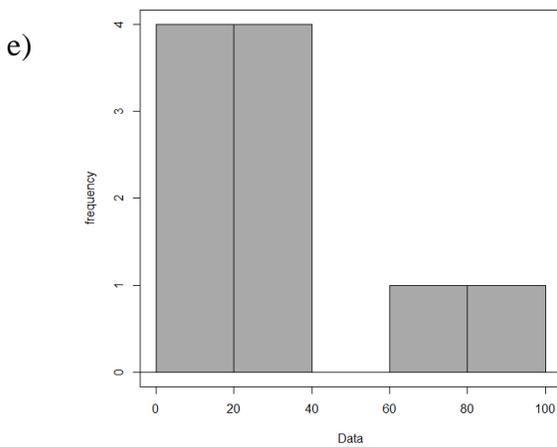
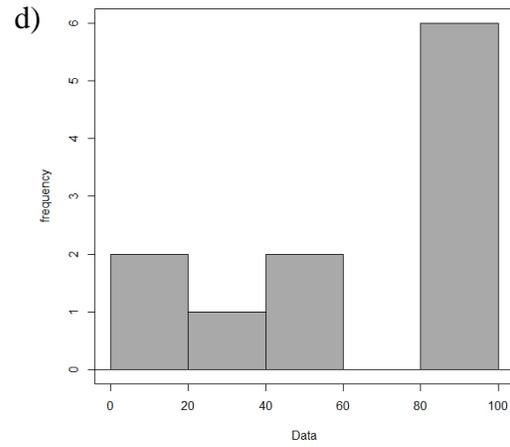
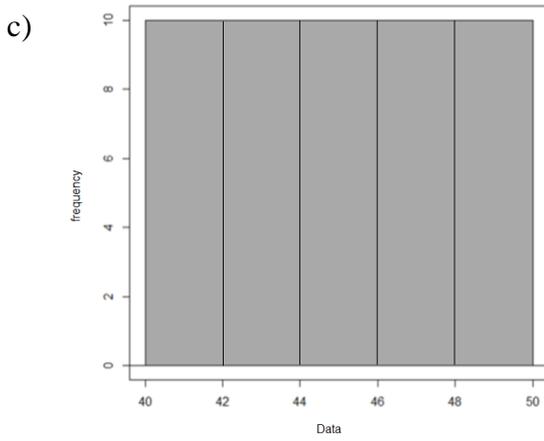
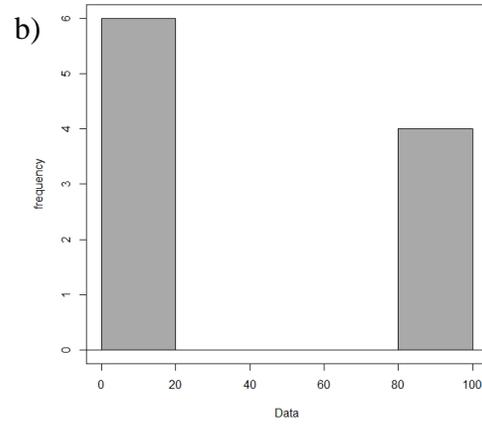
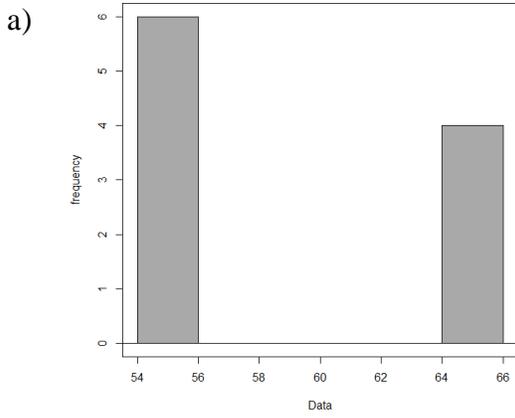


1. An online store collects information about its customers, including residential ZIP code. Which word best describes this data?
  - a) ordinal
  - b) quantitative
  - c) continuous
  - d) nominal
  - e) ratio
  
2. Two statistics classes were offered at a local school: one met in the morning and one in the afternoon. Students were free to register for either section before the school year started. There was only one statistics teacher and he wanted to study the effects of in-class use of tablets with statistical software. He designated the morning section to be the control group, while students in his afternoon class used tablets. The sections were identical in terms of lessons and teaching except for tablet use. After the school year, he compared the means of the final exams of the two classes. Which statement is true?
  - a) The teacher needed to conduct a  $\chi^2$ -test to determine if there was a difference between the two means.
  - b) With this setup, increasing the statistical significance of the findings requires using more sections and a bigger sample size.
  - c) He will be able to determine if the average scores in sections are statistically significantly different. However, the effects of using the tablet will be confounded with the effects of students taking the class in the morning versus immediately after lunch.
  - d) Cluster sampling was utilized in this study.
  - e) The teacher's findings can be generalized to other high schools with similar sizes and student profiles.
  
3. The standard deviation of the heights of 50 randomly selected Tennessee residents was calculated. If 10 male professional basketball players were added to the group and the standard deviation was recalculated, how will this new standard deviation compare to the previous standard deviation?
  - a) The new standard deviation will be higher because variability was increased due to the addition of outliers.
  - b) The new standard deviation will be lower because the 50 original heights will still have the same mean.
  - c) The standard deviation will not change.
  - d) The old standard deviation will be higher because  $SD(\bar{y}) = \frac{\sigma}{\sqrt{n}}$ .
  - e) The old standard deviation will be lower because adding more data will always increase the standard deviation.

