| Task: Franchise Opportunity | Algebra 2/Core Math I |

You are interested in opening a frozen yogurt franchise in your town. Based on the rules of the company, the population of your town must reach 80,000 people before you can officially file to open the franchise. The population of your town at the beginning of 2013 is 78,500.

a) The function P(t) = 78,500(1.0247)^t can be used to model the population of your town where t is measured in years and t = 0 represents January 1, 2013. What would you predict the population to be on April 1, 2013? Show how you decided.

b) You need to know exactly when the population will reach the needed value to ensure you are the first to file to open the franchise. Use the function to predict the exact day that the population of your town will reach 80,000. Show your reasoning.

Teacher Notes:

This task is trying to get students to think of how to transform exponential expressions to better suit what is needed in the problem.
This task could also use the aid of the graphing calculator.

Common Core State Standards for Mathematical Content	Common Core State Standards for Mathematical Practice
A-SSE.B.3c Use the properties of exponents to transform expressions for exponential functions.	1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.

Essential Understandings

- Some representations of a function may be more useful than others, depending on the context.

Explore Phase	
Possible Solution Paths	**Assessing and Advancing Questions**
a) Rewrite the function as $78{,}500(1.0247)^{t/12}$ $78{,}500(1.0247)^{3/12} \approx 78980$	**Assessing** – What does t represent in the function? What would $t = 1$ represent? **Advancing**- How can we use this function to determine the population after 1 month, 2 months?
b) $80{,}000 = 78{,}5000(1.0247)^{t/365}$ Solve by dividing by 78,500 $1.01910828 = 1.0247^{t/365}$ $\log(1.01910828) / \log(1.0247) = t/365$ $t \approx 283$ Approximately day 283 of 2013 (Remember $t = 1 \rightarrow$ Jan 2) Approx. October 11th/12th Depending when the task is used, students may use natural log instead of log base 10 to solve the equation. Since students will use their calculator, students may graph the function the line y=80,000 and find the intersection point.	**Assessing** – How did you know to set the function equal to 80,000? **Advancing**- Is this the only approach to solving this problem?
Possible Student Misconceptions	**Assessing and Advancing Questions**
a) Students may struggle with the concept that t =1/12 -> Feb. 1 and t=2/12 -> Mar. 1, so t = 3/12 -> April 1	**Assessing** – What does t represent in the function? What would t = 1 represent? **Advancing** – How can we change the function to work for months instead of years?
b) Students may not know how to come up with an exact day of when the population would reach 80,000.	**Assessing** – What did we say the population was on April 1, 2013. What had happened since Jan.1? Will this continue? **Advancing** – How can we come up with an exact day, or very close to it?
Entry/Extensions	**Assessing and Advancing Questions**
If students can't get started….	**Assessing**- What does the 78,500 represent in this problem? What does t represent in the function?

	Advancing- What is happening in this function? Could we use the calculator to help us visualize what is going on with this function?
If students finish early….	**Assessing**- What does the 1.0247 represent in the function? **Advancing**- What if after 6 months the growth rate became 1.5%? How would your answer change to part b?

Whole Group Questions

- How can a graphing calculator help us with this problem?
- What if the function had started out with t measured in months, but the questions were asking about years?
- What if the number in parentheses in the function was smaller than 1 ? What would this represent?
- Do you think this is a plausible scenario? In other words, is the function reasonable for this situation?

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B)   You need to know exactly when the population will reach the needed value to ensure you are the first to file to open the franchise. Use the function to predict the exact day that the population of your town will reach 80,000. Show your reasoning.