STUDENT NUMBER:

MTHE 224 - Midterm Test

Wednesday Oct 25, 2023

Instructions:

- Write your name and student number on this page.
- READ EACH QUESTION CAREFULLY.
- Show all of your work for full marks.
- Include units in your answers wherever possible.
- If using numeric values, keep at least 4 significant digits in your answer and during calculations.

Do not start the test until instructed to do so by your proctor.

STUDENT NUMBER:

Question 1 (6 points)**.** Determine whether each of the following random variables are binomial random variables. Explain why or why not.

a. The number of tries it takes to hit the bullseye on a dart board.

b. The number of spades chosen when picking 12 cards at random from a deck of cards.

c. The number of questions Billy gets right on a 20 question multiple choice test by guessing.

STUDENT NUMBER:

Question 2 (8 points)**.** A carnival game consists of drawing one ball from a box containing two yellow balls, five red balls, and eight white balls. If the ball is yellow, you win \$5. If the ball is red, you win \$2. If the ball is white, you lose \$3. What is your expected winnings?

STUDENT NUMBER:

Question 3 (8 points)**.** AA Batteries come in packs of 6. For a certain brand (the kind you would get at the dollar store) there is a .10 probability that exactly one battery in the pack is dead, a .01 probability that exactly two are dead. The probability that more than two are dead is 0. Suppose you select two batteries from the pack, and neither are dead. What is the probability that there is at least one dead battery in the pack?

STUDENT NUMBER:

Question 4 (8 points)**.** A high pressure pump system is built with a two sets of seals. The second set of seals are only used in the case when the first set fails. The number of days it takes for both sets to fail is a continuous random variable T with the probability density function

$$f(t) = \begin{cases} \frac{1}{100} t e^{\frac{-t}{10}} & t \geq 0 \\ 0 & t < 0. \end{cases} \tag{1}$$

a. What is the probability that both sets of seals fail within the first 5 days of operation?

b. Find the median of T.

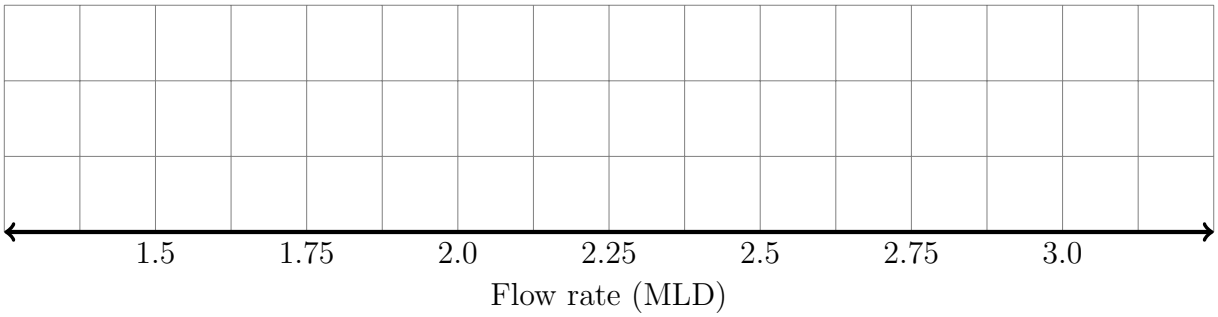
STUDENT NUMBER:

Question 5 (6 points)**.** The data below are measurements for the flow rate of wastewater on different days at a facility in rural Idaho in millions of liters per day.

Flow Rate	1.74	2.19	1.41	2.01	2.52	2.70	2.70	2.52	2.88	2.97	2.70	2.52	1.74

a. Determine the values of the first, second, and third quartiles, and calculate the interquartile range.

b. Draw a box-plot for the data. Be sure to indicate any outliers.



STUDENT NUMBER:

Question 6 (8 points)**.** Tim Hortons roll up the rim game runs every fall. The company advertises a 1/6 probability to win a prize for each hot drink you purchase. Suppose you want to play until you win two prizes. Let X be the total number of times you buy coffee during the promotion.

a. What kind of random variable is X?

b. What is the probability that you buy exactly 3 coffees?

c. What is the probability that you buy less than 3 non winning coffees?

STUDENT NUMBER:

Question 7 (8 points)**.** Let X be a continuous random variable with probability density function

$$f(t) = \begin{cases} Ct\ln(t) & \text{for } t \in (0,1) \\ 0 & \text{for } t \notin (0,1). \end{cases}$$

a. Find the value of C that makes f a probability density function.

b. Find the expected value of X.

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