4. Which of the following histograms likely corresponds to a dataset with the largest standard deviation?

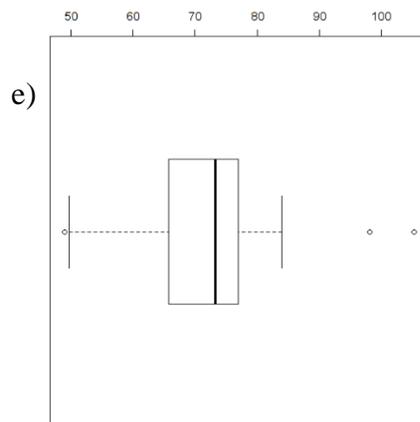
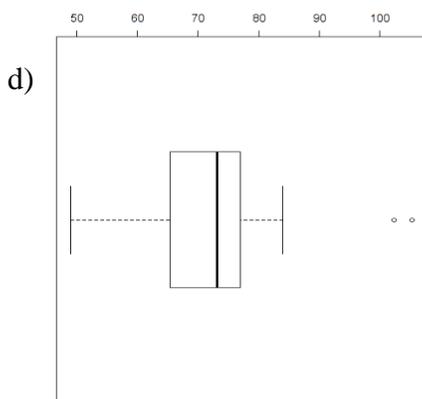
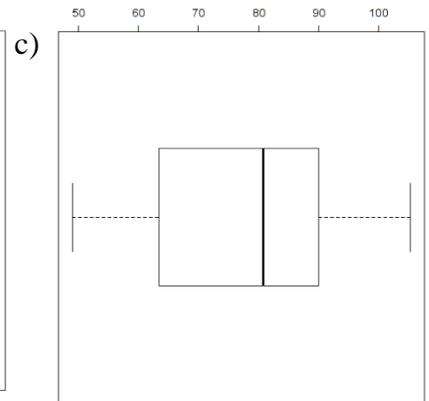
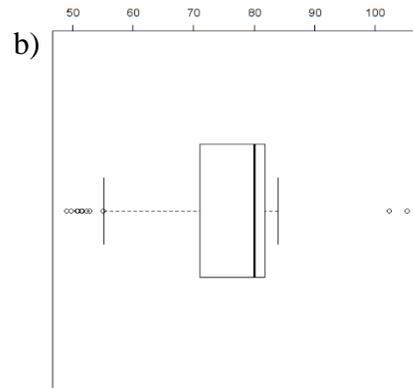
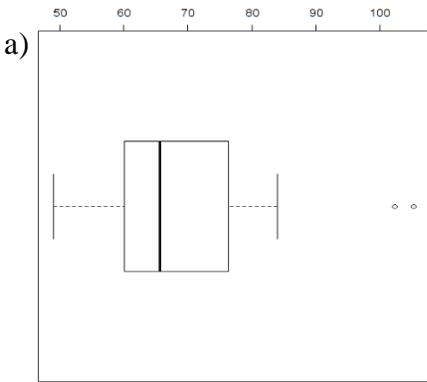
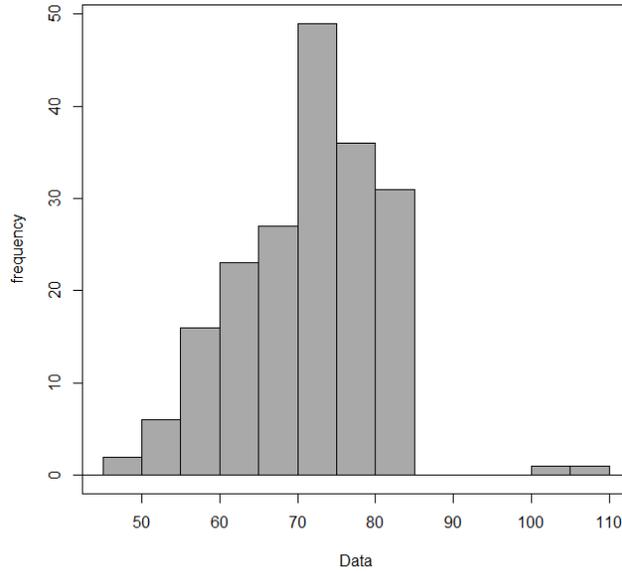


5. The 5-number summary of a dataset is shown below. What can you say about the distribution of the data?

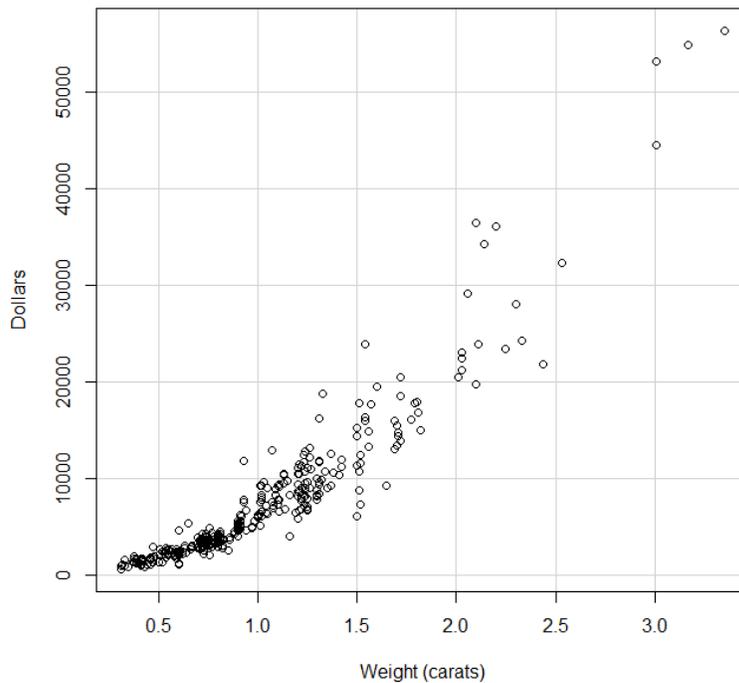
Count	190
Max	123,124.40
Q3	22,659.62
Median	10,558.66
Q1	3,752.75
Min	580.73

- a) The distribution is symmetric.
- b) The distribution is skewed to the left.
- c) The distribution is skewed to the right.
- d) The distribution is bimodal.
- e) The distribution has low spread.

