

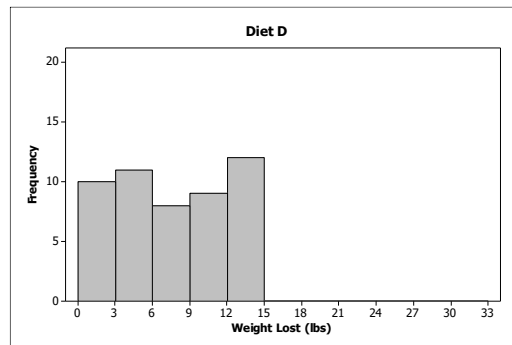
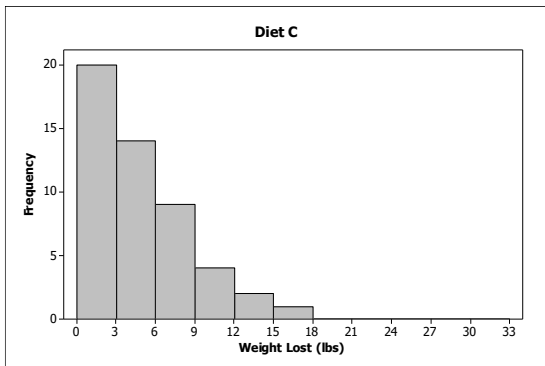
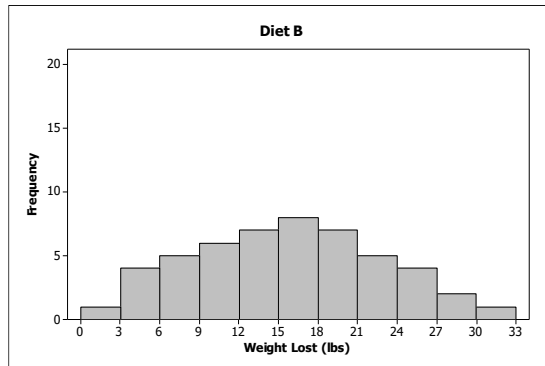
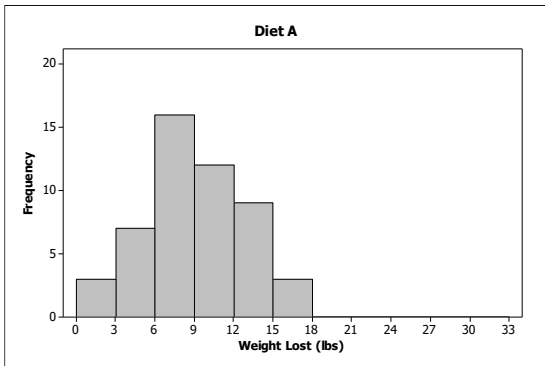
Use the following scenario to answer questions 1-2

Heights of 250 men and 200 women. The distribution of men's heights had a mean of 68" and standard deviation of 3" while the distribution of women's heights had a mean of 65" and standard deviation of 2.5". Both distributions were approximately normal.

1. Which of the following is true?
  - a. The percentage of women shorter than 62.5" is smaller than the percentage of men shorter than 65".
  - b. There are a higher percentage of women between the heights of 62.5" – 67.5" than men between the heights of 65" and 71".
  - c. More than  $\frac{1}{2}$  of the men are taller than 68" while only  $\frac{1}{4}$  of the women are taller than 67.5".
  - d. Approximately 95% of women have a heights between 60" and 70" and approximately 95% of men have heights between 62" and 74".
  - e. The percentage of men with heights between 68" and 71" and the percentage of women with heights between 65" and 67.5" is approximately 68%.
  
2. Which of the following is NOT a correct statement?
  - a. The men's heights have more variation than the women's heights.
  - b. The men's height distribution is more skewed than the women's height distribution because the standard deviation for the men is greater than the standard deviation for the women.
  - c. On average the men are taller than the women.
  - d. Since the standard deviation of men's heights is larger than the standard deviation of women's heights, you would expect the graphical display of the height distribution to be more spread out for men than for women.
  - e. Although more men were sampled, you can still expect about 68% of the women to be within one standard deviation of the mean.
  
