

Exercises and Problems for Section 1.3

Skill Refresher

In Exercises S1–S2, find $f(0)$ and $f(3)$.

S1. $f(x) = \frac{2}{3}x + 5$

S2. $f(t) = 17 - 4t$

In Exercises S3–S4, find $f(2) - f(0)$.

S3.

| | | | | |
|--------|----|---|---|---|
| x | 0 | 1 | 2 | 3 |
| $f(x)$ | -2 | 0 | 3 | 4 |

S4.

| | | | | |
|--------|----|---|---|----|
| t | -1 | 0 | 1 | 2 |
| $f(t)$ | 0 | 2 | 7 | -1 |

Exercises

Which of the tables in Exercises 1–6 could represent a linear function?

1.

| | | | | |
|--------|----|-----|-----|-----|
| x | 0 | 100 | 300 | 600 |
| $g(x)$ | 50 | 100 | 150 | 200 |

2.

| | | | | |
|--------|----|----|----|----|
| x | 0 | 10 | 20 | 30 |
| $h(x)$ | 20 | 40 | 50 | 55 |

3.

| | | | | | |
|--------|---|---|---|---|---|
| t | 1 | 2 | 3 | 4 | 5 |
| $g(t)$ | 5 | 4 | 5 | 4 | 5 |

4.

| | | | | |
|--------|----|----|----|----|
| x | 0 | 5 | 10 | 15 |
| $f(x)$ | 10 | 20 | 30 | 40 |

5.

| | | | | | |
|-------------|----|----|----|----|----|
| γ | 9 | 8 | 7 | 6 | 5 |
| $p(\gamma)$ | 42 | 52 | 62 | 72 | 82 |

6.

| | | | | |
|--------|----|----|----|----|
| x | -3 | -1 | 0 | 3 |
| $j(x)$ | 5 | 1 | -1 | -7 |

Problems

13. Table 1.24 gives the proposed fine $r = f(v)$ to be imposed on a motorist for speeding, where v is the motorist's speed and 55 mph is the speed limit.

- (a) Decide whether f appears to be linear.
 (b) What would the rate of change represent in practical

terms for the motorist?

(c) Plot the data points.

Table 1.24

| | | | | | | |
|---------------|----|-----|-----|-----|-----|-----|
| v (mph) | 60 | 65 | 70 | 75 | 80 | 85 |
| r (dollars) | 75 | 100 | 125 | 150 | 175 | 200 |

1.3 Exercises

DO: S1-S4

1-4

13-17

21 & 24

14. In 2006, the population of a town was 18,310 and growing by 58 people per year. Find a formula for P , the town's population, in terms of t , the number of years since 2006.
15. A new Toyota RAV4 costs \$21,500. The car's value depreciates linearly to \$11,900 in three years time. Write a formula which expresses its value, V , in terms of its age, t , in years.
16. In 2003, the number, N , of cases of SARS (Severe Acute Respiratory Syndrome) reported in Hong Kong¹⁴ was initially approximated by $N = 78.9 + 30.1t$, where t is the number of days since March 17. Interpret the constants 78.9 and 30.1.
17. Table 1.25 shows the cost C , in dollars, of selling x cups of coffee per day from a cart.
- Using the table, show that the relationship appears to be linear.
 - ~~Plot the data in the table.~~
 - Find the slope of the line. Explain what this means in the context of the given situation.
 - Why should it cost \$50 to serve zero cups of coffee?

Table 1.25

| | | | | | | |
|-----|-------|-------|-------|-------|-------|--------|
| x | 0 | 5 | 10 | 50 | 100 | 200 |
| C | 50.00 | 51.25 | 52.50 | 62.50 | 75.00 | 100.00 |

18. In each case, graph a linear function with the given rate of change. Label and put scales on the axes.
- Increasing at 2.1 inches/day
 - Decreasing at 1.3 gallons/mile
19. A flight costs \$10,000 to operate, regardless of the number of passengers. Each ticket costs \$127. Express profit, π , as a linear function of the number of passengers, n , on the flight.
20. A small café sells drip coffee for \$0.95 per cup. On average, it costs the café \$0.25 to make a cup of coffee (for grounds, hot water, filters). The café also has a fixed daily cost of \$200 (for rent, wages, utilities).
- Let R , C , and P be the café's daily revenue, costs, and profit, respectively, for selling x cups of coffee in a day. Find formulas for R , C , and P as functions of x . [Hint: The revenue, R , is the total amount of money that the café brings in. The cost, C , includes the fixed daily cost as well as the cost for all x cups of coffee sold. P is the café's profit after costs have been accounted for.]

¹⁴World Health Organization, www.who.int/csr/sars/country/en.¹⁵www.census.gov/ipc/www/idbusum.html, accessed January 12, 2006.

- ~~Plot P against x . For what x -values is the graph of P below the x -axis? Above the x -axis? Interpret your results.~~
- ~~Interpret the slope and both intercepts of your graph in practical terms.~~

21. Owners of an inactive quarry in Australia have decided to resume production. They estimate that it will cost them \$1000 per month to maintain and insure their equipment and that monthly salaries will be \$3000. It costs \$80 to mine a ton of rocks. Write a formula that expresses the total cost each month, c , as a function of r , the number of tons of rock mined per month.

22. Table 1.26 gives the area and perimeter of a square as a function of the length of its side.

- ~~From the table, decide if either area or perimeter could be a linear function of side length.~~
- ~~From the data make two graphs, one showing area as a function of side length, the other showing perimeter as a function of side length. Connect the points.~~
- ~~If you find a linear relationship, give its corresponding rate of change and interpret its significance.~~

Table 1.26

| | | | | | | | |
|---------------------|---|---|---|----|----|----|----|
| Length of side | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Area of square | 0 | 1 | 4 | 9 | 16 | 25 | 36 |
| Perimeter of square | 0 | 4 | 8 | 12 | 16 | 20 | 24 |

23. Make two tables, one comparing the radius of a circle to its area, the other comparing the radius of a circle to its circumference. Repeat parts (a), (b), and (c) from Problem 22, this time comparing radius with circumference, and radius with area.

24. Sri Lanka is an island that experienced approximately linear population growth from 1950 to 2000. On the other hand, Afghanistan was torn by warfare in the 1980s and did not experience linear nor near-linear growth.¹⁵

- Table 1.27 gives the population of these two countries, in millions. Which of these two countries is A and which is B? Explain.
- What is the approximate rate of change of the linear function? What does the rate of change represent in practical terms?
- Estimate the population of Sri Lanka in 1988.

Table 1.27

| | | | | | | |
|-------------------------|------|------|------|------|------|------|
| Year | 1950 | 1960 | 1970 | 1980 | 1990 | 2000 |
| Population of country A | 8.2 | 9.8 | 12.4 | 15.1 | 14.7 | 23.9 |
| Population of country B | 7.5 | 9.9 | 12.5 | 14.9 | 17.2 | 19.2 |