4.3 Tables of Linear Functions

The final concept we'll cover this unit is the table form of linear functions. Just like in the previous sections, some of these linear functions may also be proportional which means there will be no initial value. We'll start by assuming there is an initial value..

Filling Out a Table from Equations and Graphs

Perhaps the simplest thing that we can do is fill out a table based on an equation or a graph. Since the table is designed to look at specific input/output pairings, we may need to pick appropriate inputs just like we did when graphing functions. Let's fill out the tables for the following examples.

Example 1: $d = 5t - 3$

t	0		2		4
d		2		12	

For this table, note that some of the values have been given for us. If we are given an input (t in this case), then simply input that into the equation to find the output. For example, we have $t = 0$ as an input, so substitute in as follows: $d = 5(0) - 3$. Multiplying five by zero and then subtracting three gives us $d = -3$.

t	0		2		4
d	-3	2		12	

If we are given an output (d in this case), substitute that into the equation and solve for the input. For example, note that we are given $d = 2$ as an output. Substitute into the equation and solve as follows:

$$d = 5t - 3$$

$$2 = 5t - 3$$

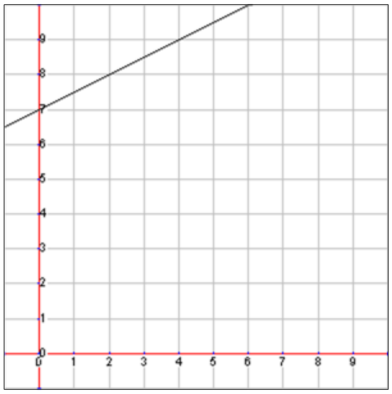
Adding three to both sides and then dividing by five gives us that $t = 1$.

t	0	1	2		4
d	-3	2		12	

It also works to look for patterns. For example, we see that the d values are going up by fives, so the next gap for d should be 7, then the 12 is given to us, and the last should be 17. We similarly know that the missing t value is 3. So our final table filled out (with our solutions in red) should look like this:

t	0	1	2	3	4
d	-3	2	7	12	17

Example 2:



In this example, we aren't given axis labels, so we'll use the standard x and y variables. Here's the table we want to fill out:

x	2		6		10
y		9		11	

For the x values (the input), we can guess from the pattern that we're counting by twos. Can you think of a reason for this based on the graph?

x	2	4	6	8	10
y		9		11	

Now that we have all the inputs, let's get the outputs (y values). At an input of 2, the output on the graph is 8. At an input of 6, follow the graph up to see that the output is 10. However, the input of 10 is off the graph. What will we do? Look for a pattern! Notice that the y values are going up by 1 for every 2 in the x direction. Following this pattern, we know that the last output should be 12.

x	2	4	6	8	10
y	8	9	10	11	12

Writing the Equation of a Table

To get a fuller picture of a function, we may want to look at the equation of the function. Since we are currently talking about linear functions with an initial value, we are dealing with equations that will be in the form $y = mx + b$ where m is the slope, rate of change, or lowest terms proportion ratio and b is the initial value or y-intercept. To get the slope, we need the rise (the change in the output) and the run (the change in the input). Examine the following table to see if you can identify the slope.

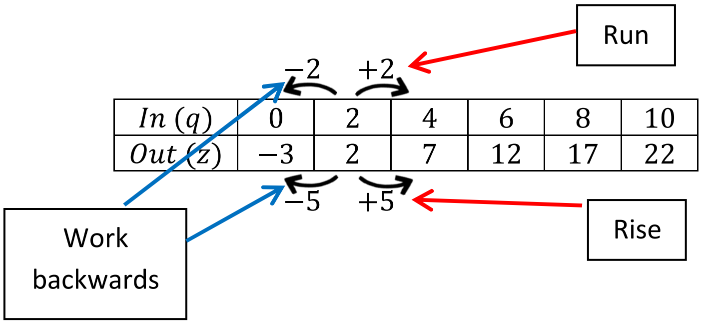
$In\ (q)$	2	4	6	8	10
$Out\ (z)$	2	7	12	17	22

Check the difference between each of the adjacent outputs (outputs that are next to each other) for the rise. Check the difference between each of the adjacent inputs for the run.