6. Which of the following boxplots matches the histogram below?

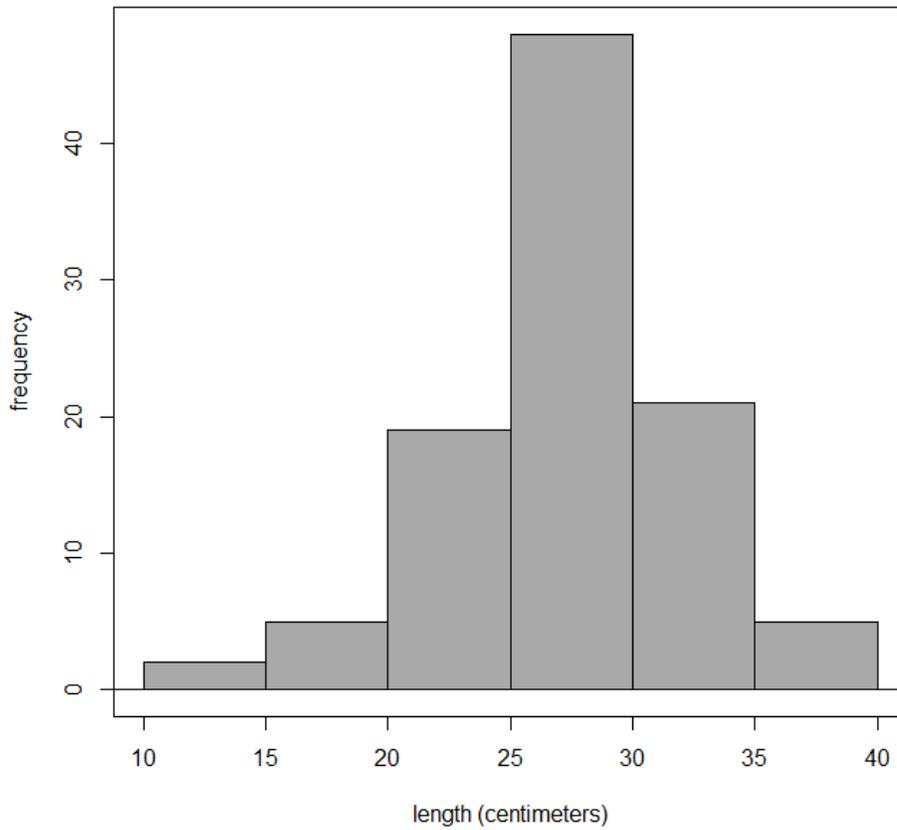


7. Hana is from Japan. She is 67 inches (5 feet 7 inches) tall. Emma is from the Netherlands and she is 70 inches (5 feet 10 inches) tall. If the mean female height in Japan is 62.48 inches with a standard deviation of 2.09 inches, and the mean female height in the Netherlands is 67.20 inches with a standard deviation of 2.48 inches, who most likely feels tall in her country and why? Assume that height is normally distributed.
- Emma feels tall in her country because her height is more than one standard deviation above the mean.
  - Hana feels tall in her country because she is higher than more than 98% of all Japanese women.
  - Emma feels tall in her country because a height of 5 feet 10 inches is higher than most women's heights around the world.
  - Hana feels tall in her country because her height is above the mean of 62.48 inches.
  - Emma feels tall in her country because 5 feet 10 inches is higher than 5 feet 7 inches.
8. The scatterplot of dollars versus diamond weight is shown below. Which of the following Pearson correlation values represents this relationship?