3. 150 students had heights that were roughly normally distributed with a mean of 65 inches and a standard deviation of 2.5 inches. Approximately 102 students would be contained in the interval
  - a. 57.5" – 62.5"
  - b. 57.5" – 72.5"
  - c. 60" – 70"
  - d. 62.5" – 67.5"
  - e. 65" – 72.5"
  
4. A two-year study of high school students in the 1980's measured the times to complete a one-mile run. The mean for boys was 460 seconds and the standard deviation was 55 seconds. The mean for girls was 591 seconds and the standard deviation was 70 seconds. Darnell ran the mile in 394 seconds and Christina ran the mile in 500 seconds. Which student actually performed better when compared to high school students of the same sex?
  - a. Darnell performed better with a z-score of -1.2 being further to the right of Christina's z-score of -1.3 on a normal distribution.
  - b. Christina performed better with a z-score of -1.3 being further to the left of Darnell's z-score of -1.2 on a normal distribution
  - c. Darnell performed better with a z-score of -1.3 being better than a z-score of -1.2 for a run time.
  - d. They both performed equally well within their groups respectively.
  - e. These scores can't be compared to see who performed better as they have different means and standard deviations for male and females.

5. A normal probability plot suggests that a normal probability model is plausible when:
- no obvious patterns are present in the plot.
  - a bell-shaped pattern is present in the plot.
  - a substantial quadratic pattern is present in the plot.
  - a substantial linear pattern is present in the plot.
  - any of the above is present in the plot.
6. For a normally distributed population with mean 0 and standard deviation 1.0, the population interquartile range is closest to which of the following values?
- 0.50
  - 1.28
  - 1.349
  - 1.645
  - 1.96
7. For a normal distribution with mean 100 and standard deviation 10, the 95<sup>th</sup> percentile is
- 1.645
  - 1.645
  - 16.45
  - 83.55
  - 116.45
8. What is the value of an observation that is at the 93<sup>rd</sup> percentile of an approximately normal data set with a mean of 86 and standard deviation of 8?
- 102
  - 100
  - 98
  - 96
  - 94
9. California fishermen fishing for spiny lobster are allowed to keep only lobsters with a carapace length of 3.25 inches or longer. (The carapace length is measured from the rear edge of the eye socket to the rear edge of the body shell.) Any lobster smaller than 3.25 must be returned to the sea. Suppose that lobster carapace lengths have a distribution that is approximately normal with a mean of 5.50 inches and a standard deviation of 2.25 inches. Approximately what proportion of lobsters will have to be returned to the sea?
- 16%
  - 34%
  - 50%
  - 68%
  - 84%

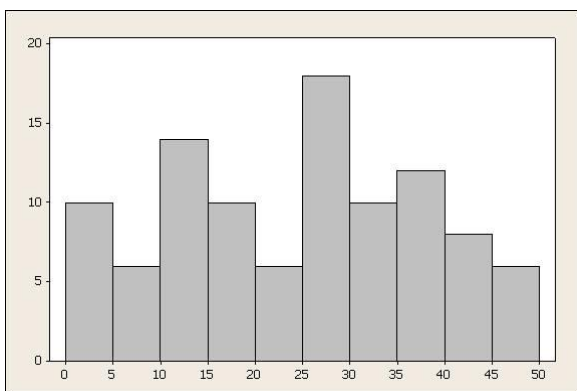
10. A study has been carried out to compare the effectiveness of 4 different diets on weight loss. Fifty people are randomly assigned to each diet for a period of 6-weeks. The distributions of the amounts of weight lost for each diet is summarized in the following histograms.



One way to compare the diets would be to compare the mean weight loss for each diet. Order the diets from largest to smallest using the mean weight loss.