	$+2$	$+2$	$+2$	$+2$	Run
$In\ (q)$	2	4	6	8	10
$Out\ (z)$	2	7	12	17	22
	$+5$	$+5$	$+5$	$+5$	Rise

Now we see that the rise is five and the run is two. That means that our slope is $\frac{5}{2}$ and our equation is $z = \frac{5}{2}q + b$ so far, but we still need the initial value.

To find the initial value in this table, we need to find what the output is when the input is zero. We can either extend the table backwards following the pattern or solve the equation. Let's first extend the table backwards. Since the run is $+2$, to move backwards we'll go -2 for the input. Since the rise is $+5$, to move backwards on the table, we'll go -5 for the output. That will look like this:



$In\ (q)$	0	2	4	6	8	10
$Out\ (z)$	-3	2	7	12	17	22

This shows us that the output at input zero (or initial value) is -3. Now we can finish our equation meaning that $z = 5q - 3$.

There may be times when it would take too long to count backwards on the table. For those times, just use the slope and a single input/output pair. Substitute all those values into the generic linear form $y = mx + b$ and solve for b. For example, we know the slope is $\frac{5}{2}$ and the output is $z = 2$ for an input of $q = 2$. Plug all those values (using the proper variables as input and output) in as follows:

$$z = mq + b$$

$$2 = \frac{5}{2}(2) + b$$

$$2 = 5 + b$$

Subtracting five from both sides of the equation shows us that $b = -3$ just like we found earlier.

Remember that in some cases the initial value will be zero making it a proportion. If you work backwards in a table and find an initial value of zero, then you'll know it is a proportion.

Solving Table Problems

Sometimes the answer is right there in the table, and other times we'll have to do some digging to find the answer. Consider the following table that shows the total cost (c) when buying hairless wildebeests (w) after paying the registration fee with the federal government to own exotic pets. How much was the registration fee? To answer this question we'll want to first figure out how much each hairless wildebeest costs by finding the rate of change (or slope). Find the rise and run like normal.

w	12	14	16	18	20
c	\$1900	\$2200	\$2500	\$2800	\$3100

Did you find that the rise was \$300 for a run of 2 wildebeests? This reduces to \$150 per wildebeest. Now we could extend the table all the way back to zero wildebeests to find the registration fee (which is the initial value), but it's probably easier to plug everything we know into an equation as follows:

$$c = mw + b$$

We know it's \$150 per wildebeest, that that is our m value. We also have an input of $w = 12$ giving us an output of $c = \$1900$. Now we'll substitute and solve:

$$1900 = 150(12) + b$$

$$1900 = 1800 + b$$

From here we can see that $b = \$100$ by subtracting 1800 from both sides of the equation. That means that the initial value, or registration fee in this case, was \$100.

Comparing Tables with Initial Values

To compare linear functions in table form, we need their slope and initial values. Consider the following three tables each representing stores that sell fire-breathing beetle wings and decide which store sells beetle wings (w) for the cheapest price (p). Other store charges an entry fee as well.

Hogwarts

w	2	4	6	8	10
p	\$18	\$21	\$24	\$27	\$30

Diagon Ally

w	1	2	3	4	5
p	\$7	\$9	\$11	\$13	\$15

Your Mom's Shop

w	3	6	9	12	15
p	\$13	\$16	\$19	\$22	\$25

Finding the rise and run for each store gives us that Hogwarts charges \$1.50 per beetle wing, Diagon Ally charges \$2 per beetle wing, and Your Mom's Shop charges \$1 per beetle wing.

By either extending the table backward or using the equation method you should find that Hogwarts charges an entry fee of \$15, Diagon Ally charges \$5, and Your Mom's Shop charges \$10 for entry.

