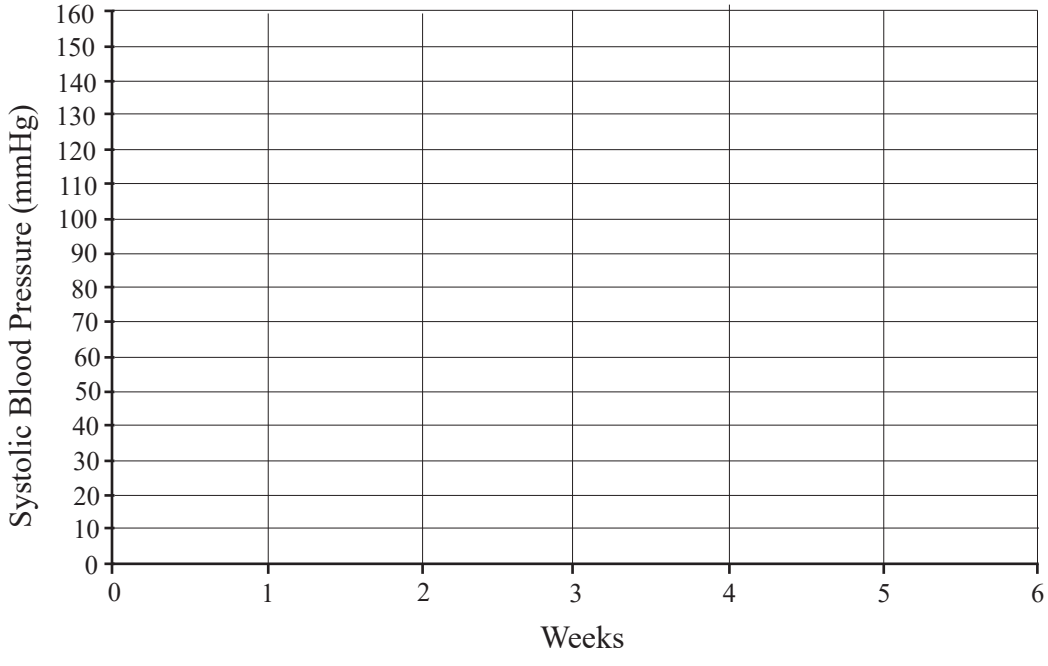
CHAPTER 2 PROJECT

Monitoring Blood Pressure Medication Response

You are assisting a nursing research team at your university's health sciences department. The team is studying how a new blood pressure medication affects systolic blood pressure (SBP) in young adults over time. They have collected data from a clinical trial and need you to analyze trends, build linear models, and evaluate the medication's effectiveness using coordinate geometry, forms of linear equations, parallel and perpendicular lines, and linear regression.

1. During the first phase of a clinical trial, a patient's systolic blood pressure (SBP), measured in millimeters of mercury (mm Hg), was recorded at weekly checkups. The data are given as ordered pairs (week, SBP): (0, 148), (1, 142), (2, 137), (3, 131), (4, 126), (5, 120). Plot these points on a Cartesian plane, with the horizontal axis representing weeks and the vertical axis representing systolic blood pressure. Then describe the trend shown by the data.



2. Using the first and last data points, (0, 148) and (5, 120), calculate the slope of the line connecting them. Interpret the slope in the context of the patient's blood pressure response to the medication.

3. Write the equation of the line from Question 2 in slope-intercept form. What does the y-intercept represent medically? Use the equation to predict the patient's SBP in week 8.

4. A second patient in the trial began with an SBP of 155 mm Hg and showed a decline of 4.8 mm Hg per week. Write the equation for this patient's SBP using point-slope form (with $t = 0$ as the starting week), then convert to slope-intercept form. After how many weeks does the model predict this patient's SBP will drop below 130 mm Hg, the threshold for Stage 1 hypertension?

5. The two patients described in Questions 2 and 4 have SBP models with slopes of −5.6 mm Hg per week and −4.8 mm Hg per week, respectively. Are the corresponding trend lines parallel, perpendicular, or neither? Explain what the comparison of the slopes tells the research team about the consistency of the medication's effect across patients.

6. A third patient's diastolic blood pressure (DBP) follows the model $D = -2.5t + 92$. A healthy DBP level is below 80 mm Hg.

a. After how many weeks will this patient's DBP reach the healthy range? Write and solve the appropriate inequality.

b. Pulse pressure is defined as SBP minus DBP. If this patient's SBP follows the model $S = -4.0t + 150$, write a linear equation for pulse pressure in terms of t. Is the pulse pressure increasing, decreasing, or remaining constant over time?

7. The full trial data set, averaged across 20 patients, is shown below.

Week (t): 0, 1, 2, 3, 4, 5, 6, 7, 8
Average SBP: 150, 145, 141, 136, 133, 128, 125, 121, 118

Use these data to determine the regression line. Interpret the meaning of the slope and the y-intercept in the context of the clinical trial.

8. Using the regression equation from Question 7, predict the average SBP at week 12. A healthy SBP is generally considered to be below 120 mm Hg. Based on the model, during which week does the average patient reach this level? Discuss one limitation of using the regression line to make this prediction.

9. Two individual patients show different response patterns. Patient A has weekly readings of (0, 155), (2, 149), (4, 145), (6, 141) and (8, 127) producing a regression line $S_A = -3.2t + 156.2$ with $r = -0.96$. Patient B has readings of (0, 145), (2, 140), (4, 142), (6, 130), and (8, 128), producing $S_B = -2.2t + 145.8$ with $r = -0.92$.

a. Which patient shows a steeper decline in SBP? Which shows a more consistent (tighter) linear pattern?

b. What might explain the weaker *r*-value for Patient B? Examine the data values for insight.

c. What does the correlation coefficient *r* tell the research team that the slope alone does not?

10. The lead researcher asks whether a linear model is appropriate for predicting long-term blood pressure response. Identify the week at which your regression model from Question 7 predicts an SBP of 0 mm Hg. Then explain why this prediction is medically unreasonable.