Chapter 3

1. Morningstar <http://news.morningstar.com/fund-category-returns/> has data on the total returns (dividends plus capital gains) for mutual funds in various fund categories (e.g., U. S. Equity Small Value). Pick one of the nine categories under U. S. Equity Funds and select one of the horizons; e.g., YTD (year to date). Click on the fund category and you will be taken to a page with the returns for all funds in that category. You should be able to cut-and-paste all of the returns into a spreadsheet or SSP. Summarize your data with a boxplot and histogram, and compare the mean and median return for the funds in your sample to the return for the S&P 500 index that year. Also calculate the fractions of your sample that are within one and two standard deviations of the mean return for your data. (You can use a different source of mutual fund returns if you like.)
2. Go to a local grocery store and collect these data for at least 75 breakfast cereals: cereal name; grams of sugar per serving; and the shelf location (bottom, middle, or top). If the store that you select does not have at least 75 breakfast cereals, then collect data from another store too. Group the data by shelf location and use three boxplots to compare the sugar content by shelf location.
3. At a local grocery store, identify two categories of chips; (for example, potato chips and tortilla chips), and in each category find the grams of fat and the milligrams of sodium per serving on the nutritional labels of at least ten different varieties. (Do not include any low-fat or low-salt brands.) Use two boxplots to compare the fat in these two categories; do the same with the sodium data.
4. Go to a local grocery store and collect data for at least 20 different soups from each of two major soup makers; for example, Campbell's and Progresso. For each of these soups, record the per-serving amounts of calories, fat, and sodium. Summarize these data.
5. Display some interesting data from the most recent *U. S. News & World Report* college rankings (or a similar source); for example, the distribution of resources/spending per student.
6. Summarize and display some cross-section or time series data on deaths due to COVID-19.
7. The real interest rate is (approximately) equal to the nominal (dollar) interest rate minus the rate of inflation. Some people argue that inflation and the interest rates on Treasury bonds move up and down together so that the real interest rates are constant. Summarize and display some data that might shed light on this assertion. (One data source is https://fred.stlouisfed.org/.)
8. Some people argue that the real inflation-adjusted interest rates on Treasury bonds are constant. The returns from Treasury Inflation-Protected Securities, or TIPS, are adjusted for inflation so that the quoted interest rates are real interest rates. Summarize and display some TIPS data that might indicate whether real interest rates are constant. (One data source is https://fred.stlouisfed.org/.)
9. Summarize and display data on the calories, fat, and salt equivalent in a McDonald's Big Mac in at least 20 countries, such as the US, UK, Canada, Chile, Japan, Israel, and Turkey.
10. Summarize and display data on the seasonally adjusted unemployment rate in the UK since 1855. (One data source is https://fred.stlouisfed.org/.)
11. Summarize and display data on the Consol (Long-term bond) yields in the United Kingdom since 1753. (One data source is https://fred.stlouisfed.org/.)
12. Summarize and display data on the monthly percentage changes in the Share Price Index (Weighted by Market Capitalisation) in the United Kingdom since 1709. (One data source is https://fred.stlouisfed.org/.)
13. Compare the monthly percentage changes since 1914 in the Share Price Index (Weighted by Market Capitalisation) in the United Kingdom and the Dow-Jones Industrial Stock Price Index for United States. (One data source is https://fred.stlouisfed.org/.)
14. Compare the monthly changes in the seasonally adjusted Case-Shiller NV-Las Vegas, TX-Dallas, and FL-Miami Home Price Indexes. (One data source is https://fred.stlouisfed.org/.)
15. Compare the monthly changes in the seasonally adjusted Case-Shiller CA-Los Angeles, CA-San Diego, and CA-San Francisco Home Price Indexes. (One data source is https://fred.stlouisfed.org/.)
16. Compare the monthly changes in the seasonally adjusted Case-Shiller CA-San Francisco, MA-Boston, and

NY-New York Home Price Indexes. (One data source is https://fred.stlouisfed.org/.)

Chapter 5

1. Flip a coin 200 times (use a real coin, not a computer simulation). Divide your results into 20 groups of 10 flips, and count the number of heads in each of these 20 groups. How often did you get ten heads in ten flips? Nine heads? And so on. Use a histogram to summarize your results. Now identify the longest streak of consecutive heads or consecutive tails in each of these 20 groups. How often did you get a streak of 10? A streak of 9? And so on. Use a histogram to summarize your results.
2. http://www.baseball-reference.com/ has detailed historical statistics for Major League Baseball (MLB) players. Select a completed season and identify the players who had at least 502 times at bat that season (the minimum required to qualify for season batting awards). Find the batting averages and wins above replacement (WAR) for each of these players. Display your data in histograms and calculate the means and standard deviations. What fractions of the batting averages and WARs are within one, two, and three standard deviations of the mean? (You can use a different source of baseball data if you like.)
3. http://www.baseball-reference.com/ has detailed historical statistics for Major League Baseball (MLB) players. Select a completed season and identify the players who pitched at least 162 times innings that season (the minimum required to qualify for season pitching awards). Find the earned run averages (ERA) and wins above replacement (WAR) for each of these players. Display your data in histograms and calculate the means and and standard deviations. What fractions of the ERAs and WARs are within one, two, and three standard deviations of the mean? (You can use a different source of baseball data if you like.)
4. http://www.baseball-reference.com/ has detailed historical statistics for Major League Baseball (MLB) players. One way to compare outstanding players from different historical periods is to see how many standard deviations each player's performance was from the average performance that year. Considering only the batting averages and wins above replacement (WAR) of players who had at least 502 times at bat that season (the minimum number required to qualify for season batting awards), compare Miguel Cabrera's performance in 2015, Tony Gwynn's performance in 1996, and Ted Williams in 1941.
5. http://www.baseball-reference.com/ has detailed historical statistics for Major League Baseball (MLB) players. One way to compare outstanding players from different historical periods is to see how many standard deviations each player's performance was from the average performance that year. Considering only the earned run averages (ERA) and wins above replacement (WAR) of players who pitched at least 162 innings that season (the minimum required to qualify for season pitching awards), compare Zack Greinke's performance in 2015, Greg Maddux's performance in 1995, and Sandy Koufax in 1966.
6. Look at http://www.baseball-reference.com/ or mlb.mlb.com for the most recently completed major league baseball season and identify the two players in the American League and the two players in the National League who hit the most home runs that season. For each of these players, use the data for the three most recent seasons to estimate the probability p that this player will hit a home run during a time at bat. Also use your data for each of these four players over all three seasons to estimate the average number of times at bat n during a season. Now, assuming the binomial model is appropriate, use your estimates of p and n to estimate each player's chances of hitting more than Roger Maris' record of 61 home runs in a season.
7. Stock returns are the *product* of returns over shorter horizons. The logarithm of returns is the *sum* of the returns over shorter horizons and may be governed by the normal distribution. Roll two standard 6-sided dice 200 times and record the product of the numbers on the two dice. Now calculate the natural logarithm of each of these 200 products and display your results in a histogram.
8. You offer a friend a choice of three bags—one containing a candy bar or some other desirable prize and the other two bags containing ABC (Already Been Chewed) gum. You know which bag contains the good prize, but your friend does not. After your friend picks a bag (and before looking inside), show your friend one of the bags that was not picked that contains ABC gum and asks your friend if they want to change

