3.1 Exercises

1. Jodiah is saving his money to buy a Playstation 3 gaming system. He estimates that he will need $950 to buy the unit itself, accessories, and a few games. He has $600 saved right now, and he can reasonably put $60 into his savings at the end of each month.

Since the amount of money saved depends on how many months have passed, choose time, in months, as your independent variable and place it on the horizontal axis. Let $t$ represent the number of months passed, and make a mark for every month.

Choose money saved, in dollars, as your dependent variable and place it on the vertical axis. Let $A$ represent the amount saved in dollars. Since Jodiah saves $60 each month, it will be convenient to let each box represent $60.

Copy the following coordinate system onto a sheet of graph paper.

\begin{align*}
\text{Amount saved } A \text{ (dollars)} & \\
\text{Time } t \text{ (months)} & \\
0 & 2 4 6 8 10 12 14 16 18 20 \\
60 & 120 180 240 300 360 420 480 540 600 660 720 780 840 900 960 1020
\end{align*}

\begin{enumerate}
\item[a)] At month 0, Jodiah has $600 saved. This corresponds to the point $(0, 600)$. Plot this point on your coordinate system.
\item[b)] For the next month, he saved $60 more. Beginning at point $(0, 600)$, move 1 month to the right and $60$ up and plot a new data point. What are the coordinates of this point?
\item[c)] Each time you go right 1 month, you must go up by $60$ and plot a new data point. Repeat this process until you reach the edge of the coordinate system.
\item[d)] Keeping in mind that we are modeling this discrete situation continuously, draw a line through your data points.
\item[e)] Use your graph to estimate how much money Jodiah will have saved after 7 months.
\item[f)] Using your graph, estimate how many months it will take him to have saved ...
\end{enumerate}

\footnote{Copyrighted material. See: http://msenux.redwoods.edu/IntAlgText/}
up enough money to buy his gaming system, accessories, and games.

2. The sign above shows the prices for a taxi ride from Liberty Cab Company. Since the cost depends on the distance traveled, make the distance be the independent variable and place it on the horizontal axis. Let $d$ represent the distance traveled, in miles. Because the cab company charges per 1/6 mile, it is convenient to mark every 1/6 mile.

Make price, in $, your dependent variable and place it on the vertical axis. Let $C$ represent the cost, in $. Because the cost occurs in increments of 40¢, mark every 40¢ along the vertical axis.

Copy the following coordinate system onto a sheet of graph paper.

<table>
<thead>
<tr>
<th>Cost $C$ ($)</th>
<th>6.20</th>
<th>6.00</th>
<th>5.80</th>
<th>5.60</th>
<th>5.40</th>
<th>5.20</th>
<th>5.00</th>
<th>4.80</th>
<th>4.60</th>
<th>4.40</th>
</tr>
</thead>
<tbody>
<tr>
<td>distance $d$ (miles)</td>
<td>3.00</td>
<td>2.80</td>
<td>2.60</td>
<td>2.40</td>
<td>2.20</td>
<td>2.00</td>
<td>1.80</td>
<td>1.50</td>
<td>1.20</td>
<td>0.80</td>
</tr>
</tbody>
</table>

a) For the first 1/6 mile of travel, the cost is $2.30. This corresponds to the point $(1/6, 2.30)$. Plot this point on your coordinate system.

b) For the next 1/6 of a mile, the cost goes up by 40¢. Beginning at point $(1/6, 2.30)$, move 1/6 of a mile to the right and 40¢ up and plot a new data point. What are the coordinates of this point?

c) Each time you go right 1/6 of a mile, you must go up by 40¢ and plot a new data point. Repeat this process until you reach the edge of your coordinate system.

d) Keeping in mind that we are modeling this discrete situation continuously, draw a line through your data points.

e) Melissa steps into a cab in the city of Niagara Falls, about 2 miles from Niagara Falls State Park. Use your graph to estimate the fare to the park.

f) Elsewhere in the area, Georgina takes a cab. She has only $5 for the fare. Use the graph to estimate how far she can travel, in miles, with only $5 for the fare.

