Quantitative Methods

PRACTICE PROBLEMS

1. The table below gives current information on the interest rates for two two-year and two eight-year maturity investments. The table also gives the maturity, liquidity, and default risk characteristics of a new investment possibility (Investment 3). All investments promise only a single payment (a payment at maturity). Assume that premiums relating to inflation, liquidity, and default risk are constant across all time horizons.

Investment	Maturity (in Years)	Liquidity	Default Risk	Interest Rate (%)
1	2	High	Low	2.0
2	2	Low	Low	2.5
3	7	Low	Low	r_3
4	8	High	Low	4.0
5	8	Low	High	6.5

Based on the information in the above table, address the following:

A. Explain the difference between the interest rates on Investment 1 and Investment 2.

B. Estimate the default risk premium.

C. Calculate upper and lower limits for the interest rate on Investment 3, r_3.

2. The nominal risk-free rate is *best* described as the sum of the real risk-free rate and a premium for:

A. maturity.

B. liquidity.

C. expected inflation.

3. Which of the following risk premiums is most relevant in explaining the difference in yields between 30-year bonds issued by the US Treasury and 30-year bonds issued by a small private issuer?

A. Inflation

B. Maturity

C. Liquidity

4. The value in six years of $75,000 invested today at a stated annual interest rate of 7% compounded quarterly is *closest* to:

A. $112,555.

B. $113,330.

C. $113,733.

5. A bank quotes a stated annual interest rate of 4.00%. If that rate is equal to an effective annual rate of 4.08%, then the bank is compounding interest:

A. daily.

B. quarterly.

C. semiannually.

6. Given a €1,000,000 investment for four years with a stated annual rate of 3% compounded continuously, the difference in its interest earnings compared with the same investment compounded daily is *closest* to:

A. €1.

B. €6.

C. €455.

7. A couple plans to set aside $20,000 per year in a conservative portfolio projected to earn 7 percent a year. If they make their first savings contribution one year from now, how much will they have at the end of 20 years?

8. Two years from now, a client will receive the first of three annual payments of $20,000 from a small business project. If she can earn 9 percent annually on her investments and plans to retire in six years, how much will the three business project payments be worth at the time of her retirement?

9. A saver deposits the following amounts in an account paying a stated annual rate of 4%, compounded semiannually:

Year	End of Year Deposits ($)
1	4,000
2	8,000
3	7,000
4	10,000

At the end of Year 4, the value of the account is *closest* to:

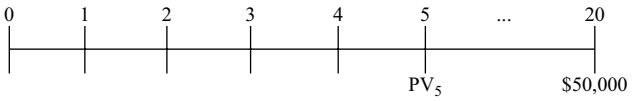
A. $30,432

B. $30,447

C. $31,677

10. To cover the first year's total college tuition payments for his two children, a father will make a $75,000 payment five years from now. How much will he need to invest today to meet his first tuition goal if the investment earns 6 percent annually?

11. Given the following timeline and a discount rate of 4% a year compounded annually, the present value (PV), as of the end of Year 5 (PV_5), of the cash flow received at the end of Year 20 is *closest* to:



A. $22,819.

B. $27,763.

C. $28,873.

12. A client requires £100,000 one year from now. If the stated annual rate is 2.50% compounded weekly, the deposit needed today is *closest* to:

A. £97,500.

B. £97,532.

C. £97,561.

13. A client can choose between receiving 10 annual $100,000 retirement payments, starting one year from today, or receiving a lump sum today. Knowing that he can invest at a rate of 5 percent annually, he has decided to take the lump sum. What lump sum today will be equivalent to the future annual payments?

14. You are considering investing in two different instruments. The first instrument will pay nothing for three years, but then it will pay $20,000 per year for four years. The second instrument will pay $20,000 for three years and $30,000 in the fourth year. All payments are made at year-end. If your required rate of return on these investments is 8 percent annually, what should you be willing to pay for:

A. The first instrument?

B. The second instrument (use the formula for a four-year annuity)?

15. Suppose you plan to send your daughter to college in three years. You expect her to earn two-thirds of her tuition payment in scholarship money, so you estimate that your payments will be $10,000 a year for four years. To estimate whether you have set aside enough money, you ignore possible inflation in tuition payments and assume that you can earn 8 percent annually on your investments. How much should you set aside now to cover these payments?

16. An investment pays €300 annually for five years, with the first payment occurring today. The present value (PV) of the investment discounted at a 4% annual rate is *closest* to:

A. €1,336.

B. €1,389.

C. €1,625.

17. At a 5% interest rate per year compounded annually, the present value (PV) of a 10-year ordinary annuity with annual payments of $2,000 is $15,443.47. The PV of a 10-year annuity due with the same interest rate and payments is *closest* to:

A. $14,708.

B. $16,216.

C. $17,443.

18. Grandparents are funding a newborn's future university tuition costs, estimated at $50,000/year for four years, with the first payment due as a lump sum in 18 years. Assuming a 6% effective annual rate, the required deposit today is *closest* to:

A. $60,699.

B. $64,341.

C. $68,201.

19. The present value (PV) of an investment with the following year-end cash flows (CF) and a 12% required annual rate of return is *closest* to:

Year	Cash Flow (€)
1	100,000
2	150,000
5	–10,000

A. €201,747.

B. €203,191.

C. €227,573.

20. A perpetual preferred stock makes its first quarterly dividend payment of $2.00 in five quarters. If the required annual rate of return is 6% compounded quarterly, the stock's present value is *closest* to:

A. $31.

B. $126.

C. $133.

21. A sweepstakes winner may select either a perpetuity of £2,000 a month beginning with the first payment in one month or an immediate lump sum payment of £350,000. If the annual discount rate is 6% compounded monthly, the present value of the perpetuity is:

A. less than the lump sum.

B. equal to the lump sum.

C. greater than the lump sum.

22. For a lump sum investment of ¥250,000 invested at a stated annual rate of 3% compounded daily, the number of months needed to grow the sum to ¥1,000,000 is *closest* to:

A. 555.

B. 563.

C. 576.

23. An investment of €500,000 today that grows to €800,000 after six years has a stated annual interest rate *closest* to:

A. 7.5% compounded continuously.

B. 7.7% compounded daily.

C. 8.0% compounded semiannually.

24. A client plans to send a child to college for four years starting 18 years from now. Having set aside money for tuition, she decides to plan for room and board also.

She estimates these costs at $20,000 per year, payable at the beginning of each year, by the time her child goes to college. If she starts next year and makes 17 payments into a savings account paying 5 percent annually, what annual payments must she make?

25. A couple plans to pay their child's college tuition for 4 years starting 18 years from now. The current annual cost of college is C$7,000, and they expect this cost to rise at an annual rate of 5 percent. In their planning, they assume that they can earn 6 percent annually. How much must they put aside each year, starting next year, if they plan to make 17 equal payments?

26. A sports car, purchased for £200,000, is financed for five years at an annual rate of 6% compounded monthly. If the first payment is due in one month, the monthly payment is *closest* to:

A. £3,847.

B. £3,867.

C. £3,957.

27. Given a stated annual interest rate of 6% compounded quarterly, the level amount that, deposited quarterly, will grow to £25,000 at the end of 10 years is *closest* to:

A. £461.

B. £474.

C. £836.

28. A client invests €20,000 in a four-year certificate of deposit (CD) that annually pays interest of 3.5%. The annual CD interest payments are automatically reinvested in a separate savings account at a stated annual interest rate of 2% compounded monthly. At maturity, the value of the combined asset is *closest* to:

A. €21,670.

B. €22,890.

C. €22,950.

PRACTICE PROBLEMS

1. Published ratings on stocks ranging from 1 (strong sell) to 5 (strong buy) are examples of which measurement scale?

   A. Ordinal

   B. Continuous

   C. Nominal

2. Data values that are categorical and not amenable to being organized in a logical order are *most likely* to be characterized as:

   A. ordinal data.

   B. discrete data.

   C. nominal data.

3. Which of the following data types would be classified as being categorical?

   A. Discrete

   B. Nominal

   C. Continuous

4. A fixed-income analyst uses a proprietary model to estimate bankruptcy probabilities for a group of firms. The model generates probabilities that can take any value between 0 and 1. The resulting set of estimated probabilities would *most likely* be characterized as:

   A. ordinal data.

   B. discrete data.

   C. continuous data.

5. An analyst uses a software program to analyze unstructured data—specifically, management's earnings call transcript for one of the companies in her research coverage. The program scans the words in each sentence of the transcript and then classifies the sentences as having negative, neutral, or positive sentiment. The resulting set of sentiment data would *most likely* be characterized as:

   A. ordinal data.

   B. discrete data.

   C. nominal data.

The following information relates to questions 6-7

An equity analyst gathers total returns for three country equity indexes over the past four years. The data are presented below.

Time Period	Index A	Index B	Index C
Year *t*–3	15.56%	11.84%	–4.34%
Year t–2	–4.12%	–6.96%	9.32%
Year *t*–1	11.19%	10.29%	–12.72%
Year *t*	8.98%	6.32%	21.44%

6. Each individual column of data in the table can be *best* characterized as:
   - **A.** panel data.
   - **B.** time-series data.
   - **C.** cross-sectional data.

7. Each individual row of data in the table can be *best* characterized as:
   - **A.** panel data.
   - **B.** time-series data.
   - **C.** cross-sectional data.

8. A two-dimensional rectangular array would be most suitable for organizing a collection of raw:
   - **A.** panel data.
   - **B.** time-series data.
   - **C.** cross-sectional data.

9. In a frequency distribution, the absolute frequency measure:
   - **A.** represents the percentages of each unique value of the variable.
   - **B.** represents the actual number of observations counted for each unique value of the variable.
   - **C.** allows for comparisons between datasets with different numbers of total observations.

10. An investment fund has the return frequency distribution shown in the following exhibit.

Return Interval (%)	Absolute Frequency
–10.0 to –7.0	3
–7.0 to –4.0	7
–4.0 to –1.0	10
–1.0 to +2.0	12
+2.0 to +5.0	23
+5.0 to +8.0	5

Which of the following statements is correct?

A. The relative frequency of the bin "−1.0 to +2.0" is 20%.

B. The relative frequency of the bin "+2.0 to +5.0" is 23%.

C. The cumulative relative frequency of the bin "+5.0 to +8.0" is 91.7%.

11. An analyst is using the data in the following exhibit to prepare a statistical report.

Portfolio's Deviations from Benchmark Return for a 12-Year Period (%)

Year 1	2.48	Year 7	−9.19
Year 2	−2.59	Year 8	−5.11
Year 3	9.47	Year 9	1.33
Year 4	−0.55	Year 10	6.84
Year 5	−1.69	Year 11	3.04
Year 6	−0.89	Year 12	4.72

The cumulative relative frequency for the bin $-1.71\% \leq x < 2.03\%$ is *closest* to:

A. 0.250.

B. 0.333.

C. 0.583.

The following information relates to questions 12-13

A fixed-income portfolio manager creates a contingency table of the number of bonds held in her portfolio by sector and bond rating. The contingency table is presented here:

	Bond Rating		
Sector	**A**	**AA**	**AAA**
Communication Services	25	32	27
Consumer Staples	30	25	25
Energy	100	85	30
Health Care	200	100	63
Utilities	22	28	14

12. The marginal frequency of energy sector bonds is *closest* to:

A. 27.

B. 85.

C. 215.

13. The relative frequency of AA rated energy bonds, based on the total count, is

closest to:

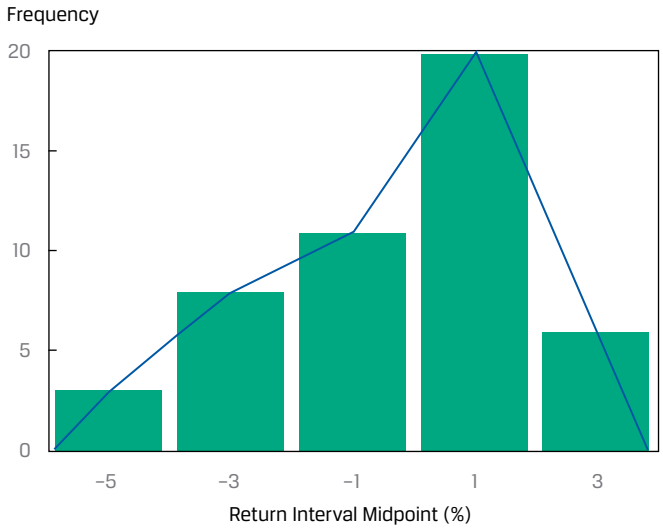
A. 10.5%.

