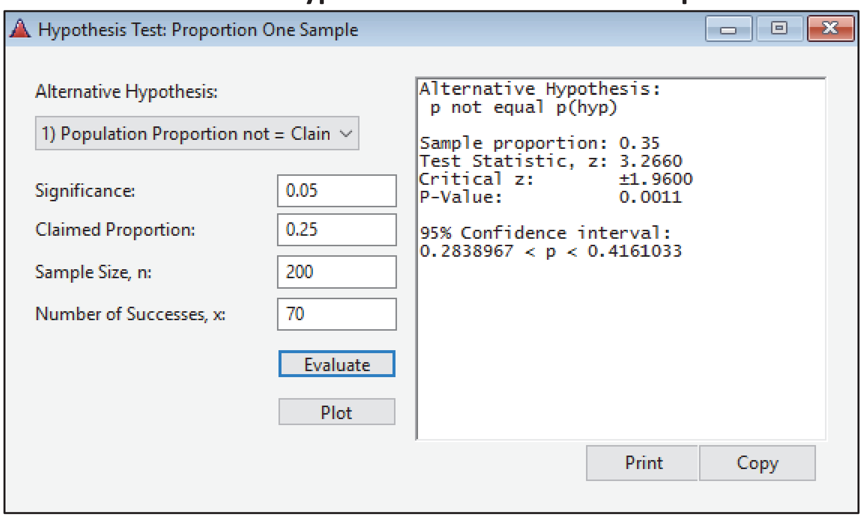


Statdisk: Finding Critical *t* Value



5. **Hypothesis Test**
Now try a hypothesis test. Click **Analysis** in the top menu, select **Hypothesis Testing** from the dropdown menu, and then select the desired type of test from the submenu. For example, select **Proportion One Sample** and proceed to use a 0.05 significance level to test the claim that p = 0.25 given a sample size of n = 200 with 70 successes. Click **Evaluate** to see results. Shown below is the dialog box. You first enter the values in the input fields at the left, and then after clicking **Evaluate,** the Statdisk results are displayed on the right. You could also click the **Plot** button to get a graph that includes the test statistic and critical values.

Statdisk Hypothesis Test With One Proportion



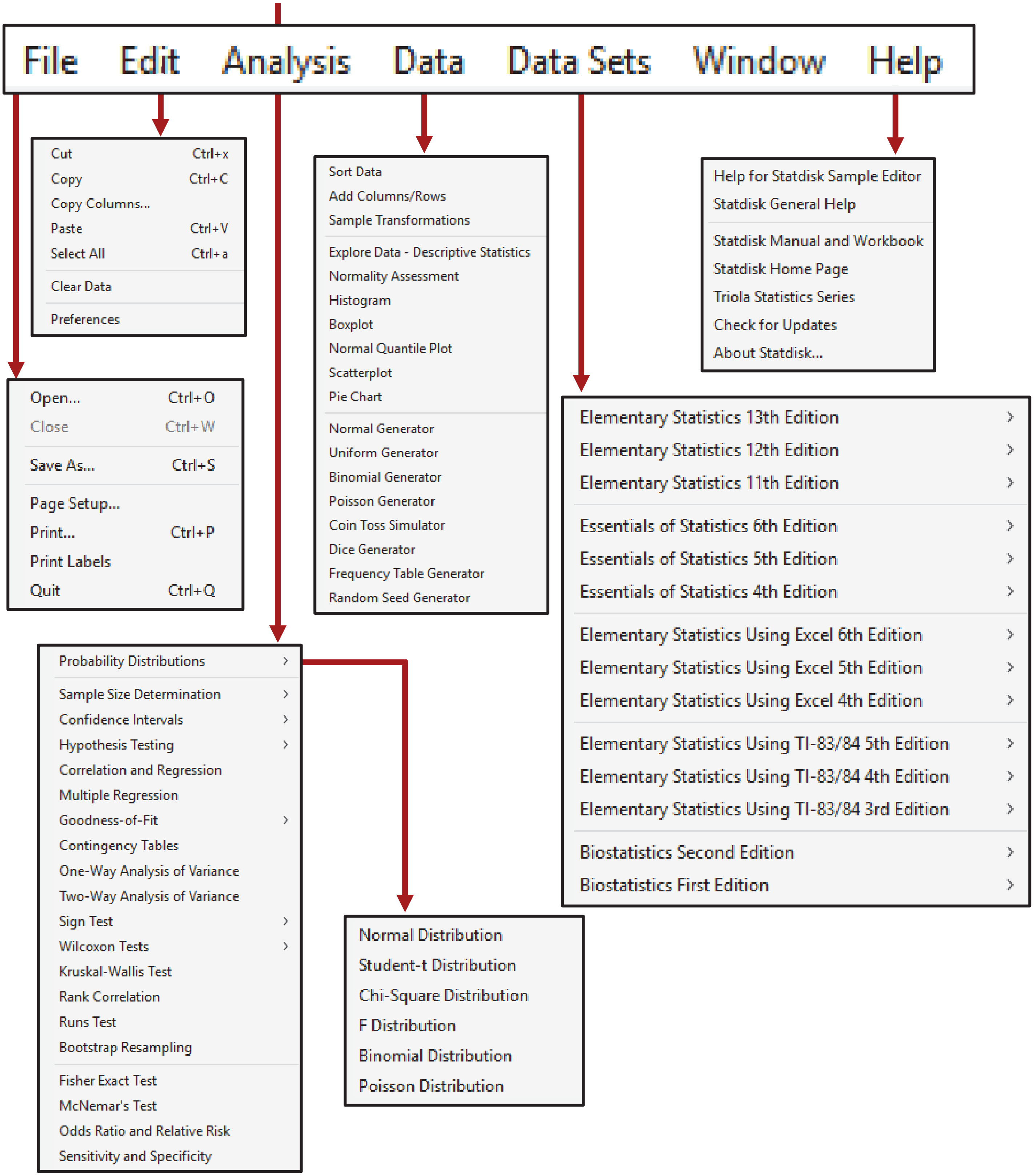
6. **Other Statdisk Functions**
Click the top menu items of **Analysis** and **Data** to see other Statdisk functions, including correlation and regression, confidence intervals, contingency tables, analysis of variance, and many other functions. *See the menu configuration on the following page.*

Hint About Using Technology

Statdisk requires little or no classroom time for instruction, but other technologies do require some time. Instructors typically find that time is at a premium, especially if they are using technology and including projects. Consider using technology to *save* some time. For example, after covering confidence intervals and hypothesis testing for situations with *one* population, assign some exercises involving *two* populations and allow students to solve the exercises by using technology. Save valuable class time while encouraging students to expand the scope of what they were taught in earlier chapters.

The author is very proud of the ease and quality of Statdisk. After seeing how easy and effective Statdisk is, you can proceed to improve the use of technology in your course by including Statdisk. The author thanks all of those statistics teachers who have made suggestions in the past, and we welcome any new suggestions for improving Statdisk.

Statdisk Menu Configuration



V. Chapter and Section Comments, Activities, Surveys and Examples

The following items correspond to chapters and sections in *Elementary Statistics,* 13th edition. Whenever time references are made, these following comments assume that an individual class session is approximately one hour. Each chapter begins with a general comment, and individual sections have comments along with activities, in-class surveys, and extra examples.

Chapter 1

First Class Session The first class of the introductory statistics course will likely involve introductions, distribution of course outlines and course policies, and a clear description of how grades are determined. This first class meeting should involve a description of course priorities, the technology to be used, and a description of any major projects.

- State that this course does not place highest priorities on mathematical computations. Instead, technology can be used to obtain results, but the emphasis is on *understanding* and *interpreting* those results. (See the preceding discussion under the heading of "Emphasize statistical literacy and develop statistical thinking.")

- Announce the technology to be used in the course. ("All students will be required to have a TI-83 Plus or TI-84 Plus calculator," or "all classes will be in the computer lab where Statdisk will be used," or "all students will be required to use Excel," and so on.)

- Identify any major projects that will be required. (*Example:* All students will work in groups of three or four to collect original data and apply some method of inferential statistics to form conclusions. The project will involve an oral class presentation, a brief written report, and printed computer results.)

Chapter 1 Survey: After introductions, distribution of course materials, and announcements such as those given above, there will not be much time left for teaching statistics content. *Suggestion:* Distribute the following survey. Ask that each student complete it now. Collect the completed surveys. If there is time left, discuss the survey by relating it to concepts in Chapter 1 of the textbook. Here are some observations:

- Responses to item 3 are qualitative or categorical data, whereas responses to item 4 are qualitative.

- The survey results constitute a sample of all students at the college, but it is not a representative sample.

- The sample is a convenience sample (instead of random, systematic, stratified, or cluster).

- Item 4 is deficient because it requires a calculation that can result in errors. It would be better to actually measure people than ask them to report their heights.

- Items 2 and 8 both involve random digits, but item 8 is more likely to yield digits that appear to be random. When people try to select random digits, they often fail because of a bias toward certain digits.

- Is there a relationship between items 9 and 10? It might not be apparent from the results of this survey, but people who exercise vigorously tend to have lower pulse rates.

- As a follow-up to item 8, ask students to identify the 5th digit of their social security number, and then ask them to announce those digits while they are recorded. Analyze the digits. It is common to get a small number of even digits or a small number of odd digits. (The 5th digit is used as a geographic locator.)

- Describe the different levels of measurement (nominal, ordinal, interval, ratio) and point out that eye colors for item 3 are nominal data, but heights from item 4 are at the ratio level of measurement. A good test for the ratio level is to determine whether ratios such as “twice” make sense in the context of the data. A height of 6 ft is twice as tall as a height of 3 ft, so heights are at the ratio level of measurement. Point out that it makes sense to do arithmetic computations with data at the ratio level of measurement, but it does not make sense to do certain computations with data at the nominal level of measurement.

The survey results can also be used for illustrations later in the course. Here are two examples:

- Correlation/regression: Use heights (item 4) and pulse rates (item 9).

- Test for a difference between two means: Use pulse rates of males and pulse rates of females.

Triola Survey

Please complete the survey and submit it now. Do not sign your name.

1. _____Female _____Male

2. Randomly select four digits and enter them here: ___ ___ ___ ___

3. Eye color: _______________

4. Enter your height in inches: _______________

5. What is the total value of all coins now in your possession? __________

6. How many keys are in your possession at this time? __________

7. How many credit cards are in your possession at this time? ___

8. Enter the last four digits of your social security number. (For reasons of security, change the order of these four digits.) ___ ___ ___ ___

9. Record your pulse rate by counting the number of heartbeats in one minute: _______________

10. Do you exercise vigorously (such as running, swimming, cycling, basketball, etc.) for at least 20 minutes at least twice a week? _____Yes _____No

11. How many credit hours of courses are you taking this semester? ________

12. Are you currently employed? _____Yes _____No
    If yes, how many hours do you work each week? __________

13. During the past 12 months, have you been the driver of a car that was involved in a crash? _____Yes _____No

14. Do you smoke? _____Yes _____No

15. _____Left-handed _____Right-handed _____Ambidextrous

1–1 Statistical and Critical Thinking

Recommendation: In the first class session, assign Section 1-1 to be read independently. Point out that answers to odd-numbered section exercises are in the back of the textbook in Appendix D. Consider announcing that only answers to even-numbered exercises will be collected or somehow checked.

Activities

1. Require completion of the survey on the preceding page, and discuss the survey items that relate to the content of Section 1-1. If the survey results are treated as a sample, can we use those results to form any conclusions about the population of all adults? Why or why not? (Answer: The sample involves only college students, so the sample is not representative of the population of all adults. We cannot use the survey results to form conclusions about the population of all adults.)

2. Consider assigning a short project of collecting current articles or ads that illustrate the misuses discussed in this section. It is not difficult to find examples of the misuse of statistics, especially with graphic illustrations.

Extra Example: ABC News conducts a survey by asking viewers to call a toll-free number to respond to this question: "Do you favor a new federal tax on movie ticket costs?"

a. Who is likely to respond to the question? (Answer: People who go to movies)
b. Is the sample of respondents likely to be representative of the general population? Why or why not? (Answer: No. People with strong feelings about movie attendance are more likely to respond.)
c. Should the responses be used to form conclusions about the general population? (Answer: No, because it is very possible that the sample is not representative of the general population.)

1-2 Types of Data

Consider assigning Section 1-2 to be read independently.

Activity: Require completion of preceding survey, and discuss the survey items that relate to the content of Section 1-2.

Extra Example: The following are the finishing positions of a sample of drivers in a NASCAR race: 3, 8, 12, 15, 27 (3rd place, 8th place, etc.)

a. What is the level of measurement of these data? (Answer: Ordinal)
b. Are these data discrete or continuous? (Answer: Discrete)
c. Are the data quantitative or categorical? (Answer: Quantitative)

1-3 Collecting Sample Data

Note: A simple random sample is often called a random sample, but strictly speaking, a random sample has the weaker requirement that each member of the population has the same chance of being selected. This distinction is not so important in the textbook.

Activity: Ask students to comment on this survey: The Dean of Planning and Information Services at your college conducts a survey by distributing it to students as they leave the cafeteria. The completed surveys are supposed to be mailed, and each student is given an addressed envelope without a postage stamp. (Answer: The sample of completed survey forms is a voluntary response sample. Because students must provide postage, they incur a cost and are less likely to respond. Those students with an interest in the survey topics are more likely to respond. The sample is not likely to be very good for making inferences about the larger population of students at the college.)

Extra Example: If you conduct a nationwide survey by randomly selecting 20 people in each state, is the result a simple random sample? Why or why not? (Answer: No. Not all samples of 1000 people have the same chance of being selected. For example, a sample of 1000 from California has no chance of being selected.)

Chapter 2

***Recommendation*:** Cover Sections 2-1 (Frequency Distributions) and 2-2 (Histograms) together in one class. If you are confident that you have planned the course syllabus so that time allows it, also include Section 2-3 (Graphs that Enlighten and Graphs that Deceive). Include scatterplots from Section 2-4, and include Part 2 (correlation) and Part 3 (regression) in Section 2-4 according to your desire for early coverage of correlation and regression. Note that correlation and regression are discussed in greater depth in Chapter 10.

Chapter 2 Survey: Distribute the survey on the next page. Ask that each student complete it now. Collect the completed surveys. If there is time left, use the survey results to work with the concepts of Chapter 2 in the textbook. Here are some suggestions:

- Construct a frequency distribution of the responses to Question 1. What can be concluded about the distribution of the amounts?
- Construct a scatterplot of the responses to Questions 4 and 5. Does there appear to be a relationship between the commute times and the pulse rates?
- Construct a dotplot of the leading digits obtained from the responses to Question 2. Do the nine different possible digits appear to be equally likely?
- Construct a histogram of the responses to Question 3. Does the histogram appear to be centered around the actual age of the President? Do the responses vary much?

Triola Survey

Please complete the survey and submit it now. Do not sign your name.

1. Enter the total value of cash now in your possession: __________

2. What is the number of the address of your home? (For example, the President of the United States lives at 1600 Pennsylvania Avenue, so the President would enter 1600.) __________

3. Enter the age of the President of the United States if you know it, or estimate it if you don't know it. __________

4. How long did it take you to arrive at your first class today?_______

5. Record your pulse rate by counting the number of heartbeats for one minute: _______________

***Complete the following if a tape measure is available*.**

6. Measure your "navel height," which is the distance from the floor to your navel. ___________

7. Remove your right shoe and measure the length of your right foot. ___________

8. Remove both shoes and measure your height. ___________

2-1 Frequency Distributions
2-2 Histograms

Cover Sections 2-1 (Frequency Distributions) and 2-2 (Histograms) together in one class. Describe the characteristics of data that are often important: center, variation, distribution, outliers, change over time (CVDOT). Refer to Table 2-2 in the textbook and explain how that table summarizes the data in Table 2-1. Describe the class width, class limits, class boundaries, and class midpoint values.

Do not use too much valuable class time describing the details of manually constructing a frequency distribution and histogram. Instead, demonstrate them with the following class activity.

Activity: Ask that each student estimate the length of the classroom. (If you want to use less time, use the pulse rates from the survey that was given in the first class.) Collect the anonymous estimates and show how to construct a frequency distribution. Compare the result to the actual length. Do the estimates tend to center about the actual length, or do students tend to underestimate or overestimate the length? After constructing a frequency distribution, identify the class limits, class midpoint, class boundaries, and class width. Then construct the corresponding histogram and show how the graph is much easier to understand than the table of numbers.

Extra Example: If you were to construct a histogram representing 1000 rolls of a fair die, then construct another histogram representing the heights of 1000 randomly selected women, what would those histograms look like, and how would they be different? (Answer: The histogram for the die would be essentially flat, whereas the histogram of the heights would be roughly bell-shaped.)

2-3 Graphs that Enlighten and Graphs that Deceive

***Recommendation*:** Don't require that students learn how to construct all of the graphs included in this section. Instead, discuss stemplots and dotplots and assign some exercises so that students can experience a variety of graphs, and focus on the art of selecting the graph that does the best job of revealing the true nature of the data set being considered. In many cases, the true nature of the data can be revealed by an original graph different from any of those included in this section.

Activity: In class, each student should record his or her pulse rate by counting the number of heart beats in one minute. Construct a frequency distribution and histogram for the pulse rates of males and construct another frequency distribution and histogram for the pulse rates of females. Compare the results. Is there an obvious difference? (Answer: Pulse rates of women tend to be lower than pulse rates of men. This principle may or may not become apparent from pulse rates collected in class.)

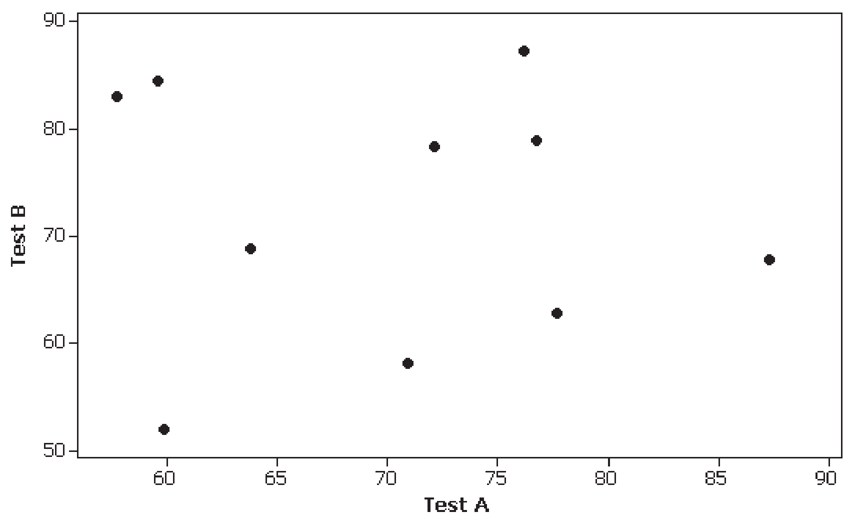
Extra Example: Refer to the "Body Temperatures" data set in Appendix B and use one of the columns of temperatures to construct a stemplot and a histogram. Compare the results.