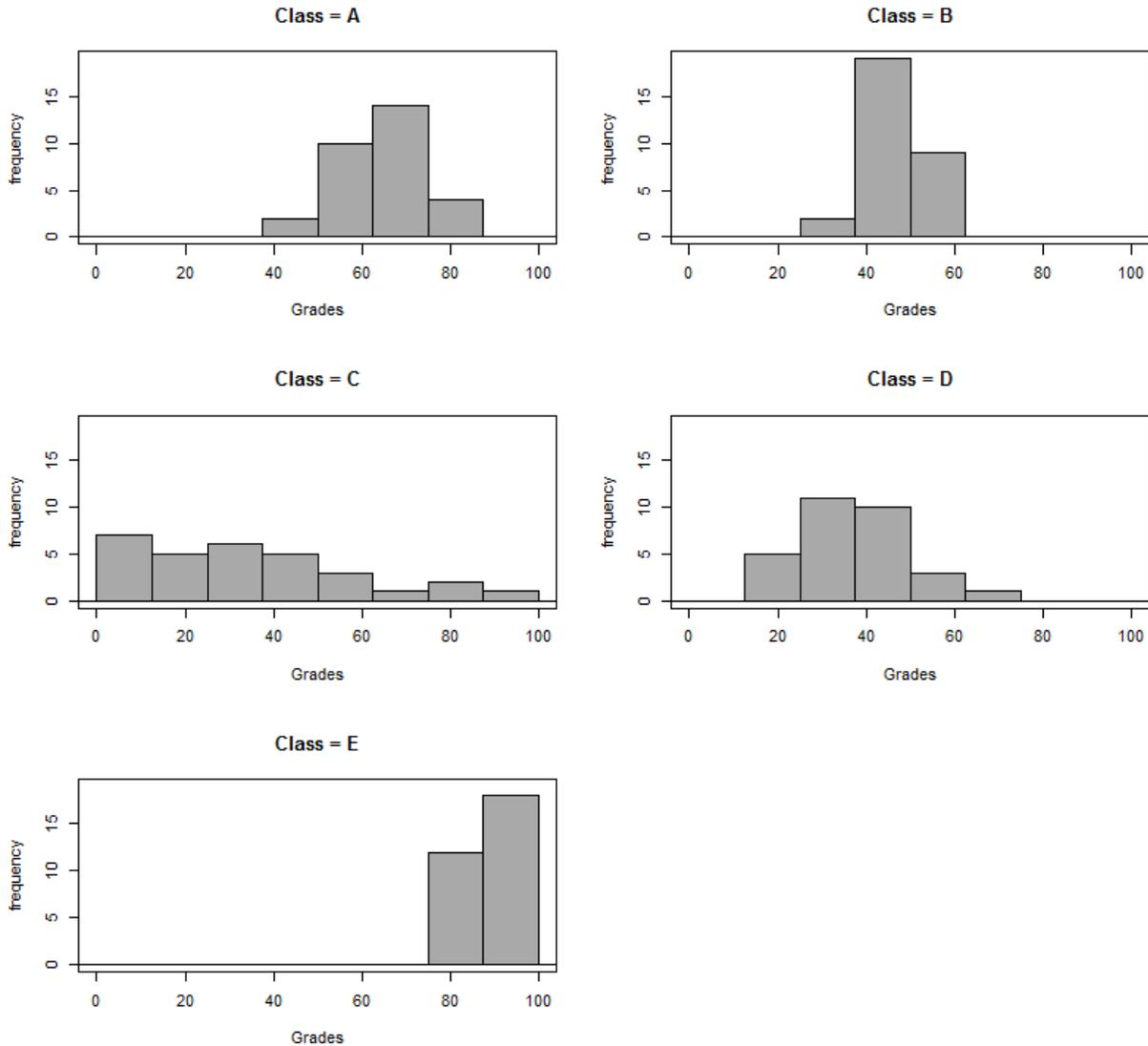
- 0.93
- 0.45
- 0.07
- 0.56
- 0.85

9. A horticulturist was studying the length of the roots of a certain plant. Shown below is the histogram of root lengths she gathered. The mean was 27.5 cm with a standard deviation of 4.81 cm. Which among the following is most likely the interval of root lengths that includes the middle 75% of the data she collected?



- a) 21.97 cm – 33.03 cm
- b) 15.06 cm – 36.21 cm
- c) 26.29 cm – 28.86 cm
- d) 14.19 cm – 37.55 cm
- e) 20.89 cm – 28.99 cm

10. Which among the following histograms best represents the class of students who performed very well overall on a test (max score = 100).



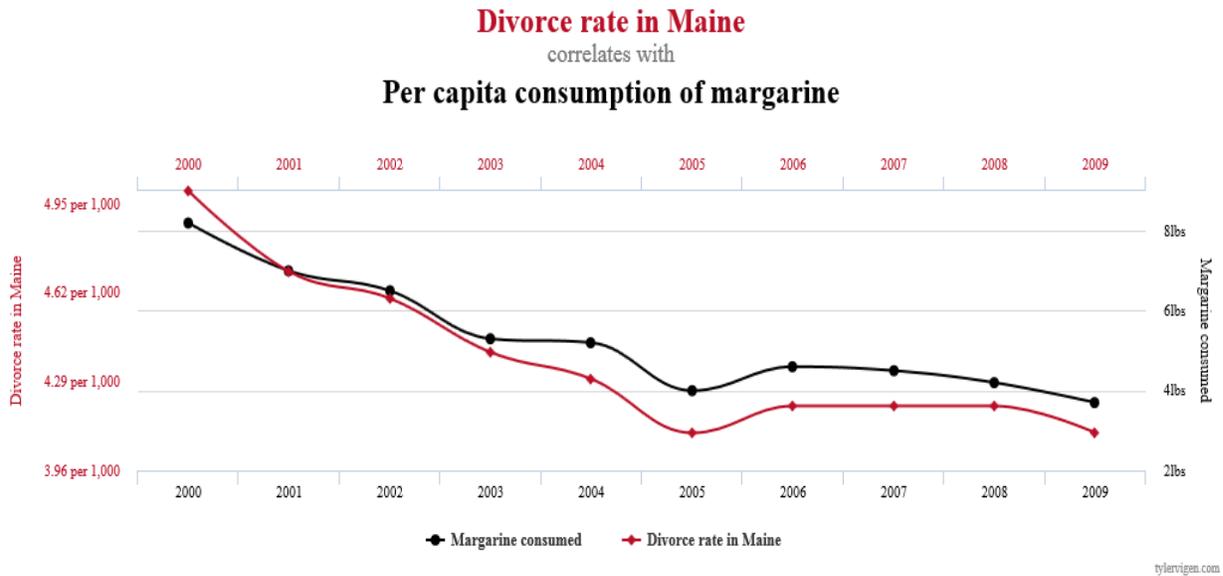
11. From a sample of 200 automobiles, 5% have bad tires. We might use this to infer about

- a) 5 cars in 20 have good tires
- b) 1 car in 20 has bad tires
- c) 5 cars in 20 have bad tires
- d) 1 car in 5 has bad tires
- e) 1 car in 10 has bad tires

12. A set of numbers has a mean of 134. Two numbers, 100 and 168, were added to the set. What will happen to the mean of the set?
- a) The mean will go up.
  - b) The mean will go down.
  - c) The mean may go up or down depending on the numbers included in the set.
  - d) The mean will not change.
  - e) It is not possible to determine whether the mean would change because the numbers in the set are unknown.
13. The same set of numbers (from question 12) with a mean of 134 has a median of 148. Two numbers, 100 and 168, were added to the set. What will happen to the median?
- a) It is not possible to determine whether the median would change because the numbers in the set are unknown.
  - b) The median will not change because  $100 < 148 < 168$ .
  - c) The median will not change because it is resistant to outliers.
  - d) The median will go up.
  - e) The median will go down.
14. A small town wants to find out if their soil is high in nitrogen. It is known that a quarter of the town's area has good loamy soil, and the rest is rocky and sandy. Loamy soil usually has a good amount of nitrogen. If soil samples are to be taken randomly from various locations, which type of sampling is most appropriate?
- a) Simple random sampling
  - b) Convenience sampling
  - c) Cluster sampling
  - d) Systematic sampling
  - e) Stratified random sampling

15. A man went to an alleged “mind-reader” to prove that he was a fraud. The man hid twenty objects in his left and right pockets and the mind-reader agreed to tell where each object was hidden. The mind-reader was correct for 14 out of the 20 objects. Which statement is the best conclusion?
- a) The mind reader got more than 50% correct. He must be real!
  - b) A 70% guess rate is still not that far from 50%. He was probably just lucky that day.
  - c) Given that for every object, there’s a 50% chance of guessing it right, anything is possible. There is not enough evidence to suggest he can read minds well.
  - d) The chance of getting at least 14 out of 20 objects correct if the mind-reader was simply guessing is only 5.77%. He might really be a mind-reader!
  - e) He is a fraud. No amount of correct answers can be considered strong evidence because correctly guessing the location is a 50-50 enterprise.
16. A company provides a 2-year insurance plan on a desktop computer that pays \$1,000 if the device fails within the first year. If it fails the second year, the payment is \$500. If the device has not failed by the beginning of any given year, the probability of failure during that year is 0.05. On average, how much should the company expect to pay per plan?
- a) \$50.00
  - b) \$75.00
  - c) \$58.20
  - d) \$23.75
  - e) \$73.75

17. It was noticed that the yearly divorce rates in Maine are highly correlated with the annual per capita consumption of margarine ( $r = 0.992558$ ). Which among the following statements is correct?



