Math 153 - Test 2

October 11, 2018

Name key

Score ________

Show all work to receive full credit. Supply explanations where necessary. You may get partial credit for correct work and explanations.

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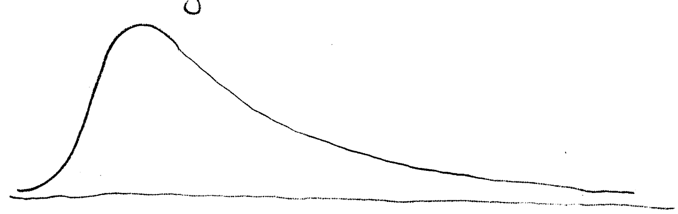
1. (6 points) After nine weeks of work, Sam's weekly earnings have a mean of \$115.87. How much will Sam's mean increase if his tenth-week paycheck is for \$157.25?

$$\text{New mean} = \frac{9(115.87) + 157.25}{10} = \frac{1200.08}{10} = 120.008 \approx 120.01$$

$$\text{Increase is } 120.01 - 115.87 = \boxed{\$4.14}$$

2. (2 points) Sketch a smooth curve that would be characteristic of a distribution of data in which the mean is greater than the median.

Skewed Right



3. (2 points) Sierra sells childrens's' t-shirts. One day she sold 16 shirts—their sizes are shown below.

6, 10, 8, 12, 12, 8, 12, 6, 10, 12, 12, 12, 6, 12, 12, 10

A customer asked Sierra about the average size she sells. Should she report the mean, median, or mode? Briefly explain.

Mode. The numbers in this example are essentially labels. They label the size, but they don't really measure size. The "average" label is probably the most common label.

4. (10 points) The following table summarizes the ages of the winners of the Best Actress Oscar.

Age of Best Actress (yr)	Frequency
20–29	29
30–39	34
40–49	14
50–59	3
60–69	5
70–79	1
80–89	1

(a) Determine the class midpoints.

$$\frac{20+29}{2} = 24.5,\ 34.5,\ 44.5,\ 54.5,\ 64.5,\ 74.5,\ 84.5$$

(b) Use class midpoints to compute the (weighted) mean.

$$\frac{29(24.5)+34(34.5)+14(44.5)+3(54.5)+5(64.5)+74.5+84.5}{29+34+14+3+5+1+1}$$

$$= \frac{3151.5}{87} \approx \boxed{36.2}$$

(c) Use class midpoints to compute the (weighted) median.

87 AGES $\Rightarrow$ 44TH IS MEDIAN

44TH IN 2ND CLASS $\Rightarrow$ MEDIAN = $\boxed{34.5}$

(d) How would you describe the distribution of ages in the table?

SKEWED RIGHT.

(e) How do your mean and median ages lend support to your description of the distribution of ages?

YES, IN SKEWED RIGHT DISTRIBUTION,

IT IS TYPICAL TO HAVE

MEAN > MEDIAN.

5. (8 points) Shown below are the prices (in dollars) listed for the TI-84 Plus graphing calculator at a variety of online shopping sites.

104.95, 111.99, 114.97, 113.99, 124.99, 139.76, 199.95, 104.99, 106.77

(a) Compute the range. In this context, do you think the range is a good measure of spread?

RANGE $= 199.95 - 104.95 = \boxed{\$95.^{00}}$

THIS IS NOT A GOOD MEASURE OF SPREAD BECAUSE \$199.95 IS EXTREME AND IT INFLATES THE RANGE.

(b) Compute the sample standard deviation.

CALCULATOR $\rightarrow$ $\boxed{S \approx 30.33}$

(c) Determine the cutoffs for unusually low and high prices.

$\bar{X} \approx 124.71$

$\bar{X} - 2S \approx 124.71 - 2(30.33) = \$64.^{05}$

$\bar{X} + 2S \approx 124.71 + 2(30.33) = \$185.^{37}$

(d) Based on your computations above, are there any unusual prices in the given list?

YES, $\boxed{\$199.^{95} \text{ IS UNUSUAL}}$

6. (6 points) In a sample of regular Chips Ahoy cookies, the mean number of chocolate chips per cookie was 24.0 with a standard deviation of 2.6. In a sample of 12 oz cans of Coke, the mean weight per can was 0.81682 lb with a standard deviation of 0.00751 lb.

(a) Compute the coefficient of variation (CV) for each product. Which has more spread, numbers of chips or weights of Coke?

CHIPS:

$CV = \dfrac{2.6}{24.0} \approx 10.8\%$

COKE:

$\dfrac{0.00751}{0.81682} \approx 0.92\%$

CHIPS HAVE MUCH MORE SPREAD.

(b) Referring to part (a), did you expect your choice of product to have more spread? Explain.

YES, I WOULD EXPECT THE PROCESS CONTROLLING AMOUNTS IN COKE CANS TO BE MUCH MORE PRECISE & CONSISTENT THAN THE PROCESS OF PUTTING CHIPS IN COOKIES.