3. A boat is 200 ft from a buoy at sea. It approaches the buoy at an average speed of 15 ft/s.

a) Choosing time, in seconds, as your independent variable and distance from the buoy, in feet, as your dependent variable, make a graph of a coordinate system on a sheet of graph paper showing the axes and units. Use tick marks to identify your scales.

b) At time $t=0$, the boat is 200 ft from the buoy. To what point does this
correspond? Plot this point on your coordinate system.

c) After 1 second, the boat has drawn 15 ft closer to the buoy. Beginning at the previous point, move 1 second to the right and 15 ft down (since the distance is decreasing) and plot a new data point. What are the coordinates of this point?

d) Each time you go right 1 second, you must go down by 15 ft and plot a new data point. Repeat this process until you reach 12 seconds.

e) Draw a line through your data points.

f) When the boat is within 50 feet of the buoy, the driver wants to begin to slow down. Use your graph to estimate how soon the boat will be within 50 feet of the buoy.

4. Joe owes $24,000 in student loans. He has finished college and is now working. He can afford to pay $1500 per month toward his loans.

a) Choose time in months as your independent variable and amount owed, in $, as the dependent variable. On a sheet of graph paper, make a sketch of the coordinate system, using tick marks and labeling the axes appropriately.

b) At time $t = 0$, Joe has not yet paid anything toward his loans. To what point does this correspond? Plot this point on your coordinate system.

c) After one month, he pays $1500. Beginning at the previous point, move 1 month to the right and $1500 down (down because the debt is decreasing). Plot this point. What are its coordinates?

d) Each time you go 1 month to the right, you must move $1500 down. Continue doing this until his loans have been paid off.

e) Keeping in mind that we are modeling this discrete situation continuously, draw a line through your data points.

f) Use the graph to determine how many months it will take him to pay off the full amount of his loans.

5. Earl the squirrel has only ten more days until hibernation. He needs to save 50 more acorns. He is tired of collecting acorns and so he is only able to gather 8 acorns every 2 days.

a) Let $t$ represent time in days and make it your independent variable. Let $N$ represent the number of acorns collected and make it your dependent variable. Set up an appropriately scaled coordinate system on a sheet of graph paper.

b) At time $t = 0$, Earl has collected zero of the acorns he needs. To what point does this correspond? Plot this point on your coordinate system.

c) After two days ($t = 2$), Earl has collected 8 acorns. Beginning at the previous point, move 2 days to the right.
and 8 acorns up. Plot this point. What are its coordinates?

d) Each time you go 2 days to the right, you must move 8 acorns up and plot a point. Continue doing this until you reach 14 days.

e) Keeping in mind that we are modeling this discrete situation continuously, draw a line through your data points.

f) Use the graph to determine how many acorns he will have collected after 10 days. Will Earl have collected enough acorns for his winter hibernation?

g) Notice that the number of acorns collected is increasing at a rate of 8 acorns every 2 days. Reduce this to a rate that tells the average number of acorns that is collected each day.

h) The table below lists the number of acorns Earl will have collected at various times. Some of the entries have been completed for you. For example, at \( t = 0 \), Earl has no acorns, so \( N = 0 \). After one day, the amount increases by 4, so \( N = 0 + 4(1) \). After two days, two increases have occurred, so \( N = 0 + 4(2) \). The pattern continues. Fill in the missing entries.

\[
\begin{array}{|c|c|}
\hline
 t & N \\
\hline
 0 & 0 \\
 1 & 0 + 4(1) \\
 2 & 0 + 4(2) \\
 3 & 0 + 4(3) \\
 4 & \\
 6 & \\
 8 & \\
 10 & \\
 12 & \\
 14 & \\
\hline
\end{array}
\]

i) Express the number of acorns collected, \( N \), as a function of the time \( t \), in days.

j) Use your function to predict the number of acorns that Earl will have after 10 days. Does this answer agree with your estimate from part (f)?