- A. b, d, a, c      B. c, b, d, a      C. b, d, a, c      D. b, a, d, c      E. c, b, a, d

11. Which of the following is closest to the value of the upper quartile for the histogram shown?



- a. 0      b. 27      c. 12      d. 50      e. 37

12. A data set consists of 5 numbers: -6.0, -4.5, 0, 5.0, and an unknown 5th number. For these 5 data points, which of the following statistics can NEVER be greater than zero?

- A. the arithmetic mean
- B. the sample standard deviation
- C. the interquartile range
- D. the median
- E. None of the above

13. The five number summary for a data set is

Minimum: 60  
Lower Quartile: 75  
Median: 78  
Upper Quartile: 82  
Maximum: 89

Which of the following is true for the data set?

- A. There are no outliers in the data set.
- B. This data set has at least one outlier on the high end and at least one outlier on the low end.
- C. This data set has at least one outlier on the high end and no outliers on the low end.
- D. This data set has no outliers on the high end and at least one outlier on the low end.
- E. It is not possible to determine if the data set contains outliers from the information provided.

14. Which of the following statements are true?

I. It is impossible for a data set to have a standard deviation that is larger than the mean.

II. If two data sets have different ranges, the data set with the larger range will always have the larger standard deviation.

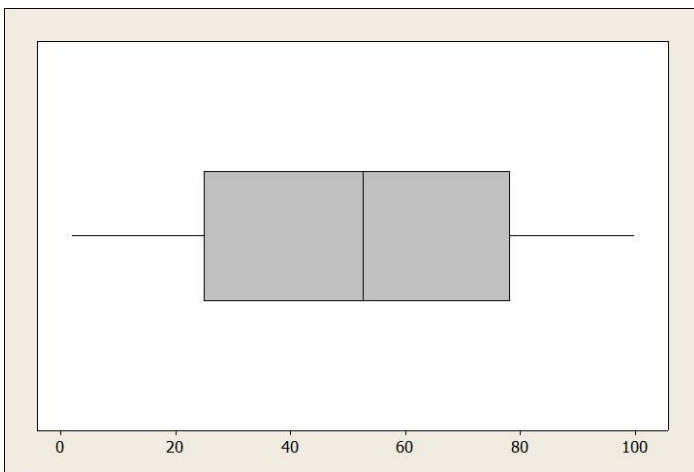
III. The interquartile range of a data set can never be larger than the range.

- A. I only
- B. II only
- C. III only
- D. II and III only
- E. I, II and III

15. The mean and standard deviation of a data set with 50 observations are 47 and 10, respectively. A new data set is formed by adding 3 to the smallest observation in the data set and subtracting 3 from the largest observation in the data set. How will the mean and standard deviation of the new data set compare to the mean and standard deviation of the original data set?

- A. The mean and standard deviation of the new data set will be equal to the mean and standard deviation of the original data set.
- B. The mean of the new data set will be equal to the mean of the original data set but the standard deviation of the new data set will be smaller than the standard deviation of the original data set.
- C. The mean of the new data set will be smaller than the mean of the original data set but the standard deviation of the new data set will be equal to the standard deviation of the original data set.
- D. The mean of the new data set will be larger than the mean of the original data set but the standard deviation of the new data set will be smaller than the standard deviation of the original data set.
- E. The mean of the new data set will be smaller than the mean of the original data set and the standard deviation of the new data set will be smaller than the standard deviation of the original data set.

16. A data set consisting of 100 observations was used to construct the following boxplot:



Based only on this boxplot, which of the following can be concluded about the shape of the sample distribution?

- I. The sample distribution is approximately symmetric.
  - II. The sample distribution is approximately normal.
  - III. The sample distribution is extremely skewed to the right (positively skewed).
- 
- A. I only
  - B. II only
  - C. III only
  - D. I and II
  - E. I and III

17. Two data sets have different variances. A constant  $k$  units is added to all the numbers in both data sets. What is the effect on their new variances?

- a. Both variances stay the same.
- b. Both variances will increase by  $k$  units.
- c. The smaller variance will now be closer to the larger variance.
- d. Both variances will increase by a factor of  $k$  units.
- e. The smaller variance will now be farther away from the larger variance.

