MA 100 **Problem Set # 2** Spring 2021

Due Sunday, March 7th by 9pm – uploaded as a single PDF to theSpring.

Show all of your work on a SEPARATE piece of paper! You will not receive full credit if I cannot determine how you arrived at your answer.

1) Diseases tend to spread according to exponential growth models. In the early days of AIDS, the growth rate was around 190%. In 1983, about 1700 people in the US died of AIDS. If the trend had continued unchecked, how many people would have died from AIDS in 1993?

2) A population of beetles are growing according to a linear growth model. The initial population is 6 beetles and after 4 weeks there are 22 beetles.

    a. How many beetles are there after 10 weeks?
    b. After how many weeks will the beetle population reach 82?

3) A bacteria culture starts with 200 bacteria. After 6 hours, the population has grown to 450 bacteria. If the population grows exponentially and this trend continues:

    a. How many bacteria will there be in one day?
    b. How long it will take for the culture to triple in size?

4) Professor Lopez loves Cadbury mini eggs. She has been eating 5 mini eggs a day since the beginning of February. On the 6th day of February she had 130 mini eggs left.

    a. How many Cadbury mini eggs did she start with (before eating any on 2/1)?
    b. Did she have enough candy corn to get through the month of February? If so, how many did she have left on February 28th (the last day of the month)?

5) In 1968, the U.S. minimum wage was $1.60 per hour. In 1976, the minimum wage was $2.30 per hour. Assume the minimum wage grows according to an exponential model where n represents the time in years after 1960.

   a. Find an explicit formula for the minimum wage.
   b. What does the model predict for a minimum wage in 1960?
   c. If the minimum wage was $5.15 in 1996 (when Professor Lopez first got a job!), is this above, below or equal to what the model predicts?

6) Inflation causes things to cost more, and for our money to buy less (hence your grandparents saying "In my day, you could buy a cup of coffee for a nickel"). Suppose inflation decreases the value of money by 5% each year. In other words, if you have $1.00 this year, next year it will only buy you $0.95 worth of stuff. How much will $1000 buy you in 20 years?

7) Suppose you have a bowl of 500 M&M candies, and each day you eat $\frac{1}{4}$ of the candies you have.

   a. Is the number of candies left changing linearly or exponentially?
   b. Write an equation to model the number of candies left after n days.
   c. How many M&M's will be left after 8 day?

8) Recursive equations can be very handy for modeling complicated situations for which explicit equations would be hard to interpret. As an example, consider a lake in which 2000 fish currently reside. The fish population grows by 10% each year, but every year 100 fish are harvested from the lake by people fishing.

   a. Write a recursive equation for the number of fish in the lake after n years.
   b. Calculate the population after 1, 2 and 3 years. Does the population appear to be increasing or decreasing?
   c. What is the maximum number of fish that could be harvested each year without causing the fish population to decrease in the long run?