B. 31.5%.

C. 39.5%.

14. The following is a frequency polygon of monthly exchange rate changes in the US dollar/Japanese yen spot exchange rate for a four-year period. A positive change represents yen appreciation (the yen buys more dollars), and a negative change represents yen depreciation (the yen buys fewer dollars).

Exhibit 1: Monthly Changes in the US Dollar/Japanese Yen Spot Exchange Rate



Based on the chart, yen appreciation:

A. occurred more than 50% of the time.

B. was less frequent than yen depreciation.

C. in the 0.0 to 2.0 interval occurred 20% of the time.

15. A bar chart that orders categories by frequency in descending order and includes a line displaying cumulative relative frequency is referred to as a:

A. Pareto Chart.

B. grouped bar chart.

C. frequency polygon.

16. Which visualization tool works *best* to represent unstructured, textual data?

A. Tree-Map

B. Scatter plot

C. Word cloud

17. A tree-map is best suited to illustrate:

A. underlying trends over time.

B. joint variations in two variables.

C. value differences of categorical groups.

18. A line chart with two variables—for example, revenues and earnings per share—is best suited for visualizing:

A. the joint variation in the variables.

B. underlying trends in the variables over time.

C. the degree of correlation between the variables.

19. A heat map is best suited for visualizing the:

A. frequency of textual data.

B. degree of correlation between different variables.

C. shape, center, and spread of the distribution of numerical data.

20. Which valuation tool is recommended to be used if the goal is to make comparisons of three or more variables over time?

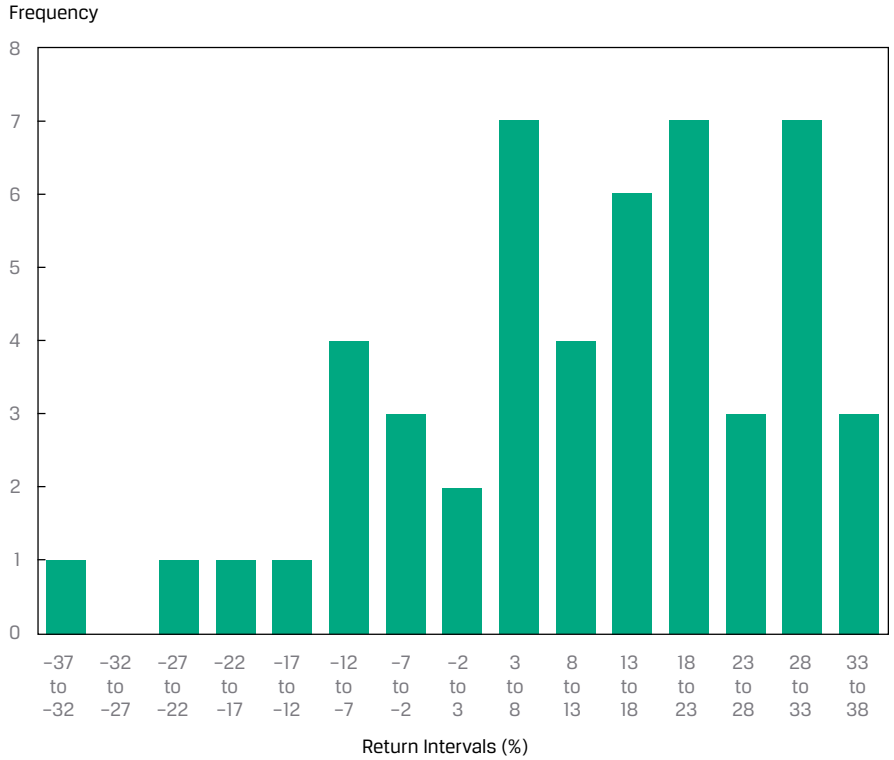
A. Heat map

B. Bubble line chart

C. Scatter plot matrix

The following information relates to questions 21-22

The following histogram shows a distribution of the S&P 500 Index annual returns for a 50-year period:



21. The bin containing the median return is:

A. 3% to 8%.

B. 8% to 13%.

C. 13% to 18%.

22. Based on the previous histogram, the distribution is *best* described as being:

A. unimodal.

B. bimodal.

C. trimodal.

23. The annual returns for three portfolios are shown in the following exhibit. Portfolios P and R were created in Year 1, Portfolio Q in Year 2.

	Annual Portfolio Returns (%)				
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Portfolio P	−3.0	4.0	5.0	3.0	7.0
Portfolio Q		−3.0	6.0	4.0	8.0
Portfolio R	1.0	−1.0	4.0	4.0	3.0

The median annual return from portfolio creation to Year 5 for:

A. Portfolio P is 4.5%.

B. Portfolio Q is 4.0%.

C. Portfolio R is higher than its arithmetic mean annual return.

24. At the beginning of Year X, an investor allocated his retirement savings in the asset classes shown in the following exhibit and earned a return for Year X as also shown.

Asset Class	Asset Allocation (%)	Asset Class Return for Year X (%)
Large-cap US equities	20.0	8.0
Small-cap US equities	40.0	12.0
Emerging market equities	25.0	–3.0
High-yield bonds	15.0	4.0

The portfolio return for Year X is *closest to*:

A. 5.1%.

B. 5.3%.

C. 6.3%.

25. The following exhibit shows the annual returns for Fund Y.

	Fund Y (%)
Year 1	19.5
Year 2	–1.9
Year 3	19.7
Year 4	35.0
Year 5	5.7

The geometric mean return for Fund Y is *closest* to:

A. 14.9%.

B. 15.6%.

C. 19.5%.

26. A portfolio manager invests €5,000 annually in a security for four years at the prices shown in the following exhibit.

	Purchase Price of Security (€ per unit)
Year 1	62.00
Year 2	76.00
Year 3	84.00
Year 4	90.00

The average price is *best* represented as the:

A. harmonic mean of €76.48.

B. geometric mean of €77.26.

C. arithmetic average of €78.00.

27. When analyzing investment returns, which of the following statements is correct?

A. The geometric mean will exceed the arithmetic mean for a series with non-zero variance.

B. The geometric mean measures an investment's compound rate of growth over multiple periods.

C. The arithmetic mean measures an investment's terminal value over multiple periods.

The following information relates to questions 28-32

A fund had the following experience over the past 10 years:

Year	Return
1	4.5%
2	6.0%
3	1.5%
4	–2.0%
5	0.0%
6	4.5%
7	3.5%
8	2.5%
9	5.5%
10	4.0%

28. The arithmetic mean return over the 10 years is *closest* to:

A. 2.97%.

B. 3.00%.

C. 3.33%.

29. The geometric mean return over the 10 years is *closest* to:

A. 2.94%.

B. 2.97%.

C. 3.00%.

30. The harmonic mean return over the 10 years is *closest* to:

A. 2.94%.

B. 2.97%.

C. 3.00%.

31. The standard deviation of the 10 years of returns is *closest* to:

A. 2.40%.

B. 2.53%.

C. 7.58%.

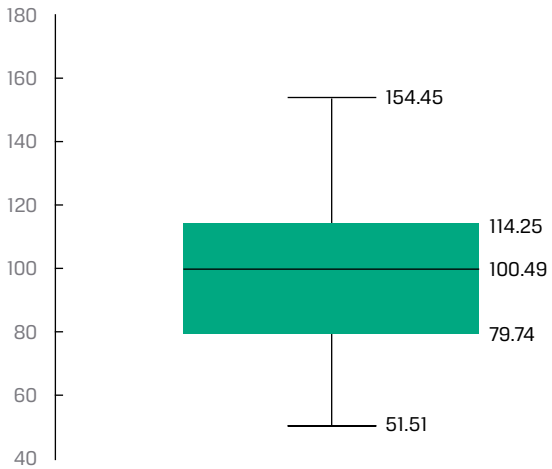
32. The target semideviation of the returns over the 10 years if the target is 2% is *closest* to:

A. 1.42%.

B. 1.50%.

C. 2.01%.

The following information relates to questions 33-34



33. The median is *closest* to:

A. 34.51.

B. 100.49.

C. 102.98.

34. The interquartile range is *closest* to:

A. 13.76.

B. 25.74.

C. 34.51.

The following information relates to questions 35-36

The following exhibit shows the annual MSCI World Index total returns for a 10-year period.

Year 1	15.25%	Year 6	30.79%
Year 2	10.02%	Year 7	12.34%
Year 3	20.65%	Year 8	–5.02%
Year 4	9.57%	Year 9	16.54%
Year 5	–40.33%	Year 10	27.37%

35. The fourth quintile return for the MSCI World Index is *closest* to:

A. 20.65%.

B. 26.03%.

C. 27.37%.

36. For Year 6–Year 10, the mean absolute deviation of the MSCI World Index total returns is *closest* to:

A. 10.20%.

B. 12.74%.

C. 16.40%.

37. Annual returns and summary statistics for three funds are listed in the following exhibit:

	Annual Returns (%)		
Year	**Fund ABC**	**Fund XYZ**	**Fund PQR**
Year 1	–20.0	–33.0	–14.0
Year 2	23.0	–12.0	–18.0
Year 3	–14.0	–12.0	6.0
Year 4	5.0	–8.0	–2.0
Year 5	–14.0	11.0	3.0
Mean	–4.0	–10.8	–5.0
Standard deviation	17.8	15.6	10.5

The fund with the highest absolute dispersion is:

A. Fund PQR if the measure of dispersion is the range.

B. Fund XYZ if the measure of dispersion is the variance.

C. Fund ABC if the measure of dispersion is the mean absolute deviation.

38. The average return for Portfolio A over the past twelve months is 3%, with a stan-

dard deviation of 4%. The average return for Portfolio B over this same period is also 3%, but with a standard deviation of 6%. The geometric mean return of Portfolio A is 2.85%. The geometric mean return of Portfolio B is:

A. less than 2.85%.

B. equal to 2.85%.

C. greater than 2.85%.

39. The mean monthly return and the standard deviation for three industry sectors are shown in the following exhibit.

Sector	Mean Monthly Return (%)	Standard Deviation of Return (%)
Utilities (UTIL)	2.10	1.23
Materials (MATR)	1.25	1.35
Industrials (INDU)	3.01	1.52

Based on the coefficient of variation, the riskiest sector is:

A. utilities.

B. materials.

C. industrials.

The following information relates to questions 40-42

An analyst examined a cross-section of annual returns for 252 stocks and calculated the following statistics:

Arithmetic Average	9.986%
Geometric Mean	9.909%
Variance	0.001723
Skewness	0.704
Excess Kurtosis	0.503

40. The coefficient of variation is closest to:

A. 0.02.

B. 0.42.

C. 2.41.

41. This distribution is best described as:

A. negatively skewed.

B. having no skewness.

C. positively skewed.

42. Compared to the normal distribution, this sample's distribution is best described as having tails of the distribution with:

A. less probability than the normal distribution.

B. the same probability as the normal distribution.

C. more probability than the normal distribution.

43. An analyst calculated the excess kurtosis of a stock's returns as –0.75. From this information, we conclude that the distribution of returns is:

