3.5 Model With Quadratic Equations

Student Text Pages
164–173

Suggested Timing
80 min

Materials and Technology Tools
- graphing calculators
- grid paper
- computers with spreadsheet software or *Fathom*™ (optional)

Related Resources
- BLM G–1 Grid Paper
- BLM A–4 Presentation Checklist
- BLM A–10 Observation General Scoring Rubric
- BLM 3–9 Section 3.5 Model With Quadratic Equations

Teaching Suggestions

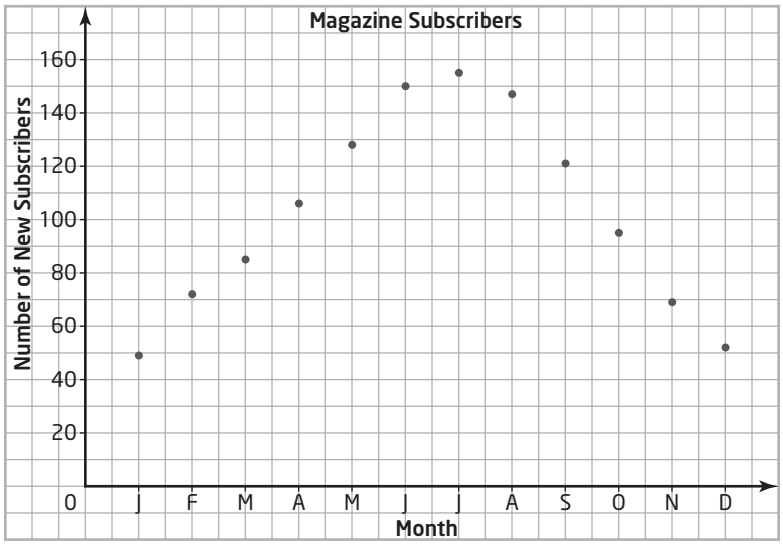
- In this section, students will use technology as a tool to facilitate the graphing process. The goal is for students to interpret the data and draw conclusions rather than spending time on the mechanics of sketching a curve or plotting points.

Investigate

- Have students work in pairs.
- Supply copies of **BLM G–1 Grid Paper.**
- Have students brainstorm possible reasons why the magazine suffers from low subscription rates and what the magazine company could do to increase the rates.

Investigate Responses (pages 164-165)

1.

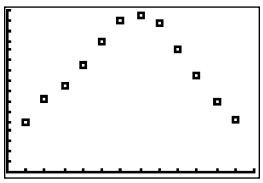


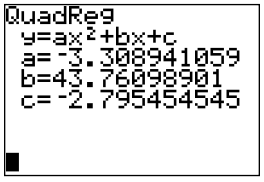
2. The data appears to model a quadratic function. The shape of the graph is parabolic.

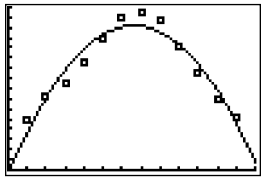
3. Explanations may vary. From the table and scatter plot, July had the greatest number of new subscribers. This may be due to the season. The summer months are usually the most active for home repairs and renovations, both interior and exterior. Therefore, more people would be likely to read these types of magazines during this period.

4. Explanations may vary. During the cold months of the year, there would be fewer exterior home repairs. December and January are also months during which major holidays occur; therefore, people are less likely to make home repairs during these months.

5.







$\mathbf{Y1} = -3.038\ 941\ 059x^2 + 43.76\ 098\ 901x - 2.795\ 454\ 545$

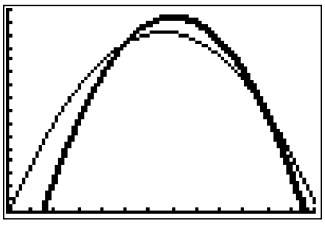
6. The quadratic model is a fairly accurate representation of the subscription trends. The parabola passes through most of the data points from the table.

