

CHAPTER 1 PROJECT

Analyzing Housing Affordability

You have just begun a summer internship at a regional real estate firm that operates in your college town. The housing market has been shifting rapidly, and your supervisor wants you to use mathematical models to help the firm understand pricing trends, evaluate agent compensation, and advise clients on affordability. Throughout this project, you will apply linear equations, quadratic equations, radical equations, and inequalities to analyze the local real estate market.

1. The firm models average monthly rent for a one-bedroom apartment near campus using the equation $R = 45t + 750$, where t is the number of years since 2020 and R is the monthly rent in dollars. What does the coefficient 45 mean in this context? What does the value 750 represent?
2. Use the rent equation $R = 45t + 750$ to predict the monthly rent in 2024 and in 2030. Show your substitutions and calculations. Is this linear model appropriate for forecasting rents over the next 20 years? Identify at least two limitations of using a linear equation for long-term rent forecasting.
3. Financial advisors often recommend that renters aim to spend no more than 30% of their gross monthly income on housing. A student earns \$15.25 per hour at a part-time campus job and works h hours per week. Assume there are 4.33 weeks in a month.
 - a. Write an expression for the student's monthly income in terms of h .
 - b. Using the rent equation's prediction for 2026, write and solve a linear inequality to determine the minimum number of hours per week the student must work to keep rent at or below 30% of their monthly income.
4. The firm estimates home listing prices using the equation $P = 185s + 22,000$ where s represents the home's square footage and P represents the price in dollars. A young couple has a budget of \$340,000. What is the maximum square footage they can afford? Show the equation you solve and interpret your answer.

5. A competing firm uses a different model to estimate home listing prices: $Q = 0.0003s^2 + 150s + 30,000$ where s represents the square footage of the home and Q represents the price in dollars. Your supervisor asks you to compare the two models.
- As square footage increases, how do the two pricing models behave differently? Which model would you expect to give higher price estimates for very large homes? Explain your reasoning.
 - Determine the square footage for which the two pricing models give the same listing price. Write the equation you solve and show your work. Then explain what each value of s represents in this context.
6. Your supervisor presents two different monthly pay plans for new real estate agents.
- Plan A: A base salary of \$500 per month plus 1.5% of monthly sales
- Plan B: A base salary of \$200 per month plus 2.0% of monthly sales
- Write an equation for each plan in terms of monthly sales x , where E represents total monthly earnings.
 - At what amount of monthly sales do the two plans result in the same earnings? Write the equation you solve and show your work.
7. A newly hired agent estimates that her monthly sales will be between \$40,000 and \$80,000 during her first year at the firm. Write and solve a linear inequality to determine the portion of this sales range for which Plan B results in higher monthly earnings than Plan A. Based on your results, which pay plan would you recommend for this agent, and why?

8. The firm models the number of homes sold per month in the region using the equation $N = -2t^2 + 24t + 100$, where t is the number of months since January ($t = 0$ represents January and $t = 11$ represents December).
- According to the model, how many homes are sold in March and in October? Show your substitutions.
 - Determine the month with the highest home sales using the model. Evaluate the model for several months around the middle of the year and explain how you know which month represents the peak.
9. The firm also models the average number of days until a home receives its first offer using the equation $T = 5\sqrt{p - 164} + 10$, where p is the listing price in thousands of dollars and T is the average number of days until the first offer. A seller receives her first offer after 40 days. How much was the home listed for? Write and solve an equation, then interpret your answer.
10. Using the model from Question 9, determine how many days it would take for a home listed at \$150,000 to receive its first offer. Does the model produce a meaningful result at this price? Explain what your answer suggests about how the model was created and when it can be used.