18. Every observation in a data set is multiplied by a constant  $k$ . What best describes the affect on summary measures for this data set?

- a. The mean will remain unchanged and the standard deviation will increase by a factor of  $k$ .
- b. The mean and standard deviation will both change by a factor of  $k$ .
- c. The standard deviation will be unchanged, but the mean will change by a factor of  $k$ .
- d. The mean and standard deviation will be unchanged because  $k$  is a constant.
- e. Both the mean and standard deviation will change, but it is not possible to determine how they would change.

19. Stanley's boss told him that he did not deserve a raise and that Stanley was making an amount similar to other accountants with his experience. Stanley gathered some data and found that the z-score for his salary as compared to other accountants with the same level of experience is  $-1.25$ . Which of the following is the best interpretation of this z-score?

- a. Stanley makes 1.25% less than other accountants with his experience level.
- b. Stanley makes 1.25% more than other accountants with his experience level.
- c. Stanley makes \$1.25 less per pay period than the average for accountants with his experience level.
- d. Stanley's salary is 1.25 standard deviations above the mean salary of other accountants with his experience level.
- e. Stanley's salary is 1.25 standard deviations below the mean salary of other accountants with his experience level.

20. Which of the following is NOT a property of all normal distributions?

- I. The distribution is symmetric
- II. The distribution is centered at 0.
- III. The median and the means are equal.

- a. I only
- b. II only
- c. III only
- d. I and II only
- e. I, II and III

21. The weights of watermelons are approximately normally distributed about a mean of 90 ounces and a standard deviation of 15 ounces. If a watermelon is in the 96<sup>th</sup> percentile for weight, then its weight, in ounces, is closest to

- a. 26
- b. 105
- c. 116
- d. 126
- e. 262

22. A variable  $X$  has a normal distribution centered at 100. About 10% of the time,  $X$  takes on a value that is less than 80. What is the approximate standard deviation of  $X$

- a. 10.0                      b. 12.2                      c. 15.6                      d. 20.0                      e. 40.0

23. The distribution of the weights of fish in a lake is approximately normal and is centered at 2 pounds. It is known that 15% of the fish in the lake are larger than 3 pounds. What is the standard deviation of the weights of fish in the lake?

- a. 0.15                      b. 0.67                      c. 0.85                      d. 0.96                      e. 1.00

24. Suppose that the number of dandelions in a one-acre grassland plot is approximately normally distributed with a mean of 750 and a standard deviation of 80. Approximately what percentage of one-acre grassland plots have between 590 and 910 dandelions?

- a. 50%                      b. 68%                      c. 75%                      d. 95%                      e. 99.7%

25. After showing up late for work again, Tom is called into his boss's office. The boss presents him with a cumulative relative frequency distribution of Tom's arrival times. In each case it is based on the time that the system clocked him in. The system records the time rounded to the next 15-minute interval, so if Tom clocked in at 8:51 it would record his arrival as 9:00. The chart is displayed below:

<b>Time of Day</b>	<b>Cumulative Relative Frequency</b>
8:45	0.04
9:00	0.15
9:15	0.27
9:30	0.61
9:45	0.83
10:00	1

According to the chart, what time is Tom most likely to clock into work?

- a. 8:46 – 9:00                      b. 9:01 – 9:15                      c. 9:16 – 9:30                      d. 9:31 – 9:45                      e. 9:46 – 10:00

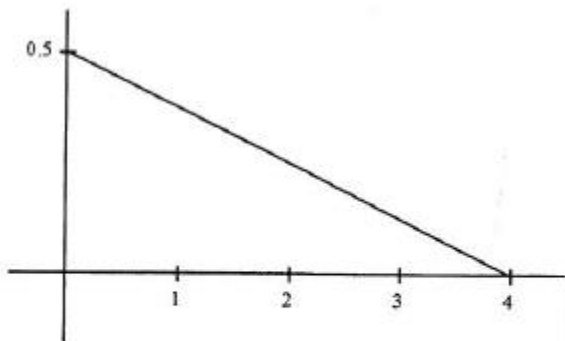
26. Consider a study in which the heights of a very large sample of male high school seniors were recorded. The mean height is 70" and the standard deviation of the heights is 3". The distribution of heights is approximately normal.

