



MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

MATH 122

Ann Clifton ¹

¹University of South Carolina, Columbia, SC USA

Calculus for Business Administration and Social
Sciences



OUTLINE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

1 4.3: GLOBAL MAXIMA AND MINIMA



OUTLINE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

1 4.3: GLOBAL MAXIMA AND MINIMA

2 2.5: MARGINAL COST AND REVENUE



OUTLINE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

1 4.3: GLOBAL MAXIMA AND MINIMA

2 2.5: MARGINAL COST AND REVENUE

3 4.4: PROFIT, COST, AND REVENUE

- Maximizing Profit
- Maximizing Revenue



GLOBAL EXTREMA

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

DEFINITION 1

For any function, f , we say



GLOBAL EXTREMA

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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For any function, f , we say

- f has a *global minimum* at p if $f(p) \leq f(x)$ for all x in the domain of f .



GLOBAL EXTREMA

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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GLOBAL EXTREMA

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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- f has a *global maximum* at p if $f(x) \leq f(p)$ for all x in the domain of f .

THEOREM 1

If f is a continuous function defined on a closed interval, $[a, b]$, then f has a global minimum and a global maximum on $[a, b]$.



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

Find the global extrema of $f(x) = x^3 - 9x^2 - 48x + 52$ on $[-5, 14]$.



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

Find the global extrema of $f(x) = x^3 - 9x^2 - 48x + 52$ on $[-5, 14]$.

$$f'(x) = 3x^2 - 18x - 48$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

Find the global extrema of $f(x) = x^3 - 9x^2 - 48x + 52$ on $[-5, 14]$.

$$f'(x) = 3x^2 - 18x - 48 = 3(x^2 - 6x - 16)$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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$$\begin{aligned}f'(x) &= 3x^2 - 18x - 48 = 3(x^2 - 6x - 16) \\ &= 3(x + 2)(x - 8)\end{aligned}$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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$$\begin{aligned}f'(x) &= 3x^2 - 18x - 48 = 3(x^2 - 6x - 16) \\&= 3(x + 2)(x - 8) \\f''(x) &= 6x - 18 = 6(x - 3)\end{aligned}$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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$$f''(x) = 6x - 18 = 6(x - 3)$$

$$\Rightarrow f''(-2) = 6(-2 - 3) < 0$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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$$f(-5) = -58$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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$$f(-5) = -58$$

$$f(14) = 360$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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$$\Rightarrow f''(8) = 6(8 - 3) > 0.$$

$$f(-5) = -58$$

$$f(14) = 360$$

$$f(-2) = 104$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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$$f(-5) = -58$$

$$f(14) = 360$$

$$f(-2) = 104$$

$$f(8) = -396.$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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$$f(-5) = -58$$

$$f(14) = 360$$

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$$f(8) = -396.$$

Maximum: (14,360).



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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$$f(-5) = -58$$

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$$f(8) = -396.$$

Maximum: (14,360).

Minimum: (8,-396).



DEFINITION

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

For a cost function, $C(q)$, and a revenue function, $R(q)$,
define



DEFINITION

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

For a cost function, $C(q)$, and a revenue function, $R(q)$, define

- the *marginal cost* is

$$\frac{d}{dq} C(q) = C'(q), .$$



DEFINITION

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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- the *marginal cost* is

$$\frac{d}{dq} C(q) = C'(q), .$$

- the *marginal revenue* is

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MARGINAL PROFIT

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

DEFINITION 2

The *marginal profit* is

$$\pi'(q) = R'(q) - C'(q).$$



MARGINAL PROFIT

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

DEFINITION 2

The *marginal profit* is

$$\pi'(q) = R'(q) - C'(q).$$

REMARK 1

Critical points occur whenever marginal cost equal marginal revenue, or one of marginal cost/revenue is undefined.



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

Find the quantity which maximizes profit for the given revenue and cost functions on $[0, 1000]$

$$R(q) = 5q - 0.003q^2$$

$$C(q) = 300 + 1.1q$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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$$R(q) = 5q - 0.003q^2$$

$$C(q) = 300 + 1.1q$$

Since

$$\pi(q) = -0.003q^2 + (5 - 1.1)q - 300$$

is a quadratic with negative leading coefficient, the global maximum occurs at



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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$$q = \frac{-(5 - 1.11)}{2(-0.003)}$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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Since

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is a quadratic with negative leading coefficient, the global maximum occurs at

$$q = \frac{-(5 - 1.11)}{2(-0.003)} = 650$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

At a price of \$80 for a half day trip, a white water rafting company attracts 300 customers.



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

At a price of \$80 for a half day trip, a white water rafting company attracts 300 customers. Every \$5 decrease in price attracts an additional 30 customers.



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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Since each \$5 decrease in the price, p , increases the number of customers, q , by 30, we have

$$q(p)$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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Since each \$5 decrease in the price, p , increases the number of customers, q , by 30, we have

$$q(p) = 300 + \frac{(80 - p)}{5} \cdot 30$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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$$\begin{aligned} q(p) &= 300 + \frac{(80 - p)}{5} \cdot 30 \\ &= 300 + 6(80 - p) \end{aligned}$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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$$\begin{aligned}q(p) &= 300 + \frac{(80 - p)}{5} \cdot 30 \\&= 300 + 6(80 - p) \\&= 300 + 480 - 6p\end{aligned}$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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$$\begin{aligned}q(p) &= 300 + \frac{(80 - p)}{5} \cdot 30 \\&= 300 + 6(80 - p) \\&= 300 + 480 - 6p \\&= -6p + 780.\end{aligned}$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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The revenue is therefore

$$R(p) =$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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The revenue is therefore

$$R(p) = p(-6p + 780)$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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The revenue is therefore

$$R(p) = p(-6p + 780) = -6p^2 + 780p.$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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The revenue is therefore

$$R(p) = p(-6p + 780) = -6p^2 + 780p.$$

This is a downward facing parabola, so the maximum occurs at the vertex



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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$$\frac{-780}{2(-6)}$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

MAXIMIZING
REVENUE

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The revenue is therefore

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This is a downward facing parabola, so the maximum occurs at the vertex

$$\frac{-780}{2(-6)} = \frac{780}{12}$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
COST, AND
REVENUE

MAXIMIZING
PROFIT

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At a price of \$80 for a half day trip, a white water rafting company attracts 300 customers. Every \$5 decrease in price attracts an additional 30 customers. What price should the company charge per trip to maximize revenue?

The revenue is therefore

$$R(p) = p(-6p + 780) = -6p^2 + 780p.$$

This is a downward facing parabola, so the maximum occurs at the vertex

$$\frac{-780}{2(-6)} = \frac{780}{12} = 65$$



EXAMPLE

MATH 122

CLIFTON

4.3: GLOBAL
MAXIMA AND
MINIMA

2.5:
MARGINAL
COST AND
REVENUE

4.4: PROFIT,
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$$R(65)$$



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The maximum revenue is

$$R(65) = \$25,350.$$