A. normally distributed.

B. thin-tailed compared to the normal distribution.

C. fat-tailed compared to the normal distribution.

44. A correlation of 0.34 between two variables, X and Y, is *best* described as:

A. changes in X causing changes in Y.

B. a positive association between X and Y.

C. a curvilinear relationship between X and Y.

45. Which of the following is a potential problem with interpreting a correlation coefficient?

A. Outliers

B. Spurious correlation

C. Both outliers and spurious correlation

The following information relates to questions 46-47

An analyst is evaluating the tendency of returns on the portfolio of stocks she manages to move along with bond and real estate indexes. She gathered monthly data on returns and the indexes:

	Returns (%)		
	Portfolio Returns	**Bond Index Returns**	**Real Estate Index Returns**
Arithmetic average	5.5	3.2	7.8
Standard deviation	8.2	3.4	10.3

	Portfolio Returns and Bond Index Returns	**Portfolio Returns and Real Estate Index Returns**
Covariance	**18.9**	**–55.9**

46. Without calculating the correlation coefficient, the correlation of the portfolio returns and the bond index returns is:

A. negative.

B. zero.

C. positive.

47. Without calculating the correlation coefficient, the correlation of the portfolio returns and the real estate index returns is:

A. negative.

B. zero.

C. positive.

48. Consider two variables, A and B. If variable A has a mean of –0.56, variable B has a mean of 0.23, and the covariance between the two variables is positive, the correlation between these two variables is:

A. negative.

B. zero.

C. positive.

PRACTICE PROBLEMS

1. In probability theory, exhaustive events are *best* described as the set of events that:

   A. have a probability of zero.

   B. are mutually exclusive.

   C. include all potential outcomes.

2. Which probability estimate *most likely* varies greatly between people?

   A. An *a priori* probability

   B. An empirical probability

   C. A subjective probability

3. If the probability that Zolaf Company sales exceed last year's sales is 0.167, the odds for exceeding sales are *closest* to:

   A. 1 to 5.

   B. 1 to 6.

   C. 5 to 1.

4. After six months, the growth portfolio that Rayan Khan manages has outperformed its benchmark. Khan states that his odds of beating the benchmark for the year are 3 to 1. If these odds are correct, what is the probability that Khan's portfolio will beat the benchmark for the year?

   A. 0.33

   B. 0.67

   C. 0.75

5. Suppose that 5% of the stocks meeting your stock-selection criteria are in the telecommunications (telecom) industry. Also, dividend-paying telecom stocks are 1% of the total number of stocks meeting your selection criteria. What is the probability that a stock is dividend paying, given that it is a telecom stock that has met your stock selection criteria?

6. You are using the following three criteria to screen potential acquisition targets from a list of 500 companies:

Criterion	Fraction of the 500 Companies Meeting the Criterion
Product lines compatible	0.20
Company will increase combined sales growth rate	0.45
Balance sheet impact manageable	0.78

   If the criteria are independent, how many companies will pass the screen?

7. Florence Hixon is screening a set of 100 stocks based on two criteria (Criterion

1 and Criterion 2). She set the passing level such that 50% of the stocks passed each screen. For these stocks, the values for Criterion 1 and Criterion 2 are not independent but are positively related. How many stocks should pass Hixon's two screens?

A. Less than 25

B. 25

C. More than 25

8. You apply both valuation criteria and financial strength criteria in choosing stocks. The probability that a randomly selected stock (from your investment universe) meets your valuation criteria is 0.25. Given that a stock meets your valuation criteria, the probability that the stock meets your financial strength criteria is 0.40. What is the probability that a stock meets both your valuation and financial strength criteria?

9. The probability of an event given that another event has occurred is a:

A. joint probability.

B. marginal probability.

C. conditional probability.

10. After estimating the probability that an investment manager will exceed his benchmark return in each of the next two quarters, an analyst wants to forecast the probability that the investment manager will exceed his benchmark return over the two-quarter period in total. Assuming that each quarter's performance is independent of the other, which probability rule should the analyst select?

A. Addition rule

B. Multiplication rule

C. Total probability rule

11. Which of the following is a property of two dependent events?

A. The two events must occur simultaneously.

B. The probability of one event influences the probability of the other event.

C. The probability of the two events occurring is the product of each event's probability.

12. Which of the following *best* describes how an analyst would estimate the expected value of a firm using the scenarios of bankruptcy and non-bankruptcy? The analyst would use:

A. the addition rule.

B. conditional expected values.

C. the total probability rule for expected value.

13. Suppose the prospects for recovering principal for a defaulted bond issue depend on which of two economic scenarios prevails. Scenario 1 has probability 0.75 and will result in recovery of $0.90 per $1 principal value with probability 0.45, or

in recovery of $0.80 per $1 principal value with probability 0.55. Scenario 2 has probability 0.25 and will result in recovery of $0.50 per $1 principal value with probability 0.85, or in recovery of $0.40 per $1 principal value with probability 0.15.

A. Compute the probability of each of the four possible recovery amounts: $0.90, $0.80, $0.50, and $0.40.

B. Compute the expected recovery, given the first scenario.

C. Compute the expected recovery, given the second scenario.

D. Compute the expected recovery.

E. Graph the information in a probability tree diagram.

14. An analyst developed two scenarios with respect to the recovery of $100,000 principal from defaulted loans:

Scenario	Probability of Scenario (%)	Amount Recovered ($)	Probability of Amount (%)
1	40	50,000	60
		30,000	40
2	60	80,000	90
		60,000	10

The amount of the expected recovery is *closest* to:

A. $36,400.

B. $55,000.

C. $63,600.

15. The probability distribution for a company's sales is:

Probability	Sales ($ millions)
0.05	70
0.70	40
0.25	25

The standard deviation of sales is *closest* to:

A. $9.81 million.

B. $12.20 million.

C. $32.40 million.

16. US and Spanish bonds have return standard deviations of 0.64 and 0.56, respectively. If the correlation between the two bonds is 0.24, the covariance of returns is *closest* to:

A. 0.086.

B. 0.335.

C. 0.390.

17. The covariance of returns is positive when the returns on two assets tend to:

A. have the same expected values.

B. be above their expected value at different times.

C. be on the same side of their expected value at the same time.

18. Which of the following correlation coefficients indicates the weakest linear relationship between two variables?

A. –0.67

B. –0.24

C. 0.33

19. An analyst develops the following covariance matrix of returns:

	Hedge Fund	Market Index
Hedge fund	256	110
Market index	110	81

The correlation of returns between the hedge fund and the market index is *closest* to:

A. 0.005.

B. 0.073.

C. 0.764.

20. All else being equal, as the correlation between two assets approaches +1.0, the diversification benefits:

A. decrease.

B. stay the same.

C. increase.

21. Given a portfolio of five stocks, how many unique covariance terms, excluding variances, are required to calculate the portfolio return variance?

A. 10

B. 20

C. 25

22. Which of the following statements is *most* accurate? If the covariance of returns between two assets is 0.0023, then:

A. the assets' risk is near zero.

B. the asset returns are unrelated.

C. the asset returns have a positive relationship.

23. A two-stock portfolio includes stocks with the following characteristics:

	Stock 1	Stock 2
Expected return	7%	10%
Standard deviation	12%	25%
Portfolio weights	0.30	0.70
Correlation	0.20	

What is the standard deviation of portfolio returns?

A. 14.91%

B. 18.56%

C. 21.10%

24. Lena Hunziger has designed the three-asset portfolio summarized below:

	Asset 1	Asset 2	Asset 3
Expected return	5%	6%	7%
Portfolio weight	**0.20**	0.30	0.50
Variance-Covariance Matrix			
	Asset 1	**Asset 2**	**Asset 3**
Asset 1	196	105	140
Asset 2	105	225	150
Asset 3	140	150	400

Hunziger estimated the portfolio return to be 6.3%. What is the portfolio standard deviation?

A. 13.07%

B. 13.88%

C. 14.62%

25. An analyst produces the following joint probability function for a foreign index (FI) and a domestic index (DI).

	R_{DI} = 30%	R_{DI} = 25%	R_{DI} = 15%
R_{FI} = 25%	0.25		
R_{FI} = 15%		0.50	
R_{FI} = 10%			0.25

The covariance of returns on the foreign index and the returns on the domestic index is *closest* to:

A. 26.39.

B. 26.56.

C. 28.12.

26. You have developed a set of criteria for evaluating distressed credits. Companies that do not receive a passing score are classed as likely to go bankrupt within 12

months. You gathered the following information when validating the criteria:

- Forty percent of the companies to which the test is administered will go bankrupt within 12 months: $P(\textit{non-survivor}) = 0.40$.
- Fifty-five percent of the companies to which the test is administered pass it: $P(\textit{pass test}) = 0.55$.
- The probability that a company will pass the test given that it will subsequently survive 12 months, is 0.85: $P(\textit{pass test} \mid \textit{survivor}) = 0.85$.

A. What is $P(\textit{pass test} \mid \textit{non-survivor})$?

B. Using Bayes' formula, calculate the probability that a company is a survivor, given that it passes the test; that is, calculate $P(\textit{survivor} \mid \textit{pass test})$.

C. What is the probability that a company is a *non-survivor*, given that it fails the test?

D. Is the test effective?

27. An analyst estimates that 20% of high-risk bonds will fail (go bankrupt). If she applies a bankruptcy prediction model, she finds that 70% of the bonds will receive a "good" rating, implying that they are less likely to fail. Of the bonds that failed, only 50% had a "good" rating. Use Bayes' formula to predict the probability of failure given a "good" rating. (Hint, let $P(A)$ be the probability of failure, $P(B)$ be the probability of a "good" rating, $P(B \mid A)$ be the likelihood of a "good" rating given failure, and $P(A \mid B)$ be the likelihood of failure given a "good" rating.)

A. 5.7%

B. 14.3%

C. 28.6%

28. In a typical year, 5% of all CEOs are fired for "performance" reasons. Assume that CEO performance is judged according to stock performance and that 50% of stocks have above-average returns or "good" performance. Empirically, 30% of all CEOs who were fired had "good" performance. Using Bayes' formula, what is the probability that a CEO will be fired given "good" performance? (Hint, let $P(A)$ be the probability of a CEO being fired, $P(B)$ be the probability of a "good" performance rating, $P(B \mid A)$ be the likelihood of a "good" performance rating given that the CEO was fired, and $P(A \mid B)$ be the likelihood of the CEO being fired given a "good" performance rating.)

A. 1.5%

B. 2.5%

C. 3.0%

29. A manager will select 20 bonds out of his universe of 100 bonds to construct a portfolio. Which formula provides the number of possible portfolios?

A. Permutation formula

B. Multinomial formula

C. Combination formula

30. A firm will select two of four vice presidents to be added to the investment com-

mittee. How many different groups of two are possible?

A. 6

B. 12

C. 24

31. From an approved list of 25 funds, a portfolio manager wants to rank 4 mutual funds from most recommended to least recommended. Which formula is *most* appropriate to calculate the number of possible ways the funds could be ranked?

A. Permutation formula

B. Multinomial formula

C. Combination formula

32. Himari Fukumoto has joined a new firm and is selecting mutual funds in the firm's pension plan. If 10 mutual funds are available, and she plans to select four, how many different sets of mutual funds can she choose?

A. 210

B. 720

C. 5,040

The following information relates to questions 33-35

Gerd Sturm wants to sponsor a contest with a $1 million prize. The winner must pick the stocks that will be the top five performers next year among the 30 stocks in a well-known large-cap stock index. He asks you to estimate the chances that contestants can win the contest.