(a) Approximately what percent of heights in this sample would exceed 79"?

(b) What is the approximate percentile of a male senior who is 73" tall?

(c) When the data were summarized the value of the first quartile was written down but then smudged. There is general agreement that the writer meant to indicate either 66" or 68". Which of these values is more likely to be the correct one? Justify your answer with appropriate statistical reasoning.

27. The density curve for a continuous random variable is shown below. Use this curve to find the following probabilities:



a)  $P(x < 1)$

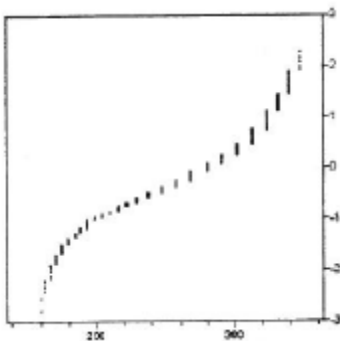
b)  $P(2 < x < 3)$

c)  $P(x \text{ is at least } 3)$

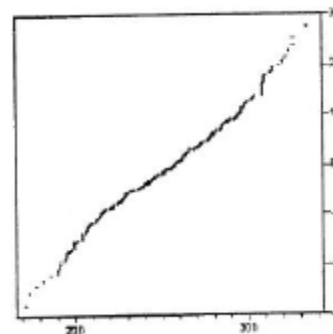
28. A gasoline tank for a certain model car is designed to hold 12 gallons of gas. Suppose that the actual capacity of the gas tank in cars of this type is well approximated by a normal distribution with mean 12.0 gallons and standard deviation 0.2 gallons. What is the approximate probability that a randomly selected car of this model will have a gas tank that holds at most 11.7 gallons?

29. Electric power cords are a common hazard in households with computers. They are easily tripped over, and the delicate computer equipment may be pulled from tables and damaged. A new “breakaway” power cord has been designed by Alpha Enterprises, and they have determined that a breakaway force of between 3.0 and 5.0 pounds is appropriate. (If the force is too low the cord would break in normal use; if the force is too high the cord would not be effective.) Alpha can order cord material from two companies, Beta and Gamma. The breakaway force for the Beta material is approximately normally distributed with a mean of 4.5 pounds and a standard deviation of 1.0 pounds. The breakaway force for the Gamma material is approximately normally distributed with a mean of 4.0 pounds and a standard deviation of 1.5 pounds. Alpha will choose the cord material that has the higher probability of breaking within the specified 3.0- and 5.0-pound limits. From which company should Alpha order cord material? Provide appropriate statistical justification for your choice.

30. The graphs below are normal probability plots of the vocabulary and math concept scores on a standardized exam for a large sample of students. One of the score distributions is approximately normal. Identify the score distribution that is approximately normal and explain the reason for your choice.

