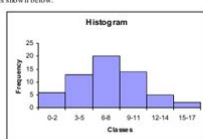


4. To develop the histogram, first construct a frequency distribution (see part a). The classes form the horizontal axis and the frequency forms the vertical axis. Bars corresponding to the frequency of each class are developed. The histogram based on the frequency distribution from part (a) is shown below.



26. a. Proportion of days in which no shortages occurred = 1 - proportion of days in which shortages occurred =  $1 - 0.24 = 0.76$ .  
b. Less than \$20 off implies that average was less than \$20 and the shortage was less than \$20 = (proportion of averages less \$20) - (proportion of shortages at most \$20) =  $0.56 - 0.05 = 0.48$ .  
c. Proportion of days with less than \$40 over or at most \$20 short = Proportion of days with less than \$40 over - proportion of days with more than \$20 short =  $0.96 - 0.08 = 0.88$ .
27. a. The data do not require grouping. The following frequency distribution is given:

x	Frequency
0	0
1	0
2	1
3	1
4	10
5	15
6	13
7	13
8	5
9	1
10	1

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and How of Data Collection Section This application is primarily descriptive in nature. The owner  
wishes to develop a presentation. She will most likely use charts, graphs, tables and numerical  
measures to describe her data The graph is a bar chart. A bar chart displays values associated with  
categories. In this case the categories are the departments at the food store. The values are the total  
monthly sales in dollars in each department. A bar chart also typically has gaps between the bars. A  
histogram has no gaps and the horizontal axis represents the possible values for a numerical  
variable A bar chart is used whenever you want to display data that has already been categorized  
while a histogram is used to display data over a range of values for the factor under consideration.  
Another fundamental difference is that there typically are gaps between the bars on a bar chart but  
there are no gaps between the bars of a histogram Businesses often make claims about their  
products that can be tested using hypothesis testing. For example, it is not enough for a  
pharmaceutical company to claim that its new drug is effective in treating a disease. In order for the  
drug to be approved by the Food and Drug Administration the company must present sufficient  
evidence that the drug first does no harm and that it also provides an effective treatment against the  
disease. The claims that the drug does no harm and is an effective treatment can be tested using

hypothesis testing The company could use statistical inference to determine if its parts last longer.

Because it is not possible to examine every part that could be produced the company could examine a randomly chosen subset of its parts and compare the average life of the subset to the average life of a randomly chosen subset of the competitor's parts. By using statistical inference procedures the company could reach a conclusion about whether its parts last longer or not. Student answers will vary depending on the periodical selected and the periodicals issue date, but should all address the three parts of the question. 182 Business Statistics A Decision-Making Approach, Tenth Edition 1.7. The appropriate chart in this case is a histogram where the horizontal axis contains the number of missed days and the height of the bars represent the number of employees who missed each number of days. Histogram Missed Days for Illness or Injury Number of Employees days 35 days 68 days 810 days Days Missed Note, there are no gaps between the bars. Because it would be too costly, too time consuming, or practically impossible to contact every subscriber to ascertain the desired information, the decision makers at Fortune might decide to use statistical inference, particularly estimation, to answer its questions. By looking at a subset of the data and using the procedures of estimation it would be possible for the decision makers to arrive at values for average age and average income that are within tolerable limits of the actual values. Student answers will vary depending on the business periodical or newspaper selected and the article referenced. However, the examples should illustrate how statistics has been used and should clearly indicate the type of statistical analysis employed.

9 Chapter 1 The Where, Why, and How of Data Collection 3 Section As discussed in this section, the pet store would most likely use a written survey or a telephone survey to collect the customer satisfaction data. A leading question is one that is designed to elicit a specific response, or one that might influence the respondent's answer by its wording. The question is posed so that the respondent believes the researcher has a specific answer in mind when the question is asked, or worded in such a way that the respondent feels obliged to provide an answer consistent with the question. For example, a question such as Do you agree with the experts who recommend that more tax dollars be given to clean up dangerous and unhealthy pollution. Leading question should be avoided in surveys because they may introduce bias. An experiment is any process that generates data as its outcome. The plan for performing the experiment in which the variable of interest is defined is referred to as an experimental design. In the experimental design one or more factors are identified to be changed so that the impact on the variable of interest can be observed or measured. There will likely be a high rate of nonresponse bias since many people who work days will not be home during the 9-11 AM time slot. Also, the data collectors need to be careful where they get the phone number list as some people do not have listed phones in phone books and others have no phone or only a cell phone. This may result in selection bias. a. Observation would be the most likely method. Observers could be located at various bike routes and observe the number of riders with and without helmets. This would likely be better than asking people if they wear a helmet since the popular response might be to say yes even when they don't always do so. b. A telephone survey to gas stations in the state. This could be a cost effective way of getting data from across the state.

