**Chapter 1**

**Data and Statistics**

**Learning Objectives**

1. Obtain an appreciation for the breadth of statistical applications in business and economics.

2. Understand the meaning of the terms elements, variables, and observations as they are used in statistics.

3. Obtain an understanding of the difference between categorical, quantitative, crossectional and time series data.

4. Learn about the sources of data for statistical analysis both internal and external to the firm.

5. Be aware of how errors can arise in data.

6. Know the meaning of descriptive statistics and statistical inference.

7. Be able to distinguish between a population and a sample.

8. Understand the role a sample plays in making statistical inferences about the population.

9. Know the meaning of the term data mining.

10. Be aware of ethical guidelines for statistical practice.

**Solutions:**

1. Statistics can be referred to as numerical facts. In a broader sense, statistics is the field of study dealing with the collection, analysis, presentation and interpretation of data.

2. a. The ten elements are the ten cars

 b. 5 variables: Size, Cylinders, City MPG, Highway MPG, and Fuel

 c. Categorical variables: Size and Fuel

 Quantitative variables: Cylinders, City MPG, and Highway MPG

 d.

|  |  |
| --- | --- |
| **Variable** | **Measurement Scale** |
| Size | Ordinal |
| Cylinders | Ratio |
| City MPG | Ratio |
| Highway MPG | Ratio |
| Fuel  | Nominal |

3. a. Average mpg for city driving = 182/10 = 18.2 mpg

 b. Average mpg for highway driving = 261/10 = 26.1 mpg

 On average, the miles per gallon for highway driving is 26.1 – 18.2 = 7.9 mpg greater compared to city driving.

 c. 3 of 10 or 30% have four cylinder engines

 d. 6 of 10 or 60% use regular fuel

4. a. The seven elements are the seven schools shown

 b. 5 variables: State, Campus Setting, Endowment, Applicants Admitted, and NCAA Division

 c. Categorical variables: State, Campus Setting, and NCAA Division

 Quantitative variables: Endowment and Applicants Admitted

5. a. Average endowment = 74.6/7 = $10.657 billion

 b. Average percentage admitted = 111/7 = 15.86%

 c. 3 of 7 or 42.9% have NCAA Division III varsity teams

 d. 3 of 7 or 42.9% have a City: Midsize campus setting

6. a. Quantitative

 b. Categorical

 c. Categorical

 d. Quantitative

 e. Categorical

7. a. Although the data are recorded as numbers, the numbers are codes for the ratings of Fair (1), Average (2), Good (3) and Excellent (4). Thus the variables are categorical with each data value corresponding to a rating category for the variable.

 b. The data may also be ranked in order of the quality. A higher number indicates a higher rating on a scale from Fair (1) to Excellent (4). Since the data can be ranked or ordered, the scale of measurement is ordinal.

8. a. 1015

 b. Categorical

 c. Percentages

 d. .10(1015) = 101.5

 101 or 102 respondents said the Federal Bank is doing a good job.

9. a. Categorical

 b. 30 of 71; 42.3%

10. a. Categorical

 b. Percentages

 c. 44 of 1080 respondents or approximately 4% strongly agree with allowing drivers of motor vehicles to talk on a hand-held cell phone while driving.

 d. 165 of the 1080 respondents or 15% of said they somewhat disagree and 741 or 69% said they strongly disagree. Thus, there does not appear to be general support for allowing drivers of motor vehicles to talk on a hand-held cell phone while driving.

11. a. Quantitative; ratio

 b. Categorical; nominal

 c. Categorical; ordinal

 d. Quantitative; ratio

 e. Categorical; ordinal. The response to this question was recorded as a numerical value from 1 to 10. While the data are numerical, they are not quantitative. The numerical values from 1 to 10 represent categories that *order* the overall rating somewhere between unacceptable and truly exceptional. The data may be ordered by response category with a higher number category indicating a higher overall rating.

 While we prefer the categorical; ordinal answer above, at times statisticians may *make the assumption* that the numerical responses are equal-interval measures on a quantitative scale from 1 to 10. When this assumption is made, the data may be considered quantitative with an interval scale of measurement. In this case, additional statistical computations such as the average overall rating become helpful in summarizing the data.

12. a. The population is all visitors coming to the state of Hawaii.

 b. Since airline flights carry the vast majority of visitors to the state, the use of questionnaires for passengers during incoming flights is a good way to reach this population. The questionnaire actually appears on the back of a mandatory plants and animals declaration form that passengers must complete during the incoming flight. A large percentage of passengers complete the visitor information questionnaire.

 c. Questions 1 and 4 provide quantitative data indicating the number of visits and the number of days in Hawaii. Questions 2 and 3 provide categorical data indicating the categories of reason for the trip and where the visitor plans to stay.