their choice. Play this game with a large number of friends and record: (a) how often people switch; and (b) how often they would have won if they had switched.

9. Mr. Smith is walking with his daughter and has a second child at home. It has been argued that the probability that the child at home is a girl is either one-third or one-half. What do you think? Gather your own data by asking a large number of people how many siblings they have. If they have one sibling, record the sex of the person and the sibling. Is the frequency with which the sexes are the same closer to one-third or one-half?
10. You have three cards: one black on both sides, one white on both sides, and one white on one side and black on the other side. After the three cards are shuffled and dropped into an empty bag, you pull one card out and look at one side of the card. What is the probability that the back of the card is the same color as the front of the card? Play this game a large number of times and see if your results confirm or contradict your expectations.

Chapter 6

1. Estimate the percentage of the seniors at your college who regularly follow the daily news, the percentage that can name the two U.S. senators from their home state, the percentage who are registered to vote, and the percentage who would almost certainly vote if a presidential election were held today.
2. Among seniors at your school who are looking for jobs, estimate the average annual salary they expect to earn their first year. Do not include moving allowances or other one-time benefits.
3. A study by Camilla Benbow and Julian Stanley of children younger than 14 who scored 700 or higher on the math SAT found that 20 percent were left handed, as compared to 8 percent of the entire population. Estimate the fraction of students at your school who are left handed.
4. A study by Camilla Benbow and Julian Stanley of children younger than 14 who scored 700 or higher on the math SAT found that 20 percent were left handed, as compared to 8 percent of the entire population. Estimate the fraction of faculty at your school who are left handed.
5. Ask at least 50 randomly selected college students whether they expect to receive more or less money from Social Security than their parents will receive. Also ask them how much monthly benefits they expect to receive (in today's dollars) Discarding those who say they will receive the same amount as their parents, estimate the overall percentage of students who believe they will receive more than their parents. Also estimate the average monthly benefit that students expect to receive.
6. College students are said to experience the Frosh 15—an average weight gain of 15 pounds during their first year at college. Test this folklore by asking at least 100 randomly selected students how much weight they gained or lost during their first year at college. Estimate a 95 percent confidence interval for the population mean.
7. People experiencing an earthquake often grossly overestimate how long the quake lasts; for example reporting that a 6-second quake lasted 30 seconds. Show a random sample of students a memorable event, such a snippet of loud music or you dancing, and then ask them how long this event lasted. Do your data indicate that people are more likely to underestimate or overestimate how long the event lasted?
8. Persi Diaconis, a famous mathematician, claims that a spun penny will land tails about 80% of the time. Put a clean Lincoln penny on a flat surface and hold the coin on its edge with one finger. Then flick the coin with a finger on your other hand. Repeat this experiment 100 times and estimate a 95% confidence interval for the probability that a spun penny will land tails. https://www.business-standard.com/article/pti-stories/guessing-heads-or-tails-isn-t-really-a-50-50-game-study-112120300282_1.html; https://www.smithsonianmag.com/science-nature/gamblers-take-note-the-odds-in-a-coin-flip-arent-quite-5050-145465423/
9. Tell someone that you randomly selected a major league baseball player who happened to have gotten 174 base hits in 612 times at bat, a 0.284 batting average. Ask them to estimate a range for the probability that this player will get a base hit in his next time at bat, such that they are 95% sure that the true probability of

this player getting a base hit is inside this range. Compare this to the actual 95% confidence interval, assuming that batting can be described by the binomial distribution.

10. Assemble a very large number of marbles, slips of paper, or other objects that are of two different colors or other features. For example, suppose that you have a very large number of marbles, of which 70% are red and 30% are blue. Place the marbles inside a closed bag or box and allow someone to reach into the bag or box and withdraw ten marbles and then, based on their results, estimate a range for the fraction of all marbles that are red (or blue), such that they are 95% sure that the true percentage is inside this range. Use this calculator <https://statpages.info/confint.html> to determine the exact 95% confidence interval. Repeat this experiment at least 20 times and see how often the ranges by the participants included the true percentage.
11. Show someone a large transparent jar of pebbles, jelly beans, or other small objects and ask them to estimate a range for the number of objects in the jar, such that they are 95% sure that the actual number of objects is in this range. Repeat this experiment at least 20 times. How often did the specified ranges include the actual number of objects?
12. Show someone a large transparent jar of pebbles, jelly beans, or other small objects and ask them to estimate the number of objects in the jar. Repeat this experiment at least 50 times. Does a 95% confidence interval include the actual number of objects? How many individuals made guesses that were more accurate than the average of all the guesses?
13. Have 10 or more friends stand in a line outside a closed door, with you stationed as the last person in line. Tell your friends standing in line that if anyone asks why they are waiting in line, they should say, “I don’t know. I just saw this line and figured it must be something good.” Estimate the probability that a person who is told this answer will join the line.

