Parabolas for Profit — Final Presentation (A-Level Sample)

Student: Jamie R. Period: 4 Team: *Data Drivers*
Client: Mandee's Pizza Product: 16" Specialty Pizza

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1. Executive Summary

Our goal was to recommend a price that **maximizes daily profit** for Mandee's 16" specialty pizza. Using realistic (teacher-provided) demand data, a *linear regression* model for demand, and a *quadratic* profit function, we found:

- **Optimal price:** \$6.00
- **Maximum estimated profit:** \$68.00 (per batch/day modeled)
- **Profit zone (break-even to break-even):** \$3.09 to \$8.92

2. Dataset (Price vs. Demand)

Prompt to customers: "What's the *maximum* you'd pay for a 16" specialty slice deal?" (synthetic, cleaned sample)

Price \$	3	4	5	6	7	8	9
Demand (buyers)	56	48	40	32	24	16	8

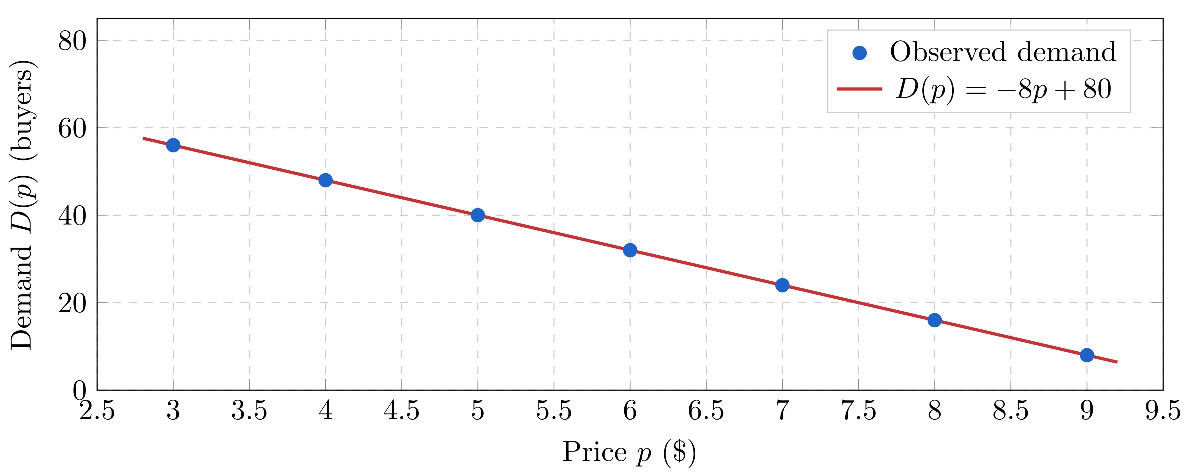
The data show a nearly linear decrease: each \$1 increase reduces expected buyers by about 8.

3. Demand Model (Regression)

Fitting a line to the data gives

$$\boxed{D(p) = -8p + 80}$$

where p is price in dollars and $D(p)$ is the number of buyers. (Here, the fit is exact for illustration.)



4. Revenue, Cost, and Profit Models

Assumptions provided by the owner (per day/batch modeled):

- Fixed daily cost: $F = \$60$ (labor, utilities allocation).
- Variable cost per pizza: $c_v = \$2.00$.

Revenue: $R(p) = p \cdot D(p) = p(-8p + 80) = -8p^2 + 80p$.
Cost: $C(p) = F + c_v \cdot D(p) = 60 + 2(-8p + 80) = 220 - 16p$.
Profit: $P(p) = R(p) - C(p) = \boxed{-8p^2 + 96p - 220}$.

