QUIZ 1 - SOLUTIONS

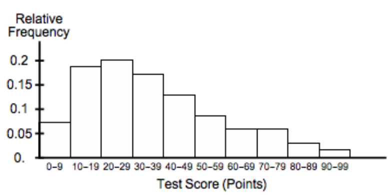
(LESSONS 1-10: INTRO and DESCRIPTIVE STATISTICS)
MATH 119 – SPRING 2020 – KUNIYUKI

1) (3 points). A college has 250 math classes. Ten of the math classes are randomly selected, and a survey is given to every student in the ten selected classes. What sampling method is being used here? Box in the best answer:
   - simple random sampling
   - systematic sampling
   - cluster sampling
   - stratified sampling

2) (4 points). 2000 one-year-old children in the U.S. were randomly sampled, and the number of hours of television ("TV") that they watched per day was recorded. Based on the observed frequencies below, find the corresponding relative frequencies. You may write your answers in fraction, decimal, or percent form. Do not round off. (Note: This was inspired by real data in *Pediatrics*, April 2004!)

Number of hours of TV per day	Frequency	Relative Frequency
0 to 3.9	1320	$\frac{1320}{2000}$ or $\frac{33}{50}$ or 0.66 or 66%
4.0 to 7.9	550	$\frac{550}{2000}$ or $\frac{11}{40}$ or 0.275 or 27.5%
8.0 to 11.9	100	$\frac{100}{2000}$ or $\frac{1}{20}$ or 0.05 or 5%
12.0 to 15.9	30	$\frac{30}{2000}$ or $\frac{3}{200}$ or 0.015 or 1.5%
	Sum = n = 2000	

3) (7 points). 70 students take an exam. A relative frequency histogram for their scores is below.



   - a) (3 points). Estimate the relative frequency of scores in the 40s (between 40 and 49 points).

     The relative frequency is between 0.1 and 0.15. (In fact, it is about 0.13.)

   - b) (4 points). Describe the distribution shape. Consider modality and skewness.

     This distribution is unimodal and right-skewed.

4) (3 points). Which statement below tends to be more true? Box in one:
   - The mean is more sensitive to outliers than the median is.
   - The median is more sensitive to outliers than the mean is.

5) (3 points). 30 schoolchildren are weighed one-by-one by the school nurse. The nurse writes down the resulting estimate of their mean weight. The nurse later finds that the scale is overestimating the weights, and the recorded weights of the 30 schoolchildren are all lowered by 5 pounds. The nurse then writes down the new estimate for their mean weight. How should the new estimate for the mean weight compare to the old estimate?

   The new estimate for the mean weight should be 5 pounds lower than the old estimate.

6) (37 points). Six airlines are randomly sampled. The time period studied was from October 2008 to May 2009, and investigators counted "on-ground" flight delays of at least three hours for each of the six airlines. The investigators wanted to analyze the rate of such delays per 10,000 flights, and the following data was obtained:

Airline	Rate of such delays per 10,000 flights
American	1.3
Continental	4.1
Delta	2.8
Mesa	1.1
United	1.1
US Airways	1.6

   - a) (4 points). Find the **mean** rate of such delays per 10,000 flights.

     The mean is: $\frac{1.3+4.1+2.8+1.1+1.1+1.6}{6} = \frac{12}{6} = \boxed{\text{2.00 delays per 10,000 flights}}$.

   - b) (2 points). Find the **median position number** of this data set.

     The median position number is: $\frac{n+1}{2} = \frac{6+1}{2} = \boxed{3.5}$.

   - c) (4 points). Find the **median** rate of such delays per 10,000 flights.

     First, sort the values: 1.1 1.1 **1.3** **1.6** 2.8 4.1

     The median is the **average** of the **third** and **fourth** lowest values:

     $$\frac{1.3+1.6}{2} = \frac{2.9}{2} = \boxed{\text{1.45 delays per 10,000 flights}}.$$

   - d) (4 points). Find the **mode** of the rate of such delays per 10,000 flights.

     The mode is the most frequent value, $\boxed{\text{1.1 delays per 10,000 flights}}$.

   - e) (4 points). Find the **midrange** of the rate of such delays per 10,000 flights.

     The midrange is: $\frac{\text{Min+Max}}{2} = \frac{1.1+4.1}{2} = \frac{5.2}{2} = \boxed{\text{2.6 delays per 10,000 flights}}$.

Treat the airline data as sample data.

- f) (4 points). Find the **range** of the sample data values.

  Range = Max – Min = 4.1 – 1.1 = $\boxed{\text{3.0 delays per 10,000 flights}}$.

- g) (6 points). Fill out the following table. For the sample mean, use your answer to Part a).