2-4 Scatterplots, Correlation, and Regression

Note: This section is new to the 13th edition of *Elementary Statistics.* The author recommends brief coverage of all three parts of this section, but many professors have valid reasons for bringing in Section 10-1 (correlation) and Section 10-2 early in the course, and this would be an ideal place to include those sections.

Activity: Use the heights and navel heights from the survey for Chapter 2. Construct a scatterplot and discuss the relationship between those two variables.

Extra Example: The scatterplot shown below results from 10 subjects each taking two different versions of the same test that is designed to measure creativity. What does the graph suggest about the two tests? (Answer: There does not appear to be a relationship between scores from the two versions of the same test. If the test is a valid measure of anything, two different versions should result in scores that are approximately the same, but the scatterplot suggests that the two versions are totally unrelated.)



Chapter 3

Recommendation: Cover all sections in Chapter 3. Sections 3-1 and 3-2 are each partitioned into two parts: (1) Basic Concepts; (2) Beyond the Basics. If time is an issue, skip the "Beyond the Basics" subsections in Sections 3-1 and 3-2.

Chapter 3 Survey: Distribute the following survey. Ask that each student complete it now. Collect the completed surveys. If there is time left, use the survey results to work with the concepts of Chapter 3 in the textbook. Here are some suggestions:

- Find the mean, median, range, and standard deviation of the pulse rates of males, and then do the same for the pulse rates of females. Compare the results.
- Find the mean, median, range, and standard deviation of the pulse rates of amounts of cash carried by males, and then do the same for the amounts of cash carried by females. Compare the results.
- Find the mean, median, range, and standard deviation of the navel heights of males, and then do the same for the navel heights of females. Compare the results.
- Find the mean, median, range, and standard deviation of the foot lengths of males, and then do the same for the foot lengths of females. Compare the results.

Triola Survey

Please complete the survey and submit it now. Do not sign your name.

1. Enter the total value of cash now in your possession: ___________

2. Record your pulse rate by counting the number of heartbeats for one minute: ________________

3. Select your gender. _____Male _____Female

Complete the following if a tape measure is available.

4. Measure your "navel height," which is the distance from the floor to your navel. ____________

5. Remove your right shoe and measure the length of your right foot. ____________

3-1 Measures of Center

Recommended approach: Rather than requiring memorization of formulas and requiring that students master the mechanics of manual calculations, allow the use of a computer or calculator for obtaining results, and really stress the *interpretation* of results. But don't totally dismiss manual calculations which have some merit in some cases. On a test, consider allowing students to use a computer or calculator, and then ask questions designed to display an *understanding* of the concepts.

Section 3-1 is partitioned into two parts: Part 1 (Basic Concepts of Measures of Center) and Part 2 (Beyond the Basics of Measures of Center). Part 1 introduces the basic definitions of mean, median, mode, and midrange. Part 2 includes frequency distributions, weighted mean, and skewness. ***Recommendation***: If you have a typical three credit introductory statistics course that is covered in one semester, cover only Part 1.

Discuss the mean, median, mode, and midrange, and illustrate them with a specific data set. Consider an activity that will generate the data to be used for an illustration. For example, have students draw a line that they estimate to be 4 cm in length. Then use rulers to determine the actual lengths.

Point out that an outlier can have a dramatic effect on the mean, but it does not affect the median so strongly. Also describe the rule for rounding results.

Activity: Collect sample data from the class, then find the mean, median, mode, and midrange. For example, use the pulse rates of males and females. After finding the measures of center for both samples, informally compare them and note that more formal comparisons can be made by using topics from later chapters.

Extra Example: Here are the volumes (in ounces) of randomly selected cans of Coke:

12.3, 12.1, 12.2, 12.3, 12.2.

Find the mean, median, mode, and midrange. (Answer: 12.22, 12.20, 12.2 & 12.3, 12.2.)

3-2 Measures of Variation

Variation is an *extremely* important topic in statistics, and this is one of the most important sections in the book, so consider devoting *two* class sessions to this section.

Suggestion: Begin by describing the single line system and the multi-line system used in banks, and then ask the class to compare the customer waiting times given below. How do the means differ? (It is the same for both.) Why did so many banks make the change to the single line system? What *does* change? (There is less variation with a single line, and this makes customers happier and less frustrated.) This situation is an ideal introduction to Section 3-2. In class, refer to the following Exercise 24 (see below) from Section 3-1, and ask half the class to find the mean, median, mode, and midrange for the single-line system while the other half of the class finds the mean, median, mode, and midrange for the individual-line system. Compare the results to see that both systems have the same measures of center. Then ask the class to simply examine and compare the two data sets. What is fundamentally different about the two data sets? (The single line system has times that *vary* much less than the times for the other system.) Because this characteristic of variation is so important, we need to develop a measure for it.

Bank Queues Waiting times (in seconds) of customers at the Madison Savings Bank are recorded with two configurations: single customer line; individual customer lines. Carefully examine the data to determine whether there is a difference between the two data sets that is not apparent from a comparison of the measures of center. If so, what is it?

Single Line	390	396	402	408	426	438	444	462	462	462
Individual Lines	252	324	348	372	402	462	462	510	558	600

Now use the values for the *single line* and develop the formula for the standard deviation as follows.

1. The mean is 429.0 seconds. Find the deviation of each value from the mean.
2. Show that the sum of the deviations from Step 1 is 0. Ask if it will always be 0 (the answer is yes).
3. We want to avoid the canceling out of the positive and negative deviations. How do we do that? (Take absolute values or square them.) We will square the deviations.
4. Now we want a single value, so we need a mean of those squared deviations, but we find the mean by dividing by n - 1 instead of n.
5. Now track the units. If the original times are in seconds, the deviations are in seconds, the squared deviations are in seconds^2, and the mean is in seconds^2.
6. Because we can't really understand seconds^2 very well, we take the square root to get back to the original units.

After showing how this procedure results in the standard deviation, stress that students need not become adept at the computations required for this formula. Instead, they should learn how to obtain values of standard deviations using calculators or programs, and the real focus should be on *understanding* the standard deviation.

Understanding standard deviation: It is recommended that you use the range rule of thumb. Skip Chebyshev's theorem and the empirical rule. For the range rule of thumb, randomly select a student and ask for an estimate of the mean height of a male at the college. They usually answer this quite well. Now randomly select another student and ask for an estimate of the standard deviation of heights of males at the college. Give the student just a few seconds before stating that it is perfectly natural to have no idea of the answer. That is the nature of the standard deviation. However, ask the same student for estimates of the minimum and maximum heights. Then use $s \approx$ range/4 to show how easy it is to get an estimate.

Now show how to interpret a known value of a standard deviation. State that typical IQ tests have a mean of 100 and a standard deviation of 15. Using the range rule of thumb, we get these results:

Range Rule of Thumb for Identifying Significant Values

Significantly low values are $\mu - 2\sigma$ or lower.

Significantly high values are $\mu + 2\sigma$ or higher.

Values not significant: Between $(\mu - 2\sigma)$ and $(\mu + 2\sigma)$

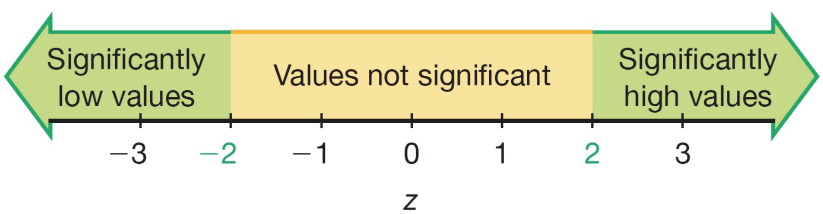
so that IQ scores that are not significant are those between 70 and 130. An IQ of 140 is significantly high.

***Recommendation*:** This section is partitioned into two parts: Part 1 (Basic Concepts of Variation) and Part 2 (Beyond the Basics of Variation). If pressed for time, omit Chebyshev's Theorem (because its results are too imprecise), omit the Empirical Rule (because it will be covered in Chapter 6), and omit the coefficient of variation. Strongly emphasize the interpretation and understanding of standard deviation using the Range Rule of Thumb. This is a great way to begin the thought process that will be used later for methods of inferential statistics.

Extra Example: A statistics professor finds that the times (in seconds) required to complete a quiz have a mean of 180 sec and a standard deviation of 30 sec. Is a time of 90 sec significantly low? Why or why not? (Answer: Yes, because 90 sec is more than 2 standard deviations below the mean.)

3-3 Measures of Relative Standing and Boxplots

Students can generally read and understand *z* scores on their own, so discuss them briefly, but stress the interpretation of *z* scores using the following:



Emphasize the point that it is unusual for a value to be below the mean by more than 2 standard deviations or above the mean by more than 2 standard deviations. This is an excellent preparation for hypothesis testing introduced later. With hypothesis tests using a normal distribution, common critical values are $z = \pm 1.96$, which is roughly 2, so we again use the same basic criterion for identifying *significant* results.

When discussing quartiles and percentiles, demonstrate use of the flowchart with two examples, one that results in an integer value of the location *L* and one that does not. Refer to the two examples in the textbook that illustrate the use of Figure 3-6.

Discuss outliers if they have not been discussed much yet. Demonstrate the effect of an outlier by computing the mean and standard deviation of the sample values 1, 1, 2, 3, 8, 165 with and without the outlier of 165 included. Comment that outliers are among the important characteristics of data (CVDOT: center, variation, distribution, outliers, changes over time) and they are important because they can have a dramatic effect on results. If an outlier is found to be a known error, delete it. But if an outlier is believed to be a correct value, do analyses with and without the outlier included so that its effect can be seen.

Describe the 5-number summary and boxplots, but really emphasize how these tools are used to understand data through descriptions, explorations, and comparisons.

Recommendation: If time is an issue, cover only Part 1 of Section 3-3.

Extra Example: Over the past 30 years, heights of basketball players at Newport University have a mean of 74.5 in. and a standard deviation of 2.5 in. The latest recruit has a height of 79.0 in.

a. Find the z score for the height of this latest recruit. (Answer: 1.80)
b. Is the height of 79.0 in. significantly low or significantly high among the heights of players over the past 30 years? Why or why not?
(Answer: No, because it is within 2 standard deviations of the mean.)

Extra Example: Here are measured reaction times (in seconds) in a test of driving skills:

2.4, 2.5, 2.8, 2.0, 2.4, 2.9, 3.2, 3.5, 2.7, 2.7, 2.8, 2.6.

Find the five-number-summary. (Answer: 2.0, 2.45, 2.7, 2.85, 3.5)

Chapter 4

Note: Here are changes from the 12th edition:

1. The terms *significantly low* and *significantly high* are now used to describe events that were previously called “unlikely” or “unusually low number of outcomes” or “unusually high number of outcomes.”

2. The separate sections on the Addition Rule and the Multiplication are now combined in one section: Section 4-2 (Addition Rule and Multiplication Rule).

3. Bayes’ Theorem has been added as Part 3 in Section 4-3 (Complements, Conditional Probability, and Bayes’ Theorem).

Probability is important as a foundation for very basic methods of statistics. For example, hypothesis tests often include a result of a “*P*-value,” which is actually a probability value. It is important to understand that probability values are numbers between 0 and 1, and small probabilities, such as 0.001, correspond to events that are very unlikely, whereas high probabilities, such as 0.999, correspond to events that are very likely.

Some professors prefer extensive coverage of probability theory by covering all of Chapter 4, while other professors choose to minimize the coverage of probability by including only section 4-1.

Recommendations: If time is an issue or if the students have minimal mathematics backgrounds, include only Section 4-1 (Basic Concepts of Probability). If time is not too much of an issue, include Section 4-2 (Addition Rule and Multiplication Rule). If time is not an issue and the students have strong mathematics backgrounds, include additional sections of Chapter 4.

Chapter 4 Survey: Distribute the following survey. Ask that each student complete it now. Collect the completed surveys. If there is time left, use the survey results to work with the concepts of Chapter 4 in the textbook. Here are some suggestions:

- Based on the responses to Question 1, what is the relative frequency estimate of the probability that a randomly selected person was born in January, February, or March? For the general population, what is the probability that a randomly selected person was born in January, February, or March?
- For Question 2, what is the expected proportion of YES responses? (3/4) Describe how the responses can be used to estimate *P*(January or February or March birthday). If the question had been very sensitive (such as a question about sex, drug use, or crime) instead of a neutral question (month of birth), how does the format of Question 2 help the researcher?
- For Questions 3 and 4, construct a two-way table that can be used for a variety of probability questions involving the addition and multiplication rules.

Triola Survey

Please complete the survey and submit it now. Do not sign your name.

1. Enter the number corresponding to the month of your birth. (Enter 1 for January, enter 2 for February, and so on.)__________

2. Flip a coin. Enter *Yes* if either the coin turns up heads or you were born in January, February, or March. Enter *No* if the coin turned up tails and you were not born in January, February, or March. __________

3. Select one of the following that describes your handedness.

   _____Right-handed _____Left-handed _____Ambidextrous

4. Select your gender. _____Male _____Female

4-1 Basic Concepts of Probability

Recommendation: Instead of discussing probability as a separate and independent topic, relate it to statistical methods by including the rare event rule for inferential statistics.

Rare Event Rule for Inferential Statistics

> **If, under a given assumption, the probability of a particular observed event is extremely small and the observed event occurs *significantly less than* or *significantly more than* what we typically expect with that assumption, we conclude that the assumption is probably not correct.**

Section 4-1 covers basic definitions and simple concepts of probability. Emphasize the importance of *understanding* the available data, because some students develop this rule for finding probabilities: Find two numbers, and then divide the smaller number by the larger one. For class examples, include at least one example where that rule doesn't work. For example, if a quality control test shows that there are 5 defective printers and there are 15 that are good, the probability of randomly selecting one that is defective is 5/20, not 5/15.

Also, stress that the usual goal is not to simply find a probability value, but to use it for making some decision. Many exercises ask questions requiring the *interpretation* of probability values.

Recommendation: If pressed for time, omit the subsection of *odds*.

Activity: Give each student a thumb tack and ask them to find the probability that the tack lands with the point up. Is the answer 0.5, because the tack either lands with the point up or does not? Why or why not?

Extra Example: A medical center has 18 female physicians and 2 male physicians.

a. If a patient randomly selects one of the physicians, what is the probability of getting a male? (Answer: 1/10 or 0.1)

b. Is it unusual for a patient to get a male when a physician is randomly selected? Why or why not? (Answer: No, because the probability of 0.1 is not small, such as 0.05 or less.)

4-2 Addition Rule and Multiplication Rule

Point out that these key points of this section: $P(A \text{ or } B)$ suggests the addition rule, and $P(A \text{ and } B)$ suggests the multiplication rule. Associate "or" with adding and associate “and” with multiplying. For the addition rule and the multiplication rule, emphasize use of the intuitive rules instead of the formal rules, because the intuitive rules are based on understanding of circumstances instead of blind application of formulas. Point out that a table such as Table 4-1 in the textbook is called a *two-way* table or *contingency* table, and such tables are very important in statistics because they arise frequently from analysis of survey results. Such tables are the focus of Section 11-2.

The basic multiplication rule has implications affecting many real applications. Redundancy, for example, is the practice of using duplicate or backup systems to greatly increase reliability. The typical single engine aircraft uses redundancy with two separate and independent electrical systems. The improved reliability can be measured by applying the basic multiplication rule. Illustrate this with specific numbers. For example, suppose the probability of one electrical system failing is 0.1. Then there is a 0.9 probability of a safe flight. But with two electrical systems, the probability of them both failing is $0.1 \times 0.1 = 0.01$, so there is now a 0.99 probability of a safe flight.

Extra Example: Considerable controversy arose when New York City introduced a program of keeping the cars belonging to people charged with drunk driving. The Associated Press conducted a poll, and the table below is based on the results. If one of the respondents is randomly selected, find the probability of getting a man or someone who answered yes. (Answer: 1296/1552 = 0.835)

Should Car Be Seized?

	Yes	**No**
Men	391	425
Women	480	256

Extra Example: A homeowner finds that there is a 0.1 probability that a flashlight does not work when turned on. If she has three flashlights, find the probability that none of them work when there is a power failure. (Answer: $0.1^3 = 0.001$)

Activity: Simulate the principle of redundancy by using coin tosses to simulate the starting of a car. Assume that a student has access to a fleet of cars, but each of the cars is old and has a 50% chance of starting. If the student needs a car to get to class, what is the probability of getting there if the “fleet” has only one such car? Two cars? Three cars?

4-3 Complements, Conditional Probability, and Bayes' Theorem

This section involves the following three parts:

Part 1: Complements: The Probability of "At Least One"
Part 2: Conditional Probability
Part 3: Bayes' Theorem

You could include any or all of these topics.

Part 1 When finding the probability of "at least one" of something, students often have some difficulty with the key concept. Begin by clearly explaining the meaning of "at least one." Then discuss the complement of "at least one." Then emphasize this key point: To find *P*(at least one of something), it's usually better to first find the probability of the complement, then subtract from 1.

To find the probability of *at least one* of something, calculate the probability of *none*, and then subtract that result from 1. That is,
***P*(at least one) = 1 − *P*(none).**

Part 2 For the second topic of *conditional probability,* emphasize careful reading and understanding of the available information and the probability being sought. Emphasize the intuitive approach.

Part 3 Bayes' Theorem is appropriate for stronger students. Otherwise, it is interesting to at least discuss Example 4 in the textbook so that students develop a sense that even though a clinical test appears to have very good results, it is very possible to get misleading conclusions.

Extra Example: A homeowner finds that there is a 0.1 probability that a flashlight does *not* work when turned on.

a. If she has three flashlights, find the probability that at least one of them works when there is a power failure. (Answer: 0.999)
b. Find the probability that the second flashlight works given that the first flashlight works. (Answer: 0.9)

4-4 Counting

Recommendation: Unless you have an abundance of time, such as the time available in a two-semester course, omit this section, but consider demonstrating the combinations rule for finding the probability of winning a lottery, as in Example 5 in the textbook.

Activity: Identify the lottery rules of your state, and show the probability of winning the grand prize. Then relate that probability to something tangible and concrete, such as the probability of selecting one particular dime in a pile of dimes. How high would the pile be?

