MTH 324, Exam #1, Fall 2023   Name _____

Instructions: Answer each question thoroughly. For questions in Part 1, use the work you did at home to answer the questions. Be sure to answer each part of each question. In Part 2, report exact answers unless directed to round.

Part I:
Use the work you did at home to answer these questions about study hours and GPA in our dataset.

1. What is the modal class on your histogram?

2. What is the shape of the Hours Per Week histogram? Roughly symmetric, right-skewed, left-skewed?

3. Which GPA level has the fewest members in the sample? How many students is that?

4. Based on your comparative box plot, which GPA group appears to study the least? Does this make sense?

5. Calculate the upper and lower fences for the Hours Per Week data, and the extreme upper and lower fences. Are there any outliers in the data? Are there any extreme outliers in the data?

6. Find the indicated probabilities.
   a. Based on previous experience, it is found that 75% of people getting into a driving simulator put on their seatbelts. What is the probability that among the next 15 people that get into the simulator, more than 12 of them will put on their seatbelts?

   b. A drive thru at a particular bank sees 15 customers pass through during a particular hour of the day. Determine the probability that the drive thru will see 5 or more passengers in the next 20 minutes?

   c. The height women has a mean of 64.3" and a standard deviation of 3.1". What is the probability that a randomly selected woman will stand more than 71" tall?

Part II:

7. Describe the procedure for calculating a simple random sample, and a systematic sample. Highlight how they differ from each other. Describe a situation in which each method is used.

8. What is the purpose of doing a block design in an experiment?

9. Why are IRBs (Institutional Review Boards) involved in research on human subjects? What is their purpose?

10. For each of the following variables, identify whether the variable is i) categorical or numerical, ii) it's level of measurement (nominal, ordinal, interval or ratio), and if it is numerical iii) whether it is discrete or continuous (write NA if it does not apply).
    a. Hair color

    b. Richter scale

    c. PIN number

    d. Number of students in a class

    e. Weight in grams

11. Use the contingency table below to answer the probability questions that follow.

	Sport Preference		
	Archery	Boxing	Cycling
Female	35	15	50	**100**
Male	10	30	60	**100**
	45	**45**	**110**	**200**

Gender

a. What is the probability that someone selected randomly from this sample prefers cycling?

b. What is the probability that someone selected randomly from this sample is male?

c. What is the probability that someone selected randomly from this sample is a male and prefers cycling?

d. What is the probability that someone selected randomly from this sample is a male or prefers cycling?

e. What is the probability that someone selected randomly from this sample is a male given that they prefer cycling?

f. What is the probability that someone selected randomly from this sample does not prefer cycling?

g. Are sports preference and gender independent events? Explain your reasoning. Show math to support your conclusion.

12. A particular rare disease occurs in just 7 out of 5000 people in population. A test for that disease correctly identifies those with the disease 99.3% of the time. For people without the disease, the test correctly identifies that they do not have the disease 99.4% of the time. If a patient tests positive for the disease, what is the probability that they actually have the disease?

13. Consider the probability distribution given by $\int_{-1}^{1} K(x^2 - 1)dx$.
    a. Find the value of K that makes this a valid probability distribution.

    b. Find the probability that $P\left(\frac{1}{4} \le X \le \frac{3}{4}\right)$.

    c. Find the mean of the distribution.

    d. Find the variance of the distribution.

    e. What value of X represents the 75th percentile?

14. Use the joint probability table below to answer the questions that follow.

		x_2			
		0	1	2	3
	0	.08	.07	.04	.00
	1	.06	.15	.05	.04
x_1	2	.05	.04	.10	.06
	3	.00	.03	.04	.07
	4	.00	.01	.05	.06

    a. What is $P(X_1 = 1, X_2 = 3)$.

b. What is $P(X_1 \leq X_2)$

c. Find the marginal probability distributions of X_1 and X_2.

d. Find the mean of X_1.

e. Find $P(X_1 = 4|X_2 = 2)$