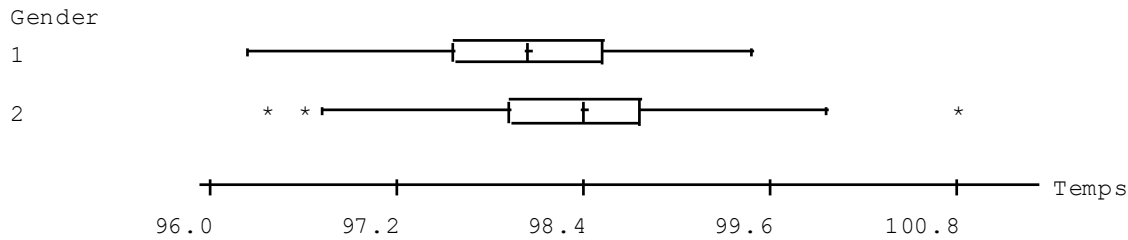


Vocabulary Score



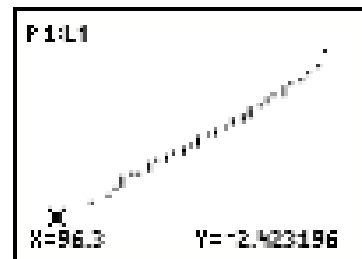
Math Concepts Score

31. We all “know” that the body temperature of a healthy person is 98.6°F. In reality, the actual body temperature of individuals varies. Here are boxplots, produced by Minitab, for the body temperatures of 130 individuals (65 males and 65 females).



(a) What do the boxplots suggest about the Normality of the distributions of temperatures for males (Gender = 1) and females (Gender = 2)? Give specific evidence to justify your answer.

(b). Here’s a Normal probability plot of the temperatures of the males. Explain how it justifies assuming that the population distribution of male temperatures is Normally distributed.



(c) According to Minitab,  $\mu = 98.103$  and  $\sigma = 0.700$  for the male temperatures. If we assume that the males’ temperatures are Normally distributed, what percent would have temperatures at 98.7 degrees or above? Show your work.

32. The best male long jumpers for State College since 1973 have jumped an average of 263.0 inches with a standard deviation of 14.0 inches. The best female long jumpers have averaged 201.2 inches with a standard deviation of 7.7 inches. This year Joey jumped 275 inches and his sister, Carla, jumped 207 inches. Both are State College students.

(a) Find the standardized values for Joey's and Carla's jumps. Which athlete had the more impressive performance? Explain briefly.

(b) Assume that male and female jumps are Normally distributed. Find the percentiles for Joey's and Carla's jumps. Interpret these percentiles in context.

33. The length of pregnancies from conception to natural birth among a certain female population is Normally distributed with mean 270 days and standard deviation 10 days.

(a) According to the 68–95–99.7 rule, what percent of pregnancies last more than 300 days? Show your method.

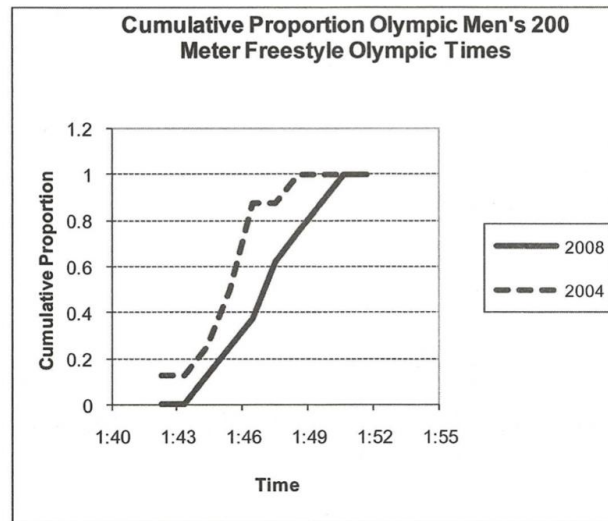
(b) How short must a pregnancy be in order to fall in the shortest 10% of all pregnancies? Show your method.

34. The table below provides the cumulative proportions for time in the Men's 200-meter freestyle Olympic race (swimming). Cumulative proportions for the 2004 and 2008 Olympics are shown below.

Cumulative Proportions for Men's 200 Meter Freestyle Olympic Entry Times

Time	2004	2008	Time	2004	2008
1:43	0.125	0	1:48	0.875	0.625
1:44	0.125	0	1:49	1	0.750
1:45	0.25	0.125	1:50	1	0.875
1:46	0.5	0.25	1:51	1	1
1:47	0.875	0.375	1:52	1	1

The cumulative proportions are graphed below:



- Use the cumulative proportions graph to approximate the median finishing time for each year.
- Use the cumulative proportions graph to approximate the interquartile range for each year.
- Using the results from part (a) and (b), write a sentence or two for a newspaper column comparing the two distributions of times.