Extra Example: Singing legend Frank Sinatra recorded 381 songs. From a list of his top-10 songs, you must select 3 that will be sung in a medley as a tribute at the next MTV Music Awards ceremony. The order of the songs is important so that they fit together well. If you select 3 of Sinatra's top-10 songs, how many different sequences are possible? (Answer: 720 permutations)

4-5 Probabilities through Simulations

Note: This section is not printed in the textbook. It is available for download at www.TriolaStats.com.

Chapter 5

Note: The 13th edition of *Elementary Statistics* now includes *one* section discussing binomial probability distributions (Section 5-2), whereas the previous 12th edition had *two* separate sections (5-3: Binomial Probability Distributions; 5-4: Parameters for Binomial Distributions).

Recommendation: Cover Sections 5-1 and 5-2. Include Section 5-3 (Poisson Probability Distribution) only if time is not an issue.

Chapter 5 Survey: Distribute the following survey. Ask that each student complete it now. Collect the completed surveys. If there is time left, use the survey results to work with the concepts of Chapter 5 in the textbook. Here are some suggestions:

- Do the responses to Question 1 appear to indicate that all five numbers are equally likely?

- Can the responses to Question 2 be used to construct a table representing a probability distribution for the numbers of children born to married couples? Why or why not? (No, because couples with no children are not represented.)

Triola Survey

Please complete the survey and submit it now. Do not sign your name.

1. The instructor will announce that he or she is thinking of a particular number between 1 and 5. Concentrate and try to mentally identify that number, and then enter it here. __________

2. Enter the number of brothers and sisters that you have. __________

5-1 Probability Distributions

Suggestion: List two samples of data, each with about 20 values. Create one sample consisting of 20 single digits with approximately equal frequencies of the digits 0, 1, 2, . . . , 9 and select the other sample to be 20 digits that are mostly 0s and 5s with a few other digits thrown in. Inform the class that both samples are the *last* digits of recorded weights of people, but one of the samples came from *measured* weights whereas the other sample resulted from *asking* people what they weighed. Ask the class to distinguish between the reported weights and the measured weights. Emphasize that they can make a conclusion about the nature of the data by simply examining the distribution. Also ask them to construct an "ideal" distribution that would result from millions of people that were actually weighed; ask them to estimate the mean and standard deviation for this distribution. (The mean should be 4.5 and the standard deviation could be estimated using the range rule of thumb; the true mean is 4.5 and the true standard deviation is around 3.)

When discussing the mean and standard deviation for a probability distribution, stress that obtaining numerical answers is not the ultimate goal. We want to *interpret* results so that they can be used in a meaningful way. This process of determining whether events are “unusual” is extremely important in the subject of statistics, and it forms the foundation for the important methods of hypothesis testing introduced in Chapter 8. Discuss the following criteria.

Identifying Significant Results with Probabilities:

Significantly *high* number of successes: x successes among n trials is a *significantly high* number of successes if the probability of x or more successes is 0.05 or less. That is, x is a significantly high number of successes if $P(x \text{ or more}) \le 0.05$.*

Significantly *low* number of successes: x successes among n trials is a *significantly low* number of successes if the probability of x or fewer successes is 0.05 or less. That is, x is a significantly low number of successes if $P(x \text{ or fewer}) \le 0.05$.*

The value 0.05 is not absolutely rigid. Other values, such as 0.01, could be used to distinguish between results that are significant and those that are not significant.

Extra Example: The random variable *x* is a count of the number of girls that occur when two babies are born. Construct a table representing the probability distribution, and then find its mean and standard deviation. (Answer: The values of 0, 1, 2 have probabilities of 0.25, 0.50, and 0.25; the mean is 1.0 and the standard deviation is 1.0.)

5-2 Binomial Probability Distributions

Note: Table A-1, the table of binomial probabilities, includes values of *n* from 2 through 8. Instead of using Table A-1, the use of technology is strongly recommended.

When introducing the notation used in the binomial probability formula, strongly emphasize that *x* counts *successes* and *p* is the probability of *success*, so *x* and *p* must both refer to the *same* outcome. A common error is to have *x* count one category of outcome while *p* is the probability of the other category of outcome. Students also have some difficulty with the probability *p*; strongly emphasize that *p* is the probability of getting a success on just *one* trial.

Although the emphasis in the course should not be on calculations with formulas, it is helpful to have students do a few calculations that require use of the formula. Here's a good strategy for using Formula 5-5: Get a single number for $n!/[(n-x)!x!]$, get a single number for p^x and a single number for q^{n-x}; and then multiply the three factors. Also, point out the common calculator error of evaluating a/bc by entering a $\div$ b $\times$ c; the correct entry is obtained by entering either a $\div$ b $\div$ c or a $\div$ (b $\times$ c).

In class, make up a few problems that can be solved with Table A-1 in the textbook, and be sure that students learn how to use it correctly. Example: When guessing the answers for 5 multiple choice test questions, find the probability that the number of correct guesses is (a) exactly 2; (b) more than 2; (c) at least 2; (d) fewer than 2.

If you are not using a specific technology such as Statdisk, Minitab, Excel, StatCrunch, or a TI-83/84 Plus calculator, comment that it is helpful to be able to interpret displayed results from such technologies. Consider providing such displays on tests, then asking questions about the results.

Recommendation: The *interpretation* of standard deviations should be stressed and reviewed, as in part (c) of Example 5 in Section 5-2. The ultimate goal is not to simply obtain a numerical result, but to interpret that result in a practical and meaningful way. Also, determining whether a result is "significant" is excellent preparation for the method of hypothesis testing introduced in Chapter 8.

Activity: Point out to students that they have an opportunity of winning $1,000,000; see the first Cooperative Group Activity at the end of the chapter.

Extra Example: Find the probability of getting exactly 3 girls when 5 babies are born. Is that event unusual? Is 3 girls a significantly high number of girls? Why or why not? (Answer: 0.312. The event is not significantly high because the probability of 3 or more girls is 0.5, which is not small, such as 0.05 or less.)

Extra Example: In a test of a gender-selection technique, 150 couples each have one baby, and the results consist of 100 girls and 50 boys.

a. Find the mean and standard deviation for the numbers of girls that would occur in groups of 150 births. (Answer: 75, 6.1)

b. Is the result of 100 girls significantly high? Why or why not? (Answer: Yes, because 100 is more than 2 standard deviations above the mean of 75.)

5-3 The Poisson Distribution

Recommendation: This section is not necessary for subsequent chapters and may be omitted. Include this section only if you are confident that you will have sufficient time for more important topics covered later in your course.

Extra Example: A barber finds that on Fridays between 4:00 PM and 5:00 PM, the mean number of arrivals is 6.0. If the arrivals follow a Poisson distribution, find the probability of getting exactly 3 arrivals during that time. Is it unlikely that the barber will get exactly 3 arrivals? (Answer: 0.0892; no, because the probability is not small, such as 0.05 or less.)

Chapter 6

Sections 6-1 through 6-4 are *extremely* important. Before beginning the chapter, stress that much of the content of this chapter will be used often throughout the remainder of the course, so it very important to learn that content as soon as possible.

Recommendation: Cover Sections 6-1 through 6-5. Section 6-6 (Normal as Approximation to Binomial) can be omitted because technology now allows us to find exact probabilities for most binomial probability distributions, so the normal approximation is becoming obsolete.

Be sure to inform your students of the materials that will be available to them on tests. ***Recommendation:*** Allow students to use the detachable Formula/Table card found in the book, which includes a copy of Table A-2. You might formally state that students should not write notes on that Formula/Table card.

Chapter 6 Survey: Distribute the following survey. Ask that each student complete it now. Collect the completed surveys. If there is time left, use the survey results to work with the concepts of Chapter 6 in the textbook. Here are some suggestions:

- Using the same scale (0, 0.25, 0.50, 0.75, 1.00, 1.25, . . . , 12.00), construct a dotplot of all numbers from Question 1. Place the dots above the scale. Then construct a dotplot of the sample means from Question 2 below the scale. How do the results illustrate the Central limit theorem?
- For Question 3, use the reported heights to test for normality.

Triola Survey

Please complete the survey and submit it now. Do not sign your name.

1. Enter the number corresponding to the month of birth for yourself and three other people. (Enter 1 for January, enter 2 for February, and so on.) For the three other people, use your mother, father, siblings, or closest friend. Enter the four numbers here: ___________________

2. Enter the mean of the numbers from Question 1: ___________

3. Enter your height in inches: ___________

6-1 The Standard Normal Distribution

Stress that Section 6-1 is *extremely* important because it introduces concepts and procedures that will be used often throughout the remainder of the course.

Constantly stress the difference between *areas* under the curve and z scores that are *distances* representing the number of standard deviations that a value is away from the mean. Note that the numbers in the body of Table A-2 in the textbook are areas, and the numbers in the extreme left column (and across the top row) are z scores that are actually distances. If a z score is to the *left* of the centerline, it must be negative. It's always a good idea to check answers to be sure that they are reasonable.

Because the content of this section is so important for subsequent sections and chapters, consider giving a quick quiz on the content of this section. Announce such quizzes in advance. Surprise quizzes add to anxiety, which is best kept at a minimum.

Recommendation: Require or strongly encourage the drawing of a graph for each problem solved. Point out that the graph provides a visual understanding that can be really helpful when solving the problems of this important chapter.

Extra Example: Given that the distribution of the random variable z is a standard normal distribution, find the probability of randomly selecting a z value between -0.97 and 2.83.
(Answer: 0.8317 or 0.8316 if using technology)

6-2 Real Applications of Normal Distributions

State that this section involves *nonstandard* normal distributions, which do not have $\mu = 0$ and $\sigma = 1$. After using the simple transformation of $z = (x - \mu)/\sigma$, we can use the same basic procedures presented in Section 6-1. If students have not yet mastered the procedures from Section 6-1, they should definitely go back and master them before continuing.

Extra Example: Assume that body temperatures of healthy adults are normally distributed with a mean of 98.20°F and a standard deviation of 0.62°F.

a. Find the probability of randomly selecting someone with a body temperature above 99.90°F. Is such a temperature unlikely? (Answer: 0.0031; yes, because its probability is small --- below 0.05.)

b. Find P_{20}. (Answer: 97.68°F)

6-3 Sampling Distributions and Estimators

Recommendation: Assign this section as reading to be done before discussing important points in class.

This section is designed to introduce the general concept of a sampling distribution of a statistic, and to demonstrate that some statistics (mean, variance, proportion) tend to target a population parameter while others do not.

This section includes a paragraph with a heading of "Why sample with replacement?" It is important to recognize why sampling with replacement is so important, given that sampling without replacement is used most often. Comment on the content of this paragraph.

After completing this section, students should know that a sampling distribution of a statistic (such as a sample proportion or sample mean) is the distribution of all values of the statistic when all possible samples of the same size *n* are taken from the same population. The sampling distribution of a statistic is typically represented as a probability distribution in the format of a table, probability histogram, or formula. They should know that the mean, variance, and proportion tend to target a population parameter while some other statistics do not.

6-4 The Central Limit Theorem

Activity: Try motivating the important concepts of this section: Ask each student to announce the last four digits of his or her social security number in any order. As they respond, construct a dotplot on the blackboard and show that it depicts a distribution that is approximately uniform. Then ask each student to compute the mean of the same four digits, and proceed to show that the sample means tend to have a bell-shaped distribution. Also, the mean of the sample means should be the same as the mean of the original list of digits. Finally, question the class and try to draw out the fact that the amount of *variation* among the sample means is less than the amount of variation present in the original list of digits. (That is, the sample means will be *closer* together than the original list of digits.)

In class, be sure to do an example similar in nature to Example 2 in this section. Do part (a) with *one* individual selected, and do part (b) with a *group* selected. Point out that with one individual, we use $z = (x - \mu)/\sigma$, but with a group of values we replace σ with $\sigma/\sqrt{n}$.

Finite Population Correction Factor Because of time limitations, many instructors choose to omit coverage of the finite population correction factor. If the finite population correction factor is omitted, do not assign Exercise 21 (located in the group of exercises labeled "Beyond the Basics").

Extra Example: Assume that body temperatures of healthy adults are normally distributed with a mean of 98.20°F and a standard deviation of 0.62°F.

a. If *one* healthy adult is randomly selected, find the probability that his or her temperature is greater than 99.00°F. (Answer: 0.0985)

b. If 9 healthy adults are randomly selected, find the probability that their mean body temperature is greater than 99.00°F. (Answer: 0.0001)

6-5 Assessing Normality

Among the topics discussed in the following chapters, some have a loose requirement that the population must have a normal distribution, whereas others have a stricter requirement of normality. For example, Section 7-2 has a requirement that is somewhat loose in the sense that the population distribution need not be exactly normal, but it must have a distribution that is basically symmetric with only one mode. But Section 7-3 has a fairly strict requirement that the population must have a normal distribution. In Section 7-3, substantial departures from a normal distribution can lead to substantial errors. This is why it is important to determine whether we have sample data that are from a normally distributed population.

Recommendation: Stress the *interpretation* of a normal quantile plot, but do not stress the mechanics of actually creating one. On a test, provide displayed results from a technology such as Statdisk, Minitab, Excel, StatCrunch, or a TI-83/84 Plus calculator, and ask whether the sample data appear to be from a normally distributed population.

Extra Example: Determine whether the following test scores are normally distributed, and give a reason: 0, 45, 46, 47, 48, 48, 48, 49, 50, 50, 51, 52, 53, 55, 100. (Answer: Because the two values of 0 and 100 are both outliers, there are 2 outliers in a relatively small sample, so the data do not appear to be normally distributed.)

6-6 Normal as Approximation to Binomial

Using software or a TI-83/84 Plus calculator, we can now solve many more binomial distribution problems directly without using a normal approximation, so the methods of this section are not as necessary as they once were. This section is not required for future chapters and may be omitted if time is an issue. ***Recommendation****:* Omit this section.

Activity: Simulate births by asking each student to toss a coin 25 times. Let outcomes of heads represent females and let tails represent males. Ask each student to announce the number of females and males, and then keep a cumulative total. *Important:* Ask that students use the normal approximation to the binomial distribution to find the probability of getting the number of females that was obtained, and then ask if this is the probability to be used for determining whether the results are unusual. (Answer: No, we need the probability of getting a number of females that is *at* *least as extreme* as the number obtained.) Proceed to find the probability of getting a number of females *at least as extreme* as the number obtained, and then determine whether the results are unusual.

Extra Example: If a gender-selection technique is tested with 500 couples who each have one baby, find the probability of getting at least 275 girls. What would that result suggest?
(Answer: 0.0143 or 0.0142 if using technology; because the probability is so small, the result suggests that the gender-selection technique appears to increase the likelihood of a baby being a girl.)

Chapter 7

New Section 7-4: Bootstrapping: Using Technology for Estimates.

Note: In Section 7-2 (Estimating a Population Mean), the "σ known" case has been relegated to a very brief discussion in Part 2 of the section. In the real world of professional statisticians and professional journals and reports, it is extremely rare that we want to estimate an unknown value of a population mean but we somehow know the value of the population standard deviation σ. In the past, there were sound reasons for starting with the "known σ" situation, including the fact that finding critical values of *t* was often difficult without technology. Technology has now empowered us to find critical *t* values for any sample size *n*, so the situation of a known σ is now much less important. Given the time constraints in the typical introductory statistics course, it is now wise to devote little or no time and effort to the unrealistic "known σ" case.

Chapter 7 is the first introduction to one of the two major activities of inferential statistics: estimating parameters and testing hypotheses. Every introductory statistics course should include at least Sections 7-1 and 7–2. Section 7-3 can be omitted if there is not sufficient time to include it.

Chapter 7 Survey: Distribute the following survey. Ask that each student complete it now. Collect the completed surveys. If there is time left, use the survey results to work with the concepts of Chapter 7 in the textbook. Here are some suggestions:

- For Question 1, use the sample results to construct a confidence interval estimate of the proportion of people with blue eyes. How does the result compare to the claim that about 35% of the population has blue eyes (based on a study of Dr. P. Sorita Soni at Indiana University)?
- For Question 2, construct a confidence interval estimate of the proportion of people who prefer the Democratic party.
- For Question 3, use the sample data to construct a confidence interval estimate of the population mean.

Triola Survey

Please complete the survey and submit it now. Do not sign your name.

1. Enter the color of your eyes. __________

2. Identify the political party of your choice.

   _____Democrat _____Republican _____Other

3. Enter the total amount of money that you spent for textbooks this semester. __________

7-1 Estimating a Population Proportion

This section introduces confidence interval estimates of a population proportion *p*, as well as determining the sample size required to estimate *p*.

Many textbooks begin with estimates of μ, followed by estimates of *p*, but this book begins with estimates of *p*. There are a few good reasons for beginning with *p,* including these: We continue with one of the last topics of the preceding chapter (normal approximation to binomial); students generally see proportions much more often in the media than they see means. They are very aware of surveys and they have all heard of "margins of error" as they relate to percentages. Students also tend to be more interested in statistics expressed as proportions or percentages. Finally, methods of inferential statistics have fewer complications when proportions are involved than when means are involved. When introducing confidence interval estimates of a parameter for the first time, it would be better to focus on the concepts and methods without being too concerned with complicating factors such as introducing the Student *t* distribution.

When describing critical values, make the point that they will be used often throughout the remainder of the book, so it is important to understand them now.

Beginning in this section and throughout the remainder of the book, a formal "requirement check" is included in solutions whenever such a check is appropriate. Encourage students to think about such requirement checks, and constantly remind them to question the source of the data, the method used to collect the sample data, the context of the data, and any other relevant factors that might affect the usefulness or validity of results.

Activity: Use the sample proportion of the number of females in the class and construct a 95% confidence interval estimate of the percentage of females in all statistics classes. Then discuss whether the sample is good for this purpose. (It is not.)

Extra Example: In the first two months of a recent year, 94 car occupants were killed by air bags, and 61 of them were "improperly belted" (based on data from the National Highway Traffic Safety Administration). Construct a 95% confidence interval estimate of the percentage of car occupants who were killed by air bags while being improperly belted. Based on the results, is it safe to say that the majority of car occupants killed by air bags were improperly belted? (Answer: 55.2% < p < 74.5%; yes, the confidence interval limits suggest that the percentage is greater than 50%.)

7-2 Estimating a Population Mean

Note: Section 7-2 is partitioned as follows:

Part 1: Estimating a population mean when σ is not known

Part 2: Estimating a population mean when σ is known
(Only Exercises 37 and 38 deal with the case of σ known.)

