Group #12 - Managerial Economics

Group #Twelve(12)

September 15, 2025

Business Problem and Six-Step Decision-Making Process

Business Problem Chosen

GYE NYAME BREAD is a medium-sized bakery shop that offers a variety of bread products such as sugar bread, butter bread, banana bread, wheat bread, coconut bread, and more. The business is facing **low sales** due to increased raw-material costs that have **skyrocketed** bread prices over the past two months.

Stated price change: from **50 cedis** to **100 cedis** per loaf.

1. Define the Problem

Low sales driven by price increases, where price increases result from:

- Higher input costs (e.g., banana, wheat, coconut, margarine, flavors).
- High importation costs.
- Bread spoilage.

2. Gather Information

I. Competitor offerings (price, delivery options, promotions, etc.).
II. Spoilage rates.
III. Customer feedback (in-store, reviews, social media).
Reported feedback: Product quality is considered high, but the sudden price increase (from 50 to 100 cedis) is causing customers to look elsewhere.
IV. Quality of the bread.

3. Identify Alternatives

I. Reduce importation of raw materials in favor of local purchases.
II. Run an aggressive local marketing and promotion campaign (sampling, ads).
III. Add online ordering plus delivery (partner with platforms such as Yango or Uber).
IV. Monitor.

4. Evaluate Alternatives (Pros, Cons, Risks)

A. Promotions increase visibility but add cost.
B. Reducing importation by purchasing locally can cut end-product cost, but quality/taste may change.
C. Delivery/online services can reach more customers but require setup investment.
D. Price cuts may boost sales volume but lower profit margins.

5. Select the Best Alternative

Recommendation: Combine **B + C + A**.

Actions:

I. Launch online ordering with a delivery partner (C) to reach stay-at-home customers and match competitors.
II. Implement price reductions enabled by cost savings from local sourcing (B).
III. Introduce 1–2 low-risk "healthy" product variants as a trial (C) to test demand.

Rationale: This mix addresses access (delivery), visibility, and product appeal without heavy margin sacrifices.

6. Implement the Decisions and Evaluate Results

I. Purchase more raw materials locally.
II. Launch an online ordering system with delivery partners.
III. Introduce two new, healthier product lines and promote them on social media.
IV. Monitor sales weekly for three months.

Mathematical Problems and Verified Solutions

Problem 1: Airline Charges

An airline charges:

- 3,000 cedis for 2,000 km
- 7,000 cedis for 4,000 km

We are to determine the cost equation.

Solution

Equation of line:

$$y = mx + c$$

$$m = \frac{7000 - 3000}{4000 - 2000} = \frac{4000}{2000} = 2$$

Using $(2000, 3000)$:

$$3000 = 2(2000) + c \quad \Rightarrow \quad c = -1000$$

$$\therefore\ y = 2x - 1000$$

(a) Cost of 3200 km

$$y = 2(3200) - 1000 = 5400$$

Answer: 5,400 cedis

(b) Distance for 4000 cedis

$$4000 = 2x - 1000 \quad \Rightarrow \quad x = 2500$$

Answer: 2,500 km

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Problem 2: Number of People

Equation:

$$N = 10n + 120$$

(a) When $n = 14$

$$N = 10(14) + 120 = 260$$

Answer: 260 employees

(b) When $N = 190$

$$190 = 10n + 120 \quad \Rightarrow \quad n = 7$$

Answer: 7 cafes

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Problem 3: Sales Revenue and Advertising

Equation:

$$S = 90000 + 12A$$

(a) When $A = 0$

$$S = 90000$$

Answer: 90,000 cedis

(b) When $A = 8000$

$$S = 90000 + 12(8000) = 186000$$

Answer: 186,000 cedis

(c) When $S = 150000$, find A

$$150000 = 90000 + 12A \quad \Rightarrow \quad A = 5000$$

Answer: 5,000 cedis

(d) When $A = 1$

$$S = 90000 + 12(1) = 90012$$

Answer: 90,012 cedis

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Problem 4: Copies (Paper vs Electronic)