If you had to buy 20 beetle wings, which store would be cheapest? Find the equations or extend the tables to see that the Hogwarts total price would be \$45, it would be \$45 at Diagon Ally, and would only be \$30 at Your Mom's Shop.

Lesson 4.3

Create a table for each of the following linear situations, equations or graphs.

1. Game Start charges \$45 (c) for 2 video games (g) purchased.

g	4		12		20
c		\$180		\$360	

2. Susie's hair is 16 inches long and it grows 2 inches in length (l) every 3 months (m)

m					
l					

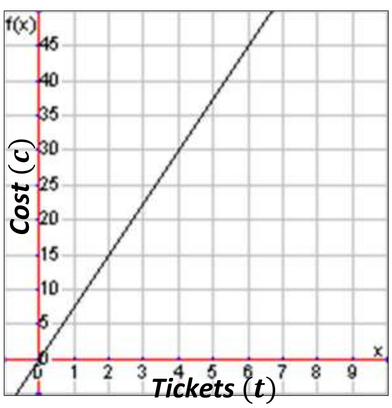
3. The height (h) of a tree in feet after a number of years (y) is determined by the following equation: $h = \frac{1}{3}y + 7$.

y	3		9		15
h		9		11	

4. At Peter's Pizza Palace the total cost (c) for pizzas (p) can be determined by using the following equation: $c = \frac{9}{2}p$.

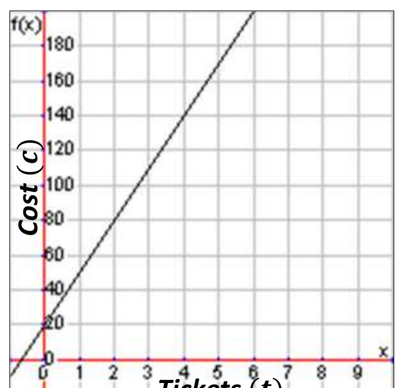
p					
c					

5. The graph shows the total cost (c) per ticket (t) for a student to go to the movies.



t	2		6		10
c		\$30		\$60	

6. The graph shows the cost (c) for tickets (t) to see Taylor Swift in concert if you order tickets online.



t					
c					

Create an equation for the following linear tables.

7. The total cost (c) for miles (m) traveled in a taxi.

m	2	4	6	8	10
c	\$4.50	\$6	\$7.50	\$9	\$10.50

8. The total cost (c) per tournament (t)

t	2	4	6	8	10
c	\$225	\$400	\$575	\$750	\$925

9. The total cost (c) to buy guitar picks (p).

p	5	10	15	20	25
c	\$2	\$4	\$6	\$8	\$10

10. The money earned (m) in a number of weeks (w).

w	2	4	6	8	10
m	\$10	\$20	\$30	\$40	\$50

11. The number of frogs (f) ordered for students (s) in science class.

s	9	15	21	27	33
f	7	9	11	13	15

12. The total cost (c) per hole of golf (g).

g	9	18	27	36	45
c	\$15	\$30	\$45	\$60	\$75

13. The distance traveled (d) in time in hours (h).

h	2	3	4	5	6
d	14	21	28	35	42

14. The amount of profit (p) of a stand selling lemon shake-ups (l).

l	250	300	350	400	450
p	\$50	\$200	\$350	\$500	\$650

15. The total weight of an aquarium (a) holding gallons (g) of water.

g	100	110	120	130	140
a	930	1015	1100	1185	1270

16. The length (l) of a bungee cord that is stretched depending on the weight (w) of the jumper.

w	100	110	120	130	140
l	80	83	86	89	92

17. Which of problems 8 to 16 represent proportions and how do you know?

Use the given tables to solve the linear questions.