33. What are the chances of winning if the contestants must pick the five stocks in the correct order of their total return? If choosing five stocks randomly, a contestant's chance of winning is one out of:

A. 142,506.

B. 17,100,720.

C. 24,300,000.

34. What are the chances of winning if the contestants must pick the top five stocks without regard to order? If choosing five stocks randomly, a contestant's chance of winning is one out of:

A. 142,506.

B. 17,100,720.

C. 24,300,000.

35. Sturm asks, "Can we trust these probabilities of winning?"

PRACTICE PROBLEMS

1. A European put option on stock conveys the right to sell the stock at a prespecified price, called the exercise price, at the maturity date of the option. The value of this put at maturity is (exercise price – stock price) or $0, whichever is greater. Suppose the exercise price is $100 and the underlying stock trades in increments of $0.01. At any time before maturity, the terminal value of the put is a random variable.

   A. Describe the distinct possible outcomes for terminal put value. (Think of the put's maximum and minimum values and its minimum price increments.)

   B. Is terminal put value, at a time before maturity, a discrete or continuous random variable?

   C. Letting Y stand for terminal put value, express in standard notation the probability that terminal put value is less than or equal to $24. No calculations or formulas are necessary.

2. Which of the following is a continuous random variable?

   A. The value of a futures contract quoted in increments of $0.05

   B. The total number of heads recorded in 1 million tosses of a coin

   C. The rate of return on a diversified portfolio of stocks over a three-month period

3. X is a discrete random variable with possible outcomes $X = \{1, 2, 3, 4\}$. Three functions—$f(x)$, $g(x)$, and $h(x)$—are proposed to describe the probabilities of the outcomes in X.

	Probability Function		
$X = x$	$f(x) = P(X = x)$	$g(x) = P(X = x)$	$h(x) = P(X = x)$
1	–0.25	0.20	0.20
2	0.25	0.25	0.25
3	0.50	0.50	0.30
4	0.25	0.05	0.35

   The conditions for a probability function are satisfied by:

   A. $f(x)$.

   B. $g(x)$.

   C. $h(x)$.

4. The value of the cumulative distribution function $F(x)$, where x is a particular outcome, for a discrete uniform distribution:

   A. sums to 1.

   B. lies between 0 and 1.

   C. decreases as x increases.

5. In a discrete uniform distribution with 20 potential outcomes of integers 1–20, the probability that X is greater than or equal to 3 but less than 6, $P(3 \leq X < 6)$, is:

   A. 0.10.

   B. 0.15.

   C. 0.20.

6. You are forecasting sales for a company in the fourth quarter of its fiscal year. Your low-end estimate of sales is €14 million, and your high-end estimate is €15 million. You decide to treat all outcomes for sales between these two values as equally likely, using a continuous uniform distribution.

   A. What is the expected value of sales for the fourth quarter?

   B. What is the probability that fourth-quarter sales will be less than or equal to €14,125,000?

7. The cumulative distribution function for a discrete random variable is shown in the following table.

$X = x$	Cumulative Distribution Function $F(x) = P(X \leq x)$
1	0.15
2	0.25
3	0.50
4	0.60
5	0.95
6	1.00

   The probability that X will take on a value of either 2 or 4 is *closest* to:

   A. 0.20.

   B. 0.35.

   C. 0.85.

8. A random number between zero and one is generated according to a continuous uniform distribution. What is the probability that the first number generated will have a value of exactly 0.30?

   A. 0%

   B. 30%

   C. 70%

9. Define the term "binomial random variable." Describe the types of problems for which the binomial distribution is used.

10. For a binomial random variable with five trials and a probability of success on each trial of 0.50, the distribution will be:

    A. skewed.

    B. uniform.

C. symmetric.

11. Over the last 10 years, a company's annual earnings increased year over year seven times and decreased year over year three times. You decide to model the number of earnings increases for the next decade as a binomial random variable. For Parts B, C, and D of this problem, assume the estimated probability is the actual probability for the next decade.

A. What is your estimate of the probability of success, defined as an increase in annual earnings?

B. What is the probability that earnings will increase in exactly 5 of the next 10 years?

C. Calculate the expected number of yearly earnings increases during the next 10 years.

D. Calculate the variance and standard deviation of the number of yearly earnings increases during the next 10 years.

E. The expression for the probability function of a binomial random variable depends on two major assumptions. In the context of this problem, what must you assume about annual earnings increases to apply the binomial distribution in Part B? What reservations might you have about the validity of these assumptions?

12. A portfolio manager annually outperforms her benchmark 60% of the time. Assuming independent annual trials, what is the probability that she will outperform her benchmark four or more times over the next five years?

A. 0.26

B. 0.34

C. 0.48

13. You are examining the record of an investment newsletter writer who claims a 70% success rate in making investment recommendations that are profitable over a one-year time horizon. You have the one-year record of the newsletter's seven most recent recommendations. Four of those recommendations were profitable. If all the recommendations are independent and the newsletter writer's skill is as claimed, what is the probability of observing four or fewer profitable recommendations out of seven in total?

14. If the probability that a portfolio outperforms its benchmark in any quarter is 0.75, the probability that the portfolio outperforms its benchmark in three or fewer quarters over the course of a year is *closest* to:

A. 0.26

B. 0.42

C. 0.68

15. Which of the following events can be represented as a Bernoulli trial?

A. The flip of a coin

B. The closing price of a stock

C. The picking of a random integer between 1 and 10

16. A stock is priced at $100.00 and follows a one-period binomial process with an up move that equals 1.05 and a down move that equals 0.97. If 1 million Bernoulli trials are conducted and the average terminal stock price is $102.00, the probability of an up move (p) is *closest* to:

A. 0.375.

B. 0.500.

C. 0.625.

17. A call option on a stock index is valued using a three-step binomial tree with an up move that equals 1.05 and a down move that equals 0.95. The current level of the index is $190, and the option exercise price is $200. If the option value is positive when the stock price exceeds the exercise price at expiration and $0 otherwise, the number of terminal nodes with a positive payoff is:

A. one.

B. two.

C. three.

18. State the approximate probability that a normal random variable will fall within the following intervals:

A. Mean plus or minus one standard deviation.

B. Mean plus or minus two standard deviations.

C. Mean plus or minus three standard deviations.

19. In futures markets, profits or losses on contracts are settled at the end of each trading day. This procedure is called marking to market or daily resettlement. By preventing a trader's losses from accumulating over many days, marking to market reduces the risk that traders will default on their obligations. A futures markets trader needs a liquidity pool to meet the daily mark to market. If liquidity is exhausted, the trader may be forced to unwind his position at an unfavorable time.

Suppose you are using financial futures contracts to hedge a risk in your portfolio. You have a liquidity pool (cash and cash equivalents) of λ dollars per contract and a time horizon of T trading days. For a given size liquidity pool, λ, Kolb, Gay, and Hunter developed an expression for the probability stating that you will exhaust your liquidity pool within a T-day horizon as a result of the daily marking to market. Kolb et al. assumed that the expected change in futures price is 0 and that futures price changes are normally distributed. With σ representing the standard deviation of daily futures price changes, the standard deviation of price changes over a time horizon to day T is $\sigma\sqrt{T}$, given continuous compounding. With that background, the Kolb et al. expression is

$$\text{Probability of exhausting liquidity pool} = 2[1 - N(x)],$$

where $x = \lambda / \left(\sigma\sqrt{T}\right)$. Here, x is a standardized value of λ. $N(x)$ is the standard normal cumulative distribution function. For some intuition about $1 - N(x)$ in the expression, note that the liquidity pool is exhausted if losses exceed the size of the liquidity pool at any time up to and including T; the probability of that event happening can be shown to be proportional to an area in the right tail of a

standard normal distribution, $1 - N(x)$.

Using the Kolb et al. expression, answer the following questions:

A. Your hedging horizon is five days, and your liquidity pool is $2,000 per contract. You estimate that the standard deviation of daily price changes for the contract is $450. What is the probability that you will exhaust your liquidity pool in the five-day period?

B. Suppose your hedging horizon is 20 days but all the other facts given in Part A remain the same. What is the probability that you will exhaust your liquidity pool in the 20-day period?

20. Which of the following is characteristic of the normal distribution?

A. Asymmetry

B. Kurtosis of 3

C. Definitive limits or boundaries

21. Which of the following assets *most likely* requires the use of a multivariate distribution for modeling returns?

A. A call option on a bond

B. A portfolio of technology stocks

C. A stock in a market index

22. The total number of parameters that fully characterizes a multivariate normal distribution for the returns on two stocks is:

A. 3.

B. 4.

C. 5.

23. A portfolio has an expected mean return of 8% and standard deviation of 14%. The probability that its return falls between 8% and 11% is *closest* to:

A. 8.5%.

B. 14.8%.

C. 58.3%.

24. A portfolio has an expected return of 7%, with a standard deviation of 13%. For an investor with a minimum annual return target of 4%, the probability that the portfolio return will fail to meet the target is *closest* to:

A. 33%.

B. 41%.

C. 59%.

25. Which parameter equals zero in a normal distribution?

A. Kurtosis

B. Skewness

C. Standard deviation

26. An analyst develops the following capital market projections.

	Stocks	Bonds
Mean Return	10%	2%
Standard Deviation	15%	5%

Assuming the returns of the asset classes are described by normal distributions, which of the following statements is correct?

A. Bonds have a higher probability of a negative return than stocks.

B. On average, 99% of stock returns will fall within two standard deviations of the mean.

C. The probability of a bond return less than or equal to 3% is determined using a Z-score of 0.25.

27. A client has a portfolio of common stocks and fixed-income instruments with a current value of £1,350,000. She intends to liquidate £50,000 from the portfolio at the end of the year to purchase a partnership share in a business. Furthermore, the client would like to be able to withdraw the £50,000 without reducing the initial capital of £1,350,000. The following table shows four alternative asset allocations.

Mean and Standard Deviation for Four Allocations (in Percent)

	A	B	C	D
Expected annual return	16	12	10	9
Standard deviation of return	24	17	12	11

Address the following questions (assume normality for Parts B and C):

A. Given the client's desire not to invade the £1,350,000 principal, what is the shortfall level, R_L? Use this shortfall level to answer Part B.

B. According to the safety-first criterion, which of the allocations is the best?

C. What is the probability that the return on the safety-first optimal portfolio will be less than the shortfall level, R_L?

28. A client holding a £2,000,000 portfolio wants to withdraw £90,000 in one year without invading the principal. According to Roy's safety-first criterion, which of the following portfolio allocations is optimal?

	Allocation A	Allocation B	Allocation C
Expected annual return	6.5%	7.5%	8.5%

	Allocation A	Allocation B	Allocation C
Standard deviation of returns	8.35%	10.21%	14.34%

A. Allocation A

B. Allocation B

C. Allocation C

29. The weekly closing prices of Mordice Corporation shares are as follows:

Date	Closing Price (€)
1 August	112
8 August	160
15 August	120

The continuously compounded return of Mordice Corporation shares for the period August 1 to August 15 is *closest* to:

A. 6.90%.

B. 7.14%.

C. 8.95%.

30. In contrast to normal distributions, lognormal distributions:

A. are skewed to the left.

B. have outcomes that cannot be negative.

C. are more suitable for describing asset returns than asset prices.

31. The lognormal distribution is a more accurate model for the distribution of stock prices than the normal distribution because stock prices are:

A. symmetrical.

B. unbounded.

C. non-negative.

32. The price of a stock at $t = 0$ is $208.25 and at $t = 1$ is $186.75. The continuously compounded rate of return for the stock from $t = 0$ to $t = 1$ is *closest* to:

A. −10.90%.

B. −10.32%.

C. 11.51%.

33. Which one of the following statements about Student's *t*-distribution is *false*?

A. It is symmetrically distributed around its mean value, like the normal distribution.

B. It has shorter (i.e., thinner) tails than the normal distribution.

C. As its degrees of freedom increase, Student's *t*-distribution approaches the normal distribution.

34. Which one of the following statements concerning chi-square and *F*-distributions is *false*?

A. They are both asymmetric distributions.

B. As their degrees of freedom increase, the shapes of their pdfs become more bell curve–like.

C. The domains of their pdfs are positive and negative numbers.

35.