- a) The correlation is highly statistically significant.
- b) Eating less margarine prevents divorce.
- c) As a whole, a town that consumes less margarine creates an environment that promotes happy marriages.
- d) Nothing can be said except that the correlation between divorce rates and margarine consumption is very high.
- e) Additional tests are needed to show that divorce rates are truly correlated with margarine consumption.

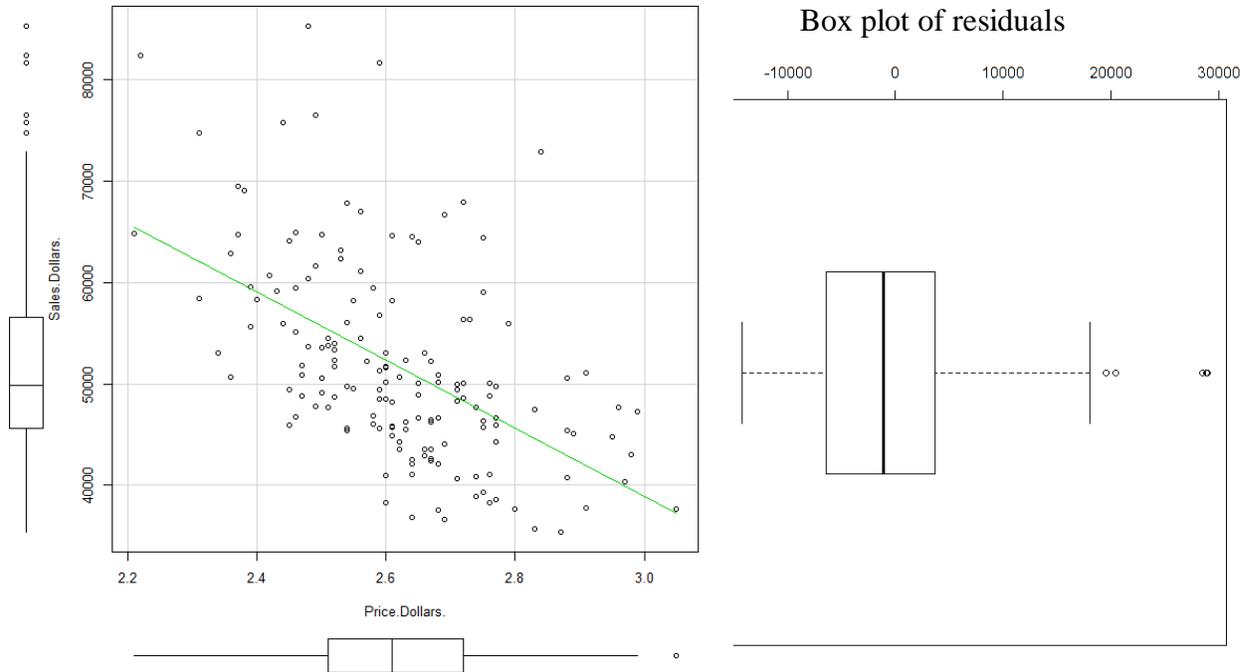
18. If two dice are rolled, what is the probability that the sum of the upturned faces is divisible by 3?

- a)  $\frac{4}{36}$
- b)  $\frac{1}{2}$
- c)  $\frac{1}{3}$
- d)  $\frac{4}{6}$
- e)  $\frac{18}{36}$

19. A car company buys an engine part from three suppliers A, B, and C. Supplier A is preferred because the chance that one of its products is defective is only 0.5%. However, it can only supply 65% of the needed parts. The company relies on B for 25% of the parts and C for the rest. The rates of defective parts from B and C are 2.5% and 5% respectively. Meanwhile in the factory, one engine part was found defective. What is the probability that it came from supplier A?
- a) 0.00325
  - b) 0.005
  - c) 0.0145
  - d) 0.22414
  - e) 0.333
20. “Large swings in systolic blood pressure over a series of physician visits are a sign that patients may face higher risks of all-cause mortality, coronary heart disease, stroke, and end-stage renal disease, according to a large study of US veterans.” What statistic could a medical researcher use to measure “large swings?”
- a) Mean
  - b) Median
  - c) Correlation coefficient
  - d) Standard deviation
  - e)  $R^2$

21. A comic book company conducted a study to determine how viable it would be to introduce a fresh and unusual comic book character. It setup booths in a national comic convention attended by avid fans nationwide and randomly selected participants to be interviewed. What can you say about this sampling strategy?
- a) If comic conventions are only attended by the most enthusiastic consumers of comic books, the sample they selected may not be representative of the whole customer base.
  - b) The random selection of survey participants and the selection of a venue where enthusiasts will be present assured that the results they gathered represent the majority of comic book readers.
  - c) The sampling frame the company selected was very thoroughly compiled.
  - d) This is an example of cluster sampling. The survey results may accurately reveal the sentiments of the whole customer base because of the randomized selection of participants.
  - e) The sampling strategy reveals that the company was concerned about the possibilities of response and non-response bias.
22. A scientist created a regression model using body mass to predict brain size among mammals. Assuming all calculations were done correctly, which among the following is a correct conclusion? ( $brain = 2.1271 + 0.7545 \cdot bodymass$ ,  $R^2 = 0.92$ )
- a) A one-unit increase in brain size is associated with a 0.7545 increase in body mass.
  - b) If a mammal had no weight, its body mass would be 2.1271.
  - c) It seems that a high percentage of variation in brain size was accounted for by body mass.
  - d) The linear model cannot be considered very accurate because a very high  $R^2$  was found.
  - e) Despite the findings, it is still possible that the correlation between brain mass and body mass is weak and negative.