Equations:

$$x + y = 35000 \quad (1), \qquad 300x + 250y = 9170000 \quad (2)$$

Multiply (1) by 250:

$$250x + 250y = 8750000$$

Subtract from (2):

$$50x = 420000 \quad \Rightarrow \quad x = 20000$$

Substitute in (1):

$$20000 + y = 35000 \quad \Rightarrow \quad y = 15000$$

Answer: $x = 20,000$ paper copies, $y = 15,000$ electronic copies

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Problem 5: Differentiation

(a) Total Revenue

$$TR = 50Q - 3Q^2, \quad \frac{d(TR)}{dQ} = 50 - 6Q$$

Answer: $\frac{d(TR)}{dQ} = 50 - 6Q$

Interpretation of Revenue Function

Refer to the plot of this function in Figure 1

Given

$$TR = 50Q - 3Q^2$$

and

$$\frac{d(TR)}{dQ} = 50 - 6Q$$

Step 1: Meaning of TR

- TR stands for **Total Revenue**.
- It is expressed as a quadratic function of Q (quantity).

So:

- The linear term $50Q$ means revenue increases with each additional unit sold (price-like effect).
- The quadratic term $-3Q^2$ is negative, meaning revenue growth slows down as Q increases — representing diminishing returns.

Step 2: First Derivative $\frac{d(TR)}{dQ}$

The derivative of TR with respect to Q is:

$$\frac{d(TR)}{dQ} = 50 - 6Q$$

This derivative represents the **Marginal Revenue (MR)** — the additional revenue obtained from selling one more unit of output.

Step 3: Interpretation

1. **When $Q = 0$:**
$$MR = 50$$
The first unit sold adds 50 units of revenue.

2. **As Q increases:** MR decreases linearly (slope $= -6$). Each extra unit contributes less revenue.

3. **When $MR = 0$:**
$$50 - 6Q = 0 \quad \Rightarrow \quad Q = \frac{50}{6} \approx 8.33$$
Revenue stops increasing after this point (maximum revenue quantity).

4. **Concavity:** Since the coefficient of Q^2 in TR is negative (-3), the parabola opens downwards, confirming TR has a maximum point at $Q \approx 8.33$.

Step 4: Maximum Revenue

At $Q = 8.33$:
$$TR = 50(8.33) - 3(8.33)^2 \approx 208.3$$
So the maximum total revenue is about **208.3 units**.

Conclusion

- $TR(Q)$ is a quadratic revenue function.
- The derivative $\frac{d(TR)}{dQ}$ gives **marginal revenue**.
- Setting $\frac{d(TR)}{dQ} = 0$ identifies the revenue-maximizing output level.