13. a. Federal spending measured in trillions of dollars

 b. Quantitative

 c. Time series

 d. Federal spending has increased over time

14. a. The graph of the time series follows:

 b. In 2007 and 2008 Hertz was the clear market share leader. In 2009 and 2010 Hertz and Avis have approximately the same market share. The market share for Dollar appears to be declining.

 c. The bar chart for 2010 is shown below.

 This chart is based on cross-sectional data.

15. a. Quantitative – number of new drugs approved

 b. Time series

 c. July; 1100

 d. 2.9%; Yes, because most recreational boating takes place during the summer months.

 e. The bar graph follows the shape of a bell curve.

16. The answer to this exercise depends upon the time series of the average price per gallon of conventional regular gasoline since April 2009. Contact the website [*www.eia.doe.gov*](http://www.eia.doe.gov) to obtain the more recent time series data. In the first quarter of 2011, the average price per gallon was once again increasing. A continuation of the usual summer peak in gasoline prices was anticipated.

17. Internal data on salaries of other employees can be obtained from the personnel department. External data might be obtained from the Department of Labor or industry associations.

18. a. 684/1021; or approximately 67%

 b. 612

 c. Categorical

19. a. All subscribers of Business Week in North America at the time the survey was conducted.

 b. Quantitative

 c. Categorical (yes or no)

 d. Crossectional - all the data relate to the same time.

 e. Using the sample results, we could infer or estimate 59% of the population of subscribers have an annual income of $75,000 or more and 50% of the population of subscribers have an American Express credit card.

20. a. 43% of managers were bullish or very bullish.

 21% of managers expected health care to be the leading industry over the next 12 months.

 b. We estimate the average 12-month return estimate for the population of investment managers to be 11.2%.

 c. We estimate the average over the population of investment managers to be 2.5 years.

21. a. The two populations are the population of women whose mothers took the drug DES during pregnancy and the population of women whose mothers did not take the drug DES during pregnancy.

 b. It was a survey.

 c. 63 / 3.980 = 15.8 women out of each 1000 developed tissue abnormalities.

 d. The article reported “twice” as many abnormalities in the women whose mothers had taken DES during pregnancy. Thus, a rough estimate would be 15.8/2 = 7.9 abnormalities per 1000 women whose mothers had *not* taken DES during pregnancy.

 e. In many situations, disease occurrences are rare and affect only a small portion of the population. Large samples are needed to collect data on a reasonable number of cases where the disease exists.

22. a. The population consists of all customers of the chain’s stores in Charlotte, North Carolina.

 b. Some of the ways that could be used to collect the data are as follows:

* Customers entering or leaving the store could be surveyed
* A survey could be mailed to customers who have a shopper’s club card for the stores
* Customers could be given a printed survey when they check out
* Customers could be given a coupon that asks them to complete a brief on-line survey; if they do, they will receive a 5% discount on their next shopping trip.

23. a. This finding is applicable to the population of all American adults.

 b. This finding is applicable to the population of American adults that own a cellphone and/or a tablet computer.

 c. They conducted a sample survey. It would be way too costly to survey all American adults or all American adults who own cellphones and/or tablet computers. As we will see later in the text, very good results can be obtained using a sample survey.

 d. These results should be quite interesting to restaurant owners. It suggests that it would be worthwhile for them to have a website and to consider advertising through an internet search company, such as Google.

24. a. This is a statistically correct descriptive statistic for the sample.

 b. An incorrect generalization since the data was not collected for the entire population.

 c. An acceptable statistical inference based on the use of the word “estimate.”

 d. While this statement is true for the sample, it is not a justifiable conclusion for the entire population.

 e. This statement is not statistically supportable. While it is true for the particular sample observed, it is entirely possible and even very likely that at least some students will be outside the 65 to 90 range of grades.

25. a. There are five variables: Exchange, Ticker Symbol, Market Cap, Price/Earnings Ratio and Gross Profit Margin.

 b. Categorical variables: Exchange and Ticker Symbol

 Quantitative variables: Market Cap, Price/Earnings Ratio, Gross Profit Margin

 c. Exchange variable:

|  |  |  |
| --- | --- | --- |
| Exchange | Frequency | Percent Frequency |
| AMEX |  5 | (5/25) 20% |
| NYSE |  3 | (3/25) 12% |
| OTC | 17 | (17/25) 68% |
|  | 25 |  |

 

 d. Gross Profit Margin variable:

|  |  |
| --- | --- |
| Gross Profit Margin | Frequency |
|  0.0 – 14.9 | 2 |
| 15.0 – 29.9 | 6 |
| 30.0 – 44.9 | 8 |
| 45.0 – 59.9 | 6 |
| 60.0 – 74.9 | 3 |



 e. Sum the Price/Earnings Ratio data for all 25 companies.

 Sum = 505.4

 Average Price/Earnings Ratio = Sum/25 = 505.4/25 = 20.2