23. A simple linear regression model was created to predict the total pizza sales of a store using the price of a single slice of pizza ( $Sales = 139547 - 33527 \cdot Price\ of\ Slice$ ). The coefficients were statistically significant. Would you use this model to predict sales if you were the store manager? Why?



- a) No. The presence of outliers and the non-normality of the residuals make the model invalid.
- b) Yes. If the coefficients were found to be statistically significant, then the model is valid.
- c) Maybe. Based on the scatterplot, it seems that there is another other factor affecting pizza sales that are more important to know to effectively run the store.
- d) Yes. The scatterplot reveals an obvious negative relationship between sales and pizza price that is simply too hard to ignore.
- e) Maybe. Even if the outliers were removed, the range of residuals is so high; it might not provide useful information to manage day-to-day operations.

24. The table below shows the number of licensed drivers in the United States and the number of accidents by age group. Which of the following statements effectively argues that age and the chance of getting into an accident are dependent?

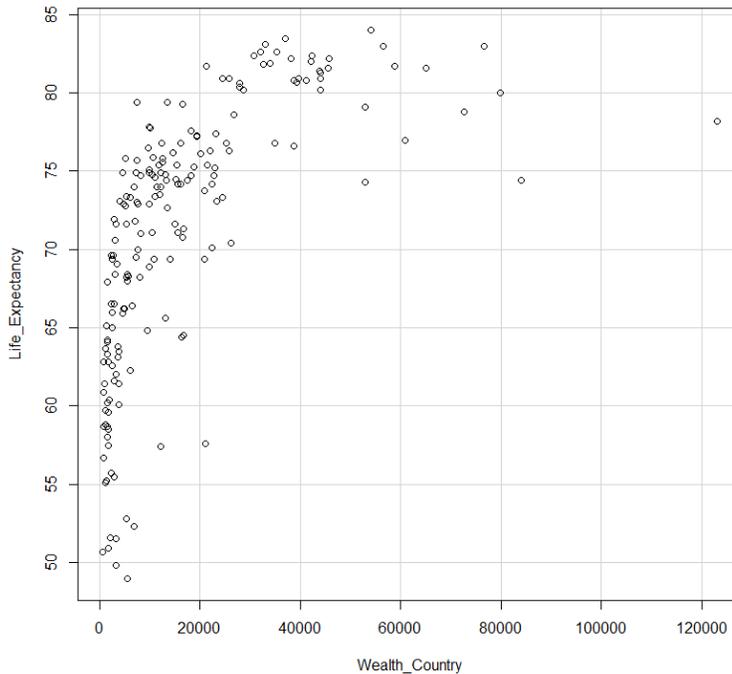
Age Group	Number of drivers (in thousands)	Number of drivers in accidents (in thousands)
19 years and under	10,326	2,020
20 to 24 years	17,465	2,480
25 to 34 years	36,694	3,270
35 to 54 years	80,345	5,660
55 to 74 years	52,546	2,530
<b>Total</b>	<b>197,376</b>	<b>15,960</b>

- a) The numbers of drivers who got into accidents by age group are not equal.
- b) There are more drivers in the 35 to 54 years age group than any other group.
- c) Overall, there is an 8% chance that a driver will get into an accident. Considered separately, 19 year olds and under have a 20% chance while 20 to 24 year olds have a 14% chance of getting into an accident.
- d) The 19 years and under group comprise 13% of all accidents. This is very close to the 20 to 24 group and the 55 to 74 group, with a 16% share each.
- e) Around 41% of drivers are aged 35 to 54 years old, as opposed to 5% for the 19-year olds and under.

25. For a typical rock-paper-scissors game, the probability of getting beat by an opponent is  $\frac{1}{3}$ . If you get beat, you quit playing. What is the probability you play no more than three games?

- a)  $\frac{4}{27}$
- b)  $\frac{19}{27}$
- c)  $\frac{8}{27}$
- d)  $\frac{1}{27}$
- e)  $\frac{1}{3}$

26. An economist was studying the relationship of the wealth of a country and life expectancy. He created a scatterplot and found  $r = 0.6251$ . Which among the following statements is an appropriate conclusion?