Chapter 7

1. Find someone who claims to have extrasensory perception (ESP) and test this claim.
2. Morningstar <http://news.morningstar.com/fund-category-returns/> has data on the total returns (dividends plus capital gains) for mutual funds in various fund categories (e.g., U. S. Equity Small Value). Pick one of the nine categories under U. S. Equity Funds and select one of the horizons; e.g., YTD (year to date). Click on the fund category and you will be taken to a page with the returns for all funds in that category. You should be able to cut-and-paste all of the returns into a spreadsheet or SSP. Now determine the two-sided P-value for a test of the null hypothesis that these data were drawn from a population with a mean equal to the return on the S&P 500 index over this horizon. (Make sure that your S&P 500 return is not just the change in the S&P, but the S&P return, dividends plus capital gains.) Also use these data to determine the two-sided P-value for a test of the null hypothesis that a randomly selected mutual fund has a 0.5 probability of doing better than the S&P 500 index.
3. A high school basketball coach said that a missed free throw by a right-handed shooter is more likely to bounce to the right, while the reverse if true of a left-hander. To investigate this claim, find five avid basketball players and ask each of them to shoot 100 free throws. Do not tell them the purpose of this experiment, which is to determine if a missed free throw is equally likely to bounce to the same or opposite side as their shooting hand.Use your data to calculate the two-sided P-value for testing the null hypothesis that missed free throws are equally likely to bounce to either side.
4. Young children who play ice hockey are separated by age. In 1991, for example, children born in 1984 were placed in the 7-year-old league and children born in 1983 were placed in the 8-year-old league. A student with a December 11 birthday observed that children with birth dates early in the year are months older than those with later birth dates—someone born in January 1984 is eleven months older than someone born in December 1984. Because coaches give more attention and playing time to better players, this student suspected that children with early birth dates have an advantage when they are young that might cumulate over the years. To test this theory, he looked at the birth dates of 1,487 National Hockey

League (NHL) players in 1991 and found that 934 of these players had birth dates during the first six months of the year. Test his theory using data for another group of professional athletes; for example, male or female soccer players.

5. Calculate the percentage change in the Dow Jones Industrial Average from the close on Thursday the 12th to the close on Friday the 13th for every Friday the 13th beginning in 1980. Is the average percentage change substantial? Determine the two-sided p value for a test of the null hypothesis that the mean percentage change is 0.
6. The Santa Claus Rally claims that the stock market does unusually well the week before Christmas, December 18 through December 24. A variation is that the market does unusually well the week after Christmas, December 26 through January 1. Test each of these two theories with data on the daily percentage changes in the S&P 500 over the past 20 years.
7. Use a single newspaper or national news magazine to collect pictures of the winner of a presidential election, some printed a month before the election and an equal number printed a month after the election. All the pictures should be from the same newspaper or magazine and be full face shots of approximately equal sizes. Do not otherwise screen the photos for being attractive or unattractive. Ask a random sample of students to pick the photo that they consider to be the most flattering and the photo that they consider to be the least flattering. Are their choices equally likely to be from the pre-election and post-election categories?
8. Select two prominent newspapers, magazines, or online news sites with very different political reputations (for example, CNN and Fox). Collect an equal number of pictures from each source of a presidential candidate printed a month before the election. All of the pictures be full face shots of approximately equal sizes. Do not otherwise screen the photos for being attractive or unattractive. Ask a random sample of students to pick the photo that they consider to be the most flattering and the photo that they consider to be the least flattering. Are their most-flattering choices equally likely to be from each source? Are their least-flattering choices equally likely to be from each source?
9. Conduct a taste test of either Coke versus Pepsi or Diet Coke versus Diet Pepsi. Survey at least 50 students who identify themselves beforehand as cola drinkers with a definite preference for one of the brands you are testing. Calculate the fraction of your sample whose choice in the taste test matches the brand identified beforehand as their favorite. (Do not tell your subjects that this is a test of their ability to identify their favorite brand; tell them it is a test of which tastes better.) Test the null hypothesis that there is a 0.5 probability that a cola drinker will choose his or her favorite brand.
10. Do more expensive cookies taste better than less expensive ones? Choose two brands of cookies that appear to be similar but cost quite different amounts. Ask at least 50 persons to taste an unlabeled cookie from each brand and to rate each cookie on a scale of 1 to 10. Calculate the difference in each person's score and test the null hypothesis that the average difference is zero.
11. The *pink tax* says that clothing marketed as female tends to cost more than identical clothing marketed as male. Test this theory by seeing whether women's T-shirts tend to be more or less expensive than essentially identical men's T-shirts. Go to a store (online is okay) that sells seemingly identical male and female T-shirts. Record the price difference for each shirt and test the null hypothesis that the average price difference is zero. (You can use other clothing instead of T-shirts.)
12. The *blue tax* says that athletic clothing marketed as male tends to cost more than athletic clothing marketed as female. Test this theory by going to a store (online is okay) that sells seemingly identical male and female athletic clothing. Record the price difference for each item and test the null hypothesis that the average price difference is zero.
13. The *pink tax* says that products marketed as female tend to cost more than identical products marketed as male. Test this theory by seeing whether women's shaving cream tends to be more or less expensive than men's shaving cream. Go to a store that sells seemingly identical male and female shaving cream sold by the same company. Record the price difference for each shaving cream and test the null hypothesis that the average price difference is zero. (You can use a different product if you want.)

