

CHAPTER 2 PROJECT

Analyzing Campus Dining Operations

You have been hired as a data analyst intern by your university's dining services department. The department is evaluating meal plan pricing, forecasting food costs, and analyzing student traffic patterns across campus dining locations. You will use the Cartesian plane, linear equations in various forms, parallel and perpendicular lines, and linear regression to support their decisions. All models in this project are based on simplified versions of the department's actual data.

1. The dining department tracks the relationship between weekly meal swipes used (x) and weekly food cost to the university (y , in dollars). Here are data from five representative weeks: (20, 85), (35, 130), (50, 175), (65, 220), (80, 265). Plot these points on the plane, labeling both axes. Describe the pattern you observe.



2. Using the first and last data points, (20, 85) and (80, 265), calculate the slope of the line through them. Interpret the slope in the context of dining services costs.
3. Write the equation of the line from Question 2 in slope-intercept form. What does the y -intercept represent in this situation? Is the y -intercept meaningful when $x = 0$ (zero meal swipes), or is it an artifact of the model? Explain.

4. The new semester meal plan proposed by the dining department is modeled by the equation $y = 4.75x + 150$, where x is the number of meal swipes purchased and y is the total cost to the student. Rewrite the equation in standard form $ax + by = c$. Then find the x - and y -intercepts and explain what each represents in this context.
5. The dining director is considering two cost models for a proposed all-you-can-eat meal plan. Model 1, $C_1 = 6.2x + 180$, is based on data collected during the first three weeks of the semester, while Model 2, $C_2 = 5.4x + 240$, uses historical data from an entire semester. In both models, x represents the number of meal swipes.
- Determine the number of meal swipes for which the two models predict the same cost. Write and solve the appropriate equation.
 - For a student purchasing 100 meal swipes, identify which model predicts a higher total cost and calculate the difference.
 - Which model would you recommend the director rely on when planning next year's pricing? Justify your answer by comparing the data sets used to construct each model.
6. The daily operating costs for two dining halls are modeled below, where h is the number of hours each hall operates per day:
- Hall A: $C_A = 350 + 8.50h$
 - Hall B: $C_B = 500 + 8.50h$
- Are the graphs of these equations parallel, perpendicular, or neither? Explain your reasoning using slopes.
 - Interpret the cost models in context. What do the equal slopes and different y intercepts reveal about the operating costs for Hall A and Hall B?

7. The dining department collected the following data on the number of students dining per hour at the main hall.

Hours after opening (x): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0

Number of students (y): 45, 78, 110, 135, 170, 198, 225, 260

Use these data to determine the regression line. Round the slope and the y -intercept to three decimal places. Interpret the meaning of the slope and the y -intercept in this context.

8. Using the regression equation from Question 7, predict the number of students dining at the main hall 5 hours after opening. The actual number of students at that time was 310. Calculate the residual (actual minus predicted) and discuss what it suggests about the reliability of the linear model when used beyond the observed data range.