Recommendation: Omit Part 2 for the case of known σ.

When estimating μ using sample data with an unknown population standard deviation σ, we use the t distribution (assuming that other requirements are satisfied). (We do not use the normal distribution when $n > 30$, as is done in a few textbooks). Professional statisticians almost never take the other approach of using the normal distribution with σ unknown, regardless of the sample size.

Activity: Request that each student record his or her pulse rate as the number of beats in one minute. Then proceed to use the sample to construct a 95% confidence interval estimate of the mean pulse rate of all such students. The active involvement of students will increase the likelihood that they better understand and remember the concepts of this section.

Extra Example: A random sample of 15 movie patrons results in a mean IQ score of 103.0 and a standard deviation of 14.7. The 15 IQ scores appear to come from a normally distributed population. Construct a 95% confidence interval estimate of the mean IQ of all movie patrons. Can we safely say that movie patrons have a mean IQ score greater than 100?
(Answer: 94.9 < μ < 111.1; no, the mean is not necessarily greater than 100.)

7-3 Estimating a Population Variance

Many instructors omit this section because of time limitations. The chi-square distribution is introduced here, but it can be introduced in Chapter 8. (Section 8-4 is written so that the chi-square distribution can be introduced there.) Many other instructors feel strongly that the importance of variation requires inclusion of this section.

Recommendation: If time is an issue, omit this section.

If this section is included, discuss the fact that for a sample with variance s^2 close to the population variance σ^2, the value of χ^2 will be close to the number of degrees of freedom $n-1$ (because the ratio of s^2/σ^2 will be close to 1). Discuss the fact that s^2 is positive, σ^2 is positive, and $n-1$ is positive, so χ^2 will be positive. This explains why the graph of χ^2 begins at 0.

Important note about the format of confidence intervals in this section: The format of (0.56, 0.74) is sometimes used instead of $0.56 < \sigma < 0.74$, but any format using $s \pm E$ *cannot* be used because s is not at the center of the confidence interval.

Sample Size Almost every other textbook ignores the topic of determining sample sizes required to estimate σ or σ^2, even after covering sample sizes required for estimating means and proportions. In many cases, the standard deviation is the most important parameter, so its estimation is critically important. That is why sample size determination is included in this section.

Extra Example: A random sample of 15 movie patrons results in a mean IQ score of 103.0 and a standard deviation of 14.7. The 15 IQ scores appear to come from a normally distributed population. Construct a 95% confidence interval estimate of the standard deviation of IQ scores of all movie patrons. (Answer: $10.8 < \sigma < 23.2$)

7-4 Bootstrapping: Using Technology for Estimates

If the original population is not normally distributed, the bootstrap method is an interesting alternative, especially for students with great enthusiasm for computers. Given that the Statdisk software is free for students using a Triola textbook and Statdisk has a bootstrapping feature, every student has access to bootstrapping capabilities.

Recommendation*:* Include this section by using Statdisk!

Extra Example: Because software is required for bootstrapping and the Appendix B data sets are available for download from www.TriolaStats.com, use the Verizon airport data speeds from the data set named "Airport Data Speeds." Construct the 95% confidence interval estimate of μ using the methods from Section 7-2 and also using the bootstrap method, then compare the results.
(Answer: Using Section 7-2:13.05 Mbps < μ < 22.15 Mbps; using bootstrapping the answer can vary, but here is a typical result: 13.54 Mbps < μ < 22.50 Mbps. Both results are close.)

Chapter 8

Every introductory statistics course should include at least Sections 8–1, 8–2, and 8–3. Section 8–4 can be omitted if there is not sufficient time to include it.

Instead of beginning coverage of hypothesis testing with terminology or a sequence of mechanical steps, begin with a big picture *overview* of the basic concept used. Focus on the issue of *significance*: Do the sample results differ from the claim by an amount that is statistically significant? ***Recommendation:*** Assign Section 8-1 for reading to be completed before this chapter is discussed in class. Consider a quick and easy quiz with a question similar to the one given in Example 1 in Section 8-1. It involves a clear situation and students can easily understand it. Comment that the actual conclusion depends on a *probability* value. Students have already seen the Rare Event Rule for inferential statistics, and methods of hypothesis testing are built around that rule.

Be sure to clearly inform students of what is expected when they conduct hypothesis tests for homework and examinations. ***Recommendation:*** Require these components:

1. Statements of H_0 and H_1
2. A graph showing the appropriate distribution, the test statistic, and either the *P*–value or the critical value(s) and critical region
3. A statement of either "reject H_0" or "fail to reject H_0"
4. Summary statement of the conclusion, which should be in non–technical terms and it should address the original claim.

Grading Recommendation: When grading a solution to a question requiring a hypothesis test, give equal credit for each of the following:

1. Statements of H_0 and H_1
2. Graph showing the correct distribution (normal, *t,* chi-square, *F*)
3. Correct value of the test statistic
4. Correct *P*-value or critical value(s)
5. Correct statement of either "reject H_0" or "fail to reject H_0"
6. Correct summary statement of the conclusion

For example, include a hypothesis test question on an exam and assign it 24 points, with 4 points for each of the six items given above.

Chapter 8 Survey: Distribute the following survey. Ask that each student complete it now. Collect the completed surveys. If there is time left, use the survey results to work with the concepts of Chapter 8 in the textbook. Here are some suggestions:

- For Question 1, test the claim that the proportion of the population with blue eyes is equal to 35%, as claimed Dr. P. Sorita Soni at Indiana University).
- For Question 3, test the claim that more than 75% of students at your college are right-handed.
- For Question 6, test the claim that more than 50% of students at your college are females.

Triola Survey

Please complete the survey and submit it now. Do not sign your name.

1. Enter the color of your eyes. __________

2. Enter your height in inches: __________

3. Select one of the following that describes your handedness.

   _____Right-handed _____Left-handed _____Ambidextrous

4. Do you own a cell phone? _____Yes _____No

5. What is your shoe size? __________

6. Select one: _____Male _____Female

8-1 Basics of Hypothesis Testing

Section 8-1 is divided into these three parts:

Part 1: Basic Concepts of Hypothesis Testing
Part 2: Type I and Type II Errors
Part 3: Power of a Hypothesis Test

It is difficult to find the power of a test, so include Part 3 only if you have sufficient time and the topic is suitable for your students.

For notation, note that the null hypothesis will be expressed in terms of *equality* only, so expressions such as $p \leq 0.5$ or $p \geq 0.5$ will not be used for the null hypothesis. (Almost all professional journals use only equality for expressions of null hypotheses.) The notation H_0 is used almost universally, but it is common to see alternative hypotheses expressed as H_1 or H_a . The textbook uses H_1 for alternative hypotheses.

Comment that students will encounter several new terms in this section. These special terms are not unique to this book, or statistics books in general. Instead, these terms are commonly used by medical researchers, manufacturers, psychologists, educators, and many other people who use methods of statistics in their professions. When students learn these terms, they are developing a statistical literacy involving language used in many different disciplines.

Hint for Students: When conducting a test of some hypothesis or claim, it is important to use the correct distribution and the correct expression of the test statistic. Point out that the different test statistics included in this section are on the detachable Formula/Table card included with the textbook. If students are allowed to use that Formula/Table card on tests, there is no need to memorize formulas. They can simply refer to the card to determine which test statistic is suitable.

P-Values: Section 8-1 includes the critical value method of testing hypotheses, the *P*-value method, and the use of confidence intervals. ***Recommendation:*** Stress the *P*-value method. *P*-values can usually be found using statistical software or a TI-83/84 Plus calculator, but if students are not using a technology and are using tables in Appendix A of the textbook instead, it will sometimes be difficult to find *P*-values (especially when using the *t,* chi-square, or *F* distributions). The critical value method will sometimes be easier for those students using only the tables in Appendix A.

Wording of Final Conclusions: Clearly announce a policy of not accepting *only* final conclusions of "reject the null hypothesis" or "fail to reject the null hypothesis," because such statements mean nothing to most people. The final statement should address the original claim, and it should not involve technical terms, such as "null hypothesis." Students typically have some degree of difficulty with the correct statement of final conclusions. Stress that the precise wording of the final conclusion is very important. Differences between terms such as "support" and "fail to reject" are very important. Show how Table 8-3 can be used to form the wording of the final conclusion. Also, some students have trouble clearly understanding the meaning of "fail to reject the null hypothesis." You might also use "don't reject" instead of "fail to reject."

Extra Example:

a. A newspaper headline consists of the claim that "Most Americans Support Increased Funding for the Space Program." Given the claim, identify the null and alternative hypotheses. (Answer: H_0: $p = 0.5$. H_1: $p > 0.5$.)

b. When testing the claim that $p \neq 0.125$, the test statistic of $z = 2.67$ is obtained. Identify the *P*-value. (Answer: 0.0076.)

c. When testing a claim that $\mu > 75.0$, the *P*-value of 0.1602 is obtained. What should you conclude? (Answer: Fail to reject the null hypothesis. There is not sufficient evidence to support the claim that the mean is greater than 75.0.)

8-2 Testing a Claim about a Proportion

This section presents three methods for testing hypotheses: (1) critical value method; (2) *P*-value method; (3) confidence intervals. Again, it is recommended that if you are making extensive use of TI-83/84 Plus calculators or computer software, you should emphasize the *P*-value approach instead of the critical value approach. There is a current trend to make more use of the *P*-value approach. When defining *P*-value, reinforce the importance of getting a value *at least as extreme* as the one found. Refer to Figure 8-1 in the textbook and suggest that students use it regularly as a basic guide for including all of the steps of a complete hypothesis test.

If you did not cover Section 6-6, point out that under certain circumstances (such as those listed as the three requirements), a binomial distribution can be approximated by a normal distribution. If Section 6-6 was covered, we use a test statistic that does not include the continuity correction from Section 6-6. The continuity correction is not included because its effects tend to be very small with large samples.

Activity: Use the proportion of females in the class to test the claim that "50% of all statistics students are females."

Extra Example: In the first two months of a recent year, 94 car occupants were killed by air bags, and 61 of them were "improperly belted" (based on data from the National Highway Traffic Safety Administration). Use a 0.05 significance level to test the claim that among car occupants killed by air bags, the majority were improperly belted.
(Answer: Test statistic is $z = 2.89$. *P*-value = 0.0019. Critical value is $z = 1.645$. Reject H_0: $p = 0.5$ and support H_1: $p > 0.5$. There is sufficient evidence to support the claim that among car occupants killed by air bags, the majority were "improperly belted.")

8-3 Testing a Claim about a Mean

Note: In this 13th edition, Section 8-3 (Testing a Claim About a Mean) is partitioned into Part 1 (for σ not known) and Part 2 (for σ known). The main focus in Section 8-3 is using the Student *t* distribution for testing a claim about a population mean. Exercises 29 and 30 are the only exercises in which σ is assumed to be known.

Recommendation: If your students are using TI-83/84 Plus calculators or statistical software, encourage use of the *P*-value approach to hypothesis testing, but if they are using only the tables in Appendix A of the textbook, allow them to use the critical value method.

Activity: Conduct an actual *t* test in class by using data collected from students in the class. Here is one example: Before class, measure your own pulse rate. In class, ask each student to measure his or her pulse rate as the number of beats in one minute. Proceed to test the claim that the class has a mean pulse rate different from yours. The active involvement will provide a better learning experience.

Extra Example: A random sample of 15 movie patrons results in a mean IQ score of 103.0 and a standard deviation of 14.7. The sample of IQ scores appears to come from a population with a normal distribution. Use a 0.05 significance level to test the claim that the mean IQ score of movie patrons is greater than 100.
(Answer: Test statistic is $t = 0.790$. *P*-value = 0.2212. Critical value is $t = 1.761$. Fail to reject H_0: $\mu = 100$. There is not sufficient evidence to support H_1: $\mu > 100$. There is not sufficient evidence to support the claim that the mean IQ of movie patrons is greater than 100.)

8-4 Testing a Claim about Variation

This section can be easily omitted if time is an issue. If Section 7-3 was omitted but this section is to be covered, be sure to describe the χ^2 distribution, because this will be the first time that students see it.

After covering this section, students will have studied three different parameters (p, μ, σ) along with three different distributions (normal, *t*, χ^2). Point out that the detachable Formula/Table card includes test statistics, and the form of the test statistic often reveals the distribution that should be used. There is no need to memorize test statistic formulas, so students can focus on more important concepts.

Recommendation: If your students are using statistical software, encourage use of the *P*-value approach to hypothesis testing, but if they are using only the tables in Appendix A, allow them to use the critical value method.

Extra Example: A random sample of 15 movie patrons results in a mean IQ score of 103.0 and a standard deviation of 14.7. The sample of IQ scores is from a population having a normal distribution. Use a 0.05 significance level to test the claim that IQ scores of movie patrons have a standard deviation less than 20.
(Answer: Test statistic is $\chi^2 = 7.563$. *P*-value = 0.0892. Critical value is $\chi^2 = 6.571$. Fail to reject H_0: $\chi^2 = 20$. There is not sufficient evidence to support H_1: $\chi^2 < 20$. There is not sufficient evidence to support the claim that the movie patrons have IQ scores with a standard deviation less than 20.)

Chapter 9

Some instructors cover all of Chapter 9 while many others omit it because they don't have enough time. Even if this chapter is not discussed in class, strongly consider assigning some exercises from it. Once students understand the basic concepts of hypothesis testing and confidence intervals (from Chapters 7 and 8), they can use software or a TI-83/84 Plus calculator to do the number crunching, then they can focus on the interpretation of the results. Also, there is a real pedagogical advantage in teaching confidence intervals in Chapter 7 and hypothesis testing in Chapter 8, and then having students independently apply the same general concepts to different circumstances included in this chapter.

Sections 9-1, 9-2 and 9-3 are especially important, so consider covering those sections or at least assigning some exercises from them.

Chapter 9 Survey: Distribute the following survey. Ask that each student complete it now. Collect the completed surveys. If there is time left, use the survey results to work with the concepts of Chapter 9 in the textbook. Here are some suggestions:

- Test the claim that the proportion of males with brown eyes is the same as the proportion of females with brown eyes.
- Construct a confidence interval estimate of the difference between the proportion of males with brown eyes and the proportion of females with brown eyes. Interpret the confidence interval.
- Test the claim that the mean pulse rate of males is less than the mean pulse rate of females.
- Construct a confidence interval estimate of the difference between the pulse rate of males and the pulse rate of females. Interpret that confidence interval.

Triola Survey

Please complete the survey and submit it now. Do not sign your name.

1. Select one: _____Male _____Female

2. Enter the color of your eyes. __________

3. Record your pulse rate by counting the number of heartbeats for one minute: _______________

9-1 Two Proportions

Finding the Numbers of Successes x_1 and x_2 Many students experience difficulty finding the actual number of successes from a statement such as this: "When 1125 people are surveyed, 47% of them said that they fly never or rarely." A brief review of the procedure for finding the number of successes can help remove that obstacle.

Point out that the concept of a pooled estimate of proportions applies only to cases in which we assume that $p_1 = p_2$. If we do not assume that $p_1 = p_2$, as in the construction of a confidence interval for their difference, we do not use a pooled estimate of proportions.

Extra Example: In a study of 1700 teens aged 15–19, half were given written surveys and half were given surveys using an anonymous computer program. Among those given the written surveys, 67 (or 7.9%) say that they carried a gun within the last 30 days. Among those given the computer surveys, 105 (or 12.4%) say that they carried a gun within the last 30 days (based on data from the Urban Institute).

a. The sample percentages of 7.9% and 12.4% are obviously not equal, but is the difference significant? Explain. (Answer: Test statistic is $z = -3.06$. P-value = 0.0022. Critical values are $z = -1.96$ and 1.96, assuming a 0.05 significance level.

   Reject H_0: $p_1 = p_2$. There is sufficient evidence to support the claim that there is a significant difference between the two percentages.)

b. Construct a 99% confidence interval estimate of the difference between the two population percentages, and interpret the result. (Answer: $-8.23\% < p_1 - p_2 < -0.71\%$ or $0.71\% < p_1 - p_2 < 8.23\%$)

9-2 Two Means: Independent Samples

This section has been partitioned into Parts 1 and 2. Part 1 involves situations in which the standard deviations of the two populations are unknown and are not assumed to be equal. Part 2 involves two other situations: (1) The two population standard deviations are unknown but are assumed to be equal; (2) the two population standard deviations are both known.

Recommendation: Cover Part 1 and skip Part 2.

Activity: Use the measured pulse rates from the class to test for a difference between the mean pulse rate of men and the mean pulse rate of women. Again, the active involvement will enhance their learning experience. It will also ensure that all students are awake and alive.

Point out that a common objective in constructing a *confidence interval* estimate of the difference $\mu_1 = \mu_2$ is to determine whether the confidence interval limits contain 0. If those limits do contain 0, then there is not a significant difference between the two sample means, which suggests that the two population means are equal. If those limits do not contain 0, then it appears that the two population means are different. Because the hypothesis test and confidence interval use the same distribution and standard error, they are equivalent in the sense that they result in the same conclusions.

Extra Example: As part of the National Health Survey, data were collected on the weights of men in two different age brackets. For 804 men aged 25–34, the mean is 176 lb and the standard deviation is 35.0 lb. For 1657 men aged 65–74, the mean and standard deviation are 164 lb and 27.0 lb, respectively.

a. Test the claim that the older men come from a population with a mean that is less than the mean for men in the 25–34 age bracket. Use a 0.01 significance level.

b. (Answer: Test statistic is t = 8.564. Critical value: t = 2.331 approximately. P-value: 0.0001 or 0.0000 if using technology. Reject H_0: $\mu_1 = \mu_2$. There is sufficient evidence to support the claim that the older men come from a population with a mean that is less than the mean for the younger men.)

c. Construct a 99% confidence interval for the difference between the means of the men in the two age brackets. Do the confidence interval limits contain 0? Does this indicate that there is or is not a significant difference between the two means?
(Answer: $8.4 < \mu_1 - \mu_2 < 15.6$; no. There does appear to be a significant difference between the two means.)

9-3 Two Dependent Samples (Matched Pairs)

Warn students against blindly using the methods of this section whenever they have paired data. For example, suppose we have pulse rates of students matched with their heights. Even though the data are paired, it would make no sense to apply the methods of this section. Such data might be analyzed using methods of correlation and regression, but we should not conduct any analysis based on differences between pulse rates and heights. It makes no sense to find the difference between an individual's pulse rate and his or her height. We should constantly warn students against blind use of formulas or procedures. We should always *think* about what we are doing.