6. On network television, a typical hour of programming contains 15 minutes of commercials and advertisements and 45 minutes of the program itself.

a) Choose amount of television watched as your independent variable and place it on the horizontal axis. Let \( T \) represent the amount of television watched, in hours. Choose total amount of commercials/ads watched as your dependent variable and place it on the vertical axis. Let \( C \) represent the total amount of commercials/ads watched, in minutes. Using a sheet of graph paper, make a sketch of a coordinate system and label appropriately.

b) For 0 hours of programming watched, 0 minutes of commercials have been watched. To what point does this correspond? Plot it on your coordinate system.

c) After watching 1 hour of program-
ming, 15 minutes of commercials/ads have been watched. Beginning at the previous point, move 1 hour to the right and 15 minutes up. Plot this point. What are its coordinates?

d) Each time you go 1 hour to the right, you must move 15 minutes up and plot a point. Continue doing this until you reach 5 hours of programming.

e) Draw a line through your data points.

f) Billy watches TV for five hours on Monday. Use the graph to determine how many minutes of commercials he has watched during this time.

g) Suppose a person has watched one hour of commercials/ads. Use the graph to estimate how many hours of television he watched.

h) The following table shows numbers of hours of programming watched as it relates to number of minutes of commercials/ads watched. For 0 hours of TV, 0 minutes of commercials/ads are watched. For each hour of TV watched, we must count 15 minutes of commercials/ads. So, for 1 hour, \(0 + 15(1)\) minutes of commercials are watched. For 2 hours, \(0 + 15(2)\) minutes; and so on. Fill in the missing entries.

<table>
<thead>
<tr>
<th>(T) (hrs)</th>
<th>(C) (mins)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>(0 + 15(1))</td>
</tr>
<tr>
<td>2</td>
<td>(0 + 15(2))</td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

i) Express the amount of commercials/ads watched, \(C\), as a function of the amount of television watched \(T\). Use your equation to predict the amount of commercials/ads watched for 5 hours of television programming. Does this answer agree with your estimate from part (f)?

7. According to NATO (the National Association of Theatre Owners), the average price of a movie ticket was 5.65 dollars in the year 2001. Since then, the average price has been rising each year by about 20¢.

a) Choose year, beginning with 2000, as the independent variable and make marks every year on the axis. Choose average ticket price, in dollars, as your dependent variable and begin at 5.65 dollars, with marks every 10¢ above. Make a sketch of a coordinate system and label appropriately.

b) In 2001, the average ticket price was 5.65 dollars, corresponding to the point \((2001, 5.65)\). Plot it on your coordinate system.

c) In 2002, one year later, the average price rose by about 20¢. Beginning at the previous point, move right by 1 year and up by 20¢ and plot the point. What are its coordinates?

d) Each time you go 1 year to the right, you must move up by 20¢ and plot a point. Continue doing this until the year 2010.

e) Keeping in mind that we are modeling this discrete situation continuously, draw a line through your data points.

f) Use the graph to estimate what year the average price of a ticket will pass 7.00 dollars.
8. When Jessica drives her car to a work-related conference, her employer reimburses her approximately 45 cents per mile to cover the cost of gas and the wear-and-tear on the vehicle.

a) Using distance traveled \( d \), in miles, as the independent variable and amount reimbursed \( A \), in dollars, as the dependent variable, make a sketch of a coordinate system and label appropriately. Mark distance every 5 miles and amount reimbursed every $0.45.

b) For traveling 0 miles, the reimbursement is 0. This corresponds to the point \((0,0)\). Plot it on your coordinate system.

c) For a trip that requires her to drive a total of 5 miles, she is reimbursed \( 5(0.45) = 2.25 \) dollars. This corresponds to the point \((5,2.25)\). Plot it.

d) For each 5 miles you go to the right, you must go up $2.25 and plot the point. Do this until you reach 20 miles.

e) Keeping in mind that we are modeling this discrete situation continuously, draw a line through your data points.

f) In March, Jessica attends a conference that is only 5 miles away. Counting roundtrip, she travels 10 total miles. Use the graph to determine how much she is reimbursed.

g) In December, she attends a conference 10 miles away. How long is her trip in total? Use the graph to determine how much she will be reimbursed.

