Math 153 - Test 1

February 5, 2015

Name **Key**

Score _____

Show all work to receive full credit. Supply explanations where necessary. You may use your calculator for all statistical computations.

1. (3 points) Researchers found a correlation between a person's brain volume and IQ score. In fact, their research indicates that people with larger brain volumes tend to have higher IQ scores. Would the researchers be correct in concluding that larger brains are the cause of higher IQ scores? Explain.

    No, CORRELATION DOES NOT IMPLY CAUSATION.

2. (3 points) In a *USA Today* online poll, 728 Internet users chose to respond, and 41% of them said that their college majors prepared them very well for their chosen careers. What is wrong with this kind of survey?

    IT IS A VOLUNTARY RESPONSE SURVEY. SUCH SURVEYS TEND TO BE COMPLETED ONLY BY PEOPLE WHO FEEL STRONGLY ABOUT THE CONTENT.

3. (3 points) A website claims that the current national debt is $16,787,451,118,147.00. Do you think this number is correct?

    PROBABLY NOT. THE NUMBER IS TOO PRECISE TO BE COMPLETELY ACCURATE.

4. (3 points) What is wrong with the following survey question: *Are you in favor of your tax dollars paying for wasteful spending?*

    IT IS A LEADING QUESTION. FEW PEOPLE WOULD WANT THEIR MONEY GOING TO SOMETHING WASTEFUL.

5. (3 points) What is the difference between an experiment and an observational study?

    IN AN OBSERVATIONAL STUDY, WE SIMPLY OBSERVE.

    IN AN EXPERIMENT, A TREATMENT IS APPLIED TO THE SUBJECTS, AND THE EFFECTS OF THE TREATMENT ARE OBSERVED.

1

6. (13 points) 125 Illinois hospitals were recently rated on a 1–10 scale according to the incidence of "hospital-acquired conditions," such as secondary infections. The higher the rating the worse the score. The results are given below.

Rating	Frequency
1–1.9	3
2–2.9	12
3–3.9	16
4–4.9	23
5–5.9	23
6–6.9	21
7–7.9	17
8–8.9	5
9–9.9	5

(a) What are the class boundaries associated with the last class listed above?

$$8.95 \text{ & } 9.95$$

(b) What is the class width?

$$1$$

(c) What are the class midpoints?

$$\frac{1+1.9}{2} = \frac{2.9}{2} = 1.45, \ 2.45, \ 3.45, \ \dots, \ 9.95$$

(d) If the frequency distribution above was changed to a cumulative frequency distribution, how many hospitals would be associated with a rating of "≤ 6.9"?

$$3 + 12 + 16 + 23 + 23 + 21 = 98$$

(e) Use class midpoints to estimate the mean hospital rating.

$$\bar{X} \approx \frac{3(1.45) + 12(2.45) + 16(3.45) + \dots + 5(9.95)}{125} = \frac{668.25}{125} = 5.346$$

(f) Use class midpoints to estimate the median.

MEDIAN IS APPROXIMATELY THE 63ʳᵈ MIDPOINT

$$\Rightarrow \text{MEDIAN} \approx 5.45$$

2

7. (8 points) Determine whether the data are discrete or continuous.

   (a) The numbers of homework exercises in textbooks

   DISCRETE (WE COUNT THEM.)

   (b) The lengths (in inches) of shoes worn by NBA players

   CONTINUOUS (WE MEASURE THEM.)

   (c) The volumes of soda in Coke cans

   CONTINUOUS (WE MEASURE THEM.)

   (d) The numbers of dogs in households in a certain neighborhood

   DISCRETE (WE COUNT THEM.)

8. (8 points) Determine the level of measurement. Choose from nominal, ordinal, interval, or ratio.

   (a) Durations of a professor's lectures

   RATIO

   (b) School letter grades

   ORDINAL

   (c) Colors of eyes of Next Top Model contestants

   NOMINAL

   (d) Years in which popes were elected

   INTERVAL

9. (4 points) On Monday Joe bought 16 gallons of gas for $1.99 per gallon. On Tuesday he bought 12 gallons for $2.41 per gallon. What is Joe's mean gas price?

$$\frac{16(1.99) + 12(2.41)}{28} = \frac{66.76}{28} = \boxed{2.17}$$

10. (10 points) What type of sampling is described in each situation. Choose from random, systematic, convenience, stratified, or cluster.