14. Ask a random sample of 50 college students to pick a roommate, sibling, or friend who is the same sex as the person being interviewed. Then ask questions such as this: “Who do you think is more likely to suffer from food poisoning this year, you or this other person?” “Who is a better driver, you or the other person?” “Who is likely to live longer?” Test the null hypothesis that people are equally likely to say themselves or someone else.
15. Ask 100 randomly selected students to tell you whether they were the first-born (or only) child in their family. Test the null hypothesis that the probability that a student at your school is first-born (or only) is equal to the national percentage of 40%.
16. Some people slip their shoes on and off without untying and retying get laces. Of those who do untie and retie their shoe laces, some people untie their laces before taking their shoes off; others slip off their still-tied shoes and untie the laces later, when they are putting their shoes back on. What percent of the students who untie their shoelaces, either before taking them off or before putting them back on, do you think would answer “before” to this question: “When you take off shoes that have shoe laces that must be untied and retied, do you generally untie the laces before taking your shoes off or before putting them back on?” Survey 100 randomly selected students and test your prediction.
17. Do a matched-pair comparison of the calories in McDonald’s menu items in two different countries; for example the U.S. and the U.K.
18. There are 20 clubs in the English Premier League (EPL). During the course of a season, each club plays the other 19 clubs twice, in home and away games. There are a total of 190 unique two-team pairings. For each of these 190 pairings, calculate the differential between the score difference for the home game and for the away game. For example, in the 2021 season, Manchester City defeated Manchester United by a score of 4-1 in the game played at Manchester City’s home field and Manchester City defeated Manchester United by a score of 2-0 in the game played at Manchester United’s home field. The differential between the home difference and the away difference is 1, regardless of whether we look at it from Man City’s viewpoint, (4-1) - (2-0) = 1, or Man United’s viewpoint, (0-2) - (1-4) = 1. Calculate the home-minus-away differential for all 190 pairings in a recent season and test the null hypothesis that the average differential is zero.
19. Teams in the English Premier League (EPL) play each other twice every season—once at home and once away. Choose a recent season and determine the number of red and yellow cards that were given to each team in each game. Test the null hypothesis that the expected value of the difference between the number of cards given to a team does not depend on whether the game is played at home or away.
20. Persi Diaconis, a famous mathematician, claims that a spun penny will land tails about 80% of the time. Put a clean Lincoln penny on a flat surface and hold the coin on its edge with one finger. Then flick the coin with a finger on your other hand. Repeat this experiment 100 times and test the null hypothesis that the probability that a spun penny will land tails in 0.80. https://www.business-standard.com/article/pti-stories/guessing-heads-or-tails-isn-t-really-a-50-50-game-study-112120300282_1.html; https://www.smithsonianmag.com/science-nature/gamblers-take-note-the-odds-in-a-coin-flip-arent-quite-5050-145465423/
21. Choose an essay that a student on your team has written for a college class. Ask ChatGPT or another large language model (LLM) to write an essay on the same subject. Show the two essays to a random sample of 30 students and ask each student to identify the LLM-generated essay. Use your results to test the null hypothesis that each essay is equally likely to be chosen.

Chapter 8

1. What percentage of the seniors at your college expect to be married within five years of graduation? What percentage expect to have children within five years of graduation? How many biological children do the seniors at your college expect to have during their lives? Do males and females differ in their answer to these questions?
2. Do Economics majors at your school get better grades in humanities courses or in science courses? (Do not

include economics courses.)

3. Ask 50 males and 50 females this question: "You were engaged to be married to A, but broke off the engagement a month before the wedding when you found A in bed with your best friend. Two years have now passed and you are engaged to be married to someone else. A month before the wedding, A calls you and says "Let's get drunk tonight for old-time's sake." Do you say yes or no?" Devise a procedure that will allow each person to respond anonymously, but will still allow you to distinguish male and female responses (for example, different colored paper). Is there a statistically persuasive difference in the male and female responses?
4. Ask 50 males and 50 females to write down a brief answer to this question: "You are engaged to be married to A and while you are both at a party, a former lover who is unknown to A flirts with you outrageously. You rebuff these advances, but afterwards A asks you who this person is who was flirting with you. What do you say?" Devise a procedure that will allow each person to respond anonymously, but will still allow you to distinguish male and female responses. Now ask someone who is unaware of your system for identifying male and female responses to classify each response as either truthful or deceitful. Is there a statistically persuasive difference in the male and female responses?
5. In the 1980s Kahneman and Tversky asked students the following question: "Imagine that you have decided to see a play and paid the admission price of $10 per ticket. As you enter the theater, you discover that you have lost the ticket. The seat was not marked and the ticket cannot be recovered. Would you pay $10 for another ticket?" They asked a different group of students this question: "Imagine that you have decided to see a play where admission is $10 per ticket. As you enter the theater, you discover that you have lost a $10 bill. Would you still pay $10 for a ticket for the play?" Do this experiment with an updated ticket price and see if there is a statistically persuasive difference in the responses to these two questions.
6. Ask a random sample of students the following question: "Your favorite singer is performing tonight and you paid $200 for a ticket to the concert. Unfortunately, you will have to drive 60 miles through a snowstorm to get to the concert. Will you go?" Ask another random sample of students this question: "Your favorite singer is performing tonight and you were given a free ticket to the concert, Unfortunately, you will have to drive 60 miles through a snowstorm to get to the concert. Will you go?" If there a statistically persuasive difference in the responses to these two questions?
7. Ask a random sample of students the following question: "Your favorite singer is performing tonight and a friend paid $200 for a ticket to the concert. Your friend is sick and gave you the ticket for free. Unfortunately, you will have to drive 60 miles through a snowstorm to get to the concert. Will you go?" Ask another random sample of students this question: "Your favorite singer is performing tonight and a friend got a free ticket to the concert. Your friend is sick and gave you the ticket. Unfortunately, you will have to drive 60 miles through a snowstorm to get to the concert. Will you go?" If there a statistically persuasive difference in the responses to these two questions?
8. A stock's dividend-price ratio is its annual dividend divided by its current market price; its earnings-price ratio is the annual earnings divided by the current price. Determine the dividend-price and earnings-price ratios on some date in the past for each of the 30 stocks in the Dow Jones Industrial Average. Identify the ten stocks with the highest dividend-price ratios; and the ten with the lowest dividend-price ratios. Calculate the percentage price increases for these 20 stocks over the next year. Redo these calculations, this time using the earnings price ratios. In each case, are the observed differences between the two groups statistically persuasive?
9. Post a sign on the main entrance to a campus building requesting the use of a less convenient entrance; for example, "Please use the door on the north side of building." From an inconspicuous location, observe how many people ignore the sign and use the main entrance and how many people do not use the main entrance. Compare the behavior of students and professors or males and females. Try to pick a building and time when traffic is light, so that large numbers do not enter simultaneously.
10. Choose a random sample of at least 20 barber shops or beauty salons that cut both men's and women's hair.