h) For longer trips, such as 200 total miles, you will probably need to make a much larger graph. And what if she travels 400 miles? Or further? It is limitations such as these that make it useful to find an equation that describes what the graph shows. To find the equation, we start with a table that helps us to understand the relationship between the dependent and independent variables. Complete the table below.

\[
\begin{array}{|c|c|}
\hline
\text{\( d \) (miles)} & \text{\( A \) ($\)} \\
\hline
0 & 0 \\
1 & 0 + 0.45(1) \\
2 & 0 + 0.45(2) \\
3 & \\
4 & \\
5 & \\
10 & \\
20 & \\
50 & \\
100 & \\
\hline
\end{array}
\]

i) Use the table from part (h) to come up with an equation that relates \( d \) and \( A \).

j) Now, use the equation to determine the reimbursement amounts for trips of 200 miles and 400 miles.

9. Temperature is typically measured in degrees Fahrenheit in the United States; but it is measured in degrees Celsius in many other countries. The relationship between Fahrenheit and Celsius is linear. Let's choose the measurement of degrees in Celsius to be our independent variable and the measurement of degrees in Fahrenheit to be our dependent variable. Water freezes at 0 degrees Celsius, which corresponds to 32 degrees Fahrenheit.
heit; and water boils at 100 degrees Celsius, which corresponds to 212 degrees Fahrenheit. We can plot this information as the two points \((0,32)\) and \((100,212)\). The relationship is linear, so we have the following graph:

![Graph showing linear relationship between Celsius and Fahrenheit]

a) Use the graph to approximate the equivalent Fahrenheit temperature for 48 degree Celsius.

b) To determine the rate of change of Fahrenheit with respect to Celsius, we draw a right triangle with sides parallel to the axes that connects the two points we know...

![Right triangle with sides \(PR\) and \(RQ\)]

Side \(PR\) is 100 degrees long, representing an increase in 100 degrees Celsius. Side \(RQ\) is 180 degrees, representing an increase in 180 degrees Fahrenheit. Find the rate of increase of Fahrenheit per Celsius.

c) The following table shows some values of temperatures in Celsius and their corresponding Fahrenheit readings. Zero degrees Celsius corresponds to 32 degrees Fahrenheit. Our rate is 9 degrees Fahrenheit for every 5 degrees Celsius, or \(9/5\) of a degree Fahrenheit for every 1 degree Celsius. So, for 1 degree Celsius, we increase the Fahrenheit reading by \(9/5\) degree, getting \(32 + \frac{9}{5}(1)\). For 2 degrees Celsius, we increase by two occurrences of \(9/5\) degree to get \(32 + \frac{9}{5}(2)\). Fill in the missing entries, following the pattern.

<table>
<thead>
<tr>
<th>C (deg)</th>
<th>F (deg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>1</td>
<td>(32 + \frac{9}{5}(1))</td>
</tr>
<tr>
<td>2</td>
<td>(32 + \frac{9}{5}(2))</td>
</tr>
<tr>
<td>3</td>
<td>(32 + \frac{9}{5}(3))</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

d) Use the table to form an equation that gives degrees Fahrenheit in terms of degrees Celsius.

10. On June 16, 2006, the conversion rate from Euro to U.S. dollars was approximately 0.8 to 1, meaning that every 0.8 Euros were worth 1 U.S. dollar.

a) Choosing dollars to be the independent variable and Euros to be the dependent variable, make a graph of co-
coordinate system. Mark every dollar on the dollar axis and every 0.8 Euros on the Euro axis. Label appropriately.

b) Zero dollars are worth 0 Euros. This corresponds to the point (0, 0). Plot it on your coordinate system.

c) One dollar is worth 0.8 Euros. Plot this as a point on your coordinate system.

d) For every dollar you move to the right, you must go up 0.8 Euros and plot a point. Do this until you reach $10.

e) Draw a line through your data points.

f) Use the graph to estimate how many Euros $8 are worth.

g) Use the graph to estimate how many dollars 5 Euros are worth.

h) The following table shows some values of dollars and their corresponding value in Euros. Fill in the missing entries.

