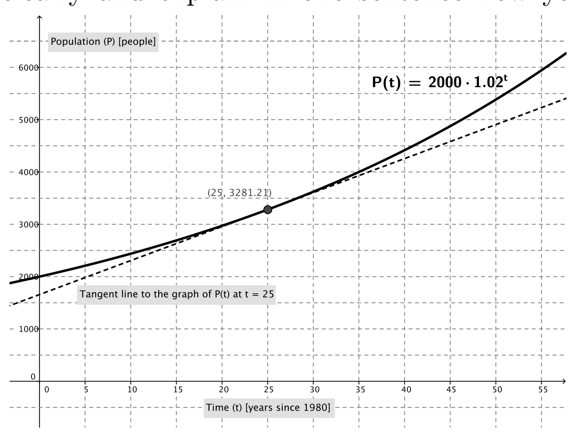
1. The population of a small town is given by $P(t) = 2000(1.02)^t$ where P is in people and t is in years since 1980.

   (a) Set up – *but do not evaluate* – an expression involving limits that would find the instantaneous rate of change in the town's population in the year 2013.

   (b) Suppose we wanted to evaluate the above limit expression using only algebraic operations and no numerical or graphical estimation. Do you think this method of solution would be appropriate for this problem? Explain.

   (c) Here is a graph of $P(t)$ along with the tangent line to the graph of P when $t = 25$. Use these to estimate the instantaneous rate of change in the population of the town in 2005. State your answer clearly and explain in one sentence how you got your answer.



   (d) Suppose a student did part (c) of this problem and came up with an answer of -450. Is this solution reasonable and consistent with practical considerations? Explain your reasoning.

2. The financial value of a mutual fund goes up and down over time. Suppose that a certain mutual fund's value V (in dollars) is a function of time t (in months since January 2010). In particular note that January 2012 corresponds to the time value $t = 24$, July 2012 is $t = 30$, and January 2013 is $t = 36$. Suppose we also know the following information about the value of the mutual fund:

$$V(24) = 8500 \qquad V(30) = 8700 \qquad V(36) = 10300 \qquad V'(36) = 200 \qquad V''(36) = -30$$

   (a) Find the average rate of change in the value of the mutual fund from January 2012 to July 2012. Show your work and put correct units on your answer.

(b) Use a central difference to approximate the value of the instantaneous rate of change in the value of the mutual fund in July 2012. Show your work and put correct units on your answer.

(c) Find the local linearization of V when $t = 36$, and then use the local linearization to predict the value of the mutual fund in July 2013.

(d) Which is more likely to be greater: The actual value of the mutual fund in July 2013, or the estimated value you calculated in part (c)? Explain your reasoning, and base your reasoning only on the data presented in this problem.