Do not choose more than one store from a chain. Have a female telephone each store in your sample and find the price of the least expensive female hair cut. A few hours later, have a male telephone this store and determine the price for the least expensive male hair cut. Are the observed differences statistically persuasive?

11. Anchoring is a general human tendency to rely on a reference point when making decisions. A student did a term paper in which randomly selected students were asked one of these two questions:

    The population of Bolivia is 5 million.
    Estimate the population of Bulgaria.

    The population of Bolivia is 15 million.
    Estimate the population of Bulgaria.

    Those who were told that Bolivia's population was 15 million tended to give higher answers than did those told that Bolivia's population was 5 million. Several similar questions confirmed this pattern. People use a known "fact" as an anchor for their guess. Redo this study using questions you make up.
12. Follow the instructions for the preceding project but use an unrelated "fact;" for example,

    Annual per capita income in Bulgaria is $4,000.
    Estimate the population of Bulgaria.

    Annual per capita income in Bulgaria is $20,000.
    Estimate the population of Bulgaria.
13. Ask at least 50 students to participate in this experiment. Tell each volunteer that you are going to ask two brief questions. Then ask the first question: Guess the number that the volunteer will pull from a bag containing 100 slips of paper, numbered 1 to 100. (In fact, 50 slips have the number 10 written on them; the other 50 slips have the number 65.) After the number is revealed, ask the second question: Estimate the percentage of total United Nations membership made up of countries in Africa. Test whether there is a substantial and statistically persuasive difference between the Africa guesses made by those who picked the number 10 and those who selected the number 65.
14. Arrange 16 facial photos in a 4-by-4 grid, with 3 of the faces smiling and the other 13 faces angry or neutral. Ask a random sample of people to pick out the 3 smiling faces and record how long it takes each person to do so. Repeat the same experiment with 3 angry faces. Does it take longer, on average, for people to recognize smiling faces or angry faces?
15. Ask someone to shoot 10 basketball free throws, then ask them to shoot 2 free throws blind-folded, and then 10 more free throws not blindfolded. Repeat this experiment with several different people, but don't let anyone in your sample see your experiment with other people. For half the people in your sample, loudly cheer after each blindfolded shot and tell the person that they made the shot; for the other half, groan after each blindfolded shot and say they missed badly. Does the negative/positive reinforcement during the blindfolded shots have any effect on their performance when not blindfolded?
16. Ask 50 female students these four questions: Among female students at this college, is your height above average or below average? Is your weight above average or below average? Is your intelligence above average or below average? Is your physical attractiveness above average or below average? Ask 50 male students these same questions (in comparison to male students). Try to design a survey procedure that will ensure candid answers. For each gender and each question, test the null hypothesis that $p = 0.5$. Also, compare the male and female answers to each question.
17. Ask 50 male and 50 female students these two questions: Compared to all male college students, is the intelligence of the average male student at your college above average or below average? Is the physical attractiveness of the average male student at your college above average or below average? Repeat the survey with a new sample, asking 50 male and 50 female students these two questions: Compared to all female college students, is the intelligence of the average female student at your college above average or

below average? Is the physical attractiveness of the average female student at your college above average or below average? Try to design a survey procedure that will ensure candid answers. For each survey question compare the male and female answers.

18. Stand in a place where a reasonable number of people walk by. Stare at the sky and have a friend record the number of people walking by who look up at the sky, too, and the number who do not. Now repeat this experiment at the same location with 5, 10, or 15 of your friends staring at the sky. Again, have a friend record the number of people walking by who look up at the sky, too, and the number who do not. Is the difference statistically persuasive?
19. Have 10 or more friends stand in a line outside a closed door, with you stationed as the last person in line. Tell your friends standing in line that if anyone asks why they are waiting in line, they should say, "I don't know. I just saw this line and figured it must be something good." Use your results to test the null hypothesis that male and female students who are told this answer are equally likely to join the line.
20. Ask at least 20 people this question: "A bag contains 10 red balls and 10 blue balls. You randomly pick a ball from the bag and win $10 if the ball is blue. What is the maximum amount you would pay to play this game once?" Ask another group of at least 20 people this question: "There are an unknown number of red and blue balls in a bag. You pick a color, red or blue, and then randomly pick a ball from the bag and win $10 if the ball is the color you picked. What is the maximum amount you would pay to play this game once?" Use your results to test the null hypothesis that the average payment is the same for these two questions.