7. (9 points) The numbers shown below are the amounts of January snowfall (in inches) measured at O'Hare Airport between 1960 and 2001 (excluding 1997 and 1998). The data have been arranged in numerical order, not time order.

40 VALUES

0.4	0.5	1.5	1.6	2.0	3.0	3.2	3.5	3.5	3.7
5.0	5.4	5.6	5.9	6.2	6.9	7.2	7.4	7.6	9.5
10.0	10.0	10.4	11.1	11.7	13.1	13.6	14.2	15.2	15.5
16.8	17.2	17.3	18.6	18.9	21.9	22.9	25.1	29.6	34.3

(a) Find the percentile corresponding to 3.5 in.

$\frac{7}{40} = 0.175 = \boxed{17.5\% \approx 18^{TH} \text{ PERCENTILE}}$

(b) What amount of snowfall is at the 80th percentile?

$40(0.80) = 32 \qquad \frac{32^{ND} + 33^{RD}}{2} = \frac{17.2 + 17.3}{2} = \boxed{17.25 \text{ in}}$

(c) What amount of snowfall is at the 38th percentile?

$40(0.38) = 15.2 \qquad 16^{TH} \text{ VALUE} = \boxed{6.9 \text{ in}}$

8. (6 points) Judy took a test for which the mean score was 20.62 and standard deviation was 5.70. Her z-score on the test was 2.12.

(a) How many standard deviations from the mean was her raw test score?

$\boxed{2.12}$

(b) Compute her raw test score.

$20.62 + 2.12(5.70) = 32.704 \approx \boxed{32.7}$

(c) Did Judy do well on the test? Explain.

YES, SHE DID VERY WELL! HER SCORE WAS MORE THAN 2 STD. DEV'S ABOVE THE MEAN ... UNUSUALLY HIGH.

9. (5 points) Listed below are the lengths of time (in years) it took for a random sample of college students to earn bachelor's degrees. Based on these results, is it unusual for someone to earn a bachelor's degree in 12 years?

4	4	4	4	4	4	4.5	4.5	4.5	4.5
4.5	4.5	6	6	8	9	9	13	13	15

$\bar{X} = 6.5$

$S \approx 3.5$

$\bar{X} + 2s \approx 6.5 + 2(3.5)$

$= 6.5 + 7 = 13.5 \Rightarrow$ 12 YEARS IS NOT UNUSUAL.

10. (12 points) Refer to the snowfall data in problem 7.

(a) Compute the five-number summary. (Note that this is easy to do by hand because of how the data are organized.)

MIN = 0.4 MED = $\frac{9.5+10}{2} = 9.75$ MAX = 34.3

$Q_1 = \frac{3.7+5}{2} = 4.35$ $Q_3 = \frac{15.5+16.8}{2} = 16.15$

(b) Compute the interquartile range (IQR).

$Q_3 - Q_1 = 16.15 - 4.35 = 11.8$

(c) Determine the cutoff values outliers.

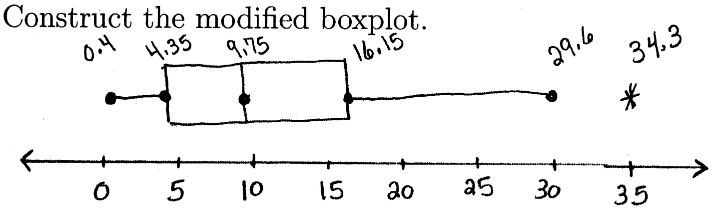
$Q_1 - 1.5(\text{IQR}) = 4.35 - 1.5(11.8) = -13.35$

$Q_3 + 1.5(\text{IQR}) = 16.15 + 1.5(11.8) = 33.85$

(d) Does the data set contain any outliers?

34.3 IS THE ONLY OUTLIER.

(e) Construct the modified boxplot.



11. (6 points) The Ford Pinto was produced from 1971 to 1980. The coefficient of variation (CV) in annual production was 43.7%. The mean number of Pintos produced was 317,349.1.

(a) Was there a great deal of spread in the annual production numbers? Explain.

YES, 43.7% IS A LARGE CV!

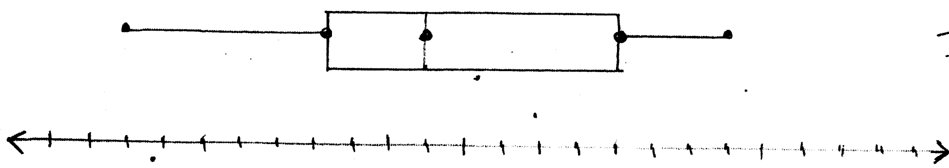
(b) Find the standard deviation in the annual numbers of Pintos produced.

$S = 0.437\,(317349.1)$

$\approx 138{,}681.6$

12. (6 points) Think carefully about the about the characteristics of a modified boxplot. For each part of this problem, sketch a boxplot that would correspond to a data set with the given properties.

