

Handout A

This handout covers linear modeling (sections 1.3 and 1.4).

1. The percent of homes with digital TV service stood at 5% at the beginning of 1999 and is projected to grow linearly so that at the beginning of 2003 the percent of such homes is projected to be 25%.

- (a) Derive an equation of the line that represents this information.

I'll let time start in 1999. this will give me the points (0, 5) and (4, 25). You could use other point for this problem: i.e. (1999, 5) and (2003, 25); (1999, .05) and (2003, .25). Whatever set of points you use will affect the formula and how you do your predictions. Just be consistent.

$$m = \frac{25 - 5}{4 - 0} = 5$$

Answer: $y - 25 = 5(x - 4)$

- (b) Using this equation, find the percent of homes with digital TV service at the beginning of 2001.

If time starts in 1999, then in the year 2001 the value of x is 2. Plug in a 2 into the formula and solve for y.

Answer: 15%

- (c) In what year will the percentage of homes with digital TV service be 48%?

Plug in a 48 for y and solve for x. This gives that $x = 8.6$ Since time starts with zero in 1999, i.e. $x=0$, then adding 1999 to 8.6 gives 2007.6. **THIS IS NOT THE ANSWER.** The problem ask for the year and we don't measure the years in decimals (yet). So the question is should we round? The answer to that is no. The .6 just tells us that it is happening sometime around July. What we do with years is to use only the integer part of the answer.

Answer: 2007

2. A minicomputer purchased at a cost of \$60,000 in 1988 has a scrap value of \$12,000 at the end of four years. If the value of the computer depreciates linearly,

- (a) Find a linear equation that represents the minicomputer's value at the end of t years.

I'll use the points (0, 60000) and (4, 12000) to get the slope of $m = -12,000$

Answer: $y - 60000 = -12000(x - 0)$

- (b) Find the minicomputer's value at the end of the third year.

Answer: \$24,000

3. The Monde Company makes a wine cooler with a capacity of 24 bottles. Each wine cooler sells for \$245. The monthly fixed cost incurred by the company are \$381,300, and the variable cost of producing each wine cooler is \$90.

- (a) Find the Cost, Revenue, and Profit functions.

For our formulas, the variable x is the number of items made and sold.

The revenue function is the number of items sold times the price per item.

$$R = 245x$$

The cost function is the number of items made times the cost per item plus the fixed cost of operating the business.

$$C = 90x + 381300$$

The profit function is the revenue minus the cost.

$$P = 245x - (90x + 381300) = 155x - 381300$$

- (b) How many coolers should be made and sold when the company breaks even?

We break even when cost is equal to the revenue. Set the cost equal to the revenue and solve for x .

Answer: 2460 coolers

- (c) What is the break even point?

Since we are looking for a point we need both the number of items, x , and the revenue or cost at that level of production.

Answer: (2460, 602700)

4. Advertising revenue for a local newspaper was \$500,000 in 1990 when the population of the city was 60,000. The paper estimates that advertising revenue rises \$2500 for each population increase of 1000 in their city.

- (a) Find a linear function that will give advertising revenue as a function of the population of the city.

I'll use the points (60000, 500000) and (61000, 502500)

$$\text{Answer: } y - 500000 = 2.5(x - 60000)$$

- (b) If the population increases by 3500 from its 1990 figure, what will be the expected advertising revenue?

Answer: \$508,750

5. Paul manages a t-shirt store which has a monthly rent of \$805. If Paul needs to sell 46 shirts each month to break even and he sells the shirts for \$28.50, what does Paul pay for each shirt?

Let x be the number of shirts sold each month. Let A be the price per shirt that Paul pays.

$$R(x) = 28.5x$$

$$C(x) = Ax + 805$$

Since Paul breaks even at 46 shirts, plug in a 46 for x and solve for A .

$$28.5 * 46 = 46A + 805$$

$$46A = 506$$

$$A = 11$$