Activity: Have students measure their pulse rates (or recall it from a previous class), then ask them to again measure their pulse rates after standing for one minute. Each student should have a matched data consisting of a sitting pulse rate and a standing pulse rate. Now use the data from the class to test the claim that the differences have a mean equal to 0.

Extra Example: In low-speed crash tests of five BMW cars, the repair costs were computed for a factory-authorized repair center and an independent repair facility. The results are listed in the accompanying table.

Authorized repair center	\$797	\$571	\$904	\$1147	\$418
Independent repair center	\$523	\$488	\$875	\$911	\$297

a. Is there sufficient evidence to support the claim that the independent center has lower repair costs? Use a 0.01 significance level.
(Answer: Test statistic: t = 3.215. Critical value: t = 3.747. P-value = 0.0162). Fail to reject H_0: $\mu_d = 0$. There is not sufficient evidence to support the claim that the independent center has lower repair costs.)

b. Construct a 99% confidence interval estimate of the mean difference between the repair costs of the factory-authorized repair center and the independent repair center. Do the confidence interval limits contain 0?
(Answer: $-64.2 < \mu_d < 361.4$; yes)

9-4 Two Variances or Standard Deviations

If time is an issue, this section can be omitted. If this section is covered, emphatically stress that the methods of this section have a very *strict* requirement of a normally distributed population. Departures from normality can result in very poor results. See the listed requirements in the textbook.

The basic method of this section involves making s_1^2 the *larger* variance, so that we can avoid the tricky problem of finding critical F values for left-tailed cases. Note, however, that the distribution of s_1^2 / s_2^2 is the F distribution only if we haven't yet imposed the condition that s_1^2 is the larger of the two sample variances. (Once we impose that condition, the ratio of s_1^2 / s_2^2 must be 1 or greater.)

There will be questions about finding critical values when the number of degrees of freedom is not one of those found in Table A-5 in the textbook. We can usually use the nearest values; it usually doesn't make a difference if we use the value above or below the desired missing value. It only makes a difference if the test statistic is between the table values, in which case you could interpolate, but it's best to run the problem using technology.

Alternative Methods Alternative methods are discussed in Part 2, and only Exercises 17 and 18 (Beyond the Basics) relate to these alternative methods. Part 2 could be assigned for independent reading or it could be omitted.

Activity: If the pulse rates of students were collected in some previous activity, it would be easy to test the null hypothesis that males and females have pulse rates with the same variation. However, before conducting the hypothesis test, set a good example and explore the data to verify the requirements, especially the requirement of normally distributed data.

Extra Example: Given the sample data below, use a 0.05 significance level to test the claim that the treatment population and the placebo population have different variances.

Treatment group:	$n = 11$, $\bar{x} = 12.6$, $s = 2.8$
Placebo group:	$n = 15$, $\bar{x} = 12.9$, $s = 1.8$

(Answer: Test statistic is $F = 2.4198$. Right critical value is $F = 3.1469$. P-value = 0.1277. Fail to reject H_0: $\sigma_1^2 = \sigma_2^2$. There is not sufficient evidence to support the claim that the two populations have different variances.)

Chapter 10

Recommendation: Include at least linear correlation and regression, as discussed in Sections 10-1 and 10-2. Section 10-4 (Multiple Regression) and Section 10-5 (Nonlinear Regression) emphasize the use of technology.

Chapter 10 Survey: Distribute the following survey. Ask that each student complete it now. Collect the completed surveys. If there is time left, use the survey results to work with the concepts of Chapter 10 in the textbook. Here are some suggestions:

Test for a linear correlation and find the equation of the regression line using:

- Questions 1 and 2
- Questions 1 and 4
- Questions 1 and 5
- Questions 1 and 6
- Questions 5 and 6

Triola Survey

Please complete the survey and submit it now. Do not sign your name.

1. Enter your height in inches: __________

2. Record your pulse rate by counting the number of heartbeats for one minute: _______________

3. Enter your shoe size? __________

Complete the following if a tape measure is available.

4. Measure your "navel height," which is the distance from the floor to your navel. ___________

5. Remove your right shoe and measure the length of your right foot. ___________

6. Measure your arm span by standing with your arms extended like the wings on an airplane, then measure the distance from the tip of your right hand to the tip of your left hand. __________

10-1 Correlation

Begin by making the important point that the *context* of data is extremely important. The context can dramatically affect the methods we use. Show an unidentified table of values, such as this one:

x	78	85	92	100	85
y	89	93	99	100	84

Ask these questions:

1. What is the key issue if these data are test grades of subjects before and after formal instruction? ("Is the instruction effective, as indicated by higher *y* scores?" See Section 9-3.)
2. What is the key issue if these data are reasoning tests for a sample of men (*x*) and a separate sample of women (*y*)? ("Does the population of men have the same mean as the population of women?" See Section 9-2.)
3. What is the key issue if each pair represents a math reasoning score *x* and a starting salary *y* in thousands of dollars? ("Is the starting salary associated with math reasoning?" See this chapter 10.)

Part 2: Formal Hypothesis Test As the title of this subsection indicates, this material requires prior coverage of Chapter 8. If you are including Sections 10-1 and 10-2 early (such as following Chapter 2), skip this subsection. If you do include this subsection, be sure to inform the class that you prefer hypothesis tests based on the linear correlation coefficient *r* or the *P*-value. There are pros and cons for both methods, but the author recommends using *r* because it is generally easier.

Finding *r* The manual calculation of the linear correlation coefficient *r* is messy. *Recommendation:* Demonstrate the calculation of *r* in class by doing the following activity, but encourage students to find *r* by using a calculator or statistical software. They should be encouraged to focus on understanding and interpreting values of *r*, not performing arithmetic calculations with a formula.

Activity: Consider doing an in-class example with six pairs of data. Randomly select six students and use their pulse rates and heights. Show the scatterplot and demonstrate how *r* can be found.

***Recommendation*:** Demonstrate the manual calculation of *r*, but move on and assume that values of *r* will be found by using calculators or software. This reflects the trend in introductory statistics courses: Require less number crunching and more thinking, analysis, and interpretation.

Extra Example: Many of us have heard that a tip should be 15% of the bill. The accompanying table lists some sample data collected from the author's students. Is there sufficient evidence to conclude that there is a relationship between the amount of the bill and the amount of the tip?

Bill ($)	33.46	50.68	87.92	98.84	63.60	107.34
Tip ($)	5.50	5.00	8.08	17.00	12.00	16.00

(Answer: r = 0.828. Critical values are r = –0.811 and r = 0.811, assuming a 0.05 significance level. P-value = 0.0418. Reject H_0: $\rho = 0$. There is sufficient evidence to support the claim that there is a relationship between the amount of the bill and the amount of the tip.)

10-2 Regression

Note that Section 10-2 is partitioned into Part 1 (Basic Concepts of Regression) and Part 2 (Beyond the Basics of Regression). Skip Part 2 if time is an issue.

Begin by briefly reviewing the $y = mx + b$ format of the equation of a straight line:

1. What does m represent? (Slope)
2. What does b represent? (y-intercept)
3. What if the equation is changed to a format of $y = b_0 + b_1x$? What is the slope? What is the y-intercept?

Finding the Regression Equation Once again, you must decide what you require from students. ***Recommendation:*** Allow students to find the slope and intercept from their calculators or statistical software. This is consistent with the trend of making the statistics course much more meaningful than laboriously cranking out formula values.

Some students experience difficulty in determining the best predicted value of a variable. Begin by randomly selecting a student and asking him or her to predict the IQ of a male who is 6 ft tall, and then explain why the answer of 100 makes sense. (There is no correlation between IQ and height, and the answer of 100 is not based on any regression equation.) Now randomly select another student and ask him or her to predict the time it would take to drive 100 miles. Answers such as two or three hours are good, and they involve a calculation using an estimated regression equation.

Activity: Use the class to collect sample paired data, then find the regression equation. Avoid using any measurements that might embarrass someone, such as weight. Consider the third Cooperative Group Activity given near the end of Chapter 10 in the textbook. It involves measures of height and "naval height" and verification of an old theory about the association between those two variables.

Extra Example: Many of us have heard that the tip should be 15% of the bill. The accompanying table lists some sample data collected from the author's students. Assuming that there is a linear correlation between the amount of the bill and the amount of the tip, find the equation that could be used for determining the amount of the tip that should be left.

Bill ($)	33.46	50.68	87.92	98.84	63.60	107.34
Tip ($)	5.50	5.00	8.08	17.00	12.00	16.00

(Answer: $y = -0.347 + 0.149x$, where y represents the tip. That is, leave 35 cents less than 14.9% of the bill. Or leave about 15% of the bill.)

10-3 Prediction Intervals and Variation

The calculations in this section will seriously challenge students without software or calculators capable of dealing with two-variable statistics. The manual calculation of the value of s_e is challenging, but this statistic is important enough to be included among the values provided by Statdisk, Minitab, Excel, StatCrunch, and the TI-83/84 Plus calculator. If you choose to cover this section, but students do not have statistical software or a TI-83/84 Plus calculator, consider providing them with displays from technology. The students can then focus on interpreting the displays or using results from them.

Extra Example: Repeat Example 1 for a country with an amount of chocolate consumption given by $x = 15$ kg per capita. (Answer: $18.6 < y < 49.4$.)

10-4 Multiple Regression

Because the formulas required for manual calculations of multiple regression equations are formidable, this section emphasizes computer usage and interpretation of computer results. This section can be covered even if students do not have access to suitable software; simply assign only those exercises that include computer displays. Some instructors include this section by assigning exercises as extra-credit or out-of-class work. If time is limited, the subsection of "Dummy Variables and Logistic Regression" can be easily omitted.

Activity: Ideally, demonstrate the statistical software or TI-83/84 Plus calculator that is being used by the class. Either collect sample data from the class or use one of the data sets in Appendix B. For example, randomly and *anonymously* select several students from the class roster, then use the numbers of absences and grades on the first test to predict grades on the second test.

Extra Example: Use the Minitab display below. Is the multiple regression equation good for making predictions? Why or why not? (Answer: Yes. The overall significance of 0.002 is low, indicating significance. The adjusted R^2 of 0.946 is very high.)

```
The regression equation is

WEIGHT = 2285 + 21.38AGE + 211.2HEADWDTH  + 128.6NECK

Predictor      Coef      Stdev     t-ratio        p
Constant    2285.21      78.45       23.64    0.022
AGE         21.3838     0.9022       21.53    0.200
HEADWDTH     211.24      20.88       20.54    0.619
NECK         28.594      5.870        4.87    0.008

s = 32.49      R-sq = 96.9%    R-sq(adj) = 94.6%

Analysis of Variance

SOURCE      DF        SS       MS       F       p
Regression  3    132425    44142   41.81   0.002
Error       4      4223     1056
Total       7    136648

SOURCE      DF    SEQ SS
AGE         1      90527
HEADWDTH    1      16844
NECK        1      25054
```

10-5 Nonlinear Regression

If time is an issue, omit this section. This section requires access to some form of technology. A TI-83/84 Plus calculator is ideal, but Statdisk, Minitab, Excel, or StatCrunch can also be used. For technology instructions, see the Tech Center box at the end of Section 10-5 in the textbook.

Recommendation: Omit this section, but assign exercises as extra-credit work, especially for those students with backgrounds that include more extensive mathematics courses.

Extra Example: Find the model that best fits the paired data given below. Explain why it fits best. (Answer: The quadratic model $y = 3x^2 + 8$ fits best because $R^2 = 1$, which is higher than R^2 for the other models.)

x	1	2	5	6	8	10
y	11	20	83	116	200	308

Chapter 11

Note: In Chapter 11, coverage of at least Part 1 of Section 11-2 is strongly recommended if time is available. Analysis of survey results often involves the use of contingency tables, so the concepts of Section 11-2 are used frequently in real applications. Both Sections 11-1 and 11-2 require the χ^2 distribution, so if it has not yet been introduced, be sure to provide a description of it. (See Section 7–3 or Section 8–4.)

Chapter 11 Survey: Distribute the following survey. Ask that each student complete it now. Collect the completed surveys. If there is time left, use the survey results to work with the concepts of Chapter 11 in the textbook. Here are some suggestions for issues to analyze:

- The four possible choices for a flat tire are selected with equal frequency.
- The tire identified as being flat is independent of the gender of the subject.
- Political party choice is independent of the gender of the subject.
- Political party choice is independent of whether the subject is right- or left-handed.
- The tire identified as being flat is independent of whether the subject is right- or left-handed.
- Gender is independent of whether the subject is right- or left-handed.
- Political party choice is independent of the tire identified as being flat.

Triola Survey

Please complete the survey and submit it now. Do not sign your name.

1. Identify the political party of your choice.

   _____Democrat _____Republican _____Other

2. Assume that you and three other students missed a test and that you all said that you got a flat tire when you were all driving to the test in the same car. Assume that on the makeup test, the professor asks you to identify the tire that went flat. If you did not really get a flat tire, which tire would you say went flat?

   _____Left front _____Right front

   _____ Left rear _____Right rear

3. Select one: _____Male _____Female

11-1 Goodness-of-Fit

Begin by reviewing *expected value*, introduced in Section 5-1. Present a few simple and obvious examples such as this one: Find the expected number of girls born in groups of 100 babies. When students respond with the correct answer of 50, ask them to describe the exact thought process that led to the answer. They will respond that they found 1/2 of 100, which can be generalized as $p \times n$, which leads to $E = np$. Also point out that the expected number of girls among 3 babies is 1.5, so the expected value need not be an integer.

Comment that the methods of this section require that each *expected frequency* must be at least 5, but there is no requirement that *observed frequencies* must be at least 5.

Lead the class to a development of their own reasoning process for why the tests of this section are all right-tailed. Ask the class these questions: If there are large discrepancies between the observed frequencies and those that are expected, what do we know about the values of $O - E$? The $(O - E)^2$ values? The value of the χ^2 test statistic? Where on the χ^2 distribution do *large* discrepancies fall?

Activity: Bring in a printout with current stock prices and collect a sample of their leading digits, then test the claim that those leading digits follow Benford's law. (See Table 11-4 in the textbook for the frequencies expected with Benford's law.) This example will also highlight the procedure for dealing with the more difficult cases in which the expected frequencies are not all the same.

Extra Example: A study was made of 147 industrial accidents that required medical attention. Among those accidents, 31 occurred on Monday, 42 on Tuesday, 18 on Wednesday, 25 on Thursday, and 31 on Friday (based on results from "Counted Data CUSUM's," by Lucas, *Technometrics,* Vol. 27, No. 2). Use a 0.05 significance level to test the claim that accidents occur with equal proportions on the five workdays.
(Answer: Test statistic is $\chi^2 = 10.653$. Critical value: $\chi^2 = 9.488$, assuming a 0.05 significance level. *P*-value = 0.0308. Reject the null hypothesis that the frequencies fit a uniform distribution. The accidents do not appear to occur with equal proportions of the five workdays.)

11-2 Contingency Tables

Note: Part 2 of this section now includes these topics:

- Test of Homogeneity
- Fisher's Exact Test
- McNemar's Test for Matched Pairs

The methods covered in Part 1 are used often in the analysis of survey results. When selecting the topics to be included in the introductory statistics course, Part 1 of Section 11-2 should be given a reasonably high priority. However, if inclusion of this topic requires that there would be no time for such important activities as group projects, then this topic should not be included.

The test statistic given in this section is the same as the one given in Section 11-1. The hypothesis tests of this section are all right-tailed, as in Section 11-1. Differences between this section and Section 11-1 are found in the method used for finding expected values *E* and the calculation of the number of degrees of freedom.

Activity: This activity is similar to the one for Section 11-1. Bring in a printout of current stock prices from two different exchanges, such as the New York Stock Exchange and NASDAQ. Use the leading digits of stock prices from the two different exchanges to construct a two-way table, and then use the methods of this section to test the claim that the leading digits are independent of the exchange.

Extra Example: In the judicial case *United States* v. *City of Chicago,* fair employment practices were challenged. A minority group (group A) and a majority group (group B) took the Fire Captain Examination. Assume that the study began with predetermined sample sizes of 24 minority candidates (Group A) and 562 majority candidates (Group B), with the results as shown in the table. At the 0.05 significance level, test the claim that the proportion of minority candidates who pass is the same as the proportion of majority candidates who pass. Based on the results, does the test appear to discriminate?

	Pass	Fail
Group A	10	14
Group B	417	145

(Answer: Test statistic is χ^2 = 12.321. Critical value is χ^2 =3.841. *P*-value = 0.0004. There is sufficient evidence to warrant rejection of the claim that the proportion of minority candidates who pass is the same as the proportion of majority candidates who pass. The test does appear to discriminate.)

Chapter 12

Begin by noting that due to the nature of the calculations, this chapter emphasizes the interpretation of displays from software or a TI-83/84 Plus calculator. This chapter can be covered without actually using any particular technology. If a technology is not available, simply use the exercises that already provide displayed results from computer software.

The recommended teaching strategy involves the interpretation of computer displays along with an understanding of basic theory by considering cases involving samples with the same number of values. The textbook suggests this strategy:

1. Understand that a small *P*-value (such as 0.05 or less) leads to rejection of the null hypothesis of equal means. [“If the *P* (value) is low, the null must go.”] With a large *P*-value (such as greater than 0.05), fail to reject the null hypothesis of equal means.
2. Develop an understanding of the underlying rationale by studying the examples in section 12-1.

Chapter 12 Survey: Distribute the following survey. Ask that each student complete it now. Collect the completed surveys. If there is time left, use the survey results to work with the concepts of Chapter 12 in the textbook. Here is a suggestion: Test the claim that the three samples of length estimates are from populations with the same mean.

Triola Survey

Please complete the survey and submit it now. Do not sign your name.

1. Estimate the length of the classroom in feet. __________

2. Select the category of the month of your birth:

_____January or February or March or April

_____May or June or July or August

_____September or October or November or December

12-1 One-Way ANOVA

Even if making extensive use of technology, a basic understanding of underlying principles is important. Carefully explain the content of the "Rationale" subsection. ***Recommendation:*** Unless sufficient time is available, discuss only the case of equal sample sizes, and omit reference to calculations with unequal sample sizes.

Part 2 (Calculations and Identifying Means that Are Different) is intended mainly for information purposes and can be easily omitted if there are time constraints. If Part 2 is discussed, note that Exercises 17 and 18 refer to the methods in Part 2, and both exercises have displayed results.

Activity: Do the first Cooperative Group Activity located near the end of the chapter.

Extra Example: The accompanying table lists the body temperatures of five randomly selected subjects from each of three different age groups. Use a 0.05 significance level to test the claim that the three age-group populations have the same mean body temperature.