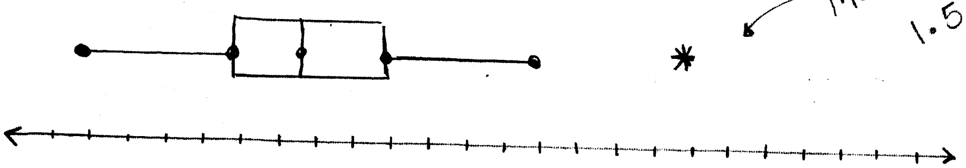
   (a) The range is about twice the IQR (interquartile range).



IQR $\approx$ 8

RANGE $\approx$ 16

   (b) There is a single outlier in the upper extreme.



MORE THAN 1.5 IQR'S BEYOND Q3

13. (6 points) A National Center for Health Statistics study states that the mean height for adult men in the United Sates is 69.4 in, with a standard deviation of 3.1 in. The mean height for adult women is 63.8 in, with a standard deviation of 2.8 in. Who is relatively taller, a 73-in-tall man or a 68-in-tall woman? (Compute and compare the corresponding z-scores.)

MAN:

$$z = \frac{73 - 69.4}{3.1} \approx 1.16$$

WOMAN:

$$z = \frac{68 - 63.8}{2.8} = 1.50$$

THE WOMAN IS RELATIVELY TALLER.

14. (2 points) At gasoline filling stations, electricity from hand-held electronic devices has been known to ignite gasoline vapor in the air. Assign a subjective probability to the event that using your cell phone while pumping gas will cause a fire.

IT SEEMS PRETTY UNLIKELY.

I SAY PROB $\approx \dfrac{1}{100{,}000}$

15. (5 points) A jar contains 8 blue marbles, 5 green marbles, and 7 red marbles. A marble is selected at random.

(a) What is the sample space for this experiment?

$\{b, g, r\}$

(b) Is your sample space uniform (equally-likely)? How do you know?

IT IS NOT A UNIFORM SAMPLE SPACE, BECAUSE THEY ARE DIFFERENT NUMBERS OF MARBLES. THE COLORS ARE NOT EQUALLY-LIKELY.

(c) What is the probability that the selected marble is blue or red?

$\{b, r\}$ $\quad \frac{8+7}{8+5+7} = \boxed{\frac{15}{20} = \frac{3}{4}}$

(d) What is the probability that the selected marble is not blue?

$\{g, r\}$ $\quad \frac{5+7}{20} = \boxed{\frac{12}{20} = \frac{3}{5}}$

(e) Are the probabilities that you assigned above theoretical, experimental, or subjective?

THEORETICAL

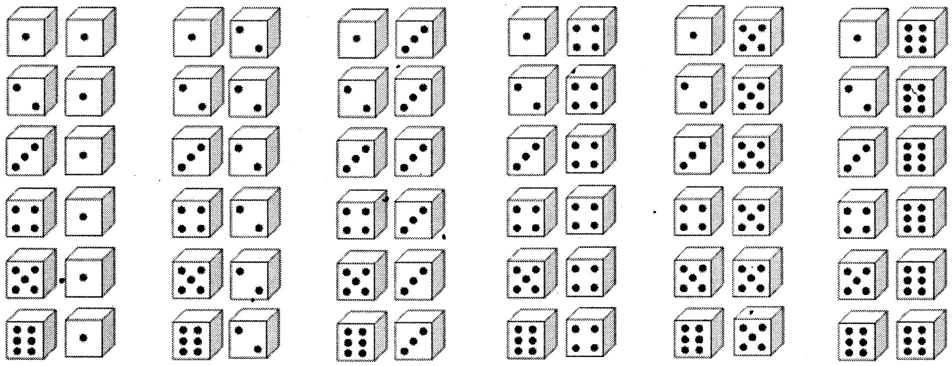
16. (3 points) Suppose the wicked witch of the east is hanging out at a random location in her big yard which measures 120 ft by 310 ft. Dorothy Gale's little house measures 12 ft by 10 ft, and a tornado is about to hurl the house into the witch's yard. What is the probability that the witch is smashed by the falling house? What type of probability are you assigning?

GEOMETRIC PROB

A KIND OF THEORETICAL PROB.

$\frac{\text{AREA OF HOUSE}}{\text{AREA OF YARD}} = \frac{12 \times 10}{120 \times 310} = \boxed{\frac{1}{310} \approx 0.32\%}$

17. (6 points) A pair of dice are rolled. All possible outcomes are shown below.



(a) What is the probability of rolling a sum of 7?

$\{(6,1), (5,2), (4,3), (3,4), (2,5), (1,6)\}$

$\boxed{\frac{6}{36} = \frac{1}{6}}$

(b) What is the probability of rolling any sum except 2?

ANYTHING EXCEPT (1,1)

$\boxed{\frac{35}{36}}$

(c) What is the probability of rolling a double (two of the same)?

$\{(1,1), (2,2), (3,3), (4,4), (5,5), (6,6)\}$

$\boxed{\frac{6}{36} = \frac{1}{6}}$