(b) Polynomial Function

$$y = -2Q^3 + 15Q^2 - 24Q - 3$$
$$\frac{dy}{dQ} = -6Q^2 + 30Q - 24$$

Answer: $\frac{dy}{dQ} = -6Q^2 + 30Q - 24$

Interpretation of a Cubic Function

Refer to the plot of this function in Figure 2

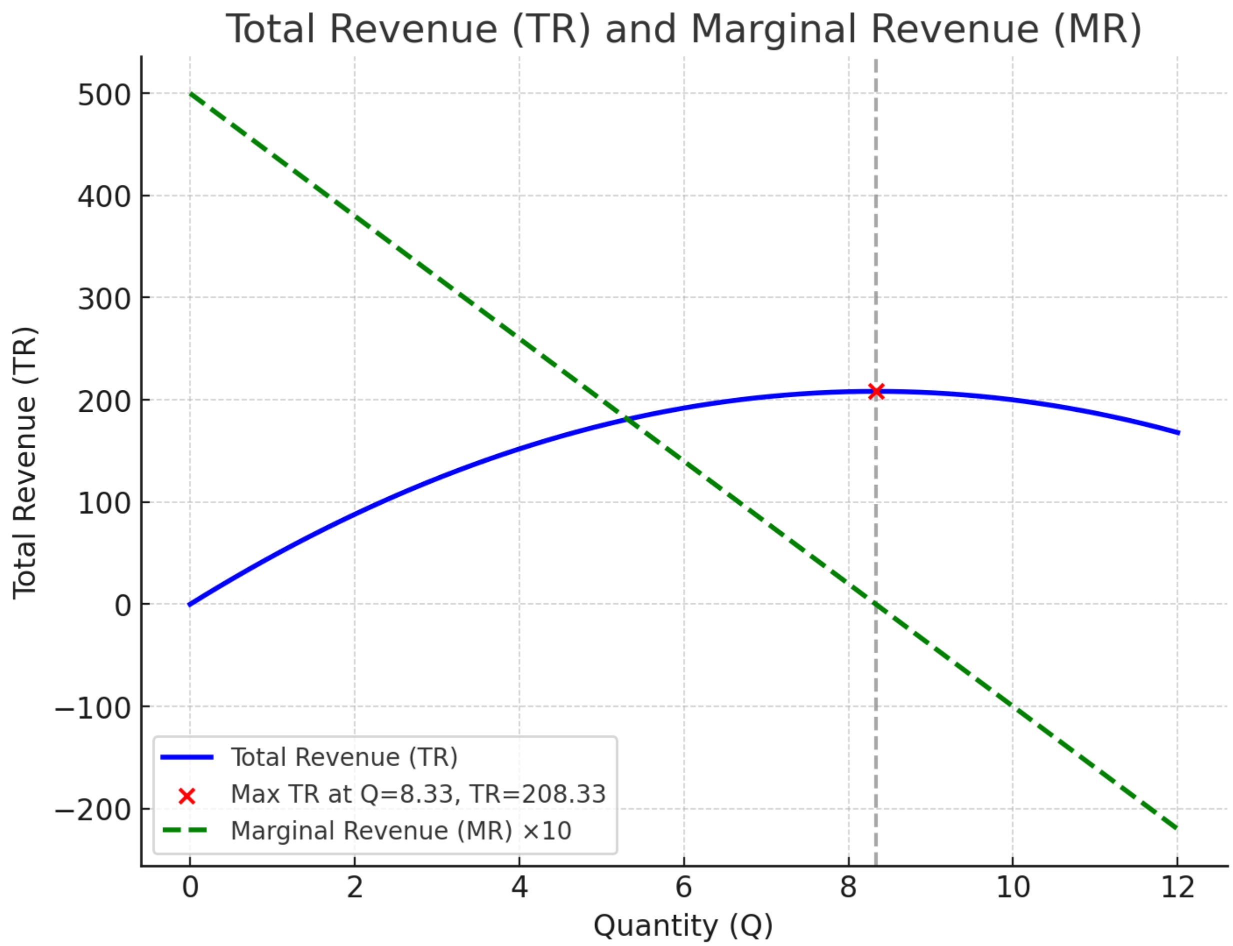

Figure 1: Total and Marginal Revenue Curve Plot

Given

$$y = -2Q^3 + 15Q^2 - 24Q - 3$$

and

$$\frac{dy}{dQ} = -6Q^2 + 30Q - 24$$

Step 1: Meaning of y

- Here, y is a **cubic function** of Q.
- Unlike the quadratic revenue parabola, this cubic is more complex:
  - The $-2Q^3$ term dominates as Q grows large, driving the function downwards eventually.
  - The $15Q^2$ and $-24Q$ terms shape the curve, creating the possibility of **turning points** (local maxima and minima).

Step 2: First Derivative $\frac{dy}{dQ}$

$$\frac{dy}{dQ} = -6Q^2 + 30Q - 24$$

- The derivative gives the **slope** of the curve $y(Q)$.
- Setting $\frac{dy}{dQ} = 0$ finds the **critical points** (where slope = 0, i.e., peaks or valleys).

Step 3: Solve Critical Points

$$-6Q^2 + 30Q - 24 = 0$$

Dividing through by -6:

$$Q^2 - 5Q + 4 = 0$$

Factorizing:

$$(Q - 4)(Q - 1) = 0$$

So:

$$Q = 1 \quad \text{or} \quad Q = 4$$

Step 4: Nature of Critical Points (Second Derivative Test)

The second derivative is:

$$\frac{d^2y}{dQ^2} = -12Q + 30$$

- At $Q = 1$: $-12(1) + 30 = 18 > 0 \quad \Rightarrow$ **Local Minimum**.
- At $Q = 4$: $-12(4) + 30 = -18 < 0 \quad \Rightarrow$ **Local Maximum**.