Chapter 9

1. Ask a random sample of students or professors to grade two short essays. One might be better organized, but have more grammatical mistakes. For half of the sample, the language in both essays reveals the authors to be female; for the other half, the language indicates the authors are male. Compare the grades taking into account gender and type of essay.
2. Look at the three most recently completed Major League Baseball seasons. In each league (American and National), identify the ten players with at least 502 times at bat who have the highest batting averages in the middle season. Taking these ten players as your sample, record their batting averages in all three seasons. If, for example, you choose the 1995, 1996, and 1997 seasons, identify the ten best batters in 1996 and then record their average batting average in 1995, 1996, and 1997. For each league, use an ANOVA test to see if their batting averages vary by season. Repeat your study, using WAR instead on batting averages.
3. Follow the directions for the preceding project, using earned run averages for pitchers who pitched at least 162 innings in the middle season. Also use pitchers' WAR.
4. Divide the departments at your school into three divisions; for example, humanities, natural sciences, and social sciences. Now ask a random sample of fourth-year students to tell you their major, to predict their annual salary ten years after graduation and, if they plan on working immediately after graduation, to predict their first-year salary (not including any moving allowances). Compare the average salaries for the three divisions.
5. Use Google Finance (or some other source) to obtain data for one year on the volume of trading and daily percentage changes in the Dow Jones Industrial Average each day of the week: Monday, Tuesday, Wednesday, Thursday, and Friday. Use an ANOVA F-test to see if the differences in the daily volume of trading or in the percentage price changes are statistically persuasive.
6. Estimate and compare the average words per sentence in three magazines or newspapers, such as *People*, *Time*, *New Republic*, or *The New York Times*, *Wall Street Journal*, and a local newspaper.
7. Choose two categories A and B based on either race or gender. Select 10 photographs of Category A people and 10 photographs of Category B people. These should not be pictures of celebrities or anyone else that your subjects will recognize. Show each subject 5 of the A pictures and 5 of the B pictures mixed together.

Then show each subject all 20 pictures and ask them to select the 10 pictures that they had been shown previously. Compare the accuracy of subjects who are in Category A with the accuracy of subjects who are in Category B in remembering faces in the two categories

Chapter 10

1. Set up a mock ESP experiment by writing the numbers 1 through 10 on ten identical pieces of paper, and placing these in a hat or other opaque container. Now tell a randomly selected person that you are going to select one of these pieces of paper and concentrate on the number, while the subject tries to read your mind. Be very careful to ensure that the subject cannot see the number on the paper. Record the answer and then tell the subject the selected number. Repeat this experiment with 100 different subjects. When you have all of your data, test at the 1 percent level the null hypothesis that each number is equally likely to be chosen by the subjects.
2. After attempting to imitate a popular television character, a young man concluded that whether one is right-handed or left-handed affects how far apart the two middle fingers on each hand can be spread. If a wider "V" is made with the right hand, the person is probably left-handed; if a wider V is made with the left hand or there is no difference, the person is probably right-handed. An article explaining this theory appeared in the February 20, 1974 issue of Current Science. Ask at least 100 randomly selected students to spread the middle two fingers on each hand to make a "V." Record whether the wider "V" is made with the right hand or the left hand (or no difference), and then ask the person whether he or she is left-handed or right-handed, How well does the wider "V" predict handedness?
3. Ask at least 100 college students, "Do you usually make sure you look good before leaving your room?" Also record the person's gender and year in college. Determine the P-values for a test of these null hypotheses:(a) the responses are unrelated to gender, and (b) the responses are unrelated to year in college.
4. Ask randomly selected college students if they have had a serious romantic relationship in the past two years and, if so, to identify the month in which the most recent relationship began. When you have found 120 students who answer yes and can identify the month, make a chi-square test of the null hypothesis that each month is equally likely for the beginning of a romantic relationship.
5. Ask randomly selected college students if they have ended a serious romantic relationship in the past two years and, if so, to identify the month in which the most recent ended relationship ended. When you have found 120 students who answer yes and can identify the month, make a chi-square test of the null hypothesis that each month is equally likely for the end of a romantic relationship.
6. In the game Roshambo (rock-scissors-paper), two players simultaneously move their fists up and down three times and then show a fist (rock), two fingers (scissors), or an open hand (paper). Rock beats scissors, scissors beats paper, and paper beats rock. Play this game against at least 120 different people, recording the initial move of each opponent. Use these data to test the null hypothesis that rock, scissors, and paper are used equally often on the initial move. Do your results support the adage, "Losers lead with rock," based on the perception that naive players lead with rock more than one-third of the time?
7. Ask 100 randomly selected students this question and then compare the male and female responses: "You have a coach ticket for a nonstop flight from Los Angeles to New York. Because the flight was overbooked, randomly selected passengers will be allowed to sit in open first-class seats. You are the first person selected. Would you rather sit next to: (a) the U.S. president; (b) the president's wife; or (c) Michael Jordan? Alternatively (since the President doesn't fly on commercial airlines), you could choose three other famous people.
8. Use the obituaries in a book of famous people, *The New York Times*, or another source to find the birth and death dates of at least 120 persons. Divide these data into four categories: deaths that occurred: during the 14 days preceding the birthday, on the birthday, during the 14 days following the birthday, and on other days. Test at the 5 percent level the null hypothesis that a person's death date is not related to the birth date.
9. Make a list of 10 well-known books (including one that you feel will be controversial) and ask at least 30

professors and 30 students to separate these books into two groups of five, based on how important it is that college students read these books: most important and least important. Are there statistically persuasive differences between how the students and professors rate the book you felt would be controversial?

