

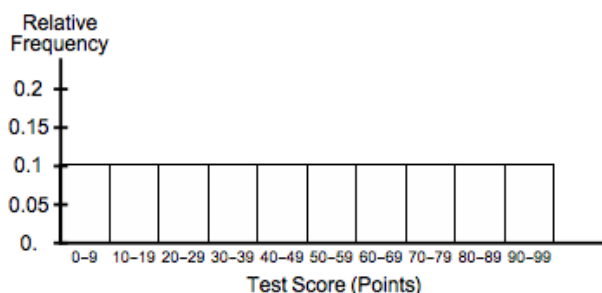
QUIZ 1 - SOLUTIONS

(LESSONS 1-10: INTRO and DESCRIPTIVE STATISTICS) MATH 119 – FALL 2024 – 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
 -
 - stratified sampling
- 2) (4 points). 2000 one-year-old children in the U.S. were randomly sampled in the year 2004, 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 20s (between 20 and 29 points), as in class.

- b) (2 points). Name the type of distribution, as in class.

- c) (2 points). Box in the correct statement below.

§ The distribution is skewed.

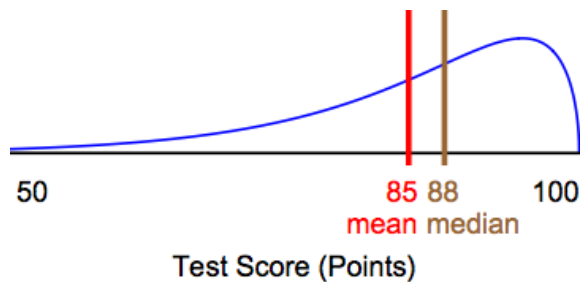
§ The distribution is symmetric.

- 4) (3 points) Let's say we are analyzing a **left-skewed** distribution with no extreme outliers. For this kind of distribution, how does the mean tend to compare to the median? Box in one:

• The mean tends to be **lower** than the median.

• The mean tends to be **higher** than the median.

Consider the sample picture below:



- 5) (40 points). The data below are the waiting times (in seconds) between ordering and receiving coffee for five randomly selected male customers at a Boston coffee shop.

120 160 60 160 100

(Note: This is based on real data in *Applied Economics*, April 2008, “Ladies First? A Field Study of Discrimination in Coffee Shops.”)

(Show work as we have in class.) Based on this data ...

- a) (4 points). Find the **mean** waiting time.

$$\text{The mean is: } \frac{120 + 160 + 60 + 160 + 100}{5} = \frac{600}{5} = \boxed{120.0 \text{ seconds}}, \text{ or 2 minutes.}$$

- b) (2 points). Find the **median position number**.

$$\text{The median position number is: } \frac{n+1}{2} = \frac{5+1}{2} = \boxed{3}.$$

- c) (4 points). Find the **median** waiting time.

First, sort the values: 60 100 **120** 160 160

The median is the **third** lowest value: $\boxed{120 \text{ seconds}}$, or 2 minutes.

- d) (4 points). Find the **mode** of the waiting times.

The mode is the most frequent value, $\boxed{160 \text{ seconds}}$.

- e) (4 points). Find the **midrange** of the waiting times.

$$\text{The midrange is: } \frac{\text{Min} + \text{Max}}{2} = \frac{60 + 160}{2} = \boxed{110.0 \text{ seconds}}.$$

Treat the waiting time data as sample data.

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

$$\text{Range} = \text{Max} - \text{Min} = 160 - 60 = \boxed{100 \text{ seconds}}.$$

- g) (3 points). Box in the most appropriate sentence:

- The midrange and the range are measures of center.
- $\boxed{\text{The midrange is a measure of center but the range is a measure of spread.}}$
- The midrange is a measure of spread but the range is a measure of center.
- The midrange and the range are measures of spread.