A. Define Monte Carlo simulation, and explain its use in investment management.

B. Compared with analytical methods, what are the strengths and weaknesses of Monte Carlo simulation for use in valuing securities?

36. A Monte Carlo simulation can be used to:

A. directly provide precise valuations of call options.

B. simulate a process from historical records of returns.

C. test the sensitivity of a model to changes in assumptions—for example, on distributions of key variables.

37. A limitation of Monte Carlo simulation is:

A. its failure to do "what if" analysis.

B. that it requires historical records of returns.

C. its inability to independently specify cause-and-effect relationships.

PRACTICE PROBLEMS

1. Perkiomen Kinzua, a seasoned auditor, is auditing last year's transactions for Conemaugh Corporation. Unfortunately, Conemaugh had a very large number of transactions last year, and Kinzua is under a time constraint to finish the audit. He decides to audit only the small subset of the transaction population that is of interest and to use sampling to create that subset.

   The most appropriate sampling method for Kinzua to use is:

   A. judgmental sampling.

   B. systematic sampling.

   C. convenience sampling.

2. Which one of the following statements is true about non-probability sampling?

   A. There is significant risk that the sample is not representative of the population.

   B. Every member of the population has an equal chance of being selected for the sample.

   C. Using judgment guarantees that population subdivisions of interest are represented in the sample.

3. The *best* approach for creating a stratified random sample of a population involves:

   A. drawing an equal number of simple random samples from each subpopulation.

   B. selecting every *k*th member of the population until the desired sample size is reached.

   C. drawing simple random samples from each subpopulation in sizes proportional to the relative size of each subpopulation.

4. Although he knows security returns are not independent, a colleague makes the claim that because of the central limit theorem, if we diversify across a large number of investments, the portfolio standard deviation will eventually approach zero as n becomes large. Is he correct?

5. Why is the central limit theorem important?

6. What is wrong with the following statement of the central limit theorem?

   Central Limit Theorem. "If the random variables $X_1, X_2, X_3, \ldots, X_n$ are a random sample of size n from any distribution with finite mean μ and variance σ^2, then the distribution of $\overline{X}$ will be approximately normal, with a standard deviation of $\sigma/\sqrt{n}$."

7. Peter Biggs wants to know how growth managers performed last year. Biggs assumes that the population cross-sectional standard deviation of growth manager

returns is 6% and that the returns are independent across managers.

A. How large a random sample does Biggs need if he wants the standard deviation of the sample means to be 1%?

B. How large a random sample does Biggs need if he wants the standard deviation of the sample means to be 0.25%?

8. A population has a non-normal distribution with mean μ and variance σ^2. The sampling distribution of the sample mean computed from samples of large size from that population will have:

A. the same distribution as the population distribution.

B. its mean approximately equal to the population mean.

C. its variance approximately equal to the population variance.

9. A sample mean is computed from a population with a variance of 2.45. The sample size is 40. The standard error of the sample mean is *closest* to:

A. 0.039.

B. 0.247.

C. 0.387.

10. An estimator with an expected value equal to the parameter that it is intended to estimate is described as:

A. efficient.

B. unbiased.

C. consistent.

11. If an estimator is consistent, an increase in sample size will increase the:

A. accuracy of estimates.

B. efficiency of the estimator.

C. unbiasedness of the estimator.

12. Petra Munzi wants to know how value managers performed last year. Munzi estimates that the population cross-sectional standard deviation of value manager returns is 4% and assumes that the returns are independent across managers.

A. Munzi wants to build a 95% confidence interval for the population mean return. How large a random sample does Munzi need if she wants the 95% confidence interval to have a total width of 1%?

B. Munzi expects a cost of about $10 to collect each observation. If she has a $1,000 budget, will she be able to construct the confidence interval she wants?

13. Find the reliability factors based on the *t*-distribution for the following confidence intervals for the population mean (df = degrees of freedom, *n* = sample size):

A. A 99% confidence interval, df = 20

B. A 90% confidence interval, df = 20

C. A 95% confidence interval, $n = 25$

D. A 95% confidence interval, $n = 16$

14. Assume that monthly returns are normally distributed with a mean of 1% and a sample standard deviation of 4%. The population standard deviation is unknown. Construct a 95% confidence interval for the sample mean of monthly returns if the sample size is 24.

15. Explain the differences between constructing a confidence interval when sampling from a normal population with a known population variance and sampling from a normal population with an unknown variance.

16. For a two-sided confidence interval, an increase in the degree of confidence will result in:

A. a wider confidence interval.

B. a narrower confidence interval.

C. no change in the width of the confidence interval.

17. For a sample size of 17, with a mean of 116.23 and a variance of 245.55, the width of a 90% confidence interval using the appropriate *t*-distribution is *closest to*:

A. 13.23.

B. 13.27.

C. 13.68.

18. For a sample size of 65 with a mean of 31 taken from a normally distributed population with a variance of 529, a 99% confidence interval for the population mean will have a lower limit *closest* to:

A. 23.64.

B. 25.41.

C. 30.09.

19. An increase in sample size is *most likely* to result in a:

A. wider confidence interval.

B. decrease in the standard error of the sample mean.

C. lower likelihood of sampling from more than one population.

20. Otema Chi has a spreadsheet with 108 monthly returns for shares in Marunou Corporation. He writes a software program that uses bootstrap resampling to create 200 resamples of this Marunou data by sampling with replacement. Each resample has 108 data points. Chi's program calculates the mean of each of the 200 resamples, and then it calculates that the mean of these 200 resample means is 0.0261. The program subtracts 0.0261 from each of the 200 resample means, squares each of these 200 differences, and adds the squared differences together. The result is 0.835. The program then calculates an estimate of the standard error

of the sample mean.

The estimated standard error of the sample mean is closest to:

A. 0.0115

B. 0.0648

C. 0.0883

21. Compared with bootstrap resampling, jackknife resampling:

A. is done with replacement.

B. usually requires that the number of repetitions is equal to the sample size.

C. produces dissimilar results for every run because resamples are randomly drawn.

22. Suppose we take a random sample of 30 companies in an industry with 200 companies. We calculate the sample mean of the ratio of cash flow to total debt for the prior year. We find that this ratio is 23%. Subsequently, we learn that the population cash flow to total debt ratio (taking account of all 200 companies) is 26%. What is the explanation for the discrepancy between the sample mean of 23% and the population mean of 26%?

A. Sampling error.

B. Bias.

C. A lack of consistency.

23. Alcorn Mutual Funds is placing large advertisements in several financial publications. The advertisements prominently display the returns of 5 of Alcorn's 30 funds for the past 1-, 3-, 5-, and 10-year periods. The results are indeed impressive, with all of the funds beating the major market indexes and a few beating them by a large margin. Is the Alcorn family of funds superior to its competitors?

24. Julius Spence has tested several predictive models in order to identify undervalued stocks. Spence used about 30 company-specific variables and 10 market-related variables to predict returns for about 5,000 North American and European stocks. He found that a final model using eight variables applied to telecommunications and computer stocks yields spectacular results. Spence wants you to use the model to select investments. Should you? What steps would you take to evaluate the model?

25. A report on long-term stock returns focused exclusively on all currently publicly traded firms in an industry is *most likely* susceptible to:

A. look-ahead bias.

B. survivorship bias.

C. intergenerational data mining.

26. Which sampling bias is *most likely* investigated with an out-of-sample test?

A. Look-ahead bias

B. Data-mining bias

C. Sample selection bias

27. Which of the following characteristics of an investment study *most likely* indicates time-period bias?

A. The study is based on a short time-series.

B. Information not available on the test date is used.

C. A structural change occurred prior to the start of the study's time series.

PRACTICE PROBLEMS

1. Which of the following statements about hypothesis testing is correct?
   A. The null hypothesis is the condition a researcher hopes to support.
   B. The alternative hypothesis is the proposition considered true without conclusive evidence to the contrary.
   C. The alternative hypothesis exhausts all potential parameter values not accounted for by the null hypothesis.

2. Willco is a manufacturer in a mature cyclical industry. During the most recent industry cycle, its net income averaged $30 million per year with a standard deviation of $10 million ($n$ = 6 observations). Management claims that Willco's performance during the most recent cycle results from new approaches and that Willco's profitability will exceed the $24 million per year observed in prior cycles.
   A. With μ as the population value of mean annual net income, formulate null and alternative hypotheses consistent with testing Willco management's claim.
   B. Assuming that Willco's net income is at least approximately normally distributed, identify the appropriate test statistic and calculate the degrees of freedom.
   C. Based on critical value of 2.015, determine whether to reject the null hypothesis.

3. Which of the following statements is correct with respect to the null hypothesis?
   A. It can be stated as "not equal to" provided the alternative hypothesis is stated as "equal to."
   B. Along with the alternative hypothesis, it considers all possible values of the population parameter.
   C. In a two-tailed test, it is rejected when evidence supports equality between the hypothesized value and the population parameter.

4. Which of the following statements regarding a one-tailed hypothesis test is correct?
   A. The rejection region increases in size as the level of significance becomes smaller.
   B. A one-tailed test more strongly reflects the beliefs of the researcher than a two-tailed test.
   C. The absolute value of the rejection point is larger than that of a two-tailed test at the same level of significance.

5. A hypothesis test for a normally distributed population at a 0.05 significance level implies a:
   A. 95% probability of rejecting a true null hypothesis.
   B. 95% probability of a Type I error for a two-tailed test.

C. 5% critical value rejection region in a tail of the distribution for a one-tailed test.

6. The value of a test statistic is *best* described as the basis for deciding whether to:

A. reject the null hypothesis.

B. accept the null hypothesis.

C. reject the alternative hypothesis.

7. Which of the following is a Type I error?

A. Rejecting a true null hypothesis

B. Rejecting a false null hypothesis

C. Failing to reject a false null hypothesis

8. A Type II error is *best* described as:

A. rejecting a true null hypothesis.

B. failing to reject a false null hypothesis.

C. failing to reject a false alternative hypothesis.

9. The level of significance of a hypothesis test is *best* used to:

A. calculate the test statistic.

B. define the test's rejection points.

C. specify the probability of a Type II error.

10. All else equal, is specifying a smaller significance level in a hypothesis test likely to increase the probability of a:

	Type I error?	Type II error?
A.	No	No
B.	No	Yes
C.	Yes	No

11. The probability of correctly rejecting the null hypothesis is the:

A. *p*-value.

B. power of a test.

C. level of significance.

12. The power of a hypothesis test is:

A. equivalent to the level of significance.

B. the probability of not making a Type II error.

C. unchanged by increasing a small sample size.

13. For each of the following hypothesis tests concerning the population mean, μ,

state the conclusion regarding the test of the hypotheses.

A. H_0: μ = 10 versus H_a: μ ≠ 10, with a calculated *t*-statistic of 2.05 and critical *t*-values of ±1.984.

B. H_0: μ ≤ 10 versus H_a: μ > 10, with a calculated *t*-statistic of 2.35 and a critical *t*-value of +1.679

C. H_0: μ = 10 versus H_a: μ ≠ 10, with a calculated *t*-statistic of 2.05, a *p*-value of 4.6352%, and a level of significance of 5%.

D. H_0: μ ≤ 10 versus H_a: μ > 10, with a 2% level of significance and a calculated test statistic with a *p*-value of 3%.

