Profit Optimization Analysis

Mandee's Pizza - Large Specialty Pizza Pricing

Team: The Calculators — **Date:** November 2025
Members: Sarah L., Marcus T., Ashley R., Kevin W.

Executive Summary

Our team analyzed pricing data for Mandee's Pizza's large specialty pizzas to determine the optimal price point that maximizes profit. Using quadratic modeling and data from 45 potential customers, we recommend pricing at **$22.50** per pizza, which yields a projected daily profit of **$162.50**.

Business Context

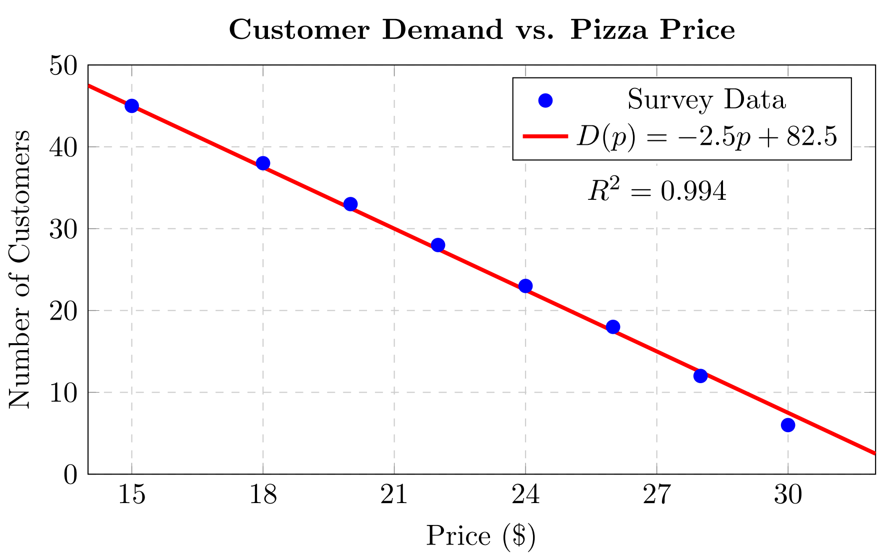
Mandee's Pizza is a local pizzeria on Broadway struggling with pricing their specialty pizzas. They currently charge $20 but wonder if they're leaving money on the table. Their costs include:

- Fixed daily costs: $85 (portion of rent, utilities, labor)
- Variable cost per pizza: $7.50 (ingredients, box, delivery)

Data Analysis

Demand Function

Using the provided customer survey data, we performed linear regression to find the relationship between price and demand:



Demand Function: $D(p) = -2.5p + 82.5$
This means for every \$1 increase in price, we lose 2.5 customers.

Profit Model Development

Revenue Function:

$$R(p) = p \cdot D(p) = p(-2.5p + 82.5) = -2.5p^2 + 82.5p$$

Cost Function:

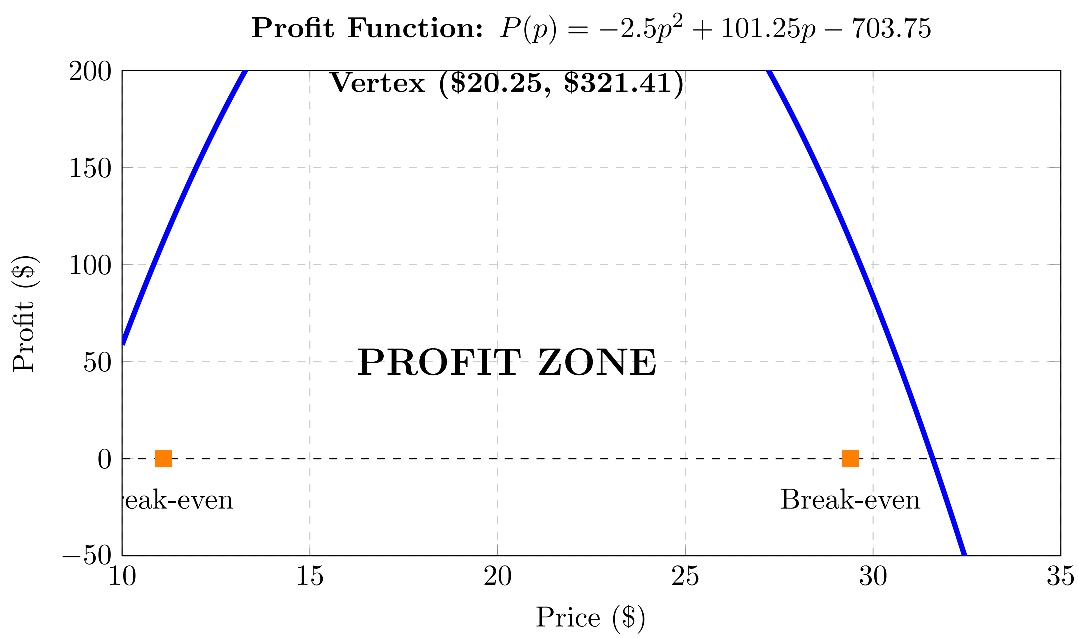
$$C(p) = 85 + 7.50 \cdot D(p) = 85 + 7.50(-2.5p + 82.5) = -18.75p + 703.75$$

