Name: ____________________________________ Date: __________________

MORE LINEAR MODELING
COMMON CORE ALGEBRA I

Although it can be challenging, it is critically important that students who exit Algebra I have a good ability to deal with **linear relationships**. In this lesson we get more practice modeling linear phenomena.

***Exercise* #1:** A warehouse is keeping track of its inventory of cardboard boxes. At the beginning of the month, they had a supply of 1,275 boxes left. They use boxes at a rate of 75 per day.

(a) How many boxes are left after 10 days? Show the calculation that leads to your answer.

(b) Which of the following linear equations correctly models the number of boxes left, *n*, after *d*-days?

(1) $n = 75d + 1275$ (3) $n = 1275 - 75d$

(2) $n = 1275d + 75$ (4) $n = 75d - 1275$

(c) If the warehouse needs to order more boxes when their supply reaches 150, how many days can they wait?

(d) If after 5 days, they start using boxes at a rate of 90 per day, how many days will it be before they run out of boxes? Show the work that leads to your answer.

We want to feel very comfortable with quickly and accurately determining linear models. Keep in mind that the two most important aspects of any linear model are its rate of change (slope) and its starting value (*y*-intercept).

***Exercise* #2:** The cost, *c*, in dollars of running a particular factory that produces *w*-widgets can be modeled using the linear function.

$$c(w) = 1.25w + 2175$$

(a) How do you interpret the fact that $c(100) = 2300$?

(b) Give a physical interpretation for the two parameters in this equation, 1.25 and 2175.

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***Exercise* #3:** Biologists estimate that the number of deer in Rhode Island in 2003 was 1,028, and in 2008 it had grown to 1,488. Biologists would like to model the deer population, p, as a function of the years, t, *since* 2000.

(a) Represent the information we have been told as two coordinate points. Be careful to know what your values of *time* are for each year.

(b) Calculate $\frac{\Delta p}{\Delta t}$ from 2003 to 2008. Include proper units in your answer.

(c) Give a physical interpretation of the value you found in part (b).

(d) Determine a linear relationship between the deer population, p, and the years since 2000, t.

(e) How many deer does this model predict were in Rhode Island in the year 2000? What does this represent about the linear function?

(f) How many deer does the model predict for Rhode Island now?

***Exercise* #4:** Water is draining out of a bathtub such that the volume still left, g-gallons, is shown as a function of the number of minutes, m, it has been draining.

m, minutes	0	2	4	6
$g(m)$, gallons	62	28	12	5

(a) Calculate the average rate of change of g over the interval $0 \le t \le 2$. Include proper units.

(b) Calculate the average rate of change of g over the interval $2 \le t \le 4$. Include proper units.

(c) Why can we say that the relationship between m and g is **not** linear?

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MORE LINEAR MODELING
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APPLICATIONS

1. A water tank is being filled by pumps at a constant rate. The volume of water in the tank V, in gallons, is given by the equation:

$$V(t)=65t+280\text{, where } t \text{ is the time, in minutes, the pump has been on}$$

(a) At what rate, in gallons per minute, is the water being pumped into the tank?

(b) How many gallons of water were in the tank when the pumps were turned on?

(c) What is the volume in the tank after two hours of the pumps running?

(d) The pumps will turn off when the volume in the tank hits 10,000 gallons. To the nearest minute, after how long does this happen?

2. A solar lease customer built up an excess of 6,500 kilowatt hours (kwh) during the summer using his solar panels. When he turned his electric heat on, the excess began to be used up at a rate of 50 kilowatt hours per day.

(a) If E represents the excess left and d represents the number of days since the heat has been turned on, write an equation for E in terms of d.

(b) How much of the excess will be left after one month (use a month length of 30 days)?

(c) If the heat will need to be turned on for 5 months, will the excess be enough to last through this time period? Justify your answer.

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3. As Evin is driving her car, she notices that after 1 hour her gas tank has 7.25 gallons left and after 4 hours of driving, it has 3.5 gallons of gas left in it.

(a) Represent this information as two coordinate pairs in the form (h, g), where h is the number of hours driven and g is the gallons of gas left.

(b) Find the slope between these two points. Using proper units, interpret this slope.

(c) Assuming the relationship between h and g is linear, find an equation for g in terms of h.

(d) According to this equation, after how many hours of driving would Evin run out of gas?

4. The population of Champaign, Illinois is given for three years in the table below:

Year	Population
1970	163,488
1980	168,392
2012	203,276

(a) Using 1970 as $t = 0$, create a linear model from the first two data points in this table to predict the population, p, as a function of the number of years since 1970, t.

(b) If this model is used to predict the population of Champaign in the year 2012, will the model overestimate or underestimate the actual population? Explain.

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