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

	Data (x) values in seconds	Deviations $(x - \bar{x})$ values	Squared Deviations $(x - \bar{x})^2$ values
Man #1	120	$120 - 120 = 0$	0
Man #2	160	$160 - 120 = 40$	1600
Man #3	60	$60 - 120 = -60$	3600
Man #4	160	$160 - 120 = 40$	1600
Man #5	100	$100 - 120 = -20$	400

- i) (1 point). What do the deviations from the sample mean add up to? 0.
- j) (4 points). Find the **sample variance**. You shouldn't have to round off.

The sample variance is: $s^2 = \frac{\sum (x - \bar{x})^2}{n - 1} = \frac{7200}{4} = 1800 \text{ seconds}^2$.

- k) (4 points). Find the **sample standard deviation**. Round it off to one decimal place.

The sample SD is: $s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}} = \sqrt{1800} \approx 42.4 \text{ seconds}$.

- 6) (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
Math	5	A-
Physics	3	B
Swimming	2	C+

Number of units taken by the student = $\sum w = 5 + 3 + 2 = 10$ units.

$$\text{GPA} = \frac{\sum w \cdot x}{\sum w} = \frac{(5)(3.7) + (3)(3) + (2)(2.3)}{10} = \frac{32.1}{10} = 3.21 \text{ grade points.}$$

7) (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	15%	80
Quiz 2	15%	85
Quiz 3	15%	90
Midterm	25%	95
Final	30%	a

What must you get on the Final to get at least 90% in the class overall? (What kind of score do you need a to be?) Show work, as in class!

$$\frac{(0.15)(80) + (0.15)(85) + (0.15)(90) + (0.25)(95) + (0.30)a}{1} \geq 90$$

$$62 + 0.3a \geq 90$$

$$0.3a \geq 28$$

$$a \geq 93.\bar{3}$$

You must get at least 94 points on the Final. (Round up to be safe.)

8) (12 points). The term GPAs at a college for the Spring 2024 term were approximately normally distributed with mean 3.05 grade points and standard deviation 0.42 grade points.

- a) (4 points). Use the “Two SD” (2σ) Rule for Usual Values to give an appropriate interval of usual GPAs for Spring 2024 term GPAs at the college.

$$(\mu - 2\sigma, \mu + 2\sigma) = (3.05 - 2(0.42), 3.05 + 2(0.42))$$

$$= \boxed{(2.21 \text{ grade points}, 3.89 \text{ grade points})}$$

- b) (2 points). According to the **Empirical Rule**, about what percent of Spring 2024 term GPAs at the college are in the correct interval from Part a) – that is, the interval that is the correct answer to Part a)?

About 95%

of the Spring 2024 GPAs at the college are within two SDs of the mean (and therefore within the interval from Part a)).

- c) (4 points). Rue Jacobs is a student at the college. Rue’s GPA in Spring 2024 was 3.94 grade points. What was the **z score** for Rue’s GPA in Spring 2024? Round off your answer to two decimal places.

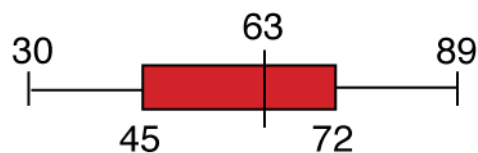
$$z = \frac{x - \mu}{\sigma} = \frac{3.94 - 3.05}{0.42} \approx \boxed{2.12}$$

• d) (2 points). Refer to Part c). Which of the following would be true, based on the “Two SD” (2σ) Rule for Usual Values? Box in the most appropriate statement:

- Rue’s Spring 2024 GPA was “usual” at the college.
- Rue’s Spring 2024 GPA was “unusual” at the college.

This is because Rue’s z score was **above 2**; it also would have been unusual if it were below -2 . Also, from Part a), we determined that the interval of usual values was (2.21 grade points, 3.89 grade points), and 3.94 grade points is **not** in this interval.

9) (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 30 points. The maximum score is 89 points. There are no extreme outliers.



Scores in Points

• a) (2 points). A score of 72 points is at which quartile?

72 points is at Q_3 , the third quartile.

• b) (2 points). A score of 72 points is at which percentile?

72 points is at P_{75} , the 75th percentile.

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

The median is at 63 points.

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

$IQR = Q_3 - Q_1 = 72 - 45 =$ 27 points.