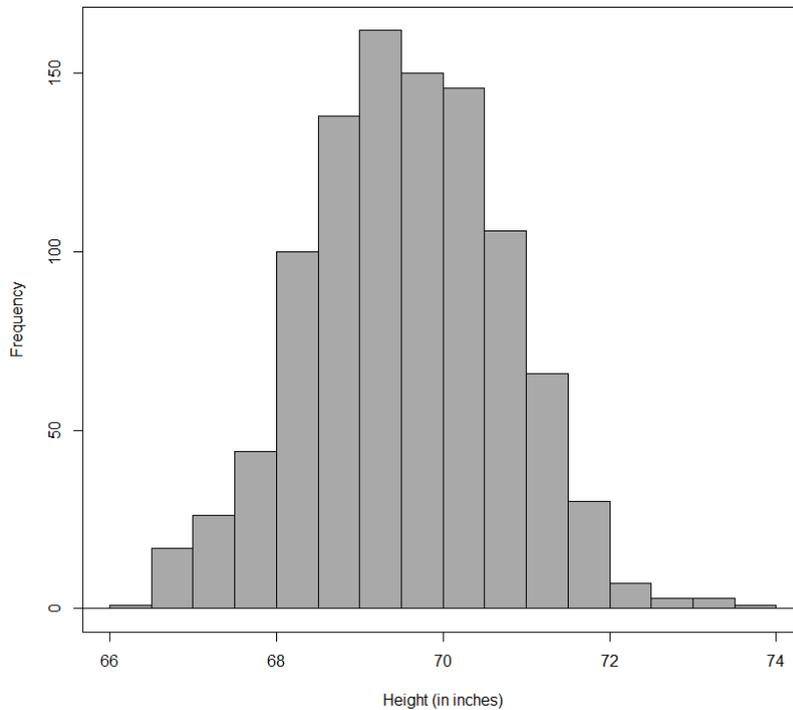


- a) Both the scatterplot and correlation coefficient show a strong linear relationship between the wealth of a country and life expectancy.
  - b) All poor countries have low life expectancies, but the relationship between country wealth and life expectancy is uncertain.
  - c) Wealthier countries have higher life expectancies but  $r$  is not a good measure of this positive relationship because it is not linear.
  - d) The relationship of country wealth and life expectancy is negative and moderate.
  - e) The relationship of country wealth and life expectancy is positive and moderate.
27. A pollster is trying to predict the outcome of a mayoral election. There are only two candidates and the person with the most votes will win. She found that 51.2% of randomly sampled voters will vote for candidate A with a margin of error of 1.75% (95% confidence). Assuming that this was an ideal poll with minimal bias, what can be concluded?
- a) Based on the interval, Candidate A may win, lose, or be tied with candidate B.
  - b) There is strong evidence that candidate A will win, assuming voters don't change their minds.
  - c) There is strong evidence that candidate A will lose, assuming voters don't change their minds.
  - d) There is weak evidence that candidate B will lose, assuming voters don't change their minds.
  - e) There is a 95% chance that 51.2% of total voters will vote for candidate A.

28. A company was manufacturing copper wire with a diameter of 2.00 millimeters. It is known that their process produce wires with diameters that are normally distributed with a standard deviation of 0.01 millimeters. If it cannot sell wire produced with diameters below 1.978 mm and above 2.022 mm, what is the probability of wires being rejected?
- a) 5.00%
  - b) 2.78%
  - c) 1.39%
  - d) 2.28%
  - e) 2.50%
29. In an assembly line, a worker follows a three-step process in assembling a stool. The first step is to drill holes on the seat, which takes an average of 0.5 minute, with a standard deviation of 0.1 minute. The second step is to fasten the legs in place, which takes an average of 1.2 minutes, with a standard deviation of 0.2 minute. Finally, the worker has to attach the rubber feet on the ends of the legs. The final step takes an average of 2.4 minutes, with a standard deviation of 0.2 minutes. If the steps are independent and the times for each are known to be normally distributed, what is the probability that the worker would take more than 4.8 minutes to complete the process?
- a) 8%
  - b) Around 1%
  - c) Essentially 0%
  - d) 99%
  - e) There is not enough information to answer this question.
30. In a study investigating whether taking a low-dose aspirin daily will reduce the risk of a heart attack, when will a type I error occur?
- a) When in reality, taking a low-dose aspirin daily reduces the risk of a heart attack but the analysis implied it does not.
  - b) When taking a low-dose aspirin daily reduces the risk of a heart attack but a patient still had a heart attack.
  - c) When the percentage of patients who get heart attacks is below 5%.
  - d) When taking a low-dose aspirin daily reduces the risk of a heart attack and no patient has had a heart attack.
  - e) When in reality, taking a low-dose aspirin daily does not reduce the risk of a heart attack but the analysis implied it does.

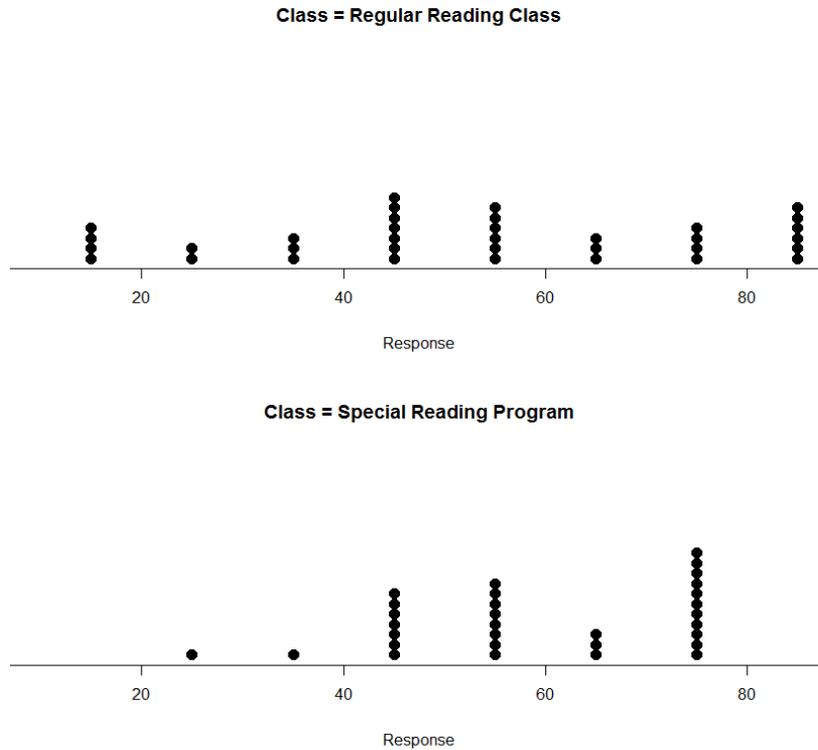
31. A study was conducted in a university (with a 30,000 student population) to determine if students would register for a course that started at 7:45 in the morning. Two hundred randomly selected students were polled, 76 had a positive response, and 124 had a negative response. Which statement is correct?
- a) Around 11,400 students on campus would prefer to register for a course that starts that early.
  - b) There is a 95% chance that the percentage of students who do prefer this morning class is between 31% to 45%.
  - c) It is highly likely that 38% of students will register for this morning class if it was offered.
  - d) There is a 95% chance that the percentage of students who prefer this morning class is 38%.
  - e) If the survey were administered many times, and 95% confidence intervals were made each time, then about 95% of these confidence intervals would contain the true proportion.
32. Many people believe students gain weight as college freshmen. Suppose we plan to conduct a study to see if this is true. Which design would best answer this question?
- a) Randomly select 30 freshmen students. Weigh them on the first day. Weigh them again before the spring semester ends. Conduct a two sample  $t$ -test to check the difference between the mean of the first day weights and the end of year average weight.
  - b) Randomly select 30 freshmen students. Weigh them on the first day. Weigh them again before the spring semester ends. Check the difference between the proportions of those who gained weight and those who did not.
  - c) Randomly select 30 freshmen students. Weigh them on the first day. Weigh them again before the spring semester ends. Check the change in standard deviations.
  - d) Randomly select 30 freshmen students. Weigh them on the first day. Weigh them again before the spring semester ends. Compare the fall semester mean and the end of spring semester mean using a  $z$ -test.
  - e) Randomly select 30 freshmen students. Weigh them on the first day. Weigh them again before the spring semester ends. Conduct a paired data  $t$ -test.