Body Temperatures (^{o}F) Categorized by Age

18–20	21–29	30 and older
98.0	99.6	98.6
98.4	98.2	98.6
97.7	99.0	97.0
98.5	98.2	97.5
97.1	97.9	97.3

(Answer: Test statistic is F = 1.88. Critical value is F = 3.8853. P-value = 0.1949. Fail to reject H_0: $\mu_1 = \mu_2 = \mu_3$. There is not sufficient evidence to warrant rejection of the claim that the three age-group populations have the same mean body temperature.)

12-2 Two-Way ANOVA

This section focuses on the interpretation of displays obtained from technology.

Extra Example: Twelve different 4-cylinder cars were tested for highway fuel consumption (in mi/gal) after being driven under identical highway conditions; the results are listed in the table and accompanying Minitab display.

a. At the 0.05 significance level, test the claim that fuel consumption is not affected by an *interaction* between engine size and transmission type.

b. Assume that fuel consumption is not affected by an interaction between engine size and type of transmission. Use a 0.05 level of significance to test the claim that fuel consumption is not affected by engine size.

c. Assume that fuel consumption is not affected by an interaction between engine size and type of transmission. Use a 0.05 level of significance to test the claim that fuel consumption is not affected by type of transmission.

	Engine Size (liters)		
	1.5	**2.2**	**2.5**
Automatic Transmission	31, 32	28, 26	31, 23
Manual Transmission	33, 36	33, 30	27, 34

```
Analysis of Variance for MPG
Source        DF       SS        MS        F        P
Transmission   1     40.3      40.3     3.56    0.108
Engine         2     43.2      21.6     1.90    0.229
Interaction    2      1.2       0.6     0.05    0.950
Error          6     68.0      11.3
Total         11    152.7
```

(Answer:

a. Test statistic: F = 0.05. Critical value: F = 5.1433. P-value = 0.950. Fuel consumption does not appear to be affected by an interaction between transmission type and engine size.

b. Test statistic: F = 1.90. Critical value: F = 5.1433. P-value = 0.229. The size of the engine does not appear to have an effect on fuel consumption.

c. Test statistic: F = 3.56. Critical value: F = 5.9874. P-value = 0.108. The type of transmission does not appear to have an effect on fuel consumption.)

Chapter 13

If there are issues with the availability of time, this chapter can be omitted, but it does include some very important and practical topics.

This chapter can be covered separately as one block of procedures devoted to nonparametric methods, or individual sections of this chapter can be covered along with the related parametric methods found in the preceding chapters. Here is a guide that relates the nonparametric methods of this chapter to the corresponding parametric methods.

Nonparametric	↔	Parametric
13-2, 13-3	↔	9-3
13-4	↔	9-2
13-5	↔	12-1
13-6	↔	10-1

Chapter 13 Survey: Distribute the following survey. Ask that each student complete it now. Collect the completed surveys. If there is time left, use the survey results to work with the concepts of Chapter 13 in the textbook. Here are some suggestions:

- Use the sign test to test the claim that males and females have the same median pulse rate.
- Use rank correlation to test for a correlation between height and pulse rate.
- Use rank correlation to test for a correlation between height and navel height.
- Use rank correlation to test for a correlation between height and length of the right foot.
- Use rank correlation to test for a correlation between height and arm span.

Triola Survey

Please complete the survey and submit it now. Do not sign your name.

1. Select one: _____Male _____Female

2. Enter your height in inches: __________

3. Record your pulse rate by counting the number of heartbeats for one minute: _______________

4. What is your shoe size? __________

***Complete the following if a tape measure is available*.**

5. Measure your "navel height," which is the distance from the floor to your navel. ___________

6. Remove your right shoe and measure the length of your right foot. ___________

7. Measure your arm span by standing with your arms extended like the wings on an airplane, then measure the distance from the tip of your right hand to the tip of your left hand. __________

13-2 Sign Test

Point out that the sign test procedure is summarized in the flowchart of Figure 13-1 in the textbook. *Tricky Point:* Try to carefully discuss and clarify a very important component of Figure 13-1 in the textbook: the decision diamond that includes the question "Do the sample data contradict H_1?" Stress that although the flowchart might make it appear that the procedure is automatic, it is important to *think* about the sample data and the claim being tested. If the sample data *contradict* the alternative hypothesis H_1, then fail to reject the null hypothesis and there is no need to actually complete the steps of a formal sign test. For example, you need not formally test a claim that a coin favors heads if 100 tosses result in 48 heads. There is no way that we could ever support the claim of heads being favored if we get heads in fewer than 50% of the trials.

Activity: (This same activity was suggested for Section 9-3.) Have students measure their pulse rates (or recall it from a previous class), then ask them to again measure their pulse rates after standing for one minute. Each student should have a pair of matched data consisting of a sitting pulse rate and a standing pulse rate. Now use the sample data from the class to test the claim that the differences have a mean equal to 0.

Extra Example: In low-speed crash tests of five BMW cars, the repair costs were computed for a factory-authorized repair center and an independent repair facility. The results are listed in the accompanying table. Use the sign test with a 0.05 significance level to test the claim that the paired values have differences with a median equal to 0.

Authorized repair center	\$797	\$571	\$904	\$1147	\$418	\$1442
Independent repair center	\$523	\$488	\$875	\$911	\$297	\$898

(Answer: Test statistic is $x = 0$. Critical value is 0. Reject the null hypothesis that the median of the differences is equal to 0. There appears to be a significant difference between the costs from the two repair facilities.)

13-3 Wilcoxon Signed-Ranks Test for Matched Pairs

This procedure requires that you sort data, and then assign ranks. When working with larger data sets, sorting and ranking is tedious, but technology can be used to automate that process. Stem-and-leaf plots can also be very helpful in sorting data.

Because the methods of this section and the following section both involve names of "Wilcoxon," it is easy to confuse the two methods or to forget which method is appropriate for independent samples and which is appropriate for matched pairs. The textbook suggests that confusion can be avoided by using the Internal Revenue Service for the mnemonic of IRS to remind us of "**I**ndependent: **R**ank **S**um". That is, if the samples are independent, use the rank sum test. But the methods of this section involve matched pairs (instead of independent samples), so use the signed-ranks test.

Activity: Use the same activity suggested for Section 13-2

Extra Example: In low-speed crash tests of five BMW cars, the repair costs were computed for a factory-authorized repair center and an independent repair facility. The results are listed in the accompanying table. Use the sign test with a 0.05 significance level to test the claim that the paired values have differences with a median equal to 0.

Authorized repair center	\$797	\$571	\$904	\$1147	\$418	\$1442
Independent repair center	\$523	\$488	\$875	\$911	\$297	\$898

(Answer: Test statistic is $T = 0$. Critical value is 1. Reject the null hypothesis that the median of the differences is equal to 0. There appears to be a significant difference between the costs from the two repair facilities.)

13-4 Wilcoxon Rank-Sum Test for Two Independent Samples

The test described in this section is equivalent to the Mann-Whitney *U* test described in some other textbooks. Also, some technologies have a feature for the Mann-Whitney *U* test, so those features can be used for this section.

Activity: (This is the same activity suggested for Section 9-2.) Use the measured pulse rates from the class to test for a difference between the mean pulse rate of men and the mean pulse rate of women.

Extra Example: Listed below are weights (grams) of randomly selected M&M plain candies. Use a 0.05 significance level to test the claim that yellow M&Ms and brown M&Ms have the same median.

Yellow	0.883	0.769	0.859	0.784	0.824	0.858	0.848	0.851
Brown	0.696	0.876	0.855	0.806	0.840	0.868	0.859	0.982

(Answer: The first rank sum is 61.5, $\mu = 68$, $\sigma = 9.5219$. Test statistic is $z = -0.68$. Critical values are $z = -1.96$ and 1.96. *P*-value = 0.4949. Fail to reject the null hypothesis of equal medians. Yellow M&Ms and brown M&Ms appear to have weights with the same median.)

13-5 Kruskal-Wallis Test

This section deals with comparisons of three or more sets of sample data, so it could be covered along with Section 12-1 (ANOVA). The advantage of the Kruskal–Wallis test is that unlike the ANOVA methods of Section 12–1, there is no requirement that the populations have a normal distribution or any other particular distribution. If the class lacks sufficient time or energy to study analysis of variance, this section might be used as a quicker and easier alternative.

Extra Example: The accompanying table lists the body temperatures of five randomly selected subjects from each of three different age groups. Use a 0.05 significance level to test the claim that the three age-group populations have the same median body temperature.

Body Temperatures (ºF) Categorized by Age

18–20	21–29	30 and older
98.0	99.6	98.6
98.4	98.2	98.6
97.7	99.0	97.0
98.5	98.2	97.5
97.1	97.9	97.3

(Answer: The rank sums are 35, 52, 33. Test statistic is $H = 2.1800$. Critical value is 5.991. P-value = 0.3362. There is not sufficient evidence to warrant rejection of the claim that the three age-group populations have the same median body temperature.)

Activity: First, partition the students into three or four groups according to major or type of major (such as liberal arts, math or science, history or economics, and "other"). Then ask each student to estimate the length of the classroom. Collect the estimates and group them according to the different categories, then test the claim that the different groups will produce estimates with the same median.

13-6 Rank Correlation

Recommendation: Cover this section along with Section 10–1. Section 10–1 has a requirement of a normal distribution, but this section does not require a normal distribution or any other particular distribution.

Activity: Consider doing an in-class example with six pairs of data. Randomly select six students and use their pulse rates and heights. Test for a correlation between those two variables.

Extra Example: Many of us have heard that the tip should be 15% of the bill. The accompanying table lists some sample data collected from the author's students. Use the sample data and use the rank correlation coefficient to determine whether there is sufficient evidence to conclude that there is a relationship between the amount of the bill and the amount of the tip.

Bill ($)	33.46	50.68	87.92	98.84	63.60	107.34
Tip ($)	5.50	5.00	8.08	17.00	12.00	16.00

(Answer: Test statistic is $r_s = 0.829$. Critical values are –0.886 and 0.886, assuming a 0.05 significance level. Fail to reject the null hypothesis of no correlation. There does not appear to be correlation between the amount of the bill and the amount of the tip.)

13-7 Runs Test for Randomness

Really stress that the runs test for randomness is based on the *order* in which sample data occur. This is *not* a test to determine whether there is a *biased* sample with one group occurring disproportionately more often than the other group. The issue of bias could be addressed with other methods, such as the sign test or a parametric test based on proportions (as in Section 8-2 or 9-1).

Activity: Using the seating arrangement of the class, conduct a runs test for randomness in the way that males and females are seated.

Extra Example: A statistics professor observes that students enter her class in groups that appear to consist of mutual friends. She claims that the genders of students who enter her class are not in random order. Use the sample data below to test that claim.

F F F F F F M M F F F F F M M M M M M M M F F F F

(Answer: $n_1 = 15$, $n_2 = 10$, and there are 5 runs. Test statistic is $G = 5$. Critical values are 7 and 18. Reject the null hypothesis of randomness. There is sufficient evidence to support the claim that the order of the genders is not random.)

Chapter 14

This chapter is particularly important for students majoring in business or technology. Due to time constraints, not too many professors are able to include this chapter in their syllabus, and it can be easily omitted.

The decision to include this section might be affected somewhat by the technology that is being used in the course. Minitab, StatCrunch, and XLSTAT are ideal, because they are capable of automatically generating the graphs described in this chapter. If using no technology or a technology that is not designed to generate control charts, you can cover this chapter by simply using the displays that are available in the textbook.

Chapter 14 Survey: Partition the class into pairs. Number the pairs consecutively (Group 1, Group 2, Group 3, and so on). Both members of each pair should measure their individual pulse rates (number of beats in one minute) after standing then sitting a number of times corresponding to the group number. Both members of Group 1 should stand and then sit once, then measure their individual pulse rates. Both members of Group 2 should stand then sit twice, then measure their individual pulse rates. The pulse rates in Group 3 should be measured after standing and sitting three times, and so on.

Collect the completed surveys. If there is time left, use the survey results to work with the concepts of Chapter 14 in the textbook. Here are some suggestions:

- Construct, analyze, and interpret a run chart of the individual pulse rates listed in order according to group number.
- Construct, analyze, and interpret a range chart.
- Construct, analyze, and interpret an $\bar{x}$ chart.

Triola Survey

Please complete the survey and submit it now. Do not sign your name.

1. Enter your group number. __________

2. After standing and sitting a number of times corresponding to your Group number, record your pulse rate by counting the number of heartbeats for one minute: _______________

3. Using your pulse rate and the pulse rate from the other member of your group, find the range and enter it here. __________

4. Using your pulse rate and the pulse rate from the other member of your group, find the mean and enter it here. __________

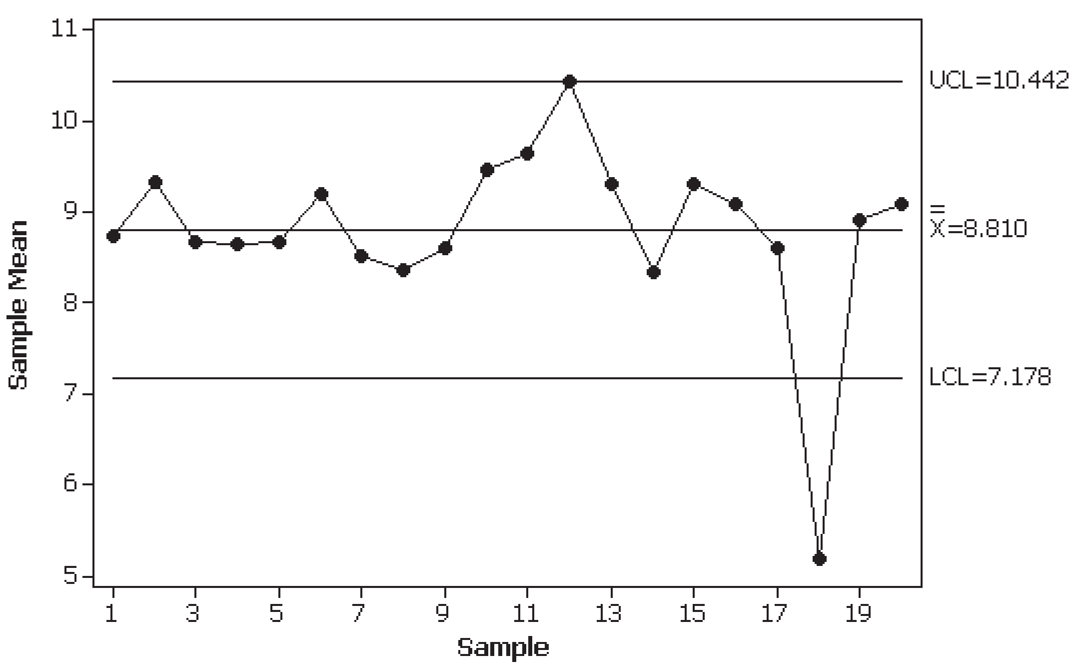
14-1 Control Charts for Variation and Mean

This section considers the following graphs.

1. Run charts
2. *R* Charts: Control charts to monitor the variation in a process
3. $\bar{x}$ Charts: Control charts to monitor a process mean.

Be sure to emphasize and clarify the fact that the control charts are based on *actual* behavior, not *desired* behavior. It is possible to have a manufacturing process in statistical control, but if that process is consistently filling 12 oz cans with only 4 oz of cola, then the process *specifications* are not being met.

Extra Example: The Battlecreek Battery Company manufactures 9 volt batteries. A battery is selected from the production run every 12 minutes, so there is a sample of 5 batteries each hour. The selected batteries are tested for their voltage levels. The $\bar{x}$ chart for 20 consecutive hours of production is given below. Examine that control chart and determine whether the process is within statistical control. (Answer: Production is out of control, because there is a point that lies below the lower control limit.)



14-2 Control Charts for Attributes

Point out that the examples and exercises in Section 14-2 assume that all samples have the same size *n*. There are ways to deal with unequal sample sizes, but we do not consider them in the textbook. (Minitab includes a procedure for automatically making adjustments for different sample sizes. See the *Minitab Manual*.)

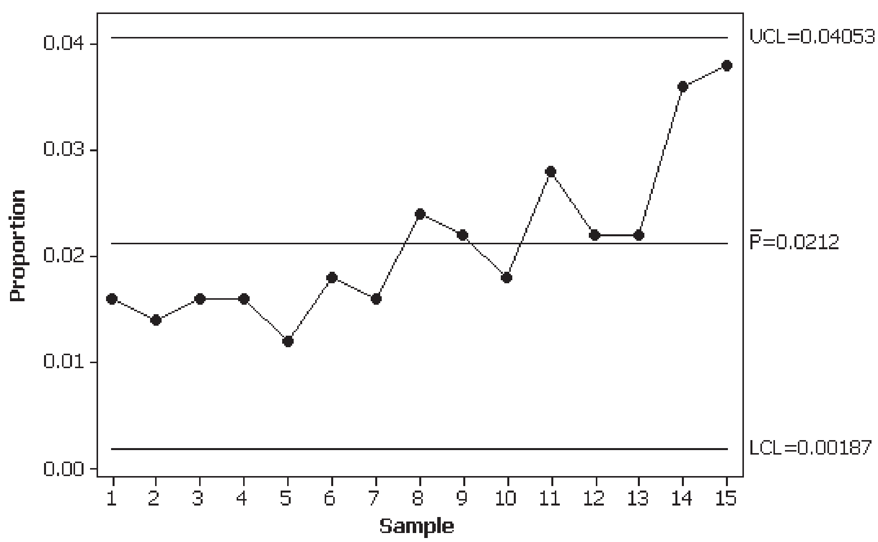
Also point out that the upper and lower control limits are essentially the same as confidence interval limits described in Section 7-1. The 95% confidence interval limits would use 1.96 instead of 3. The use of "3" corresponds to a confidence level of 99.7%.

Activity: If Chapter 14 is covered, it is probably covered closer to the end of the course, so there should be a record of attendance up to this point. Assume that the class size is constant and list the numbers of absences up to this point. Use a control chart to determine whether absences are in statistical control.

Extra Example: The Mighty Mouse Manufacturing Company manufactures 500 computer mice each day. Listed below are the numbers of defective mice on each of several consecutive days. Construct a control chart for the defect rate and determine whether production is within statistical control.

8 7 8 8 6 9 8 12 11 9 14 11 11 18 19

(Answer: The process is out of statistical control because there is an upward trend in the defect rate. The control chart is shown below.)



Chapter 15

Chapter 15 in the 13th edition of *Elementary Statistics* now includes only the topic of ethics. Instead of exercises similar in nature to those found in Chapters 1 through 14, this chapter includes ten discussion points.