10. The nine positions on a baseball team can be divided into four categories: pitcher, catcher, the four infielders, and the three outfielders. Collect all the data you can on major league baseball managers and test the null hypothesis that, among those managers who played baseball, the probabilities of having played in these four categories are 1/9, 1/9, 4/9, and 3/9, respectively.
11. Follow the instructions for the preceding exercise but for a different sport such as soccer, football, or basketball.
12. Administer the following four tests to at least 50 subjects, and then apply a chi-square test with the columns right or left handed and the rows tests a, b, and c.
    a. Ask the subject to stand with his or her back to you. Then ask the subject to jump around in a single motion to face you. Record whether the person jumps clockwise (pushing off with a dominant left foot) or counterclockwise (pushing off with a dominant right foot).
    b. Ask the subject to look at an object 10 feet away through a tube made with the hands held a foot in front of his or her face. Close or cover first one eye and then the other and record whether the subject can still see the object through the tube when the left eye is open (left-eye dominance) or when the right eye is open (right-eye dominance).
    c. Ask the subject to put his or her hands together behind the head, with the fingers interlaced. Record whether the thumb on the bottom (the dominant thumb) is from the left or right hand.
    d. Ask the subject whether he or she is lefthanded or righthanded.
13. Ask a random sample of 100 college students to compare themselves to other students in the population the sample was taken from. For example, if you survey a random sample of ABC College students, ask each student to compare himself or herself to other ABC students. Ask the students to rank themselves in their ability to get along with others; top 25%, next 25%, next 25%, bottom 25%. Test the null hypothesis that a randomly selected person is equally likely to pick each of these four quartiles.
14. Ask 100 randomly selected students to tell you their birth order: only child, first-born, second-born, third-born, or other, and compare these to the national percentages.

Chapter 11

1. For the two most recently completed major league baseball seasons, identify those players with at least 502 official times at bat in each season. Use the simple regression model to see how well each player's batting average in the most recent season is predicted by his batting average the preceding season. Do these results exhibit regression toward the mean?
2. Imagine that you are a U.S. government statistician in the 1860s. Use the census data for the years 1790 to 1860 to predict the U.S. population in 1930. To do so, estimate the equation $y = \alpha + \beta x + \varepsilon$, where y is the population and x is the year (1790, 1800, and so on).
3. Has there been any long-term trend in voter turnout in U.S. presidential elections? Does the Democratic or Republican presidential candidate tend to do better when there is a heavy turnout?
4. Select a U. S. President who ran for office twice; for example, Bill Clinton, George Bush, Barack Obama, or Donald Trump. For each of the 50 states, calculate this person's percentage of the total votes cast for the Democratic and Republican presidential candidates in each year; do not include the votes cast for other candidates. Is there a statistical relationship between these two sets of data? Are there any apparent outliers or anomalies?
5. An old Wall Street saying is, "As January goes, so goes the year." Use the simple regression model to see whether the February-through-December percentage change in the Dow Jones industrial average of stock prices is well predicted by the percentage change in January.
6. Use the simple regression model to see whether the annual percentage-point change in the interest rate on

10-year Treasury bonds is well predicted by the change the preceding year.

7. Use the simple regression model to see whether the annual percentage change in the Dow Jones industrial average of stock prices is well predicted by the percentage change the preceding year.
8. It has been argued that interest rates move up-and-down in lockstep with the rate of inflation. Test this theory by using annual data to estimate the model, $R = \alpha + \beta P + \varepsilon$, where R is the interest rate on one-year Treasury bonds and P is the annual rate of inflation.
9. Are future interest rates better predicted by current interest rates or by the current rate of inflation? Use annual data to estimate these two models, $R = \alpha_1 + \beta_1 S + \varepsilon_1$, and $R = \alpha_2 + \beta_2 P + \varepsilon_2$ where R is the interest rate on one-year Treasury bonds, S is interest rate the previous year and P is the annual rate of inflation the previous year.
10. Find the heights and weights of the quarterbacks, running backs, and wide receivers who have been inducted into professional football's hall of fame. For each of these three positions, estimate a linear regression model with height as the dependent variable and time as the explanatory variable and another linear regression model with weight as the dependent variable and time as the explanatory variable. In each case, let the time variable equal the year in which the player first played professional football.
11. Pick a date and approximate time of day (for example, 10:00 in the morning on April 1) for scheduling nonstop flights from an airport near you to at least a dozen large U.S. cities. Determine the cost of a coach seat on each of these flights and the distance covered by each flight. Use your data to estimate a simple regression model with ticket cost the dependent variable and distance the explanatory variable. Are there any outliers?
12. Collect data for at least 50 years on the cost of attending your college. Taking into account the increase in the overall price level during these years, use the simple regression model to see whether there has been a trend in the real cost of attending this college.
13. Investigate how well mutual fund performance is predicted by past performance.
14. Use data for several presidential elections to estimate a simple regression model where Y = percent of two-party vote for U.S. President received by the incumbent party's candidate and X = percent change in real disposable income in the last year of the incumbent party's term. Is there a statistically persuasive and substantial effect? Which elections appear to be outliers or anomalies?
15. This website <https://www.spotrac.com/mlb/rankings/2022/salary/> has Major League Baseball (MLB) player salaries. This site <https://www.espn.com/mlb/war/leaders/_/type/seasonal/year/2022> has data for player wins above replacement. Looking at the 30-50 highest-paid players for the most recently completed season, how strong is the relationship between pay and performance?
16. Looking at the most recently completed Major League Baseball (MLB) season, how strong is the relationship between team payroll and regular-season team performance?
17. Looking at the most recently completed National Basketball Association (NBA) season, how strong is the relationship between team payroll and regular-season team performance?
18. Looking at the most recently completed English Premier League (EPL) season, how strong is the relationship between club payroll and regular-season club performance?
19. This website <https://www.multpl.com/shiller-pe/table/by-year> has data on the Shiller PE ratio (CAPE) on January 1 of every year going back to 1872. This website https://www.multpl.com/s-p-500-historical-prices/table/by-year > has data on the S&P 500 on January 1 of every year going back to 1871. Starting with January 1, 1872, how well does the Shiller P/E ratio at the start of each year predict the percentage change in the S&P 500 that year?
20. Ask a random sample of people to think of the last two digits of their Social Security number. Then show them a picture of a bottle of wine (or some other item of uncertain value) and ask them to guess the price of the wine. Do people with higher Social Security numbers tend to guess higher prices?