5. Key Features (Graph & Calculations)

Vertex (optimal price). For $P(p) = ap^2 + bp + c$ with $a = -8, b = 96$,

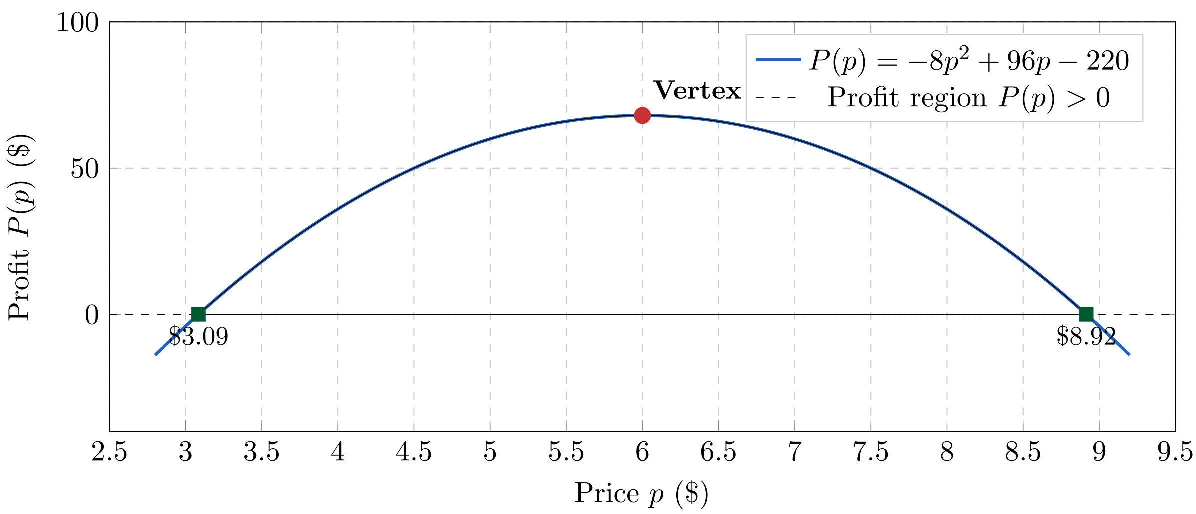
$$p = -\frac{b}{2a} = -\frac{96}{2(-8)} = \boxed{6.00}$$

$$P(p) = P(6) = -8(36) + 96(6) - 220 = \boxed{\$68.00}$$

Break-even prices. Solve $P(p) = 0$:

$$-8p^2 + 96p - 220 = 0 \;\Rightarrow\; 2p^2 - 24p + 55 = 0 \;\Rightarrow\; p = \frac{24 \pm \sqrt{576 - 440}}{4} = \frac{24 \pm \sqrt{136}}{4} = \frac{12 \pm \sqrt{34}}{2}$$

Numerically: $p \approx \boxed{3.09}$ and $\boxed{8.92}$.



6. Recommendation (Business-Facing)

- **Set price at \$6.00** for the 16" specialty pizza.
- This is the vertex (maximum of the profit parabola), with estimated daily profit $\approx \$68$ given our model.
- **Flexible promotions:** Any price in the *profit zone* [\$3.09, \$8.92] remains profitable; e.g., a \$5.50 happy-hour deal would likely increase volume while staying in the green.

7. One-Slide Math Summary (for Poster or PPT)

- $D(p) = -8p + 80 \quad$ (demand decreases linearly with price)
- $R(p) = p \cdot D(p) = -8p^2 + 80p$
- $C(p) = 60 + 2 \cdot D(p) = 220 - 16p$
- $P(p) = R - C = \boxed{-8p^2 + 96p - 220}$
- Vertex at $p = 6 \Rightarrow P = 68$. Break-evens: $p \approx 3.09, 8.92$.

8. Assumptions & Limitations

- Demand was modeled as perfectly linear (real behavior can curve).
- Fixed and variable costs were constant; in reality, they can change with time or volume.
- Our results reflect the *sample day/batch* scope; new data should refresh the model.

9. Reflection (Student Voice)

Before this project, I knew a vertex was "the top of a parabola." Now I can explain it as the **best price** for a business to charge when profit is quadratic in price. The two x-intercepts weren't just numbers—they were **break-even prices**. Making graphs and equations that a real owner could use helped me see how algebra turns into decisions.

Rubric cues (met): accurate modeling, clear graphs with labels, correct optimization via vertex, correct break-even analysis, profit zone interpretation, concise client-ready recommendation, and professional visual communication.