Recommendation: Assign Chapter 15 for independent reading.

VI. Supplements, Videos, and Technology Resources

The student and instructor supplements packages are intended to be the most complete and helpful learning system available for the introductory statistics course. See the Preface in the textbook for detailed descriptions of the supplements. Instructors should contact their local Pearson sales representative for more information or to obtain some of these resources. Here are some of the available supplements:

Web site: www.TriolaStats.com Author web site that includes a wide variety of resources, such as the free Statdisk software, technology instructional videos, Appendix B data sets in a variety of different formats, textbooks supplements and more.

Supplements For Students

- **MathXL® for Statistics Online Course**
- ***MyStatLab Online Course for Elementary Statistics*, 13e**
- ***Student's Solutions Manual***
- ***Student Workbook for the Triola Statistics Series***

Supplements for Instructors

- ***Annotated Instructor's Edition***, by Mario F. Triola, contains answers to exercises in the margin, plus recommended assignments, and teaching suggestions.
- ***Instructor's Solutions Manual***
- ***Insider's Guide to Teaching with the Triola Statistics Series***
- ***TestGen®* Computerized Test Bank**
- ***PowerPoint® Lecture Slides***
- ***Learning Catalytics:*** A web-based "bring-your-own-device" direct response system, which serves as an engagement and assessment tool.

Video Resources

Video resources have been expanded and now supplement most sections in the book, with many topics presented by the author. This is an excellent resource for students who have missed class or wish to review a topic. It is also an excellent resource for instructors involved with distance learning, individual study, or self-paced learning programs. Videos also contain optional English and Spanish captioning. All videos are available through the MyStatLab online course.

- **Section Lecture Videos**
- **Chapter Review Exercise Videos** walk students through the exercises and help them understand key chapter concepts.
- **New! Technology Video Tutorials** These short, topical videos address how to use Excel, Statdisk, and the TI-83/84 Plus calculator to complete exercises.
- **StatTalk Videos:** 24 Conceptual videos to enhance understanding.

Technology Manuals

- *Excel Student Laboratory Manual and Workbook,*
- *MINITAB Student Laboratory Manual and Workbook,*
- *Graphing Calculator Manual for the TI-84 Plus, TI-84 Plus C and TI-84 Plus CE*
- *Statdisk Student Laboratory Manual and Workbook*
- *SPSS Student Laboratory Manual and Workbook*

Technology Resources Available at www.TriolaStats.com

- Statdisk: A free robust statistical program designed for the Triola Statistics Series.
- Downloadable Appendix B data sets in a variety of technology formats, including Minitab, SPSS, SAS, Excel, JMP, and text files.
- Downloadable textbook supplements including Glossary of Statistical Terms and Formulas and Tables.
- Online instructional videos created specifically for the 13th Edition that provide step-by-step technology instructions.
- Triola Blog which highlights current applications of statistics, statistics in the news and online resources.
- Contact link providing one-click access for instructors and students to contact the author, Marty Triola, with questions and comments.

Other Technology Resources

- **StatCrunch™**
  Full access to StatCrunch is available with a MyStatLab kit, and StatCrunch is available by itself to qualified adopters. StatCrunch Mobile is now available to access from your mobile device. For more information, visit our Web site at www.StatCrunch.com, or contact your Pearson representative.
- **Minitab® 17 and Minitab Express**
  Available for bundling.
- **JMP Student Edition Version 12**
  Available for bundling.

VII. General Teaching Tips

I. How to Be an Effective Teacher

(From David Royse, *Teaching Tips for College and University Instructors: A Practical Guide*, published by Allyn & Bacon, Boston, MA. © 2001 by Pearson Education, Inc. Adapted by permission of the publisher.)

A look at fifty years of research "on the way teachers teach and learners learn" reveals five broad principles of good teaching practice (Chickering and Gamson).

Five Principles of Good Teaching Practice

1. **Frequent student-faculty contact:** Faculty who are concerned about their students and their progress and who are perceived to be easy to talk to, serve to motivate and keep students involved.

   Things you can do to apply this principle:
   - Attend events sponsored by students.
   - Serve as a mentor or advisor to students.
   - Keep "open" or "drop-in" office hours.

2. **The encouragement of cooperation among students:** There is a wealth of research indicating that students benefit from the use of small-group and peer-learning instructional approaches.

   Things you can do to apply this principle:
   - Have students share in class their interests and backgrounds.
   - Create small groups to work on projects together.
   - Encourage students to study together.

3. **Prompt feedback:** Learning theory research has consistently shown that the quicker the feedback, the greater the learning.

   Things you can do to apply this principle:
   - Return quizzes and exams by the next class meeting.
   - Return homework within one week.
   - Provide students with detailed comments on their written papers.

4. **Emphasize time on task:** Use classroom and preparation time effectively and efficiently for the material being studied and applied. Faculty need good time-management skills.

   Things you can do to apply this principle:
   - Require students who miss class to make up lost work.
   - Require students to rehearse before making oral presentations.
   - Don't let class breaks stretch out too long.

5. **Communicating high expectations:** The key here is not to make the course impossibly difficult but to have goals that can be attained as long as individual learners stretch and work hard, going beyond what they already know.

   Things you can do to apply this principle:
   - Communicate expectations orally and in writing at the beginning of the course.
   - Explain the penalties for students who turn work in late.
   - Identify excellent work by students; display exemplars if possible.

> **✓ Tips for Thriving:**
> **Creating an Inclusive Classroom**
> How do you model an open, accepting attitude within your classroom where students will feel it is safe to engage in give-and-take discussions? First, view students as individuals instead of representatives of separate and distinct groups. Cultivate a climate that is respectful of diverse viewpoints, and don't allow ridicule, or defamatory or hurtful remarks. Try to encourage everyone in the class to participate, and be careful not to show favoritism.

II. Planning Your Course

(From David Royse, *Teaching Tips for College and University Instructor's: A Practical Guide,* published by Allyn & Bacon**,** Boston, MA. © 2001 by Pearson Education, Inc. Adapted by permission of the publisher.)

Constructing the syllabus: The syllabus should clearly communicate course objectives, assignments, required readings, and grading policies. Think of the syllabus as a stand-alone document. Those students who miss the first or second meeting of a class should be able to learn most of what they need to know about the requirements of the course from reading the syllabus. Start by collecting syllabi from colleagues who have recently taught the course you will be teaching and look for common threads and themes.

Problems to avoid: One mistake commonly made by educators teaching a course for the first time is that they may have rich and intricate visions of how they want students to demonstrate comprehension and synthesis of the material, but they somehow fail to convey this information to those enrolled. Check your syllabus to make sure your expectations have been fully articulated. Be very specific. Avoid vaguely worded instructions that can be misinterpreted.

✓ Tips for Thriving:
Visual Quality
Students today are highly visual learners, so you should give special emphasis to the visual quality of the materials you provide to students. Incorporate graphics into your syllabus and other course materials. Color-code your materials so material for different sections of the course use different color schemes.

III. Your First Class

(From Richard E. Lyons, Marcella L. Kysilka, & George E. Pawlas, *The Adjunct Professor's Guide to Success: Surviving and Thriving In The Classroom,* published by Allyn & Bacon, Boston, MA. © 1999 by Pearson Education, Inc. Adapted by permission of the publisher.)

Success in achieving a great start is almost always directly attributable to the quality and quantity of planning that has been invested by the course professor. If the first meeting of your class is to be successful, you should strive to achieve seven distinct goals.

Seven Goals for a Successful First Meeting

1. **Create a positive first impression:** Some communications experts make the claim that you have fewer than 10 seconds to create a positive image of yourself. Students are greatly influenced by the visual component; therefore, you must look the part of the professional professor. Dress as you would for a professional job interview. Greet each student entering the room. Be approachable and genuine.

2. **Introduce yourself effectively:** Communicate to students who you are and why you are credible as the teacher of the course. Seek to establish your approachability by "building common ground," such as stating your understanding of students' hectic lifestyles or their common preconceptions toward the subject matter.

3. **Clarify the goals and expectations:** Create a presentation that covers the course syllabus and defines the learning goals for each section of the syllabus. Articulate your expectations of the students in terms of behavior, deliverables and academic achievement. Provide clarification and elicit questions.

4. **Conduct an activity that introduces students to each other:** Students' chances of being able to complete a course effectively is enhanced if each comes to perceive the classmates as a "support network." The small amount of time you invest in an icebreaker will help create a positive classroom atmosphere and will pay additional dividends throughout the term.

5. **Learn students' names:** A student who is regularly addressed by name feels more valued, is invested more effectively in classroom discussion, and will approach the professor with questions and concerns.

6. **Whet students' appetite for the course material:** The textbook adopted for the course is critical to your success. Your first meeting should include a review of its approach, features, and sequencing. Explain to students what percentage of class tests will be derived from material from the textbook.

7. **Reassure students of the value of the course:** At the close of your first meeting, reassure students that the course will be a valuable learning experience and a wise investment of their time. Review the reasons why the course is a good investment: important and relevant content, interesting classmates, and a dynamic classroom environment.

IV. Strategies for Teaching and Learning

(From David Royse, *Teaching Tips for College and University Instructors: A Practical Guide,* published by Allyn & Bacon, Boston, MA. © 2001 by Pearson Education. Inc. Adapted by permission of the publisher.)

Team learning: The essential features of this small group learning approach, developed originally for use in large college classrooms are (1) relatively permanent heterogeneous task groups; (2) grading based on a combination of individual performance, group performance, and peer evaluation; (3) organization of the course so that the majority of class time is spent on small group activities; (4) a six-step instructional process similar to the following model:

1. Individual study of material outside of the class is assigned.
2. Individual testing is used (multiple-choice questions over homework at the beginning of class).
3. Groups discuss their answers and then are given a group test of the same items. They then get immediate feedback (answers).
4. Groups may prepare responses to feedback from answers to test items.
5. Feedback is given from instructor.
6. An application-oriented activity is assigned (e.g., a problem to be solved requiring input from all group members).

If you plan to use team learning in your class, inform students at the beginning of the course of your intentions to do so and explain the benefits of small group learning. Foster group cohesion by sitting groups together and letting them choose "identities" such as a team name or slogan. You will need to structure and supervise the groups and ensure that the projects build on newly acquired learning. Make the projects realistic and interesting and ensure that they are adequately structured so that each member's contribution is 25 percent. Students should be given criteria by which they can assess and evaluate the contributions of their peers on a project-by-project basis (Michaelsen, 1994).

✓ Tips for Thriving:

Active Learning and Lecturing

Lecturing is one of the most time-honored teaching methods, but does it have a place in an active learning environment? There are times when lecturing can be effective. Think about the following when planning a lecture:

Build interest: Capture your students' attention by leading off with an anecdote, topical real-world example, or cartoon.

Maximize understanding and retention: Use brief visual aids, handouts and demonstrations to enable your students to see as well as hear.

Involve students during the lecture: Interrupt the lecture occasionally to challenge students to answer spot quiz questions.

Reinforce the lecture: Give students a self-scoring review test at the end of the lecture.

V. Grading and Assessment Techniques

(From Philip C. Wankat, *The Effective, Efficient Professor: Teaching Scholarship And Service,* published by Allyn & Bacon, Boston, M. © 2002 by Pearson Education, Inc. Adapted by permission of the publisher.)

Philosophy of grading: Develop your own philosophy of grading by picturing in your mind the performance of typical A students, B students and so on. Try different grading methods until you find one that fits your philosophy and is reasonably fair. Always look closely at students on grade borders—take into account personal factors if the group is small. Be consistent with or slightly more generous than the procedure outlined in your syllabus.

Criterion grading: Professor Philip Wankat writes: "I currently use a form of criterion grading for my sophomore and junior courses. I list the scores in the syllabus that will guarantee the students A's, B's, and so forth. For example, a score of 85 to 100 guarantees an A; 75 to 85, a B; 65 to 75, a C; and 55 to 65, a D. If half the class gets above 85% they all get an A. This reduces competition and allows students to work together and help each other. The standard grade gives students something to aim for and tells them exactly what their grade is at any time. For students whose net scores are close to the borders at the end of the course, I look at other factors before deciding a final grade, such as attendance."

✓ Tips for Thriving:
Result Feedback
As stated earlier, feedback on results is the most effective of motivating factors. Anxious students are especially hungry for positive feedback. You can quickly and easily provide it by simply writing "Great job!" on the answer sheets or tests. For students who didn't perform well, a brief note such as "I'd love to talk with you at the end of class" can be especially reassuring. The key is to be proactive and maintain high standards, while requiring students to retain ownership of their success.

VI. Managing Problem Situations

(From Philip C. Wankat. *The Effective, Efficient Professor: Teaching, Scholarship And Service,* published by Allyn & Bacon, Boston, MA. © 2002 by Pearson Education, Inc. Adapted by permission of the publisher.)

Cheating: Cheating is one behavior that should not be tolerated. Tolerating cheating tends to make it worse. Prevention of cheating is much more effective than trying to cure it once it has occurred. A professor can prevent cheating by:

- Creating rapport with students
- Gaining a reputation for giving fair tests
- Giving clear instructions and guidelines before, during, and after tests
- Educating students on the ethics of plagiarism
- Requiring periodic progress reports and outlines before a paper is due

Try to develop exams that are perceived as fair and secure by students. Often, the accusation that certain questions were tricky is valid as it relates to ambiguous language and trivial material. Ask your mentor or an experienced instructor to closely review the final draft of your first few exams for these factors.

(From David Royse**,** *Teaching Tips for College and University Instructors: A Practical Guide,* published by Allyn & Bacon, Boston, MA. © 2001 by Pearson Education, Inc. Adapted by permission of the publisher.)

Unmotivated students: There are numerous reasons why students may not be motivated. The "required course" scenario is a likely explanation—although statistics could be your life's work, it is safe to assume that not everyone will share your enthusiasm. There are also personal reasons such as a death of a loved one or depression. Whenever you detect a pattern that you assume to be due to lack of motivation (e.g., missing classes, not handing assignments in on time, nonparticipation in class), arrange a time to have the student meet with you outside the classroom. Candidly express your concerns and then listen.

✓ Tips for Thriving:
Discipline
One effective method for dealing with some discipline problems is to ask the class for feedback (Angelo & Cross, 1993). In a one-minute quiz, ask the students, "What can I do to help you learn?" Collate the responses and present them to the class. If behavior such as excessive talking appears in some responses (e.g., "Tell students to stop talking in class") this gives you the backing to ask students to be quiet. Use of properly channeled peer pressure is often effective in controlling undesired behavior.

Motivating students is part of the faculty member's job. To increase motivation, professors should show enthusiasm for the topic, use various media and methods to present material, use humor in the classroom, employ activities that encourage active learning, and give frequent, positive feedback.

(From Sharon Baiocco, Jamie N. De Waters, *Successful College Teaching: Problem Solving Strategies of Distinguished Professors,* published by Allyn & Bacon, Boston, MA. © 1998 by Pearson Education, Inc. Adapted by permission of the publisher.)

Credibility problems: If you are an inexperienced instructor, you may have problems with students not taking you seriously. At the first class meeting, articulate clear rules of classroom decorum and conduct yourself with dignity and respect for students. Try to exude that you are in charge and are the "authority" and avoid trying to pose as the students' friend.

VII. Improving Your Performance

(From Richard E. Lyons, Marcella L. Kysilka & George E. Pawlas, *The Adjunct Professor's Guide to Success: Surviving and Thriving In The Classroom,* published by Allyn & Bacon, Boston, MA. © 1999 by Pearson Education, Inc. Adapted by permission of the publisher.)

Self-evaluation: The instructor who regularly engages in systematic self-evaluation will unquestionably derive greater reward from the formal methods of evaluation commonly employed by colleges and universities. One method for providing structure to an ongoing system of self-evaluation is to keep a journal of reflections on your teaching experiences. Regularly invest 15 or 20 introspective minutes following each class meeting to focus especially on the strategies and events in class that you feel could be improved. Committing your thoughts and emotions enables you to develop more effective habits, build confidence in your teaching performance, and make more effective comparisons later. The following questions will help guide self-assessment:

How do I typically begin a class?
Where/How do I position myself in the class?
How do I move in the classroom?
Where are my eyes usually focused?
Do I facilitate students' visual processing of course material?
Do I change the speed, volume, energy, and tone of my voice?
How do I ask questions of students?
How often, and when, do I smile or laugh in class?
How do I react when students are inattentive?
How do I react when students disagree or challenge what I say?
How do I typically end a class?

✓ Tips for Thriving:
Video-Recording Your Class

In recent years, a wide range of professionals have markedly improved their job performance by employing video recorders in their preparation efforts. As an instructor, an effective method might be to ask your mentor or another colleague to tape a 10-to 15-minute mini-lesson, then to debrief it using the assessment questions above. Critiquing a videotaped session provides objectivity and is therefore more likely to effect change. Involving a colleague as an informal coach will enable you to gain from their experience and perspective.

References

Ailes, R. (1996) *You are the message: Getting what you want by being who you are.* New York: Doubleday.

Chickering, A. W., & Gamson, Z. F. (1987) "Seven principles for good practice in undergraduate education." *AAHE Bulletin,* 39, *3-7.*

Michaelson, L. K. (1994). Team Learning: Making a case for the small-group option. In K. W. Prichard & R. M. Sawyer (Eds.), *Handbook of college teaching.* Westport, CT: Greenwood Press.

Sorcinelli, M. D. (1991). Research findings on the seven principles. In A.W. Chickering & Z. Gamson (eds.). "Applying the seven principles of good practice in undergraduate education." *New Directions for Teaching and Learning*. San Francisco: Jossey-Bass.

VIII. Suggested Course Syllabi

The following pages include five different suggested syllabi for the 13th Edition of *Elementary Statistics* or other books in the Triola Statistics Series. When selecting the sections to be included, consider assigning some sections as out-of-class independent work. For example, after covering confidence intervals in Chapter 7 and hypothesis tests in Chapter 8, consider assigning exercises from Chapter 9 (Inferences from Two Samples) without discussing Chapter 9 in class.

The Version A syllabus is designed for a more relaxed pace with greater opportunities to include technology, activities, and projects.

Note: The "class hour" referred to in the following course outlines consists of approximately one hour.

Changes Affecting the Syllabus

Chapter Objectives: All chapters now begin with a list of key learning goals for that chapter. *Chapter Objectives* replaces the former *Review and Preview* numbered section. The first numbered section of each chapter now covers a major topic.

