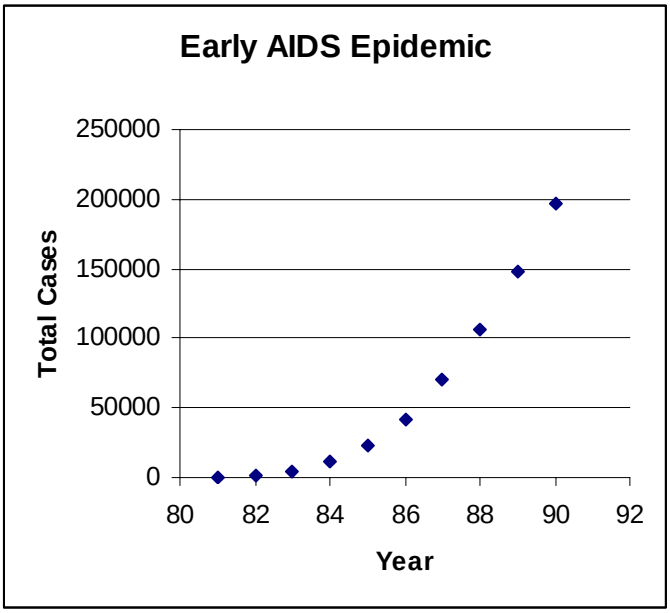
Math 126 Calculus I Class Example Week 2 Block 3

In 1760 when smallpox was epidemic in Europe, Daniel Bernoulli produced the first mathematical model of epidemics. He mathematically modeled the epidemic in order to assess whether inoculations would help deter its spread. His work also is helpful in understanding the spread of the AIDS epidemic of the 1980's. We will be using calculus to try and better understand the spread of AIDS.

The data are in a different form that on the first quiz in order that you confront data in the same format as Bernoulli. First, the numbers represent **annual rather than semi-annual figures**. Second, these data represent the **total number (cumulative) of cases** reported up through the given year.

Below are the actual data on AIDS cases during the first 10 years of the epidemic. These represent the total number of AIDS cases from the beginning of the epidemic through the given year (as defined by the Centers for Disease Control).

Year	Total Cases
81	321
82	1489
83	4564
84	10807
85	22590
86	41630
87	70216
88	105697
89	148441
90	197138



Instructions: Work in groups of two or three of your own choosing. Be sure that everyone has a group to work in.

Briefly discuss each of the following questions. After jointly agreeing on an answer, have a member with neat handwriting record your responses. Turn in only one solution, but be sure to put all your names on the paper.

I. The function $y = f(x)$ describing the AIDS epidemic is given numerically and then graphically. Recall one way we defined the derivative as a limit: $\lim_{h\to 0} \frac{f(x+h) - f(x)}{h}$.

However, **with numerically defined functions, we cannot let h $\rightarrow$ 0.** Thus, we can only approximate the derivative.

A. Approximate $f'(86)$ (the slope of the graph) geometrically as best you can by carefully sketching the tangent to the curve at x = 86 on the graph above and then finding its slope by approximating rise over run.
B. Approximate f '(86) numerically by choosing appropriate values of h and using a difference quotient.

C. Interpret f '(86) for the layperson who might have an interest in the AIDS epidemic.

D. For our data, the total number of cases is given for each year. How might you approximate f '(86.75) from this data? Explain and give your approximation.