Step 5: Interpretation

- The cubic curve $y(Q)$ therefore has:
  - A **valley (local minimum)** at $Q = 1$.
  - A **peak (local maximum)** at $Q = 4$.
- After $Q = 4$, the function decreases toward $-\infty$ because of the dominating $-2Q^3$ term.

Conclusion

- The derivative identifies the turning points.
- The second derivative confirms whether each is a minimum or maximum.
- This cubic demonstrates how a function can have both a dip and a peak, unlike the quadratic case where there is only a single maximum.

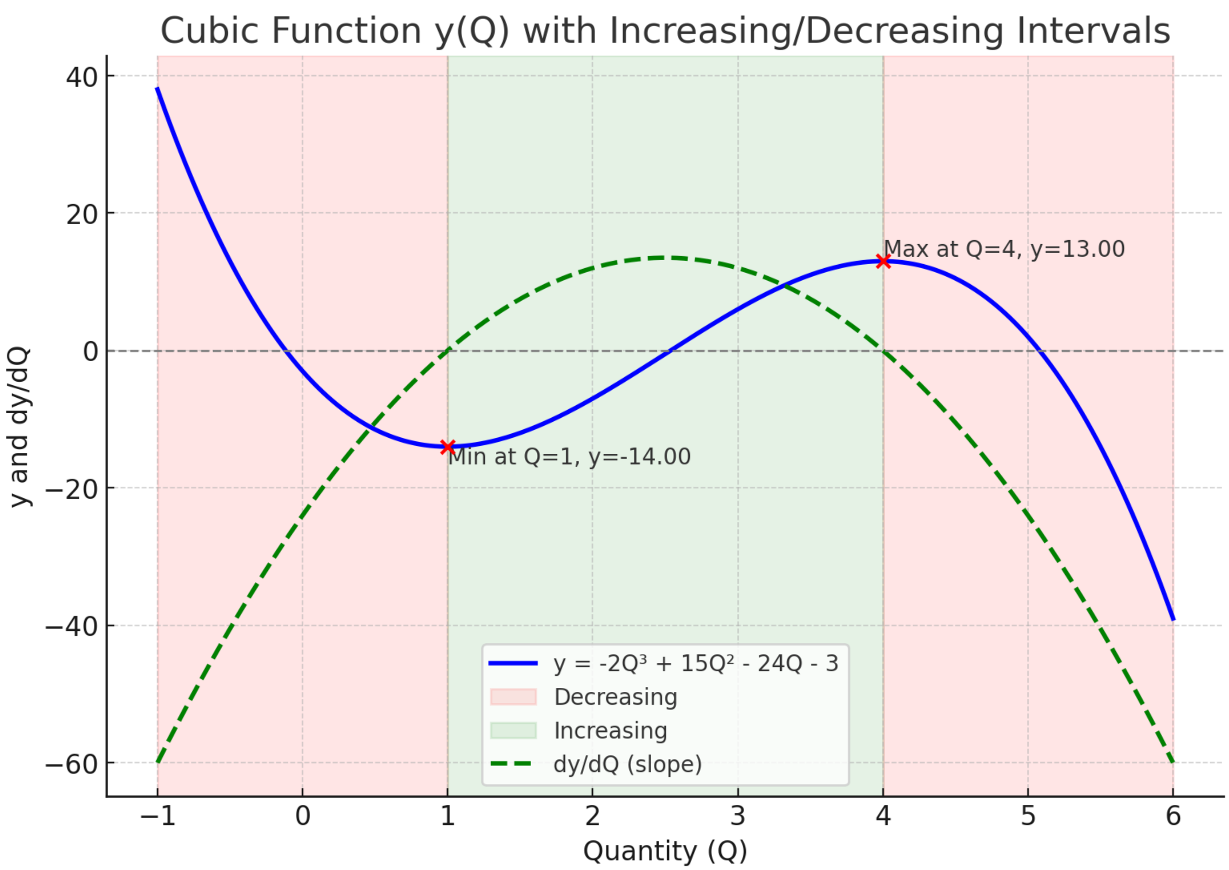

Figure 2: Polynomial Function Plot

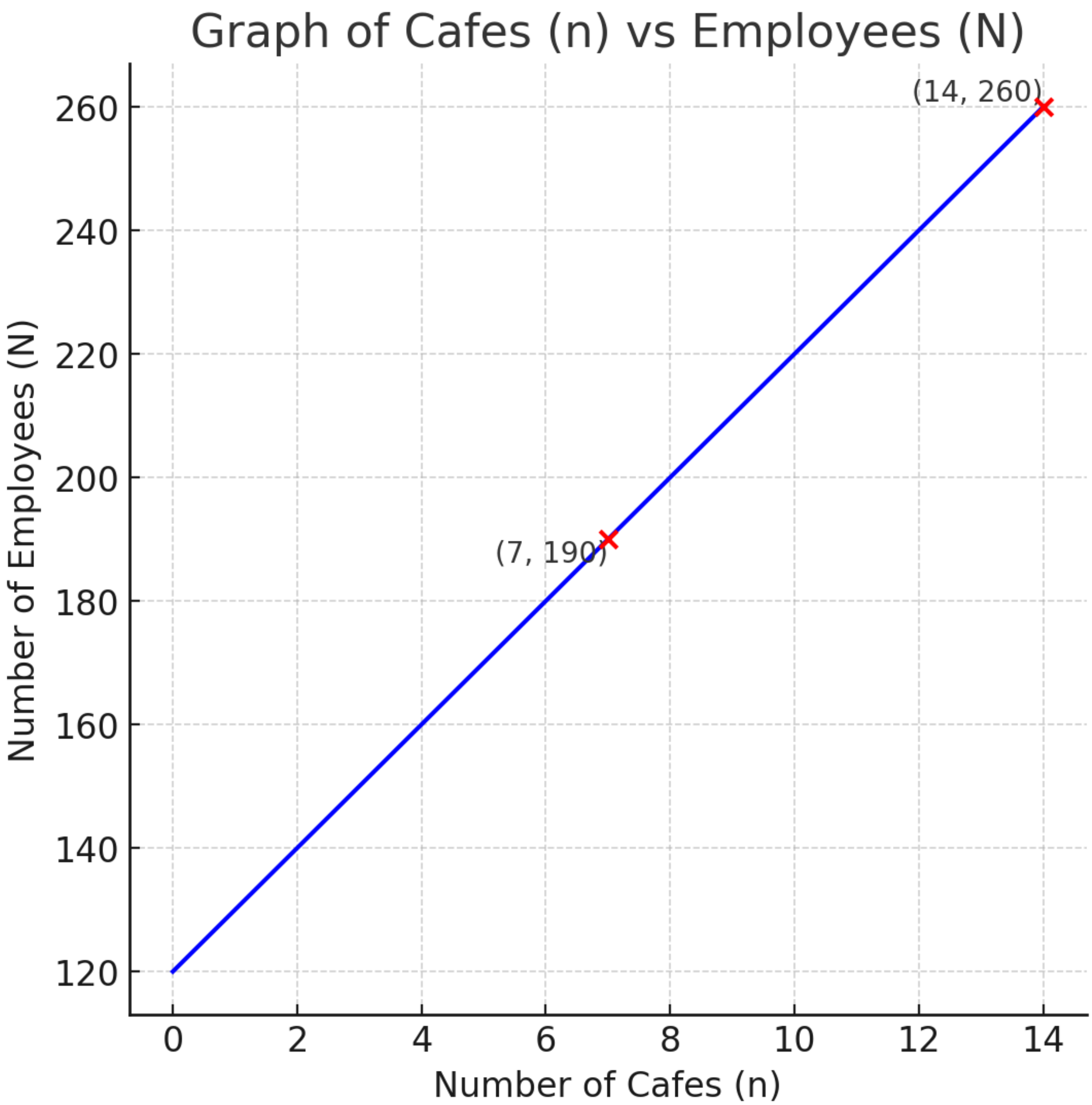