(a) A telemarketer chooses every 25th person in the local phonebook.

SYSTEMATIC

(b) Twenty different pages of a dictionary were randomly selected, and the numbers of words on each of those pages were counted.

CLUSTER

(c) Each person in class wrote his/her name on a slip of paper and placed it into a box. Five names were selected, one at a time, while the box was being shaken.

RANDOM

(d) News stations often obtain opinions by interviewing neighbors of the people who are the focus of the news story.

CONVENIENCE

(e) Students in an auditorium are asked to count-off from 1 to 5. Each student who was a "5" participates in a survey.

SYSTEMATIC

11. (12 points) Use *frequency polygon, dot plot, bar graph, time-series graph, scatterplot, pie chart, ogive, histogram, stem-and-leaf plot*, or *Pareto chart* to answer each question. You may get partial credit if you offer brief explanations.

(a) What type of graph could be described as a cumulative frequency polygon?

Ogive

(b) What type of graph should be used to show how portions of a whole are divided among categories?

Pie Chart

(c) What type of graph simply displays a collection of plotted ordered pairs?

Scatterplot

(d) What type of bar graph has the bars arranged in descending order according to frequencies?

Pareto Chart

(e) If you used segments to connect class midpoints along the tops of the bars of a histogram, what type of graph would you obtain?

Frequency Polygon

(f) What type of graph represents quantitative data by separating each data value into two parts?

Stem-and-leaf plot

12. (14 points) In the following stem-and-leaf plot, 4|5 means 45.

```
3 | 1 4
4 | 1 2 5
5 | 0 0 2 6  7  8
6 | 3 8 8
7 | 0
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(a) Are the data values shown above approximately normally distributed? Briefly explain.

YES, IT SEEMS SO. THE DISTRIBUTION IS SYMMETRIC WITH A SINGLE PEAK IN THE MIDDLE DECREASING SMOOTHLY TO EACH SIDE.

(b) Compute the mean, median, and mode(s).

$$\bar{X} = \frac{31 + 34 + 41 + \cdots + 68 + 70}{15} = \frac{785}{15} = \boxed{52.\overline{3}}$$

MEDIAN = 8TH VALUE = $\boxed{52}$

MODES ARE $\boxed{50 \ \& \ 68}$

(c) Compute the range.

$$70 - 31 = \boxed{39}$$

(d) Without actually computing it, find a reasonable approximation for the standard deviation. Explain.

A REASONABLE APPROX IS $\dfrac{RANGE}{4} = \dfrac{39}{4} = \boxed{9.75}$

(e) Briefly explain how the values of the mean and median support your conclusion in part (a).

IN A NORMAL DISTRIBUTION, MEAN $\approx$ MEDIAN AND THIS IS PRECISELY WHAT HAPPENS HERE.

13. (6 points) The depths (in inches) at which 10 artifacts were found at an archaeological dig are listed below.

$$20.7 \quad 24.8 \quad 30.5 \quad 26.2 \quad 36.0 \quad 34.3 \quad 30.3 \quad 29.5 \quad 27.0 \quad 38.5$$

(a) Use your calculator to compute the mean and sample standard deviation.

$$\bar{X} = 29.78, \quad S \approx 5.41$$

(b) Use your results from above to determine what depths would be unusually large.

$$\bar{X} + 2S = 40.6$$

ANY DEPTH GREATER THAN 40.6 IN

14. (3 points) Eight males and seven females are selected at random. Is this a simple random sample of size 15? Explain.

No, NOT EVERY SAMPLE OF SIZE 15 IS EQUALLY LIKELY. FOR EXAMPLE, A SAMPLE OF 15 MALES IS IMPOSSIBLE.

15. (2 points) Identify the population and the sample: A study of 33,043 infants in Italy was conducted to find a link between a heart rhythm abnormality and sudden infant death syndrome.

POPULATION: ITALIAN INFANTS

SAMPLE: 30,043 ITALIAN INFANTS IN THE STUDY

16. (5 points) The prices for a gallon of gasoline have mean $3.18 and standard deviation $0.18. What are the cut-offs for unusually low and high gas prices?

Low: $\bar{X} - 2S = 3.18 - 2(0.18) = \boxed{2.82}$

High: $\bar{X} + 2S = 3.18 + 2(0.18) = \boxed{3.54}$