

QUIZ 1 - SOLUTIONS

(LESSONS 1-10: INTRO and DESCRIPTIVE STATISTICS)
MATH 119 – FALL 2023 – KUNIYUKI

1) (3 points). Fredonia has 25 states with roughly equal populations. A filmmaker randomly selects three adults from each of the 25 states. The filmmaker will talk with these 75 people to see if they will be interesting subjects for a political film. What sampling method is being used here? Box in the best answer:

- simple random sampling
- systematic sampling
- cluster sampling
- stratified sampling

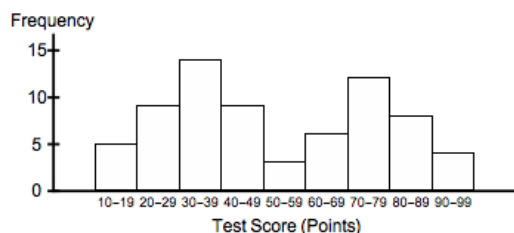
2) (4 points). Twenty years after the 9/11/2001 attacks on the U.S., a 2021 poll used a random sample of 782 American adults. They were asked if the U.S. is safer from terrorism now than before 9/11/2001, if the U.S. is less safe now, or if they didn't know.

Based on the observed frequencies below, find the corresponding relative frequencies. Write the answers in **percent form**. If you round off, round off to three significant digits. It may help to show some work for partial credit.

(Note: These figures are based on a 2021 ABC News / Washington Post poll.)

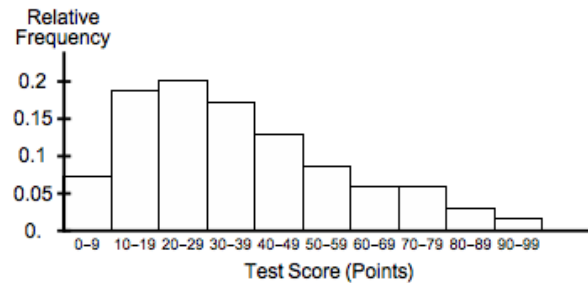
Response	Frequency	Relative Frequency (as a percent)
The U.S. is safer now.	383	$\frac{383}{782} \approx 0.490$ or 49.0%
The U.S. is less safe now.	321	$\frac{321}{782} \approx 0.410$ or 41.0%
Don't know	78	$\frac{78}{782} \approx 0.0997$ or 9.97%
	Sum = n = 782	

3) (3 points). 70 students take an exam. A frequency histogram for their scores is below. Estimate the number of students who scored in the 20s (between 20 and 29 points).



Between 5 and 10 students scored in the 20s. (In fact, 9 did.)

4) (2 points). Describe the skewness of the distribution below.



This distribution is right-skewed.

5) (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.

6) (3 points). The mean is considered to be a very appropriate measure of center for which of the following types of distributions? Box in one (the best answer):

- a left-skewed distribution
- a right-skewed distribution
- a symmetric distribution

7) (18 points). A pharmaceutical company randomly selects seven people with diabetes to participate in a study. Their fasting blood glucose levels are tested and are recorded as follows (in milligrams per deciliter, or mg/dL).

160 209 177 209 179 300 166

- a) (4 points). Find the **mean** of the fasting blood glucose levels.

$$\text{The mean is: } \frac{160 + 209 + 177 + 209 + 179 + 300 + 166}{7} = \frac{1400}{7} = \boxed{200.0 \frac{\text{mg}}{\text{dL}}}.$$

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

$$\text{The median position number is: } \frac{n+1}{2} = \frac{7+1}{2} = \boxed{4}.$$

- c) (4 points). Find the **median** of the fasting blood glucose levels.

First, sort the values:

160 166 177 **179** 209 209 300

$$\text{The median is the fourth lowest value, } \boxed{179 \frac{\text{mg}}{\text{dL}}}.$$

- d) (4 points). Find the **mode** of the fasting blood glucose levels.

$$\text{The mode is the most frequent value, } \boxed{209 \frac{\text{mg}}{\text{dL}}}.$$

- e) (4 points). Find the **midrange** of the fasting blood glucose levels.

$$\text{The midrange is: } \frac{\text{Min} + \text{Max}}{2} = \frac{160 + 300}{2} = \boxed{230 \frac{\text{mg}}{\text{dL}}}.$$

- 8) (11 points). A student's grade report for a term is below. Find the GPA for the term to two decimal places.