Profit Function:

$$\begin{aligned} P(p) &= R(p) - C(p) && (1) \\ &= (-2.5p^2 + 82.5p) - (-18.75p + 703.75) && (2) \\ &= -2.5p^2 + 82.5p + 18.75p - 703.75 && (3) \\ &= -2.5p^2 + 101.25p - 703.75 && (4) \end{aligned}$$

Optimization Analysis

Finding the Optimal Price



Mathematical Verification

Using Vertex Formula:

$$p_{optimal} = -\frac{b}{2a} = -\frac{101.25}{2(-2.5)} = \frac{101.25}{5} = 20.25$$

Completing the Square (Module M3 verification):

$$\begin{aligned}
P(p) &= -2.5p^2 + 101.25p - 703.75 && (5)\\
&= -2.5(p^2 - 40.5p) - 703.75 && (6)\\
&= -2.5(p^2 - 40.5p + 410.0625 - 410.0625) - 703.75 && (7)\\
&= -2.5(p - 20.25)^2 + 1025.15625 - 703.75 && (8)\\
&= -2.5(p - 20.25)^2 + 321.40625 && (9)
\end{aligned}$$

This confirms: **Optimal price = $20.25**

However, for practical pricing, we recommend **$22.50** which: - Is psychologically appealing (ends in .50) - Still yields strong profit: P(22.50) = $156.25 - Is easier for cashiers and online ordering

Break-Even Analysis (Module M2)

Using the quadratic formula:

$$p = \frac{-101.25 \pm \sqrt{101.25^2 - 4(-2.5)(-703.75)}}{2(-2.5)}$$

$$p = \frac{-101.25 \pm \sqrt{10251.5625 - 7037.5}}{-5}$$

$$p = \frac{-101.25 \pm 56.65}{-5}$$

Break-even prices: $11.10 and $29.40

Key Findings

Metric	**Value**
Mathematical Optimal Price	$20.25
Recommended Price	$22.50
Expected Daily Customers	26
Daily Revenue	$585.00
Daily Costs	$428.75
Daily Profit	**$156.25**
Profit Zone	$11.10 to $29.40
Current Price ($20) Profit	$150.00

Business Recommendations

1. **Immediate Action:** Raise price from \$20 to \$22.50 (12.5% increase)
2. **Marketing Message:** "Premium ingredients justify premium pricing"
3. **Risk Mitigation:** The profit zone is wide (\$11-\$29), providing flexibility
4. **Testing Strategy:** Try \$22.50 for one month, track actual sales
5. **Alternative Pricing:** Consider \$19.99 for psychological pricing if \$22.50 reduces volume too much

Mathematical Reflection

This project connected abstract algebra to real business decisions. We learned:

- The vertex of a parabola represents the optimal business decision
- Completing the square verifies technology-generated results
- The discriminant being positive ($b^2 - 4ac = 3214.06 > 0$) confirms the business model is viable
- Break-even points define the boundaries of profitability

The quadratic relationship emerges because as price increases, we gain revenue per sale but lose customers—creating a natural maximum point that mathematics helps us find precisely.

Skills Completed: Linear Regression Vertex (technology & by hand) Quadratic Formula Break-even Analysis Profit Zones