The respondent would have the information and be able to provide the correct price. c. A written survey of passengers. This could be given out on the plane before the plane lands and passengers could drop the surveys in a box as they deplane. This method would likely garner higher response rates compared to sending the survey to passengers mailing address and asking them to return the completed survey by mail. The two types of validity mentioned in the section are internal validity and external validity. For this problem external validity is easiest to address. It simply means the sampling method chosen will be sufficient to insure the results based on the sample will be able to be generalized to the population of all students. Internal validity would involve making sure the data gathering method, for instance a questionnaire, accurately determines the respondent's attitude.

toward the registration process This data could have been collected through a survey. Employees of the USDA could provide periodic reports of fire ant activity in their region. Also, medical reports could be used to collect data assuming people with bites had required medical attention There are many potential sources of bias associated with data collection. If data is to be collected using personal interviews it will be important that the interviewer be trained so that interviewer bias, arising from the way survey questions are asked, is not injected into the survey. If the survey is conducted using either a mail survey or a telephone survey then it is important to be aware of nonresponse bias from those who do not respond to the mailing or refuse to answer your 10 4 Business Statistics A DecisionMaking Approach, Tenth Edition calls. You must also be careful when selecting your survey subjects so that selection bias is not a problem.

In order to have useful, reliable data that is representative of the true student opinions regarding campus food service, it is necessary that the data collection process be conducted in a manner that reduces or eliminates the potential for these and other sources of potential bias For retailers technology that scans the product UPC code at checkout makes the collection of data fast and accurate. Retailers that use such technology can automatically update their inventory records and develop an extensive collection of customer buying habits. By applying advanced statistical techniques to the data the retailer can identify relationships among purchases that might otherwise go unnoticed. Such information could enable retailers to target their advertising or even rearrange the placement of products in the store to increase sales. Manufacturing firms use bar code scanning to collect information concerning product availability and product quality. Credit card purchases are automatically tracked by the retailer and the bankcard company. In this way the credit card company is able to track your purchases and even alert you to potential fraud if purchases on your card appear to be unusual. Finally, some companies are using radio frequency identification RFID to track products through their supply chain, so that product delays and inventory problems can be minimized One advantage of this form of data gathering is the same as for mail questionnaires. That is low cost. Additional factors being speed of delivery and, with current software, with closed ended questions, instant updating of data analysis. Disadvantages are also similar, in particular low response and potential confusion about questions. An additional factor might be the ability of competitors to hack into the database and analysis program Student answers will vary. Look for clarity of questions and to see that the issue questions are designed to gather useful data.

Look for appropriate demographic questions Students should select some form of personal observation as the datagathering technique. In addition, there should be a discussion of a sampling procedure with an effort made to ensure the sample randomly selected both days of the week unless daily observations are made, and randomly selected times of the day since 24 hour observation would likely be impossible. A complete answer would also address efforts to reduce the potential bias of having an observer standing in an obvious manner by the displays Student answers will vary. However, the issue questions should be designed to gather the desired data regarding customers preferences for the use of the space. Demographic questions should provide data so that the responses can be broken down appropriately so that United Fitness Center managers can determine which subset of customers have what opinion about this issue. Regarding questionnaire layout, look at neatness and answer location space. Make sure questions are properly worded, used reasonable vocabulary, and are not leading questions The results of the survey are based on telephone interviews with 744 adults, aged 18 and older. Students may also answer that the survey could have been conducted using a written survey via mail questionnaire or internet survey. Because telephone interviews were used to collect the survey data nonresponse biases associated with sampled adults who are not at home when phoned, or adults who refuse to participate in the survey. There is also the problem that some adults do not have a landline phone. If written surveys are used to collect the data then it is important to guard against nonresponse bias from those sampled adults who do not complete the survey There is also the problem of selection bias. In phone interviews we may miss

the people who work evenings and nights. If written surveys are used we must be careful to select a representative sample of the adult population.