New Subsection 1-3, Part 2: *Big Data and Missing Data: Too Much and Not Enough*

New Section 2-4: *Scatterplots, Correlation, and Regression*
The previous edition included scatterplots in Chapter 2, but this new section includes scatterplots in Part 1, the linear correlation coefficient *r* in Part 2, and linear regression in Part 3. These additions are intended to greatly facilitate coverage for those professors who prefer some early coverage of correlation and regression concepts. Chapter 10 continues to include these topics discussed with much greater detail. Choose between Syllabus Versions A or B with early light coverage of correlation and regression in Section 2-4 followed by more in-depth coverage later in Chapter 10, or Syllabus Version C by with early in-depth coverage of correlation and regression.

New Subsection 4-3, Part 3: *Bayes' Theorem*

New Section 7-4: *Bootstrapping: Using Technology for Estimates*

Combined Sections:

- **4-2: Addition Rule and Multiplication Rule**
  Combines 12th edition Section 4-3 (*Addition Rule*) and Section 4-4 (*Multiplication Rule: Basics*).
- **5-2: Binomial Probability Distributions**
  Combines 12th edition Section 5-3 (*Binomial Probability Distributions*) and Section 5-4 (*Parameters for Binomial Distributions*)

Removed Sections:
Section 15-2 (*Projects*) has been changed to an insert in the Instructor's Edition and has been moved to accompany the first set of *Cooperative Group Activities* in Chapter 1. Section 15-3 (*Procedures*) and Section 15-4 (*Perspectives*) have been removed.

Syllabus Version A: Relaxed Pace With Minimum Probability

Class Hour	Text Section	Topic
1	1-1	Statistical and Critical Thinking
2	1-2	Types of Data
3	1-3	Collecting Sample Data
4	2-1, 2-2	Frequency Distributions and Histograms
5	2-3	Graphs that Enlighten and Graphs that Deceive
6	2-4	Scatterplots, Correlation, and Regression
7	3-1	Measures of Center
8	3-2	Measures of Variation
9	3-2	Measures of Variation
10	3-3	Measures of Relative Standing and Boxplots
11	Ch. 1, 2, 3	Review
12	Ch. 1, 2, 3	Test 1
13	4-1	Basics Concepts of Probability
14	5-1	Probability Distributions
15	5-2	Binomial Probability Distributions
16	Ch. 4, 5	Review
17	Ch. 4, 5	Test 2
18	6-1	The Standard Normal Distribution
19	6-2	Real Applications of Normal Distributions
20	6-3	Sampling Distributions and Estimators
21	6-4	The Central Limit Theorem
22	6-5	Assessing Normality
23	7-1	Estimating a Population Proportion
24	7-1	Estimating a Population Proportion
25	7-2	Estimating a Population Mean
26	7-2	Estimating a Population Mean
27	7-4	Bootstrapping: Using Technology for Estimates
28	Ch. 6, 7	Review
29	Ch. 6, 7	Test 3
30	8-1	Basics of Hypothesis Testing
31	8-2	Testing a Claim about a Proportion
32	8-3	Testing a Claim about a Mean
33	8-3	Testing a Claim about a Mean
34	Ch. 8	Review
35	Ch. 8	Test 4
36	10-1	Correlation
37	10-2	Regression
38	11-2	Contingency Tables
39		Group Project Presentations
40		Group Project Presentations
41	Ch. 10, 11	Review
42	Ch. 10, 11	Test 5
43		Review for Comprehensive Final Exam
44		Review for Comprehensive Final Exam

Syllabus Version B

Class Hour	Text Section	Topic
1	1-1	Statistical and Critical Thinking
2	1-2	Types of Data
3	1-3	Collecting Sample Data
4	2-1, 2-2	Frequency Distributions and Histograms
5	2-3	Graphs that Enlighten and Graphs that Deceive
6	2-4	Scatterplots, Correlation, and Regression
7	3-1	Measures of Center
8	3-2	Measures of Variation
9	3-2	Measures of Variation
10	3-3	Measures of Relative Standing and Boxplots
11	Ch. 1, 2, 3	Review
12	Ch. 1, 2, 3	Test 1
13	4-1	Basics Concepts of Probability
14	4-2	Addition Rule and Multiplication Rule
15	5-1	Probability Distributions
16	5-2	Binomial Probability Distributions
17	Ch. 4, 5	Review
18	Ch. 4, 5	Test 2
19	6-1	The Standard Normal Distribution
20	6-2	Real Applications of Normal Distributions
21	6-3	Sampling Distributions and Estimators
22	6-4	The Central Limit Theorem
23	6-5	Assessing Normality
24	7-1	Estimating a Population Proportion
25	7-2	Estimating a Population Mean
26	7-2	Estimating a Population Mean
27	7-4	Bootstrapping: Using Technology for Estimates
28	Ch. 6, 7	Review
29	Ch. 6, 7	Test 3
30	8-1	Basics of Hypothesis Testing
31	8-2	Testing a Claim about a Proportion
32	8-3	Testing a Claim about a Mean
33	8-3	Testing a Claim about a Mean
34	Ch. 8	Review
35	Ch. 8	Test 4
36	10-1	Correlation
37	10-2	Regression
38	11-2	Contingency Tables
39		Group Project Presentations
40		Group Project Presentations
41	Ch. 10, 11	Review
42	Ch. 10, 11	Test 5
43		Review for Comprehensive Final Exam
44		Review for Comprehensive Final Exam

Syllabus Version C: Early In-Depth Coverage of Correlation and Regression

Class Hour	Text Section	Topic
1	1-1	Statistical and Critical Thinking
2	1-2	Types of Data
3	1-3	Collecting Sample Data
4	2-1, 2-2	Frequency Distributions and Histograms
5	2-3	Graphs that Enlighten and Graphs that Deceive
6	2-4	Scatterplots, Correlation, and Regression
7	10-1	Correlation
8	10-2	Regression
9	Ch. 1, 2, 10	Review
10	Ch. 1, 2, 10	Test 1
11	3-1	Measures of Center
12	3-2	Measures of Variation
13	3-2	Measures of Variation
14	3-3	Measures of Relative Standing and Boxplots
15	4-1	Basics Concepts of Probability
16	4-2	Addition Rule and Multiplication Rule
17	Ch. 3, 4	Review
18	Ch. 3, 4	Test 2
19	5-1	Probability Distributions
20	5-2	Binomial Probability Distributions
21	6-1	The Standard Normal Distribution
22	6-2	Real Applications of Normal Distributions
23	6-3	Sampling Distributions and Estimators
24	6-4	The Central Limit Theorem
25	6-5	Assessing Normality
26	Ch. 5, 6	Review
27	Ch. 5, 6	Test 3
28	7-1	Estimating a Population Proportion
29	7-2	Estimating a Population Mean
30	7-2	Estimating a Population Mean
31	7-4	Bootstrapping: Using Technology for Estimates
32	8-1	Basics of Hypothesis Testing
33	8-2	Testing a Claim about a Proportion
34	8-3	Testing a Claim about a Mean
35	8-3	Testing a Claim about a Mean
36	Ch. 7, 8	Review
37	Ch. 7, 8	Test 4
38	9-1	Two-Proportions
39	9-2	Two-Means: Independent Samples
40	11-2	Contingency Tables
41	Ch. 9, 11	Quiz on Sections 9-1, 9-2, and 11-2
42		Group Project Presentations
43		Group Project Presentations
44		Review for Comprehensive Final Exam

Syllabus Version D: Integration of Some Nonparametric Statistics

Class Hour	Text Section	Topic
1	1-1	Statistical and Critical Thinking
2	1-2	Types of Data
3	1-3	Collecting Sample Data
4	**13-7**	**Runs Test for Randomness**
5	2-1, 2-2	Frequency Distributions and Histograms
6	2-3	Graphs that Enlighten and Graphs that Deceive
7	2-4	Scatterplots, Correlation, and Regression
8	3-1	Measures of Center
9	3-2	Measures of Variation
10	3-2	Measures of Variation
11	3-3	Measures of Relative Standing and Boxplots
12	Ch. 1, 2, 3	Review
13	Ch. 1, 2, 3	Test 1
14	4-1	Basics Concepts of Probability
15	4-2	Addition Rule and Multiplication Rule
16	5-1	Probability Distributions
17	5-2	Binomial Probability Distributions
18	Ch. 4, 5	Review
19	Ch. 4, 5	Test 2
20	6-1	The Standard Normal Distribution
21	6-2	Real Applications of Normal Distributions
22	6-3	Sampling Distributions and Estimators
23	6-4	The Central Limit Theorem
24	6-5	Assessing Normality
25	7-1	Estimating a Population Proportion
26	7-2	Estimating a Population Mean
27	7-2	Estimating a Population Mean
28	7-4	Bootstrapping: Using Technology for Estimates
29	Ch. 6, 7	Review
30	Ch. 6, 7	Test 3
31	8-1	Basics of Hypothesis Testing
32	8-2	Testing a Claim about a Proportion
33	8-3	Testing a Claim about a Mean
34	Ch. 8	Review
35	Ch. 8	Test 4
36	10-1	Correlation
37	10-2	Regression
38	**13-6**	**Rank Correlation**
39	**13-3**	**Wilcoxon Signed-Ranks Test**
40	**13-5**	**Kruskal-Wallis Test**
41	Ch. 10, 13	Review
42	Ch. 10, 13	Test 4
43		Group Project Presentations
44		Group Project Presentations
45		Review for Comprehensive Final Exam

Syllabus Version E: Two-Semester Course

A two-semester sequence of statistics courses allows for more time to better incorporate computer usage, cooperative group activities and projects, and simulation techniques in probability

First Semester

Chapter 1 (Sections 1-1 through 1-3):	4 classes
Chapter 2 (Sections 2-1 through 2-4):	3 classes
Chapter 3 (Sections 3-1 through 3-3):	5 classes
Chapter 4 (Sections 4-1 through 4-5):	6 classes
Chapter 5 (Sections 5-1 through 5-3):	5 classes
Chapter 6 (Sections 6-1 through 6-6):	6 classes
Chapter 7 (Sections 7-1 through 7-4):	6 classes
Chapter 8 (Sections 8-1 through 8-4):	7 classes

Second Semester

Chapter 9 (Sections 9-1 through 9-4):	8 classes
Chapter 10 (Sections 10-1 through 10-5):	10 classes
Chapter 11 (Sections 11-1 and 11-2):	5 classes
Chapter 12 (Sections 12-1 and 12-2):	6 classes
Chapter 13 (Sections 13-1 through 13-7):	5 classes
Chapter 14 (Sections 14-1 and 14-2):	6 classes
Chapter 15	2 classes

IX. Transition Guide
from Triola's Elementary Statistics, 12th edition to Triola's Elementary Statistics, 13th edition

Terminology

Significant: References in the previous edition to "unusual" outcomes are now described in terms of "significantly low" or "significantly high," so that the link to hypothesis testing is further reinforced.

Multiplication Counting Rule: References in Section 4-4 (*Counting*) to the "fundamental counting rule" now use "multiplication counting rule" so that the name of the rule better suggests how it is applied.

Organization Changes from 12th Edition to 13th Edition

New Chapter Objectives: All chapters now begin with a list of key learning goals for that chapter. *Chapter Objectives* replaces the former *Review and Preview* numbered section. The first numbered section of each chapter now covers a major topic.

New Subsection 1-3, Part 2: *Big Data and Missing Data: Too Much and Not Enough*

New Section 2-4: *Scatterplots, Correlation, and Regression*
The previous edition included scatterplots in Chapter 2, but this new section includes scatterplots in Part 1, the linear correlation coefficient r in Part 2, and linear regression in Part 3. These additions are intended to greatly facilitate coverage for those professors who prefer some early coverage of correlation and regression concepts. Chapter 10 continues to include these topics discussed with much greater detail.

New Subsection 4-3, Part 3: *Bayes' Theorem*

New Section 7-4: *Bootstrapping: Using Technology for Estimates*

Combined Sections:

- **4-2: Addition Rule and Multiplication Rule**
  Combines 12th edition Section 4-3 (*Addition Rule*) and Section 4-4 (*Multiplication Rule: Basics*).
- **5-2: Binomial Probability Distributions**
  Combines 12th edition Section 5-3 (*Binomial Probability Distributions*) and Section 5-4 (*Parameters for Binomial Distributions*)

Removed Sections:
Section 15-2 (*Projects*) has been changed to an insert in the Instructor's Edition and has been moved to accompany the first set of *Cooperative Group Activities* in Chapter 1. Section 15-3 (*Procedures*) and Section 15-4 (*Perspectives*) have been removed.

Early Coverage of Correlation and Regression: Some instructors prefer to cover the basics of correlation and regression early in the course. Section 2-4 now includes basic concepts of scatterplots, correlation, and regression without the use of formulas and greater depth found in Sections 10-1 (*Correlation*) and 10-2 (*Regression*).

Minimum Probability: Some instructors prefer extensive coverage of probability, while others prefer to include only basic concepts. Instructors preferring minimum coverage can include Section 4-1 while skipping the remaining sections of Chapter 4, as they are not essential for the chapters that follow. Many instructors prefer to cover the fundamentals of probability along with the basics of the addition rule and multiplication rule (Section 4-2).

New Examples and Exercises

The following table summarizes the status of new material in the 13th edition.

	Number	New to This Edition	Use Real Data
Exercises	1756	81% (1427)	92% (1618)
Examples	211	73% (153)	94% (198)
Chapter Problems	14	93% (13)	100% (14)

Conversion Guide: 11th Edition to 12th Edition

The following two pages provide a conversion guide between sections in the Twelfth Edition of *Elementary Statistics* and the Thirteenth Edition of *Elementary Statistics*.

***Elementary Statistics*, 12e**	***Elementary Statistics*, 13e**
1-1 Review and Preview	
1-2 Statistical and Critical Thinking	1-1 Statistical and Critical Thinking
1-3 Types of Data	1-2 Types of Data
1-4 Collecting Sample Data	1-3 Collecting Sample Data
2-1 Review and Preview	
2-2 Frequency Distributions	2-1 Frequency Distributions for Organizing and Summarizing Data
2-3 Histograms	2-2 Histograms
2-4 Graphs that Enlighten and Graphs that Deceive	2-3 Graphs That Enlighten and Graphs That Deceive
	2-4 Scatterplots, Correlation, and Regression
3-1 Review and Preview	
3-2 Measures of Center	3-1 Measures of Center
3-3 Measures of Variation	3-2 Measures of Variation
3-4 Measures of Relative Standing and Boxplots	3-3 Measures of Relative Standing and Boxplots
4-1 Review and Preview	
4-2 Basic Concept of Probability	4-1 Basic Concepts of Probability
4-3 Addition Rule	**4-2 Addition Rule and Multiplication Rule**
4-4 Multiplication Rule: Basics	
4-5 Multiplication Rule: Complements and Conditional Probability	4-3 Complements, Conditional Probability, and **Bayes' Theorem**
4-6 Counting	4-4 Counting
4-7 Probabilities Through Simulations (CD-ROM)	4-5 Probabilities Through Simulations (*download only*)
4-8 Bayes' Theorem (on CD-ROM)	
5-1 Review and Preview	
5-2 Probability Distributions	5-1 Probability Distributions
5-3 Binomial Probability Distributions	5-2 Binomial Probability Distributions
5-4 Parameters for Binomial Probability Distributions	
5-5 Poisson Probability Distributions	5-3 Poisson Probability Distributions
6-1 Review and Preview	
6-2 The Standard Normal Distribution	6-1 The Standard Normal Distribution
6-3 Applications of Normal Distributions	6-2 Real Applications of Normal Distributions
6-4 Sampling Dist's. and Estimators	6-3 Sampling Distributions and Estimators
6-5 Central Limit Theorem	6-4 Central Limit Theorem
6-6 Assessing Normality	6-5 Assessing Normality
6-7 Normal as Approximation to Binomial	6-6 Normal as Approximation to Binomial
7-1 Review and Preview	
7-2 Estimating a Population Proportion	7-1 Estimating a Population Proportion
7-3 Estimating a Population Mean	7-2 Estimating a Population Mean
7-4 Estimating a Population Standard Deviation or Variance	7-3 Estimating a Population Standard Deviation or Variance
	7-4 Bootstrapping: Using Technology for Estimates
8-1 Review and Preview	
8-2 Basics of Hypothesis Testing	8-1 Basics of Hypothesis Testing
8-3 Testing a Claim About a Proportion	8-2 Testing a Claim About a Proportion
8-4 Testing a Claim About a Mean	8-3 Testing a Claim About a Mean
8-5 Testing a Claim About a Standard Deviation or Variance	8-4 Testing a Claim About a Standard Deviation or Variance

Elementary Statistics, 12e	*Elementary Statistics*, 13e
9-1 Review and Preview	
9-2 Two Proportions	9-1 Two Proportions
9-3 Two Means: Independent Samples	9-2 Two Means: Independent Samples
9-4 Two Dependent Samples (Matched Pairs)	9-3 Two Dependent Samples (Matched Pairs)
9-5 Two Variances or Standard Deviations	9-4 Two Variances or Standard Deviations
10-1 Review and Preview	
10-2 Correlation	10-1 Correlation
10-3 Regression	10-2 Regression
10-4 Prediction Intervals and Variation	10-3 Prediction Intervals and Variation
10-5 Multiple Regression	10-4 Multiple Regression
10-6 Nonlinear Regression	10-5 Nonlinear Regression
11-1 Review and Preview	
11-2 Goodness-of-Fit	11-1 Goodness-of-Fit
11-3 Contingency Tables	11-2 Contingency Tables
12-1 Review and Preview	
12-2 One-Way ANOVA	12-1 One-Way ANOVA
12-3 Two-Way ANOVA	12-2 Two-Way ANOVA
13-1 Review and Preview	13-1 Basics of Nonparametric Tests
13-2 Sign Test	13-2 Sign Test
13-3 Wilcoxon Signed-Ranks Test for Matched Pairs	13-3 Wilcoxon Signed-Ranks Test for Matched Pairs
13-4 Wilcoxon Rank-Sum Test for Two Independent Samples	13-4 Wilcoxon Rank-Sum Test for Two Independent Samples
13-5 Kruskal-Wallis Test	13-5 Kruskal-Wallis Test for Three or More Samples
13-6 Rank Correlation	13-6 Rank Correlation
13-7 Runs Test for Randomness	13-7 Runs Test for Randomness
14-1 Review and Preview	
14-2 Control Charts for Variation and Mean	14-1 Control Charts for Variation and Mean
14-3 Control Charts for Attributes	14-2 Control Charts for Attributes
15-1 Ethics in Statistics	15-1 Ethics in Statistics
15-2 Projects	
15-3 Procedures	
15-4 Perspectives	