<table>
<thead>
<tr>
<th>Dollars</th>
<th>Euros</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0 + 0.8(1)</td>
</tr>
<tr>
<td>2</td>
<td>0 + 0.8(2)</td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

i) Use the table to make an equation that can be used to convert dollars to Euros.

j) Use the equation from (i) to convert $8 to Euros. Does your answer agree with the answer from (f) that you obtained using the graph?

11. The Tower of Pisa in Italy has its famous lean to the south because the clay and sand ground on which it is built is softer on the south side than the north. The tilt is often found by measuring the distance that the upper part of the tower overhangs the base, indicated by \( h \) in the figure below. In 1980, the tower had a tilt of \( h = 4.49 \text{ m} \), and this tilt was increasing by about 1 \( \text{mm/year} \).

Figure 1. \( h \) measures the tilt of the Tower of Pisa.

We will investigate how the tilt of the tower changed from 1980 to 1995.

a) First, note that our units do not match: The tilt in 1980 was given as 4.49 m, but the annual increase in the tilt is given as 1 mm/year. Our first goal is to make the units the same. We will use millimeters (mm). Convert 4.49 m to mm.

b) Get a sheet of graph paper. Since the tilt of the tower depends on the year, make the year the independent variable and place it on the horizontal axis. Let \( t \) represent the year.

Make the tilt the dependent variable and place it on the vertical axis. Let \( h \) represent the tilt, measured in millimeters (mm).

Choose 1980 as the first year on the horizontal axis and mark every year
thereafter, until 1995. Let the vertical axis begin at 4.49 m, converted to mm from part (a), since that was our first measurement; and then we mark every 1 mm thereafter up to 4510 mm.

c) Think of 1980 as the starting year. Together with the tilt measurement from that year, it forms a point. What are the coordinates of this point? Plot the point on your coordinate system.

d) Beginning at the first point, from part (c), move one year to the right (to 1981) and 1 mm up (because the tilt increases) and plot a new data point.

e) Each time you move one year to the right, you must move 1 mm up and plot a new point. Repeat this process until you reach the year 1995.

f) Keeping in mind that we are modeling this discrete situation continuously, draw a line through your data points. We can use this model to make predictions.

g) According to computer simulation models, which use sophisticated mathematics, the tower would be in danger of collapsing when \( h \) reaches about 4495 mm. Use your graph to estimate what year this would happen.

h) In reality, the tilt of the tower passed 4495 mm and the tower did not collapse. In fact, the tilt increased to 4500 mm before the tower was closed on January 7, 1990, to undergo renovations to decrease the tilt. (The tower was reopened in 2001, after engineers used weights and removed dirt from under the base to decrease the tilt by 450 mm.) What might be some reasons why the prediction of the computer model was wrong?

i) The following table lists the tilt of the tower, \( h \), the year, and the number of years since 1980. In 1980, the tilt was 4490 mm and no occurrences of the 1 mm increase had happened yet, so we fill in \( 4490 + 0(1) = 4490 \). In 1981, one occurrence of the 1 mm increase had occurred because one year had passed since 1980. Therefore, the tilt was \( 4490 + 1(1) \). In 1982, two occurrences of the 1 mm increase had occurred, because 2 years had passed since 1980. Thus, the tilt was \( 4490 + 2(1) \). And the pattern continues in this manner. Fill in the remaining entries.

<table>
<thead>
<tr>
<th>Year</th>
<th>yrs ( x ) after ’80</th>
<th>tilt ( h )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>0</td>
<td>4490 + 0(1)</td>
</tr>
<tr>
<td>1981</td>
<td>1</td>
<td>4490 + 1(1)</td>
</tr>
<tr>
<td>1982</td>
<td>2</td>
<td>4490 + 1(2)</td>
</tr>
<tr>
<td>1983</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1984</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td></td>
<td></td>
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<tr>
<td>1986</td>
<td></td>
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<tr>
<td>1987</td>
<td></td>
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<td>1988</td>
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<td>1989</td>
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<td>1994</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

j) Let \( x \) represent the number of years since 1980 and \( h \) represent the tilt. Using the table above, write an equation that relates \( h \) and \( x \).

k) Use your equation to predict the tilt in 1990. Does it agree with the actual
value from 1990? Does it agree with the value that is shown on the graph you made?