Figure 3: Cafe Number and Employee Graph

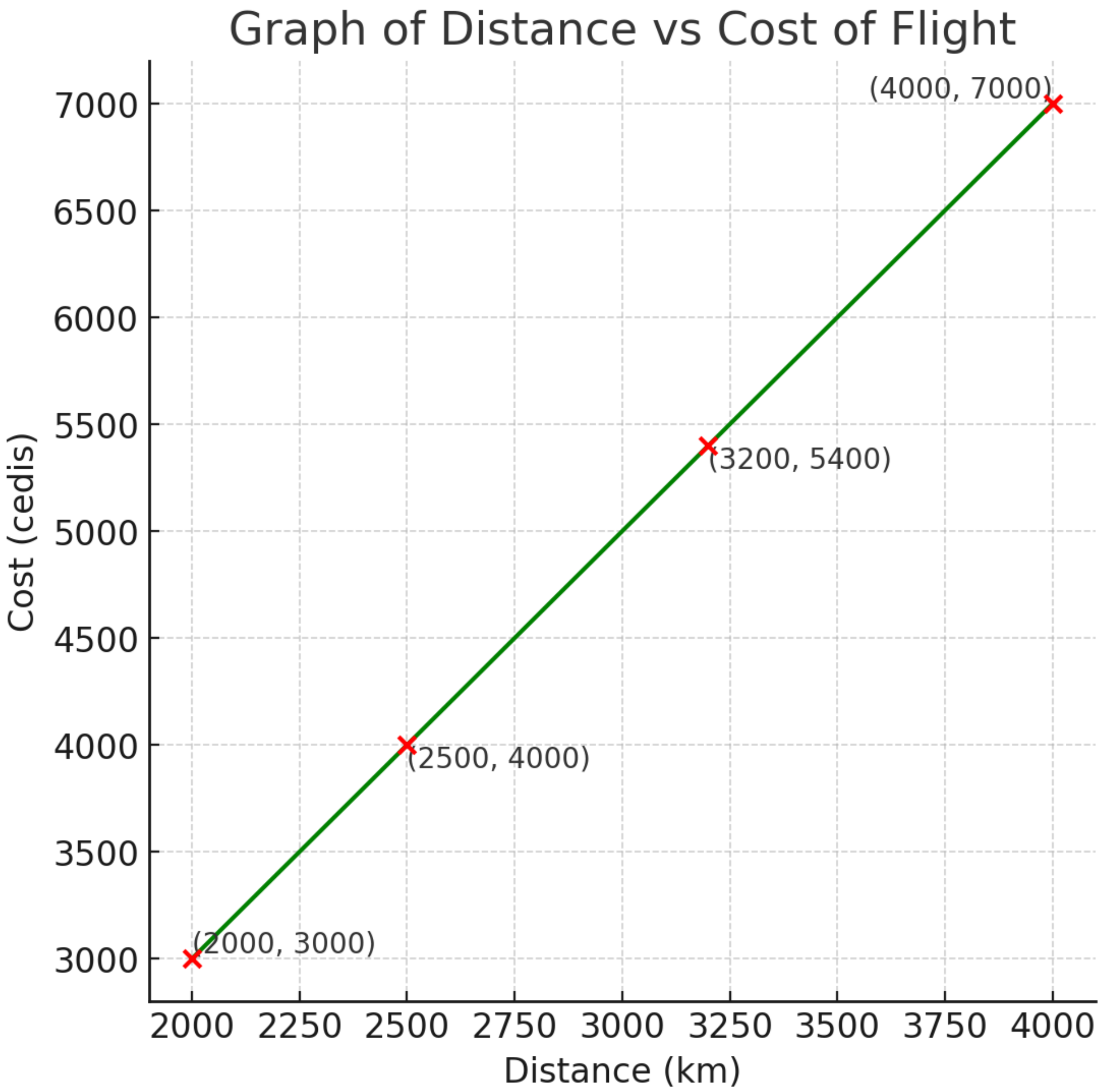

Figure 4: Distance and Flight Cost Graph

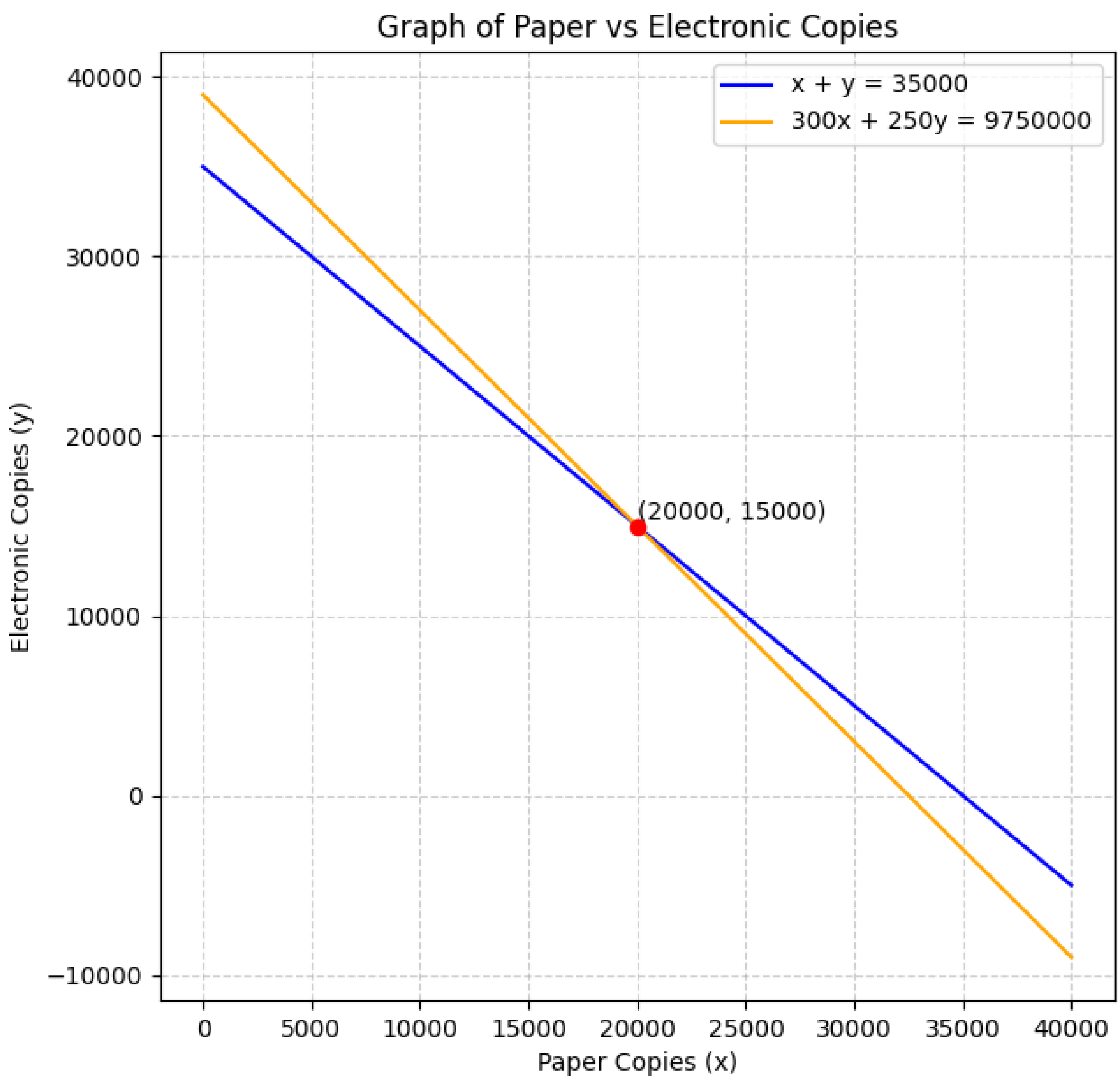

Figure 5: Paper and Electronic Copies Graph