7. a) vertex from scatter plot: (7, 155); other point: (6, 150)

$$y = a(x - h)^2 + k$$
$$150 = a(6 - 7)^2 + 155$$
$$150 = a(-1)^2 + 155$$
$$-5 = a^2$$

The vertex form of the quadratic equation is $y = -5(x - 7)^2 + 155$.

b)



The graph created by the quadratic regression equation is wider than the graph of the equation in vertex form.

8. Answers may vary. The magazine company could attract more new subscribers during the slow months if they offered a free period for the subscription or a discount rate.

Examples

- Encourage students to work through both methods of determining an equation to model a parabolic curve.

Communicate Your Understanding

- Have students discuss the advantages and disadvantages of finding the equation of the curve of best fit using both methods.
- Have students work in pairs to answer each question. Discuss the solutions as a class.
- You may wish to use **BLM 3–9 Section 3.5 Model With Quadratic Equations** for remediation or extra practice.

Communicate Your Understanding Responses (page 169)

C1 Methods may vary. **Method 1:** Use technology. Enter the data into a graphing calculator or software. Perform a quadratic regression on the data to determine the equation of the quadratic function of best fit. **Method 2:** Estimate the coordinates of the vertex and determine the coordinates of one other point on the curve. Substitute the coordinates of both points into the vertex form of the quadratic equation, $y = a(x - h)^2 + k$. Solve for a and then write the equation with all known values.

C2 $y = a(x - r)(x - s)$; x-intercepts: $r = 0$, $s = 50$

$(x, y) = (7, 23)$

$$23 = a(7 - 0)(7 - 50)$$
$$23 = 7a(-43)$$
$$23 = -301a$$
$$-\frac{23}{301} = a$$
$$y = -\frac{23}{301}(x - 0)(x - 50)$$
$$y = -0.085\,7262\,624x^2 + 4.276\,582\,752x - 0.955\,248\,812\,2$$
$$y = -0.0912(x - 25)^2 + 57$$

The graphing calculator model (second equation) is the best fit since the parabola passes through the majority of the points relative to the other two models.

Ongoing Assessment

- While students are working, circulate and see how well each works. This may be an opportunity to begin observing and recording individual students' learning skills. Use **BLM A–10 Observation General Scoring Rubric**.

Accommodations

Gifted and Enrichment–have students collect data that can be modelled with a quadratic function. Ask students to determine the equation of the parabola of best fit.

Language–allow students to work in pairs to provide support in reading the questions

Practise, Connect and Apply, Extend

- As an alternative to graphing calculators, you may wish to have students use computers with spreadsheet software or *Fathom*™.
- **Questions 1 and 2** highlight the two methods of determining a quadratic equation to model a set of data.
- **Question 7** relates to the Chapter Problem. You may wish to have students flag their answers to this question for use in the Chapter Problem Wrap-Up.
- For **question 12**, students should use the data in the table to determine an equation, then they can use the equation and the information given in the question to determine Bokita's distance from the hoop.

Career Connections

- Have students discuss what they know about a career as a civil engineering technician. As an extension, have students research this career and other similar careers, and present their findings to the class. You may wish to use **BLM A–4 Presentation Checklist** to assess students' presentations. Using their research, have each student discuss:
  - The duties of a civil engineering technician.
  - The type of education and training needed for this career.
  - Similar careers.
  - The differences in the training and education required for a similar career.
- You may wish to have students include their research in their portfolios. For more career resources for your students, go to *www.mcgrawhill.ca/functionsapplications11* and follow the links.

Mathematical Processes Integration

The table shows questions that provide good opportunities for students to use the mathematical processes.

Process Expectations	Selected Questions
Problem Solving	9–13, 15
Reasoning and Proving	2, 4, 8, 10–12, 14
Reflecting	7, 10–13
Selecting Tools and Computational Strategies	1, 3, 5, 6, 9–15
Connecting	9–14
Representing	1, 3, 6, 9, 10, 13, 15
Communicating	10–12