

6. [11 points] Aziza and Zainab are former Math 115 students at a prestigious weather forecasting company near Cloudytown, MI. Each using different meteorological instruments, they've recorded the rainfall over Cloudytown during a storm. They've let  $F(t)$  be the total rainfall, in inches,  $t$  hours after the start of the storm. They collected the following data.

Aziza's data:  $F(0) = 0$ ,  $F(1) = 0.3$ , and  $F(2) = 0.5$ .

Zainab's data:  $F'(0) = 0.6$ ,  $F'(1) = 0.7$ , and  $F'(2) = 0.3$ .

- a. [4 points] Use Aziza's data (and *not* Zainab's data) to estimate how quickly the rain was falling, in inches per hour, at the start of the storm (time  $t = 0$ ) and after one hour ( $t = 1$ ).

*Solution:* At the start of the storm, the rainfall rate is  $F'(0)$  which can be approximated by the average rate of change of  $F$  between  $t = 0$  and  $t = 1$ :

$$F'(0) \approx \frac{F(1) - F(0)}{1 - 0} = 0.3.$$

Similarly, the rainfall rate after one hour is approximated by

$$F'(1) \approx \frac{F(2) - F(1)}{2 - 1} = 0.2.$$

(NOTE: Several answers are acceptable for the second part.)

$$t = 0 : \underline{0.3 \text{ in/hr}} \quad t = 1 : \underline{0.2 \text{ in/hr}}$$

- b. [4 points] (True or False) Circle "T" (True) or "F" (False) for each of the statements below.

- Assuming all the data gathered was correct, throughout the second hour of the storm it was raining at a rate of about 0.7 inches per hour. F
- Assuming all the data gathered was correct, during the first hour of the storm rainfall slowed down and later sped up again. T
- Either Aziza's instrument or Zainab's instrument must be faulty because their measurements give different values for  $F'(0)$  and  $F'(1)$ . F
- Assuming all the data gathered was correct, since  $F'(0) = 0.6$  we know that about 0.6 inches of rain fell in the first hour. F

- c. [3 points] Give a practical interpretation of  $F'(0) = 0.6$  that begins, "During the first five minutes of the storm...".

*Solution:* The equation  $F'(0) = 0.6$  means the rainfall rate is 0.6 in/hr at the beginning of the storm. There are twelve five minute periods in an hour, so this rate is equivalent to 0.05 inches per 5 minutes. This means our interpretation should be "During the first five minutes of the storm, approximately 0.05 inches of rain fell."