18. How many calories (c) would you burn in a day if you walked 2 miles (m)?

m	4	5	6	7	8
c	1800	1900	2000	2100	2200

19. How many minutes (m) would it take for a pot of water to reach a temperature (t) of $210°F$?

m	1	2	3	4	5
t	85	110	135	160	185

20. How many cups of cheese (c) would you need for an 18-inch pizza (p)?

p	8	12	16	20	24
c	2	3	4	5	6

21. How many months (m) could you afford the cost (c) of your own cell phone if you have $190?

m	2	4	6	8	10
c	$34	$58	$82	$106	$130

22. How much would it cost (c) to buy 13 shirts (s) at Kohl's?

s	2	4	6	8	10
c	$10	$30	$50	$70	$90

23. How many songs (s) could your purchase for $45 ($c$)?

s	4	6	8	10	12
c	$6	$9	$12	$15	$18

24. How many CDs (c) would an artist need to sell in order to make a profit (p) of $3,000?

c	50	60	70	80	90
p	$2250	$2300	$2350	$2400	$2450

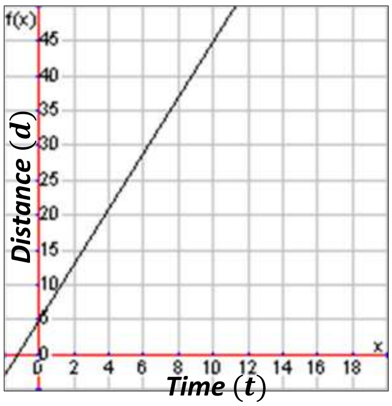
25. How much profit (p) would Harry's Hot Dogs make if they sold 400 hot dogs (h) in a month?

h	200	225	250	275	300
p	100	150	200	250	300

26. Which of problems 18 to 25 are proportional and how do you know?

Answer the following questions comparing linear function equations, graphs, tables and descriptions.

Your neighborhood friends have decided to have a running race down the street. Here is the information about the distance (d) (including a head start in some cases) in terms of time (t) in seconds.

<table>
<tr>
<td>Mitchell
Runs 5 meters in 2 seconds and has a 10 meter head start</td>
<td>Kyra
Distance is modeled by the equation $d = \frac{9}{2}t + 3$</td>
</tr>
<tr>
<td>Gloria

</td>
<td>Hashim
<table>
<tr><td>t</td><td>20</td><td>22</td><td>24</td><td>26</td><td>28</td></tr>
<tr><td>d</td><td>77</td><td>84</td><td>91</td><td>98</td><td>105</td></tr>
</table>
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27. Which runner has the fastest pace, and how do you know?

28. Which runner has the biggest head start, and how do you know?

29. How far could each runner go in 10 seconds? Who would go the farthest?

30. Who would win the race if the race was 15 meters long?

Answer the following questions comparing proportional function equations, graphs, tables and descriptions.

Your family is deciding which activity to participate in while on your vacation in San Diego. Here is the information about the cost (c) for admission for all of your family members (f).

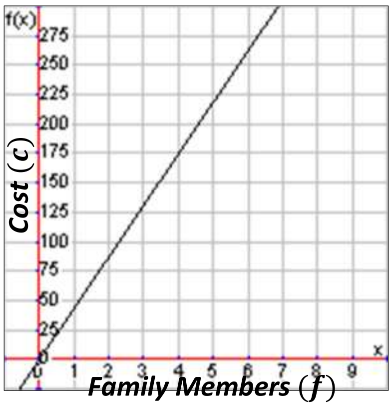
City Tour

Charges $\$30$ per family member

San Diego Zoo

Cost is modeled by the equation $c = \frac{75}{2}f$

SeaWorld



Kayaking

f	2	4	6	8	10
c	65	130	195	260	325

31. Which activity is the cheapest per family member, and how do you know?

32. Which activity is the most expensive per family member, and how do you know?

33. How many people could you bring to each activity if you budgeted $\$400$? Which activity allows you to bring the most people for that amount of money?

34. How much would it cost at each activity to bring a family of 4? Which activity is the cheapest for that many people?