Multiple Regression

1. Ask 100 randomly selected students to give their grade point average, birth order (first-born or only child, middle-born, or last-born), and height. Now estimate a multiple regression model with grade point average as the dependent variable and birth order and height as the explanatory variables.
2. Construct a plausible multiple-regression model for predicting the first-year salaries of seniors at your school who are looking for jobs. Now use a random survey to gather data on their predicted salary (or actual salary if they already have a job) and your explanatory variables, and use least squares to estimate your model.
3. Use either RealEstate.com, ZipRealty.com, or Zillow.com to find the prices for houses that are for sale in Claremont, your hometown, or where you plan to live in the future. Specify a plausible multiple-regression model for explaining these prices and use a random sample of at least 60 houses to estimate your model's parameters.
4. Select a car model and year (for example, 2015 Camry), and estimate a plausible multiple regression model for predicting used car prices.
5. Use data for several presidential elections to estimate a multiple regression model where Y = percent of the two-party vote for U.S. President received by the incumbent party's candidate, X1 = percent of the two-party vote for U.S. President received by the incumbent party's candidate in the previous presidential election, and X2 = percent change in real disposable income in the last year of the incumbent party's term. In the 2020 election, for example, Donald Trump (a Republican) was the incumbent, so Y is the percent of the 2020 two-party vote received by the Republican candidate; X1 is the percent of the 2016 two-party vote received by the Republican candidate; and X2 is the percent change in real disposable income in 2020. Are the coefficients of both explanatory variables statistically persuasive and substantial? Which elections appear to be outliers or anomalies?
6. Use data for each of the 50 states and one presidential election to estimate a multiple regression model where Y = percent of the two-party vote for U.S. President received by the incumbent party's candidate in this state in this election year, X1 = percent of the two-party vote for U.S. President received by the incumbent party's candidate in this state in the previous presidential election, and X2 = percent change in the unemployment rate in this state in the last year of the incumbent party's term. In the 2020 election, for example, Donald Trump (a Republican) was the incumbent, so Y for Iowa in 2020 is the percent of the 2020 two-party vote in Iowa received by the Republican candidate; X1 is the percent of the 2016 two-party vote in Iowa received by the Republican candidate; and X2 is the percent change in the unemployment rate in Iowa in 2020. Are the coefficients of both explanatory variables statistically persuasive and substantial? Which elections appear to be outliers or anomalies?
7. Collect data for Y = the daily percentage price changes in the S&P 500 during a recent year and for 100 explanatory variables, each equal to the daily difference between the high and low temperatures in 100 diverse cities. Estimate a multiple regression model using all 100 explanatory variables. Identify the 5 cities with the highest t-values and estimate a second multiple regression model using only these 5 cities as explanatory variables. What is your conclusion?
8. Collect data for Y = the daily percentage price changes in the S&P 500 during a recent year and daily data for 100 explanatory variables, with the daily value of each explanatory variable equal to a randomly generated number. Estimate a multiple regression model using all 100 explanatory variables. Identify the 5 explanatory variables with the highest t-values and estimate a second multiple regression model using only these 5 explanatory variables. What is your conclusion?
9. Use a random number generator to create 250 observations for 101 variables. Estimate a multiple regression model using your first random variable as the dependent variable and the other 100 random variables as 100 explanatory variables. Identify the 5 explanatory variables with the highest t-values and estimate a second multiple regression model using only these 5 explanatory variables. What is your conclusion?

10. Use the following four variables, all recorded the year before the Super Bowl, to predict the Super Bowl score differential, AFC team score minus NFC team score, in the years 2017 through 2021:
    High temperature in London on June 30
    Average price of tea worldwide on June 30
    Average number of letters in the names of Physics Nobel Prize winners
    Number of points earned by the soccer team winning the Premier League
    What is your conclusion?
11. Use the following explanatory variables to predict the Democratic Party candidate's percentage share of the total two-party vote for President in these 11 presidential elections (1980 - 2020): the high temperatures on election day in these ten cities: Claremont, California; Bozeman, Montana; Broken Bow, Nebraska; Burlington, Vermont; Caribou, Maine; Cody, Wyoming; Dover, Delaware; Elkins, West Virginia; Fargo, North Dakota; and Pocatello, Idaho. What is your conclusion?
12. This website <https://www.spotrac.com/epl/payroll/> has data on English Premier League (EPL) club payrolls separated into forwards, midfielders, defensemen, and goalkeepers. Looking at the most recently completed season, how well is club performance predicted by the payroll in these four categories?
13. This website <https://www.premierleague.com/stats/top/clubs/wins?se=489> has data on English Premier League (EPL) club wins, red cards, and yellow cards. Looking at the most recently completed season, how well is club performance predicted by the number of red cards and yellow cards?
14. Are future interest rates better predicted by current interest rates or by the current rate of inflation? Use annual data to estimate the model, $R = \alpha + \beta_1 S + \beta_2 P + \varepsilon$, where R is the interest rate on one-year Treasury bonds, S is interest rate the previous year and P is the annual rate of inflation the previous year.
15. This website <https://www.multpl.com/s-p-500-historical-prices/table/by-year > has data on the S&P 500 on January 1 of every year going back to 1871. This website <https://www.multpl.com/s-p-500-earnings-yield > has data on the S&P 500 earnings yield on January 1 of every year going back to 1871. This website <https://www.multpl.com/s-p-500-dividend-yield/table/by-year> has data on the S&P 500 dividend yield on December 31 of every year going back to 1871. How well is the percentage change in the S&P 500 each year predicted by the earnings yield and dividend yield at the start of that year?