14. In the step "stating a decision rule" in testing a hypothesis, which of the following elements must be specified?

A. Critical value

B. Power of a test

C. Value of a test statistic

15. When making a decision about investments involving a statistically significant result, the:

A. economic result should be presumed to be meaningful.

B. statistical result should take priority over economic considerations.

C. economic logic for the future relevance of the result should be further explored.

16. An analyst tests the profitability of a trading strategy with the null hypothesis that the average abnormal return before trading costs equals zero. The calculated *t*-statistic is 2.802, with critical values of ±2.756 at significance level α = 0.01. After considering trading costs, the strategy's return is near zero. The results are *most likely*:

A. statistically but not economically significant.

B. economically but not statistically significant.

C. neither statistically nor economically significant.

17. Which of the following statements is correct with respect to the *p*-value?

A. It is a less precise measure of test evidence than rejection points.

B. It is the largest level of significance at which the null hypothesis is rejected.

C. It can be compared directly with the level of significance in reaching test conclusions.

18. Which of the following represents a correct statement about the *p*-value?

A. The *p*-value offers less precise information than does the rejection points approach.

B. A larger *p*-value provides stronger evidence in support of the alternative hypothesis.

C. A *p*-value less than the specified level of significance leads to rejection of the null hypothesis.

19. Which of the following statements on *p*-value is correct?

A. The *p*-value indicates the probability of making a Type II error.

B. The lower the *p*-value, the weaker the evidence for rejecting the H_0.

C. The *p*-value is the smallest level of significance at which H_0 can be rejected.

20. The following table shows the significance level (α) and the *p*-value for two hypothesis tests.

	α	*p*-Value
Test 1	0.02	0.05
Test 2	0.05	0.02

In which test should we reject the null hypothesis?

A. Test 1 only

B. Test 2 only

C. Both Test 1 and Test 2

21. Identify the appropriate test statistic or statistics for conducting the following hypothesis tests. (Clearly identify the test statistic and, if applicable, the number of degrees of freedom. For example, "We conduct the test using an *x*-statistic with *y* degrees of freedom.")

A. H_0: μ = 0 versus H_a: μ ≠ 0, where μ is the mean of a normally distributed population with unknown variance. The test is based on a sample of 15 observations.

B. H_0: μ = 5 versus H_a: μ ≠ 5, where μ is the mean of a normally distributed population with unknown variance. The test is based on a sample of 40 observations.

C. H_0: μ ≤ 0 versus H_a: μ > 0, where μ is the mean of a normally distributed population with known variance σ^2. The sample size is 45.

D. H_0: $\sigma^2 = 200$ versus H_a: $\sigma^2 \neq 200$, where σ^2 is the variance of a normally distributed population. The sample size is 50.

E. H_0: $\sigma_1^2 = \sigma_2^2$ versus H_a: $\sigma_1^2 \neq \sigma_2^2$, where σ_1^2 is the variance of one normally distributed population and σ_2^2 is the variance of a second normally distributed population. The test is based on two independent samples, with the first sample of size 30 and the second sample of size 40.

F. H_0: $\mu_1 - \mu_2 = 0$ versus H_a: $\mu_1 - \mu_2 \neq 0$, where the samples are drawn from normally distributed populations with unknown but assumed equal variances. The observations in the two samples (of size 25 and 30, respectively) are independent.

22. For each of the following hypothesis tests concerning the population mean, state the conclusion.

A. H_0: $\sigma^2 = 0.10$ versus H_a: $\sigma^2 \neq 0.10$, with a calculated chi-square test statistic of 45.8 and critical chi-square values of 42.950 and 86.830.

B. H_0: $\sigma^2 = 0.10$ versus H_a: $\sigma^2 \neq 0.10$, with a 5% level of significance and a *p*-value for this calculated chi-square test statistic of 4.463%.

C. H_0: ${\sigma_1}^2 = {\sigma_2}^2$ versus H_a: ${\sigma_1}^2 \neq {\sigma_2}^2$, with a calculated *F*-statistic of 2.3. With 40 and 30 degrees of freedom, the critical *F*-values are 0.498 and 1.943.

D. H_0: $\sigma^2 \leq 10$ versus H_a: $\mu\sigma^2 > 10$, with a calculated test statistic of 32 and a critical chi-square value of 26.296.

The following information relates to questions 23-24

Performance in Forecasting Quarterly Earnings per Share

	Number of Forecasts	Mean Forecast Error (Predicted – Actual)	Standard Deviation of Forecast Errors
Analyst A	10	0.05	0.10
Analyst B	15	0.02	0.09

Critical *t*-values:

	Area in the Right-Side Rejection Area	
Degrees of Freedom	***p* = 0.05**	***p* = 0.025**
8	1.860	2.306
9	1.833	2.262
10	1.812	2.228
11	1.796	2.201
12	1.782	2.179
13	1.771	2.160
14	1.761	2.145
15	1.753	2.131
16	1.746	2.120
17	1.740	2.110
18	1.734	2.101
19	1.729	2.093
20	1.725	2.086
21	1.721	2.080
22	1.717	2.074
23	1.714	2.069
24	1.711	2.064
25	1.708	2.060
26	1.706	2.056
27	1.703	2.052

23. Investment analysts often use earnings per share (EPS) forecasts. One test of forecasting quality is the zero-mean test, which states that optimal forecasts should have a mean forecasting error of zero. The forecasting error is the difference between the predicted value of a variable and the actual value of the variable.

You have collected data (shown in the previous table) for two analysts who cover two different industries: Analyst A covers the telecom industry; Analyst B covers automotive parts and suppliers.

A. With μ as the population mean forecasting error, formulate null and alternative hypotheses for a zero-mean test of forecasting quality.

B. For Analyst A, determine whether to reject the null at the 0.05 level of significance.

C. For Analyst B, determine whether to reject the null at the 0.05 level of significance.

24. Reviewing the EPS forecasting performance data for Analysts A and B, you want to investigate whether the larger average forecast errors of Analyst A relative to Analyst B are due to chance or to a higher underlying mean value for Analyst A. Assume that the forecast errors of both analysts are normally distributed and that the samples are independent.

A. Formulate null and alternative hypotheses consistent with determining whether the population mean value of Analyst A's forecast errors (μ_1) are larger than Analyst B's (μ_2).

B. Identify the test statistic for conducting a test of the null hypothesis formulated in Part A.

C. Identify the rejection point or points for the hypotheses tested in Part A at the 0.05 level of significance.

D. Determine whether to reject the null hypothesis at the 0.05 level of significance.

25. An analyst is examining a large sample with an unknown population variance. Which of the following is the *most* appropriate test to test the hypothesis that the historical average return on an index is less than or equal to 6%?

A. One-sided *t*-test

B. Two-sided *t*-test

C. One-sided chi-square test

26. Which of the following tests of a hypothesis concerning the population mean is *most* appropriate?

A. A *z*-test if the population variance is unknown and the sample is small

B. A *z*-test if the population is normally distributed with a known variance

C. A *t*-test if the population is non-normally distributed with unknown variance and a small sample

27. For a small sample from a normally distributed population with unknown variance, the *most* appropriate test statistic for the mean is the:

A. z-statistic.

B. t-statistic.

C. χ^2 statistic.

28. An investment consultant conducts two independent random samples of five-year performance data for US and European absolute return hedge funds. Noting a return advantage of 50 bps for US managers, the consultant decides to test whether the two means are different from one another at a 0.05 level of significance. The two populations are assumed to be normally distributed with unknown but equal variances. Results of the hypothesis test are contained in the following tables.

	Sample Size	Mean Return (%)	Standard Deviation
US managers	50	4.7	5.4
European managers	50	4.2	4.8

Null and alternative hypotheses	H_0: $\mu_{US} - \mu_E = 0$; H_a: $\mu_{US} - \mu_E \neq 0$
Calculated test statistic	0.4893
Critical value rejection points	±1.984

The mean return for US funds is μ_{US} and μ_E is the mean return for European funds.

The results of the hypothesis test indicate that the:

A. null hypothesis is not rejected.

B. alternative hypothesis is statistically confirmed.

C. difference in mean returns is statistically different from zero.

29. A pooled estimator is used when testing a hypothesis concerning the:

A. equality of the variances of two normally distributed populations.

B. difference between the means of two at least approximately normally distributed populations with unknown but assumed equal variances.

C. difference between the means of two at least approximately normally distributed populations with unknown and assumed unequal variances.

30. The following table gives data on the monthly returns on the S&P 500 Index and small-cap stocks for a 40-year period and provides statistics relating to their mean differences. Further, the entire sample period is split into two subperiods of 20 years each, and the return data for these subperiods is also given in the table.

Measure	S&P 500 Return (%)	Small-Cap Stock Return (%)	Differences (S&P 500 – Small-Cap Stock)
Entire sample period, 480 months			
Mean	1.0542	1.3117	–0.258
Standard deviation	4.2185	5.9570	3.752
First subperiod, 240 months			
Mean	0.6345	1.2741	–0.640

Measure	S&P 500 Return (%)	Small-Cap Stock Return (%)	Differences (S&P 500 – Small-Cap Stock)
Standard deviation	4.0807	6.5829	4.096
Second subperiod, 240 months			
Mean	1.4739	1.3492	0.125
Standard deviation	4.3197	5.2709	3.339

Use a significance level of 0.05 and assume that mean differences are approximately normally distributed.

A. Formulate null and alternative hypotheses consistent with testing whether any difference exists between the mean returns on the S&P 500 and small-cap stocks.

B. Determine whether to reject the null hypothesis for the entire sample period if the critical values are ±1.96.

C. Determine whether to reject the null hypothesis for the first subperiod if the critical values are ±1.96.

D. Determine whether to reject the null hypothesis for the second subperiod if the critical values are ±1.96.

31. When evaluating mean differences between two dependent samples, the *most* appropriate test is a:

A. *z*-test.

B. chi-square test.

C. paired comparisons test.

32. A chi-square test is *most* appropriate for tests concerning:

A. a single variance.

B. differences between two population means with variances assumed to be equal.

C. differences between two population means with variances assumed to not be equal.

33. During a 10-year period, the standard deviation of annual returns on a portfolio you are analyzing was 15% a year. You want to see whether this record is sufficient evidence to support the conclusion that the portfolio's underlying variance of return was less than 400, the return variance of the portfolio's benchmark.

A. Formulate null and alternative hypotheses consistent with your objective.

B. Identify the test statistic for conducting a test of the hypotheses in Part A, and calculate the degrees of freedom.

C. Determine whether the null hypothesis is rejected or not rejected at the 0.05 level of significance using a critical value of 3.325.

34. You are investigating whether the population variance of returns on an index

changed subsequent to a market disruption. You gather the following data for 120 months of returns before the disruption and for 120 months of returns after the disruption. You have specified a 0.05 level of significance.

Time Period	*n*	Mean Monthly Return (%)	Variance of Returns
Before disruption	120	1.416	22.367
After disruption	120	1.436	15.795

A. Formulate null and alternative hypotheses consistent with the research goal.

B. Identify the test statistic for conducting a test of the hypotheses in Part A, and calculate the degrees of freedom.

C. Determine whether to reject the null hypothesis at the 0.05 level of significance if the critical values are 0.6969 and 1.4349.

35. Which of the following should be used to test the difference between the variances of two normally distributed populations?