33. The average height of adult males 20 years and older in the United States is 69.2 inches. A small city randomly selected 1000 men and collected their height information. The histogram of heights in inches is shown below. If a one-sample  $t$ -test (95% confidence) is conducted to see how the male population in this city compares to the whole country, which of the following statements is true?



- a) The  $p$ -value is very small ( $< 0.05$ ). There is strong evidence to suggest that the mean height of males in this city is not 69.2 inches. In fact, there is evidence that it is higher.
  - b) There is not enough information to conduct a  $t$ -test. Although the histogram seems to be centered above 69.2, this is not enough to show that the average in this city is indeed any different.
  - c) The histogram is not nearly normal, which means that a  $t$ -test cannot be conducted.
  - d) There are many men in the sample with heights less than or equal to 69.2 inches, which means that this city is comparable to the total population.
  - e) The  $p$ -value is higher than 0.05. There is no evidence to suggest that the mean height of males in this city is not 69.2 inches.
34. For a given confidence level, what happens to the margin of error as the sample size decreases?
- a) The margin of error decreases.
  - b) The margin of error increases.
  - c) The margin of error remains unchanged.
  - d) The margin of error may decrease or increase depending on the sample size change.
  - e) The margin of error is not related to sample size.

35. In one study, 4<sup>th</sup> grade students were randomly assigned to two classes. One class was a regular reading class (35 students) and the other class was a special reading class (31 students). The goal of this investigation was to determine if the special reading program increased the reading performance of students. At the end of the school year, the grades of students were collected. The dot plots of grades are shown below. A two-sample  $t$ -test was also conducted. Which among the following statements is the most likely conclusion of the investigators?



- a)  $H_A$  is rejected.
- b) There is not enough information to determine the results of the  $t$ -test.
- c) The  $p$ -value is below 0.05. There is evidence to suggest that the special reading program resulted to higher student grades.
- d) The  $p$ -value is not less than 5%, but also the necessary assumptions for performing the test might not be met.
- e) There is no evidence to suggest that the special reading program resulted to higher student grades.

36. The social sciences department in a local college wanted to find out if there were differences in the selection of majors between their male and female students. The summary of the data they collected is shown below. Is there evidence to suggest a difference between genders?

College Major	Number of Females	Number of Males	Total
Anthropology	21	5	26
Archeology	6	6	12
Sociology	19	19	38
<b>Total</b>	<b>46</b>	<b>30</b>	<b>76</b>

- a) A  $\chi^2$ -test failed to show evidence that selection of college majors is not independent of gender.
- b) A two-sample proportion test failed to show evidence that selection of college majors is not independent of gender.
- c) A  $\chi^2$ -test shows evidence that selection of college majors is not independent of gender.
- d) A two-sample proportion test shows evidence that selection of college majors is not independent of gender.
- e) There are more females than males in this study which makes it impossible to determine whether there are differences between the two.

37. The 95% confidence interval found for the difference between sexes of the mean weight of a certain species of worms was  $6.45 \pm 4.02$ . What was the most likely  $p$ -value?

- a) 0.170
- b) 0.003
- c) 0.096
- d) 0.365
- e) 0.089

38. Two new hair loss drugs were being tested by a researcher. Both drugs showed signs of promise – the first increased hair growth after one month ( $p$ -value = 0.018), and the second increased hair growth after one month ( $p$ -value = 0.0005). Which of the following statements is correct?
- a) The second drug seems to be better because the  $p$ -value is smaller.
  - b) The tests for the first drug showed a  $p$ -value of 0.018, which is closer to the threshold of 0.05. It seems that there is less certainty in this drug.
  - c) Both drugs show signs of promise but the second one seems to be more statistically significant.
  - d) If the aim of the drug is to promote hair growth quickly, then the first drug is more promising.
  - e) No conclusion can be made at this time because both drugs are still being tested.
39. A marketing company was investigating the percentage of customers who would switch to a new brand of laundry detergent. This new product is very critical to their client company so they wanted to make sure they provide the most accurate market information. Which of the following should be prioritized?
- a) Increase the confidence level of tests to 99%.
  - b) Put all efforts in reducing possible bias and obtaining an adequate sample size.
  - c) Increase the margins of error at all cost.
  - d) Use the marketing budget to get the biggest sample size possible.
  - e) Use the most modern and sophisticated statistical techniques.
40. An education researcher found that using blue pens during a math test instead of black pens increased test scores from an average of 52% to 53% (two-sample  $t$ -test  $p$ -value = 0.00081). Which of the following is the best recommendation the researcher can provide given this information?
- a) Despite the evidence that switching to blue pens increases test scores, it is not practical to require students to buy blue pens because the increase in average test scores is so small. In fact, the resulting average grade is still below passing.
  - b) The evidence for score improvement is weak, with  $p = 0.00081$ . Schools must require students to use blue pens.
  - c) There is no evidence to suggest that blue pens would make any difference. No change is necessary.
  - d) It was proven that blue pens are superior.
  - e) Schools should be wary of the possibilities of type I or type II errors. Another study should be conducted to confirm the results of the first.