MA1020 Quantitative Literacy – Chapter 9 Quiz

Solutions

October 27, 2006

1. A study is conducted of the IQ levels of adopted children. An ad is placed in a newspaper for parents with adopted children to bring their children in to have an IQ test performed.

    (a) What is the population in this study?

    Solution. Adopted children. □

    (b) What is the sample in this study?

    Solution. Adopted children who have parents that read the ad and bring the children in for the test. □

    (c) What is the variable in this study?

    Solution. IQ levels. □

2. A subdivision in a suburban neighborhood has 150 homes, half of which are single-family homes and half of which are condominiums. The homeowner's association for the subdivision is taking a survey of homeowner's opinions about building a new playground. Representatives from the association go to the existing playground and then interview people who come to the playground. How might bias be introduced in the study because of the way the sample is selected?

3. Due to the bias you described in the prior problem, the same subdivision decides to alter its ways. It creates a table of that breaks up the subdivision into sections according to house sizes.

Type	Percentage of the subdivision
Less than 1200 ft^2	32.1%
1200 - 1500 ft^2	20.9%
1500 - 1800 ft^2	17.7%
1800 - 2100 ft^2	16.9%
Greater than 2100 ft^2	12.4%

The homeowner's association wants to survey the homeowners in the subdivision using quota sampling with a sample size of 75. Approximately how many homes of each size should be included in the sample?

4. Find the following for the data set $10, 8, 9, 3, 12, 15, 4, 6, 1, 5, 11$.

   (a) Range

   (b) Median

   (c) First and third quartiles

   (d) Interquartile range

   (e) Five number summary

   (f) A box-and-whisker plot.

MA1020 Quantitative Literacy – Chapter 9 Quiz –Take-Home

Name _____

The following is the TAKE-HOME portion of the quiz. You are NOT to discuss this problem with anyone or work with another person for this section. If evidence is found indicating that you have collaborated with another person, you will automatically receive a score of zero.

This take-home is due by noon sharp on Monday, October 30. You may certainly hand in your work when you come to class, although you may also drop it by my office–Fisher 226C. Just slide your work under my door if I am not in the office.

Complete the following two problems on your own white paper.

Problem I: 9.2 #34 For part (b), do not use the table in the book. Instead, select one of the methods of generating random numbers from class and indicate on your paper which method you used and what numbers were produced.

Solution.

a) Cluster sampling of counties, for example would help to reduce travel time. A county would be selected and all farms in the county would be investigated.

b) First list the counties and number them 1 to 36. Suppose a random number generator gives you the numbers 10, 19, 24, 33, 4, 30, 3, 34, 23, and 6. Then the corresponding counties are selected.

c) Each region is more homogeneous in terms of climate and geography than the state in general. If stratified random sampling is used with regions as the strata, then farms with field crops could be randomly selected in proportion to the number in each region.

$\square$

Problem II: Consider the data set 12,9,7,15,6.

a) Find the mean and the sample standard deviation. Show your calculations.

Solution. The mean is 9.8. The standard deviation is 3.70. $\square$

b) Modify the data set by dividing each data value by 10, then find the mean and the sample standard deviation of the new data set. Show your calculations.

Solution. The modified data are 1.2, 0.9, 0.7, 1.5, and 0.6. The mean is 0.98. The standard deviation is 0.370. □

c) How do the means from parts (a) and (b) compare. Explain why this result will be true in general.

Solution. The mean from part (a) is 9.8. The mean from part (b) is 0.98. Notice that we divided each original data value by 10. If we divide the original mean by 10, we get $\frac{9.8}{10} = 0.98$ which is the modified mean. In general whether we have a sample or a population, the mean of a data set in which every value is divided by a constant is the original mean divided by the constant. Consider the case in which we divided each data value by 10:

Modified mean $= \frac{(\frac{x_1}{10})+(\frac{x_2}{10})+\cdots+(\frac{x_n}{10})}{N} = \frac{\frac{1}{10}(x_1+x_2+\cdots+x_N)}{N} = \frac{1}{10}\left(\frac{x_1+x_2+\cdots+x_N}{N}\right) = \frac{1}{10}$(Original mean). This argument is true no matter what constant we divide by. □

d) How do the sample standard deviations from parts (a) and (b) compare? Explain why this result will be true in general.

Solution. The sample standard deviation from part (a) is approximately 3.70. The sample standard deviation from part (b) is 0.370. Dividing every data value by 10 changes the spread of the data by a factor of $\frac{1}{10}$. The sample standard deviation of the modified data set is one-tenth the original sample standar deviation. Consider the case in which we divided each data value by 10:

Modified sample standard deviation $= \sqrt{\frac{(\frac{x_1}{10}-\frac{\bar{x}}{10})^2+(\frac{x_2}{10}-\frac{\bar{x}}{10})^2+\cdots+(\frac{x_n}{10}-\frac{\bar{x}}{10})^2}{n-1}}$

$= \sqrt{\frac{\frac{1}{100}(x_1-\bar{x})^2+\frac{1}{100}(x_2-\bar{x})^2+\cdots+\frac{1}{100}(x_n-\bar{x})^2}{n-1}} = \sqrt{\frac{\frac{1}{100}\left((x_1-\bar{x})^2+(x_2-\bar{x})^2+\cdots+(x_n-\bar{x})^2\right)}{n-1}}$

$= \frac{1}{10}\sqrt{\frac{(x_1-\bar{x})^2+(x_2-\bar{x})^2+\cdots+(x_n-\bar{x})^2}{n-1}} = \frac{1}{10}$(Original sample standard deviation). This argument is true no mater what constant we divide by. □