Functions and Models (Sec 1.2)

13. ***Cost*** A piano manufacturer has a daily fixed cost of \$1,000 and a marginal cost of \$1,500 per piano. Find the cost $C(x)$ of manufacturing x pianos in one day. Use your function to answer the following questions:

a. On a given day, what is the cost of manufacturing three pianos?

b. What is the cost of manufacturing the third piano that day?

c. What is the cost of manufacturing the 11th piano that day?

d. What is the variable cost? What is the fixed cost? What is the marginal cost?

e. Graph C as a function of x. [**Hint:** See Example 1.]

15. ***Break-Even Analysis*** Your college newspaper, *The Collegiate Investigator*, has fixed production costs of $70 per edition and marginal printing and distribution costs of 40¢ per copy. *The Collegiate Investigator* sells for 50¢ per copy.

a. Write down the associated cost, revenue, and profit functions. [**Hint:** See Examples 1 and 2.]

b. What profit (or loss) results from the sale of 500 copies of *The Collegiate Investigator*?

c. How many copies should be sold to break even?

19. ***Break-Even Analysis: School Construction Costs*** The cost, in millions of dollars, of building a two-story high school in New York State was estimated to be

$$C(x) = 1.7 + 0.12x - 0.0001x^2 \quad (20 \leq x \leq 400)$$

where x is the number of thousands of square feet.[†] Suppose that you are contemplating building a for-profit two-story high school and estimate that your total revenue will be \$0.1 million dollars per thousand square ft. What is the profit function? What size school should you build to break even?

33. ***Equilibrium Price: Cars and Light Trucks*** Annual sales of new cars and light trucks in the U.S. from 2016–2021 can be approximated by

$$q = -p + 57$$

million vehicles sold when the price (in constant 2021 dollars) was $\$p$ thousand.*

a. If car dealers were prepared to supply $q = 4p - 136$ million vehicles at a sale price of $\$p$, what would have been the equilibrium price?

b. The actual average sale price in constant 2021 dollars was \$38,400 in 2018. Estimate the projected shortage or surplus at that price. [**Hint:** See Quick Example 7 and also Example 4.]

39. Spending on Corrections in the 1990s Incarceration in the U.S. underwent a massive surge that began around 1990. The following table shows the annual spending by all states in the United States on corrections:

Year t (year since 1990)	0	2	4	6	7
Spending ($ billion)	16	18	22	28	30

a. Which of the following functions best fits the given data? (Warning: None of them fits exactly, but one fits more closely than the others.) [**Hint:** See Example 5.]

A. $S(t) = -0.2t^2 + t + 16$

B. $S(t) = 0.2t^2 + t + 16$

C. $S(t) = t + 16$

b. Use your answer to part (a) to "predict" spending on corrections in 1998, assuming that the trend continued.