Airline	Data (x) values	Deviations $(x-\bar{x})$ values	Squared Deviations $(x-\bar{x})^2$ values
American	1.3	1.3 – 2 = $\boxed{-0.7}$	$\boxed{0.49}$
Continental	4.1	4.1 – 2 = $\boxed{2.1}$	$\boxed{4.41}$
Delta	2.8	2.8 – 2 = $\boxed{0.8}$	$\boxed{0.64}$
Mesa	1.1	1.1 – 2 = $\boxed{-0.9}$	$\boxed{0.81}$
United	1.1	1.1 – 2 = $\boxed{-0.9}$	$\boxed{0.81}$
US Airways	1.6	1.6 – 2 = $\boxed{-0.4}$	$\boxed{0.16}$

- h) (1 point). What do the deviations from the sample mean add up to? $\boxed{0}$.

- i) (4 points). Find the **sample variance**. Round it off to two decimal places, but avoid rounding when doing Part j) below.

  The sample variance is: $s^2 = \frac{\sum(x-\bar{x})^2}{n-1} = \frac{7.32}{5} \approx$ $\boxed{\text{1.46 delays}^2\text{ per 10,000 flights}}$.

- j) (4 points). Find the **sample standard deviation**. Round it off to two decimal places.

  The sample SD is: $s = \sqrt{\frac{\sum(x-\bar{x})^2}{n-1}} = \sqrt{\frac{7.32}{5}} \approx$ $\boxed{\text{1.21 delays per 10,000 flights}}$.

7) (12 points). A student's grade report for a term is below. Find the GPA for the term to two decimal places. As stated in class, grades of "A," "B," "C," "D," and "F" are worth 4, 3, 2, 1, and 0 grade points, respectively. A "+" modifier adds 0.3, while a "-" subtracts 0.3. Show work, as in class!

Grade Report		
Course	**Number of Units**	**Grade**
English	5	C-
Math	4	B+
Volleyball	3	A

Number of units taken by the student = $\sum w$ = 5 + 4 + 3 = 12 units.

GPA = $\frac{\sum w \cdot x}{\sum w} = \frac{(5)(1.7)+(4)(3.3)+(3)(4)}{12} = \frac{33.7}{12} \approx$ $\boxed{\text{2.81 grade points}}$.

8) (10 points). So far, your grade record in a class looks like this:

Exam	% of overall grade	Your score (out of 100 points)
Quiz 1	10%	50
Quiz 2	10%	75
Midterm 1	25%	70
Midterm 2	25%	80
Final	30%	b

What must you get on the Final to get at least 80% in the class overall? (What kind of score do you need b to be?) Show work, as in class!

$$\frac{(0.10)(50)+(0.10)(75)+(0.25)(70)+(0.25)(80)+(0.30)(b)}{1} \geq 80$$

$$50 + 0.30b \geq 80$$

$$0.30b \geq 30$$

$$b \geq 100$$

$\boxed{\text{You must get 100 points on the Final.}}$

9) (12 points). The birth weights of full-term babies are approximately normally distributed with mean 3500 grams and standard deviation 600 grams. (Source: *Ultrasound in Obstetrics and Gynecology*, 2009.)

- a) (4 points). Use the "Two SD" (2σ) Rule for Usual Values to give an appropriate interval of usual birth weights of full-term babies.

  $$(\mu - 2\sigma, \mu + 2\sigma) = (3500 - 2(600), 3500 + 2(600))$$
  $$= \boxed{(2300 \text{ grams}, 4700 \text{ grams})}$$

- b) (2 points). According to the **Empirical Rule**, about what percent of birth weights of full-term babies are within **one** standard deviation of the mean?

  $\boxed{\text{About 68\%}}$ of such birth weights are within one SD of the mean.

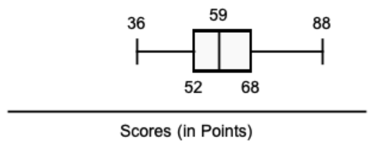
- c) (2 points). According to the **Empirical Rule**, about what percent of birth weights of full-term babies are within **two** standard deviations of the mean?

  $\boxed{\text{About 95\%}}$ of such birth weights are within two SDs of the mean.

- d) (4 points). If the birth weight of a full-term baby is 2500 grams, what would be the z score for that birth weight to two decimal places?

  $z = \frac{x-\mu}{\sigma} = \frac{2500-3500}{600} \approx \boxed{-1.67}$

10) (9 points). The scores on a test (in points) in a large class are summarized by the boxplot (also known as a “box-and-whisker” plot) below. The minimum score is 36 points. The maximum score is 88 points. There are no extreme outliers.



- a) (2 points). A score of 52 points is at which quartile?

  52 points is at $\boxed{Q_1}$, the first quartile.

- b) (2 points). A score of 52 points is at which percentile?

  52 points is at $\boxed{P_{25}}$, the 25th percentile.

- c) (2 points). What is the **median** of the class scores?

  The median is at $\boxed{\text{59 points}}$.

- d) (3 points). What is the **IQR (Interquartile Range)** of the class scores?

  $\text{IQR} = Q_3 - Q_1 = 68 - 52 = \boxed{\text{16 points}}$.