11 Chapter 1 The Where, Why, and How of Data Collection 5 Section a. Because the population is spread over a large geographical area, a cluster random sample could be selected to reduce travel costs. b. A stratified random sample would probably be used to keep sample size as small as possible. c. Most likely a convenience sample would be used since doing a statistical sample would be too difficult To determine the range of employee numbers for the first employee selected in a systematic random sample use the following Population Size 18,000 Part Range 180 Sample Size 100 Thus, the first person selected will come from employees Once that person is randomly selected, the second person will be the one numbered 180 higher than the first, and so on Whenever a descriptive numerical measure such as an average is calculated from the entire population it is a parameter. The corresponding measure calculated from a subset of the population, that is to say a sample, is a statistic Statistical sampling techniques consist of those sampling methods that select samples based on chance. Nonstatistical sampling techniques consist of those methods of selecting samples using convenience, judgment, or other nonchance processes. In convenience sampling, samples are chosen because they are easy or convenient to sample. There is no attempt to randomize the selection of the selected items. In convenience sampling not every item in the population has a random chance of being selected. Rather, items are sampled based on their convenience alone. This could be done using a random number table or by having a statistical package or a spreadsheet generate a random number between 1 and 25. Once this value is determined the bank would select that numbered customer as the first sampled customer and then select every 25th customer after that until 100 customers are sampled A census is an enumeration of the entire set of measurements taken from the population as a whole.

While in some cases, the items of interest are obtained from people such as through a survey, in many instances the items of interest come from a product or other inanimate object. For example, a study could be conducted to determine the defect rate for items made on a production line. The census would consist of all items produced on the line in a defined period of time Values computed from a sample are always considered statistics. In order for a value, such as an average, to be considered a parameter it must be computed from all items in the population In stratified random sampling, the population is divided into homogeneous groups called strata. The idea is to make all items in a stratum as much alike as possible with respect to the variable of interest thereby reducing the number of items that will need to be sampled from each stratum. In cluster sampling, the idea is to break the population into heterogeneous groups called clusters usually on a geographical basis such that each cluster looks as much like the original population 12 6 Business Statistics A DecisionMaking Approach, Tenth Edition as possible. Then clusters are randomly selected and from the cluster, individual items are selected using a statistical sampling method Using Excel, choose the Data tab, select Data Analysis from the Analysis Group, then Random Number Generation shown as follows The next step is to complete the random number generation dialog as follows The resulting random numbers generated are 13 Chapter 1 The Where, Why, and How of Data Collection 7 Note, the students answers may differ since Excel generates different streams of random numbers each time it is used. Also, if the application requires integer numbers, the Decrease Decimal option can be used If these percentages were based on all students attending college in those years they would be parameters, if the percentages were based on a sample they would be statistics This is a statistic.

A poll would be a sample of eligible voters rather than all eligible voters Solution a. Stratified random sampling b. Simple random sampling or possibly cluster random sampling c. Systematic random sampling d. Stratified random sampling This is a statistical sample. Every employee has an equal chance of being selected using this method. In fact, this is an example of a simple random sample because every possible sample of size 50 has an equal chance of being selected a. Student

answers will vary b. Cluster sampling could be used to ensure that you get all types of cereal. Make each cluster the area where certain cereals are located i.e., aisle, row, shelf, etc. c. Cluster sampling would give you a better idea of the inventory of all types of cereal. Simple random sampling could possibly end up with only looking at 2 or 3 cereal types Students should choose the Data tab, select Data Analysis from the Analysis group Random Number Generation process. Students answers will differ since Excel generates different streams of random numbers each time it is used, but 40 random numbers should be generated from a uniform distribution with values ranging from 1 to 578. Since the application requires integer numbers, the Decrease Decimal option should be used a. The population should be all users of crosscountry ski lots and trailheads in Colorado. b. Several sampling techniques could be selected. Be sure that some method of ensuring randomness is discussed. In addition, some students might give greater weight to frequent users of the lots. In which case the population would really be user days rather than individual users. c. Students using Excel should choose the Data tab, select Data Analysis from the Analysis group Random Number Generation process. Students answers may differ since Excel generates different streams of random numbers each time it is used. Since the application requires integer numbers, the Decrease Decimal option should be used a.