1) In part (g), you used the graph to predict the year in which the tilt would be 4495mm. Use your equation to make the same prediction. Do the answers agree?

12. According to the Statistical Abstract of the United States (www.census.gov), there were approximately 31,000 crimes reported in the United States in 1998, and this was dropping by a rate of about 2900 per year.

a) On a sheet of graph paper, make a coordinate system and plot the 1998 data as a point. Note that you will only need to graph the first quadrant of a coordinate system, since there are no data for years before 1998 and there cannot be a negative number of crimes reported. Use the given rate to find points for 1999 through 2006, and then draw a line through your data. We are constructing a continuous model for our discrete situation.

b) The following table lists the number of crimes reported, \( C \), the year, and the number of years since 1998. In 1998, the number was 31,000 and no occurrences of the 2900 decrease had happened yet, so we fill in 31000 – 2900(0). In 1999, one occurrence of the 2900 decrease had happened because one year had passed since 1998. Therefore, the number of crimes reported was 31000 – 2900(1). And the pattern continues in this manner. Fill in the remaining entries.

\[
\begin{array}{|c|c|c|}
\hline
\text{Year} & \text{yrs } x \text{ after 1998} & \text{No. of crimes } C \\
\hline
1998 & 0 & 31000 – 2900(0) \\
1999 & 1 & 31000 – 2900(1) \\
2000 & 2 & \text{ } \\
2001 & 3 & \text{ } \\
2002 & 4 & \text{ } \\
\hline
\end{array}
\]

c) Observing the pattern in the table, we come up with the equation \( C = 31000 – 2900x \) to relate the number of crimes \( C \) to the number of years \( x \) after 1998. Here, \( C \) is a function of \( x \), and so we can use the notation \( C(x) = 31000 – 2900x \) to emphasize this.

i. Compute \( C(5) \).
ii. In a complete sentence, explain what \( C(5) \) represents.
iii. Compute \( C(8) \).
iv. In a complete sentence, explain what \( C(8) \) represents.

13. According to the Statistical Abstract of the United States (www.census.gov), there were approximately 606,000 inmates in United States prisons in 1999, and this was increasing by a rate of about 14,000 per year.

a) On a sheet of graph paper, make a coordinate system and plot the 1999 data as a point. Note that you will only need to graph the first quadrant of a coordinate system, since there are no data for years before 1999 and there cannot be a negative number of crimes reported. Use the given rate to find points for 2000 through 2006, and then draw a line through your data. We are constructing a continuous model for our discrete situation.
b) The following table lists the number of inmates, $N$, the year, and the number of years since 1999. In 1999, the number was 606,000 and no occurrences of the 14,000 increase had happened yet, so we fill in $606000 + 14000(0)$. In 2000, one occurrence of the 14,000 increase had happened because one year had passed since 1999. Therefore, the number of crimes reported was $606000 + 14000(1)$. And the pattern continues in this manner. Fill in the remaining entries.

<table>
<thead>
<tr>
<th>Year</th>
<th>yrs $x$ after '99</th>
<th>No. of inmates $N$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>0</td>
<td>$606000+14000(0)$</td>
</tr>
<tr>
<td>2000</td>
<td>1</td>
<td>$606000+14000(1)$</td>
</tr>
<tr>
<td>2001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

c) Observing the pattern in the table, we come up with the equation $N = 606000 + 14000x$ to relate the number of crimes $C$ to the number of years $x$ after 1999. Here, $N$ is a function of $x$, and so we can use the notation $N(x) = 606000 + 14000x$ to emphasize this.

i. Compute $N(5)$.
ii. In a complete sentence, explain what $N(5)$ represents.
iii. Compute $N(7)$.
iv. In a complete sentence, explain what $N(7)$ represents.
3.1 Answers