Grade Report		
Course	Number of Units	Grade
English	6	C+
Math	5	B
Music	3	A-

Number of units taken by the student = $\sum w = 6 + 5 + 3 = 14$ units.

$$\text{GPA} = \frac{\sum w \cdot x}{\sum w} = \frac{(6)(2.3) + (5)(3) + (3)(3.7)}{14} = \frac{39.9}{14} = \boxed{2.85 \text{ grade points}}.$$

- 9) (9 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! The answer is interesting!

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

$$50 + 0.30b \geq 80$$

$$0.30b \geq 30$$

$$b \geq 100$$

You must get 100 points on the Final.

- 10) (23 points). 1000 students in a large lecture class take a test. Four of the tests are randomly selected and are graded. Their scores in points are as follows:

55 80 95 70

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

$$\text{Range} = \text{Max} - \text{Min} = 95 - 55 = \boxed{40 \text{ points}}$$

- b) (4 points). Find the **sample mean**.

$$\text{The sample mean is: } \bar{x} = \frac{55 + 80 + 95 + 70}{4} = \frac{300}{4} = \boxed{75.0 \text{ points}}$$

- c) (6 points). Fill out the following table:

Data (x) values in points	Deviations $(x - \bar{x})$ values	Squared Deviations $(x - \bar{x})^2$ values
55	-20	400
80	5	25
95	20	400
70	-5	25

- d) (1 point). What do the deviations from the sample mean add up to?
- e) (4 points). Find the **sample variance**. Round it off to one decimal place, but avoid rounding when doing f) below.

The sample variance is: $s^2 = \frac{\sum(x - \bar{x})^2}{n-1} = \frac{850}{3} \approx \boxed{283.3 \text{ square points}}$

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

The sample SD is: $s = \sqrt{\frac{\sum(x - \bar{x})^2}{n-1}} = \sqrt{\frac{850}{3}} \approx \boxed{16.8 \text{ points}}$

- 11) (12 points). Annual incomes of high-school teachers in Fredonia are approximately normally distributed with mean \$55,000 and standard deviation \$10,000.

- a) (4 points). Use the “Two SD” (2σ) Rule for Usual Values to give an appropriate interval of usual annual incomes for high-school teachers in Fredonia.

$$(\mu - 2\sigma, \mu + 2\sigma) = (\$55,000 - 2(\$10,000), \$55,000 + 2(\$10,000))$$

$$= \boxed{(\$35,000, \$75,000)}$$

- b) (2 points). According to the **Empirical Rule**, about what percent of annual incomes of high-school teachers in Fredonia are within **two** standard deviations of the mean?

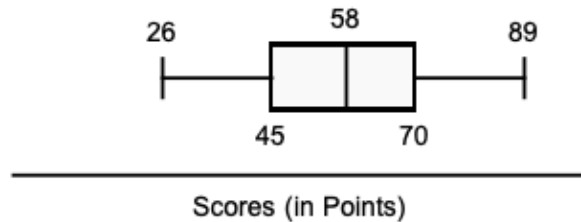
of such annual incomes are within two SDs of the mean.

- c) (4 points). If a high-school teacher in Fredonia makes an annual income of \$40,000, what would be the z score for that income to two decimal places?

$$z = \frac{x - \mu}{\sigma} = \frac{\$40,000 - \$55,000}{\$10,000} = \boxed{-1.50}$$

- d) (2 points). **Interpret the z score** from c), as in class.

- 12) (9 points total). 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 26 points. The maximum score is 89 points. There are no extreme outliers.



- a) (2 points). A score of 70 points is at which **quartile**?

70 points is at Q_3 , the third quartile.

- b) (2 points). A score of 70 points is at which **percentile**?

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

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

The median is at 58 points.

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

$IQR = Q_3 - Q_1 = 70 - 45 = \underline{25 \text{ points}}$.