A. *t*-test

B. *F*-test

C. Paired comparisons test

36. In which of the following situations would a nonparametric test of a hypothesis *most likely* be used?

A. The sample data are ranked according to magnitude.

B. The sample data come from a normally distributed population.

C. The test validity depends on many assumptions about the nature of the population.

37. An analyst is examining the monthly returns for two funds over one year. Both funds' returns are non-normally distributed. To test whether the mean return of one fund is greater than the mean return of the other fund, the analyst can use:

A. a parametric test only.

B. a nonparametric test only.

C. both parametric and nonparametric tests.

38. The following table shows the sample correlations between the monthly returns for four different mutual funds and the S&P 500. The correlations are based on 36 monthly observations. The funds are as follows:

Fund 1	Large-cap fund
Fund 2	Mid-cap fund
Fund 3	Large-cap value fund
Fund 4	Emerging market fund
S&P 500	US domestic stock index

	Fund 1	Fund 2	Fund 3	Fund 4	S&P 500
Fund 1	1				
Fund 2	0.9231	1			
Fund 3	0.4771	0.4156	1		
Fund 4	0.7111	0.7238	0.3102	1	
S&P 500	0.8277	0.8223	0.5791	0.7515	1

Test the null hypothesis that each of these correlations, individually, is equal to zero against the alternative hypothesis that it is not equal to zero. Use a 5% significance level and critical *t*-values of ±2.032.

39. You are interested in whether excess risk-adjusted return (alpha) is correlated with mutual fund expense ratios for US large-cap growth funds. The following table presents the sample.

Mutual Fund	Alpha	Expense Ratio
1	–0.52	1.34
2	–0.13	0.40
3	–0.50	1.90
4	–1.01	1.50
5	–0.26	1.35
6	–0.89	0.50
7	–0.42	1.00
8	–0.23	1.50
9	–0.60	1.45

A. Formulate null and alternative hypotheses consistent with the verbal description of the research goal.

B. Identify and justify the test statistic for conducting a test of the hypotheses in Part A.

C. Determine whether to reject the null hypothesis at the 0.05 level of significance if the critical values are ±2.306.

40. Jill Batten is analyzing how the returns on the stock of Stellar Energy Corp. are related with the previous month's percentage change in the US Consumer Price Index for Energy (CPIENG). Based on 248 observations, she has computed the sample correlation between the Stellar and CPIENG variables to be –0.1452. She also wants to determine whether the sample correlation is significantly different from zero. The critical value for the test statistic at the 0.05 level of significance is approximately 1.96. Batten should conclude that the statistical relationship between Stellar and CPIENG is:

A. significant, because the calculated test statistic is outside the bounds of the critical values for the test statistic.

B. significant, because the calculated test statistic has a lower absolute value than the critical value for the test statistic.

C. insignificant, because the calculated test statistic is outside the bounds of the critical values for the test statistic.

41. An analyst group follows 250 firms and classifies them in two dimensions. First, they use dividend payment history and earnings forecasts to classify firms into one of three groups, with 1 indicating the dividend stars and 3 the dividend laggards. Second, they classify firms on the basis of financial leverage, using debt ratios, debt features, and corporate governance to classify the firms into three groups, with 1 indicating the least risky firms based on financial leverage and 3 indicating the riskiest. The classification of the 250 firms is as follows:

Financial Leverage Group	Dividend Group		
	1	2	3
1	40	40	40
2	30	10	20
3	10	50	10

A. What are the null and alternative hypotheses to test whether the dividend and financial leverage groups are independent of one another?

B. What is the appropriate test statistic to use in this type of test?

C. If the critical value for the 0.05 level of significance is 9.4877, what is your conclusion?

42. Which of the following statements is correct regarding the chi-square test of independence?

A. The test has a one-sided rejection region.

B. The null hypothesis is that the two groups are dependent.

C. If there are two categories, each with three levels or groups, there are six degrees of freedom.

PRACTICE PROBLEMS

1. Homoskedasticity is best described as the situation in which the variance of the residuals of a regression is:

   A. zero.

   B. normally distributed.

   C. constant across observations.

2. Julie Moon is an energy analyst examining electricity, oil, and natural gas consumption in different regions over different seasons. She ran a simple regression explaining the variation in energy consumption as a function of temperature. The total variation of the dependent variable was 140.58, and the explained variation was 60.16. She had 60 monthly observations.

   A. Calculate the coefficient of determination.

   B. Calculate the *F*-statistic to test the fit of the model.

   C. Calculate the standard error of the estimate of the regression estimation.

   D. Calculate the sample standard deviation of monthly energy consumption.

3. An economist collected the monthly returns for KDL's portfolio and a diversified stock index. The data collected are shown in the following table:

Month	Portfolio Return (%)	Index Return (%)
1	1.11	−0.59
2	72.10	64.90
3	5.12	4.81
4	1.01	1.68
5	−1.72	−4.97
6	4.06	−2.06

   The economist calculated the correlation between the two returns and found it to be 0.996. The regression results with the KDL return as the dependent variable and the index return as the independent variable are given as follows:

Regression Statistics	
R^2	0.9921
Standard error	2.8619
Observations	6

Source	df	Sum of Squares	Mean Square	*F*	*p*-Value
Regression	1	4,101.6205	4,101.6205	500.7921	0.0000
Residual	4	32.7611	8.1903		
Total	5	4,134.3815			

	Coefficients	Standard Error	*t*-Statistic	*p*-Value
Intercept	2.2521	1.2739	1.7679	0.1518
Index return (%)	1.0690	0.0478	22.3784	0.0000

When reviewing the results, Andrea Fusilier suspected that they were unreliable. She found that the returns for Month 2 should have been 7.21% and 6.49%, instead of the large values shown in the first table. Correcting these values resulted in a revised correlation of 0.824 and the following revised regression results:

Regression Statistics	
R^2	0.6784
Standard error	2.0624
Observations	6

Source	df	Sum of Squares	Mean Square	*F*	*p*-Value
Regression	1	35.8950	35.8950	8.4391	0.044
Residual	4	17.0137	4.2534		
Total	5	52.91			

	Coefficients	Standard Error	*t*-Statistic	*p*-Value
Intercept	2.2421	0.8635	2.5966	0.060
Slope	0.6217	0.2143	2.9050	0.044

Explain how the bad data affected the results.

The following information relates to questions 4-7

An analyst is examining the annual growth of the money supply for a country over the past 30 years. This country experienced a central bank policy shift 15 years ago, which altered the approach to the management of the money supply. The analyst estimated a model using the annual growth rate in the money supply regressed on the variable (SHIFT) that takes on a value of 0 before the policy shift and 1 after. She estimated the following:

	Coefficients	Standard Error	*t*-Stat.
Intercept	5.767264	0.445229	12.95348
SHIFT	–5.13912	0.629649	–8.16188

Critical *t*-values, level of significance of 0.05:

One-sided, left side: –1.701
One-sided, right side: +1.701
Two-sided: ±2.048

4. The variable SHIFT is best described as:

   A. an indicator variable.

   B. a dependent variable.

   C. a continuous variable.

5. The interpretation of the intercept is the mean of the annual growth rate of the money supply:

   A. over the enter entire period.

   B. after the shift in policy.

   C. before the shift in policy.

6. The interpretation of the slope is the:

   A. change in the annual growth rate of the money supply per year.

   B. average annual growth rate of the money supply after the shift in policy.

   C. difference in the average annual growth rate of the money supply from before to after the shift in policy.

7. Testing whether there is a change in the money supply growth after the shift in policy, using a 0.05 level of significance, we conclude that there is:

   A. sufficient evidence that the money supply growth changed.

   B. not enough evidence that the money supply growth is different from zero.

   C. not enough evidence to indicate that the money supply growth changed.

8. You are examining the results of a regression estimation that attempts to explain the unit sales growth of a business you are researching. The analysis of variance output for the regression is given in the following table. The regression was based on five observations ($n = 5$).

Source	df	Sum of Squares	Mean Square	*F*	*p*-Value
Regression	1	88.0	88.0	36.667	0.00904
Residual	3	7.2	2.4		
Total	4	95.2			

   A. Calculate the sample variance of the dependent variable using information in the table.

   B. Calculate the coefficient of determination for this estimated model.

   C. What hypothesis does the *F*-statistic test?

   D. Is the *F*-test significant at the 0.05 significance level?

   E. Calculate the standard error of the estimate.

The following information relates to questions 9-12

Kenneth McCoin, CFA, is a challenging interviewer. Last year, he handed each job applicant a sheet of paper with the information in the following table, and he then asked several questions about regression analysis. Some of McCoin's questions, along with a sample of the answers he received to each, are given below. McCoin told the applicants that the independent variable is the ratio of net income to sales for restaurants with a market cap of more than $100 million and the dependent variable is the ratio of cash flow from operations to sales for those restaurants. Which of the choices provided is the best answer to each of McCoin's questions?

Regression Statistics

R^2	0.7436
Standard error	0.0213
Observations	24

Source	df	Sum of Squares	Mean Square	*F*	*p*-Value
Regression	1	0.029	0.029000	63.81	0
Residual	22	0.010	0.000455		
Total	23	0.040			

	Coefficients	Standard Error	*t*-Statistic	*p*-Value
Intercept	0.077	0.007	11.328	0
Net income to sales (%)	0.826	0.103	7.988	0

9. The coefficient of determination is *closest* to:

A. 0.7436.

B. 0.8261.

C. 0.8623.

10. The correlation between X and Y is *closest* to:

A. −0.7436.

B. 0.7436.

C. 0.8623.

11. If the ratio of net income to sales for a restaurant is 5%, the predicted ratio of cash flow from operations (CFO) to sales is *closest* to:

A. −4.054.

B. 0.524.

C. 4.207.

12. Is the relationship between the ratio of cash flow to operations and the ratio of net income to sales significant at the 0.05 level?

A. No, because the R^2 is greater than 0.05

B. No, because the *p*-values of the intercept and slope are less than 0.05

C. Yes, because the *p*-values for *F* and *t* for the slope coefficient are less than 0.05

The following information relates to questions 13-17

Howard Golub, CFA, is preparing to write a research report on Stellar Energy Corp. common stock. One of the world's largest companies, Stellar is in the business of refining and marketing oil. As part of his analysis, Golub wants to evaluate the sensitivity of the stock's returns to various economic factors. For example, a client recently asked Golub whether the price of Stellar Energy Corp. stock has tended to rise following increases in retail energy prices. Golub believes the association between the two variables is negative, but he does not know the strength of the association.

Golub directs his assistant, Jill Batten, to study the relationships between (1) Stellar monthly common stock returns and the previous month's percentage change in the US Consumer Price Index for Energy (CPIENG) and (2) Stellar monthly common stock returns and the previous month's percentage change in the US Producer Price Index for Crude Energy Materials (PPICEM). Golub wants Batten to run both a correlation and a linear regression analysis. In response, Batten compiles the summary statistics shown in Exhibit 1 for 248 months. All the data are in decimal form, where 0.01 indicates a 1% return. Batten also runs a regression analysis using Stellar monthly returns as the dependent variable and the monthly change in CPIENG as the independent variable. Exhibit 2 displays the results of this regression model.

Exhibit 1: Descriptive Statistics

	Stellar Common Stock Monthly Return	Lagged Monthly Change	
		CPIENG	PPICEM
Mean	0.0123	0.0023	0.0042
Standard deviation	0.0717	0.0160	0.0534
Covariance, Stellar vs. CPIENG	–0.00017		
Covariance, Stellar vs. PPICEM	–0.00048		
Covariance, CPIENG vs. PPICEM	0.00044		

	Stellar Common Stock Monthly Return	Lagged Monthly Change	
		CPIENG	PPICEM
Correlation, Stellar vs. CPIENG	−0.1452		

Exhibit 2: Regression Analysis with CPIENG

Regression Statistics			
R^2	0.0211		
Standard error of the estimate	0.0710		
Observations	248		
	Coefficients	**Standard Error**	***t*-Statistic**
Intercept	0.0138	0.0046	3.0275
CPIENG (%)	−0.6486	0.2818	−2.3014

Critical *t*-values

One-sided, left side: −1.651
One-sided, right side: +1.651
Two-sided: ±1.967

13. Which of the following best describes Batten's regression?

A. Time-series regression

B. Cross-sectional regression

C. Time-series and cross-sectional regression

14. Based on the regression, if the CPIENG *decreases* by 1.0%, the expected return on Stellar common stock during the next period is *closest* to:

A. 0.0073 (0.73%).

B. 0.0138 (1.38%).

C. 0.0203 (2.03%).

15. Based on Batten's regression model, the coefficient of determination indicates that:

A. Stellar's returns explain 2.11% of the variability in CPIENG.

B. Stellar's returns explain 14.52% of the variability in CPIENG.

C. changes in CPIENG explain 2.11% of the variability in Stellar's returns.

16. For Batten's regression model, 0.0710 is the standard deviation of:

A. the dependent variable.

B. the residuals from the regression.

C. the predicted dependent variable from the regression.

17. For the analysis run by Batten, which of the following is an *incorrect* conclusion from the regression output?

A. The estimated intercept from Batten's regression is statistically different from zero at the 0.05 level of significance.