1.
   b) (1, $660)
   d) $1020
   e) 10 seconds

3.
   b) (0, 200)
   c) (2, 8)
   f) 40 acorns
g) 4 acorns/day

h) 

<table>
<thead>
<tr>
<th>$t$</th>
<th>$N$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>$0 + 4(1)$</td>
</tr>
<tr>
<td>2</td>
<td>$0 + 4(2)$</td>
</tr>
<tr>
<td>3</td>
<td>$0 + 4(3)$</td>
</tr>
<tr>
<td>4</td>
<td>$0 + 4(4)$</td>
</tr>
<tr>
<td>6</td>
<td>$0 + 4(6)$</td>
</tr>
<tr>
<td>8</td>
<td>$0 + 4(8)$</td>
</tr>
<tr>
<td>10</td>
<td>$0 + 4(10)$</td>
</tr>
<tr>
<td>12</td>
<td>$0 + 4(12)$</td>
</tr>
<tr>
<td>14</td>
<td>$0 + 4(14)$</td>
</tr>
</tbody>
</table>

i) $N = 0 + 4t$ or $N = 4t$

j) $N = 40$; yes.

7.

c) (2002, 5.85)

e) 

d) $F = \frac{9}{5}C + 32$

11.

a) 4490mm

c) (1980, 4490)

f) 2008
g) 1985

h) The computer model must not have taken into consideration certain unexpected factors.

i)

<table>
<thead>
<tr>
<th>Year</th>
<th>yrs after 1980</th>
<th>tilt h</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>0</td>
<td>4490</td>
</tr>
<tr>
<td>1981</td>
<td>1</td>
<td>4490 + 1(1)</td>
</tr>
<tr>
<td>1982</td>
<td>2</td>
<td>4490 + 1(2)</td>
</tr>
<tr>
<td>1983</td>
<td>3</td>
<td>4490 + 1(3)</td>
</tr>
<tr>
<td>1984</td>
<td>4</td>
<td>4490 + 1(4)</td>
</tr>
<tr>
<td>1985</td>
<td>5</td>
<td>4490 + 1(5)</td>
</tr>
<tr>
<td>1986</td>
<td>6</td>
<td>4490 + 1(6)</td>
</tr>
<tr>
<td>1987</td>
<td>7</td>
<td>4490 + 1(7)</td>
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<tr>
<td>1988</td>
<td>8</td>
<td>4490 + 1(8)</td>
</tr>
<tr>
<td>1989</td>
<td>9</td>
<td>4490 + 1(9)</td>
</tr>
<tr>
<td>1990</td>
<td>10</td>
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<tr>
<td>1991</td>
<td>11</td>
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</tr>
<tr>
<td>1992</td>
<td>12</td>
<td>4490 + 1(12)</td>
</tr>
<tr>
<td>1993</td>
<td>13</td>
<td>4490 + 1(13)</td>
</tr>
<tr>
<td>1994</td>
<td>14</td>
<td>4490 + 1(14)</td>
</tr>
<tr>
<td>1995</td>
<td>15</td>
<td>4490 + 1(15)</td>
</tr>
</tbody>
</table>

j) \( h = 4490 + 1x \)

k) 4500mm. Yes, it agrees with the actual value in 1990.

l) 1985. Yes, it agrees with our answer from (g).

13.

a)

b)

<table>
<thead>
<tr>
<th>Year</th>
<th>yrs x after '99</th>
<th>No. of inmates N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>0</td>
<td>606000+14000(0)</td>
</tr>
<tr>
<td>2000</td>
<td>1</td>
<td>606000+14000(1)</td>
</tr>
<tr>
<td>2001</td>
<td>2</td>
<td>606000+14000(2)</td>
</tr>
<tr>
<td>2002</td>
<td>3</td>
<td>606000+14000(3)</td>
</tr>
</tbody>
</table>

i. 676,000.

ii. It means that, according to our model, 5 years after 1999 (that is, in 2004), the number of inmates will be 676,000.

iii. 704,000.

iv. It means that, according to our model, in 2006, the number of inmates will be 704,000.