B. In the month after the CPIENG declines, Stellar's common stock is expected to exhibit a positive return.

C. Viewed in combination, the slope and intercept coefficients from Batten's regression are not statistically different from zero at the 0.05 level of significance.

The following information relates to questions 18-26

Anh Liu is an analyst researching whether a company's debt burden affects investors' decision to short the company's stock. She calculates the short interest ratio (the ratio of short interest to average daily share volume, expressed in days) for 50 companies as of the end of 2016 and compares this ratio with the companies' debt ratio (the ratio of total liabilities to total assets, expressed in decimal form).

Liu provides a number of statistics in Exhibit 1. She also estimates a simple regression to investigate the effect of the debt ratio on a company's short interest ratio. The results of this simple regression, including the analysis of variance (ANOVA), are shown in Exhibit 2.

In addition to estimating a regression equation, Liu graphs the 50 observations using a scatter plot, with the short interest ratio on the vertical axis and the debt ratio on the horizontal axis.

Exhibit 1: Summary Statistics

Statistic	Debt Ratio X_i	Short Interest Ratio Y_i
Sum	19.8550	192.3000
Sum of squared deviations from the mean	$\sum_{i=1}^{n}(X_i - \overline{X})^2 = 2.2225.$	$\sum_{i=1}^{n}(Y_i - \overline{Y})^2 = 412.2042.$
Sum of cross-products of deviations from the mean	$\sum_{i=1}^{n}(X_i - \overline{X})(Y_i - \overline{Y}) = -9.2430.$	

Exhibit 2: Regression of the Short Interest Ratio on the Debt Ratio

ANOVA	Degrees of Freedom (df)	Sum of Squares	Mean Square
Regression	1	38.4404	38.4404
Residual	48	373.7638	7.7867
Total	49	412.2042	
Regression Statistics			

ANOVA	Degrees of Freedom (df)	Sum of Squares	Mean Square
R^2	0.0933		
Standard error of estimate	2.7905		
Observations	50		
	Coefficients	**Standard Error**	***t*-Statistic**
Intercept	5.4975	0.8416	6.5322
Debt ratio (%)	–4.1589	1.8718	–2.2219

Critical *t*-values for a 0.05 level of significance:

One-sided, left side: –1.677

One-sided, right side: +1.677

Two-sided: ±2.011

Liu is considering three interpretations of these results for her report on the relationship between debt ratios and short interest ratios:

Interpretation 1 Companies' higher debt ratios cause lower short interest ratios.

Interpretation 2 Companies' higher short interest ratios cause higher debt ratios.

Interpretation 3 Companies with higher debt ratios tend to have lower short interest ratios.

She is especially interested in using her estimation results to predict the short interest ratio for MQD Corporation, which has a debt ratio of 0.40.

18. Based on Exhibits 1 and 2, if Liu were to graph the 50 observations, the scatter plot summarizing this relation would be *best* described as:

A. horizontal.

B. upward sloping.

C. downward sloping.

19. Based on Exhibit 1, the sample covariance is *closest to*:

A. –9.2430.

B. –0.1886.

C. 8.4123.

20. Based on Exhibits 1 and 2, the correlation between the debt ratio and the short interest ratio is *closest to*:

A. –0.3054.

B. 0.0933.

C. 0.3054.

21. Which of the interpretations *best* describes Liu's findings?

A. Interpretation 1

B. Interpretation 2

C. Interpretation 3

22. The dependent variable in Liu's regression analysis is the:

A. intercept.

B. debt ratio.

C. short interest ratio.

23. Based on Exhibit 2, the degrees of freedom for the *t*-test of the slope coefficient in this regression are:

A. 48.

B. 49.

C. 50.

24. Which of the following should Liu conclude from the results shown in Exhibit 2?

A. The average short interest ratio is 5.4975.

B. The estimated slope coefficient is different from zero at the 0.05 level of significance.

C. The debt ratio explains 30.54% of the variation in the short interest ratio.

25. Based on Exhibit 2, the short interest ratio expected for MQD Corporation is *closest* to:

A. 3.8339.

B. 5.4975.

C. 6.2462.

26. Based on Liu's regression results in Exhibit 2, the *F*-statistic for testing whether the slope coefficient is equal to zero is *closest* to:

A. –2.2219.

B. 3.5036.

C. 4.9367.

The following information relates to questions 27-31

Elena Vasileva recently joined EnergyInvest as a junior portfolio analyst. Vasileva's supervisor asks her to evaluate a potential investment opportunity in Amtex, a multinational oil and gas corporation based in the United States. Vasileva's

supervisor suggests using regression analysis to examine the relation between Amtex shares and returns on crude oil.

Vasileva notes the following assumptions of regression analysis:

Assumption 1	The error term is uncorrelated across observations.
Assumption 2	The variance of the error term is the same for all observations.
Assumption 3	The dependent variable is normally distributed.

Vasileva runs a regression of Amtex share returns on crude oil returns using the monthly data she collected. Selected data used in the regression are presented in Exhibit 1, and selected regression output is presented in Exhibit 2. She uses a 1% level of significance in all her tests.

Exhibit 1: Selected Data for Crude Oil Returns and Amtex Share Returns

	Oil Return (X_i)	Amtex Return (Y_i)	Cross-Product $(X_i - \bar{X})\ (Y_i - \bar{Y})$	Predicted Amtex Return $\hat{Y}_i$	Regression Residual $Y_i - \hat{Y}_i$	Squared Residual $(Y_i - \hat{Y}_i)^2$
Month 1	−0.032000	0.033145	−0.000388	0.002011	−0.031134	0.000969
Month 36	0.028636	0.062334	0.002663	0.016282	−0.046053	0.002121
Sum			0.085598			0.071475
Average	−0.018056	0.005293				

Exhibit 2: Selected Regression Output, Dependent Variable: Amtex Share Return

	Coefficient	Standard Error
Intercept	0.0095	0.0078
Oil return	0.2354	0.0760

Critical *t*-values for a 1% level of significance:

One-sided, left side: −2.441

One-sided, right side: +2.441

Two-sided: ±2.728

Vasileva expects the crude oil return next month, Month 37, to be −0.01. She computes the standard error of the forecast to be 0.0469.

27. Which of Vasileva's assumptions regarding regression analysis is *incorrect*?

A. Assumption 1

B. Assumption 2

C. Assumption 3

28. Based on Exhibit 1, the standard error of the estimate is *closest* to:

A. 0.04456.

B. 0.04585.

C. 0.05018.

29. Based on Exhibit 2, Vasileva should reject the null hypothesis that:

A. the slope is less than or equal to 0.15.

B. the intercept is less than or equal to zero.

C. crude oil returns do not explain Amtex share returns.

30. Based on Exhibit 2 and Vasileva's prediction of the crude oil return for Month 37, the estimate of Amtex share return for Month 37 is *closest* to:

A. −0.0024.

B. 0.0071.

C. 0.0119.

31. Using information from Exhibit 2, the 99% prediction interval for Amtex share return for Month 37 is *best* described as:

A. $\hat{Y}_f \pm 0.0053$.

B. $\hat{Y}_f \pm 0.0469$.

C. $\hat{Y}_f \pm 0.1279$.

The following information relates to questions 32-34

Doug Abitbol is a portfolio manager for Polyi Investments, a hedge fund that trades in the United States. Abitbol manages the hedge fund with the help of Robert Olabudo, a junior portfolio manager.

Abitbol looks at economists' inflation forecasts and would like to examine the relationship between the US Consumer Price Index (US CPI) consensus forecast and the actual US CPI using regression analysis. Olabudo estimates regression coefficients to test whether the consensus forecast is unbiased. If the consensus forecasts are unbiased, the intercept should be 0.0 and the slope will be equal to 1.0. Regression results are presented in Exhibit 1. Additionally, Olabudo calculates the 95% prediction interval of the actual CPI using a US CPI consensus forecast of 2.8.

Exhibit 1: Regression Output: Estimating US CPI

Regression Statistics	
R^2	0.9859

Regression Statistics			
Standard error of estimate	0.0009		
Observations	60		
	Coefficients	**Standard Error**	***t*-Statistic**
Intercept	0.0001	0.0002	0.5000
US CPI consensus forecast	0.9830	0.0155	63.4194

Notes:

1. The absolute value of the critical value for the *t*-statistic is 2.002 at the 5% level of significance.
2. The standard deviation of the US CPI consensus forecast is $s_x = 0.7539$.
3. The mean of the US CPI consensus forecast is $\overline{X} = 1.3350$.

Finally, Abitbol and Olabudo discuss the forecast and forecast interval:

Observation 1	For a given confidence level, the forecast interval is the same no matter the US CPI consensus forecast.
Observation 2	A larger standard error of the estimate will result in a wider confidence interval.

32. Based on Exhibit 1, Olabudo should:

A. conclude that the inflation predictions are unbiased.

B. reject the null hypothesis that the slope coefficient equals one.

C. reject the null hypothesis that the intercept coefficient equals zero.

33. Based on Exhibit 1, Olabudo should calculate a prediction interval for the actual US CPI *closest* to:

A. 2.7506 to 2.7544.

B. 2.7521 to 2.7529.

C. 2.7981 to 2.8019.

34. Which of Olabudo's observations of forecasting is correct?

A. Only Observation 1

B. Only Observation 2

C. Both Observation 1 and Observations 2

The following information relates to questions 35-38

Espey Jones is examining the relation between the net profit margin (NPM) of companies, in percent, and their fixed asset turnover (FATO). He collected a sample of 35 companies for the most recent fiscal year and fit several different

functional forms, settling on the following model:

$\ln\text{NPM}_i = b_0 + b_1 \text{FATO}_i$.

The results of this estimation are provided in Exhibit 1.

Exhibit 1: Results of Regressing NPM on FATO

Source	df	Sum of Squares	Mean Square	*F*	*p*-Value
Regression	1	102.9152	102.9152	1,486.7079	0.0000
Residual	32	2.2152	0.0692		
Total	33	105.1303			

	Coefficients	Standard Error	*t*- Statistic	*p*-Value
Intercept	0.5987	0.0561	10.6749	0.0000
FATO	0.2951	0.0077	38.5579	0.0000

35. The coefficient of determination is *closest* to:

A. 0.0211.

B. 0.9789.

C. 0.9894.

36. The standard error of the estimate is *closest* to:

A. 0.2631.

B. 1.7849.

C. 38.5579.

37. At a 0.01 level of significance, Jones should conclude that:

A. the mean net profit margin is 0.5987%.

B. the variation of the fixed asset turnover explains the variation of the natural log of the net profit margin.

C. a change in the fixed asset turnover from 3 to 4 times is likely to result in a change in the net profit margin of 0.5987%.

38. The predicted net profit margin for a company with a fixed asset turnover of 2 times is *closest* to:

A. 1.1889%.

B. 1.8043%.

C. 3.2835%

39. Using the same information as in Question 8, what would Accent's cost of goods

sold be under the weighted average cost method?

A. £120,000.

B. £122,000.

C. £124,000.