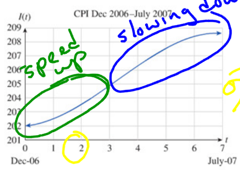
63. ***Inflation*** The following graph shows the approximate value of the United States Consumer Price Index (CPI) from December 2006 through July 2007.[31]



$\frac{I'(t)}{I(t)} = \frac{1.22}{203.48} = .006 = .6\%$

%

$I' = -.12t^2 + .8t + .1$

The approximating curve shown on the figure is given by

$I(t) = -0.04t^3 + 0.4t^2 + 0.1t + 202 \quad (0 \le t \le 7)$ $I(2)$

where t is time in months ($t = 0$ represents December 2006).

a. Use the model to estimate the monthly inflation rate in February 2007 ($t = 2$). [Recall that the inflation *rate* is $I'(t)/I(t)$.]

b. Was inflation slowing or speeding up in February 2007?

c. When was inflation speeding up? When was inflation slowing? HINT [See Example 3.]

$I'' = -.24t + .8$

$I'' = -.24(2) + .8 = .3$

$-.24t + .8 = 0$
$\quad -.8 \quad -.8$
$\frac{-.24t}{-.24} = \frac{-.8}{-.24}$
$t \approx 3.3$

speed up $0 \le t \le 3.3$
slow down $3.4 \le t \le 7$
speed up dec – Mar
slow down Mar – Jul

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64. ***Inflation*** The following graph shows the approximate value of the U.S. Consumer Price Index (CPI) from September 2004 through November 2005.[32]

The approximating curve shown on the figure is given by

$I(t) = -0.005t^3 + 0.12t^2 - 0.01t + 190 \quad (0 \le t \le 14)$

where t is time in months ($t = 0$ represents September 2004).

a. Use the model to estimate the monthly inflation rate in July 2005 ($t = 10$). [Recall that the inflation *rate* is $I'(t)/I(t)$.]

b. Was inflation slowing or speeding up in July 2005?

c. When was inflation speeding up? When was inflation slowing? HINT [See Example 3.]

$I' = -.015t^2 + .24t - .01$

.45%

$I'' = -.03t + .24$

$-.03t + .24 = 0$
$-.03t = -.24$
$t = 8$

Speeding up 0–8 sept – May
slow down 8–14 May – Nov.

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$y = (2-3x)^5$
$y' = 5(2-3x)^4(-3)$

$y = e^{2-3x}$
$y' = e^{2-3x}(-3)$

$y = \ln(2-3x)$
$y' = \frac{1}{2-3x}(-3)$

$y = (2x+3)^4(2-3x)^5$
$y' = (2x+3)^4\, 5(2-3x)^4(-3) + 4(2x-3)^3(2)\,(2-3x)^5$

$y = (2x+3)^4 \ln(x)$
$y' = 4(2x+3)^3 \cdot 2\ln(x) + (2x+3)^4 \cdot \frac{1}{x}$
$= 8(2x+3)^3 \ln(x) + \frac{(2x+3)^4}{x}$

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$y = (2x+3)^4 \ln(x)$
$y' = 4(2x+3)^3 \cdot 2\ln(x) + (2x+3)^4 \cdot \frac{1}{x}$
$= 8(2x+3)^3 + \frac{(2x+3)^4}{x}$

$y = (2x+5)^3 e^{4x}$
$y' = 3(2x+5)^2 \cdot 2e^{4x} + (2x+5)^3 e^{4x} \cdot 4$
$= 6(2x+5)^2 e^{4x} + 4(2x+5)^3 e^{4x}$

$y = (2x+1)^4 \ln(3x+1)$
$y' = 4(2x+1)^3 \cdot 2\ln(3x+1) + (2x+1)^4 \cdot \frac{1}{3x+1} \cdot 3$
$= 8(2x+1)^3 \ln(3x+1) + \frac{3(2x+1)^4}{3x+1}$

$y = e^{4x} \ln(3x+1)$
$y' = e^{4x} \cdot 4\ln(3x+1) + e^{4x} \cdot \frac{1}{3x+1} \cdot 3$
$= 4e^{4x} \ln(3x+1) + \frac{3e^{4x}}{3x+1}$

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When p = 8 then q = 100 and when p = 4 then q = 600.
Find a function relating p and q. ★ linear

x: p	y: q
8	100
4	600

① $m = \frac{600-100}{4-8} = \frac{500}{-4} = -125$

② $q = -125p + b$

$100 = -125 \cdot 8 + b$

$100 = -1000 + b$

$+1000 \quad +1000$

$1100 = b$

$q = -125p + 1100$

Linear equation

Linear function

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When p = 40 then q = 8,000 and when p = 60 then q = 6,000.
Find a function relating p and q.

p	q
40	8,000
60	6,000

$m = \frac{6{,}000 - 8{,}000}{60-40} = \frac{-2000}{20} = -100$

$q = -100p + b$

$8{,}000 = -100 \cdot 40 + b$

$8000 = -4000 + b$

$+4000 \quad +4000$

$12000 = b$

$q = -100p + 12000$

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Given the demand function: $q = 4000 - 500p$

a. find a revenue function whose variable is p

b. find a revenue function whose variable is q.

c. Given a per-item cost (no overhead) of \$6 per item, find a ~~profit~~ cost function whose variable is q

d. Find a cost function whose variable is p

e. Find a profit function for this situation (put together two of the above functions)

d. Use e to maximize the profit

i. What production quantity maximizes the profit?

ii. What price point maximizes the profit?

iii. What is the maximum profit?

a. $(4000-500p)p = 4000p - 500p^2$

b. $q = 4000 - 500p$

$-4000 \quad -4000$

$\frac{q-4000}{-500} = \frac{-500p}{-500}$

$-.002q + 8 = p$

$(-.002q+8)q = -.002q^2 + 8q$

c. $= 6q$

$C = 6(4000-500p)$
$= 24000 - 3000p$

e. $= 4000p - 500p^2 - (24000 - 3000p)$
$= -500p^2 + 7000p - 24000$

$= -.002q^2 + 8q - 6q = -.002q^2 + 2q$

$P' = -1000p + 7000 = 0$

ii → $-1000p = -7000$

$p = 7$

i $q = 4000 - 500 \cdot 7$
$= 500$

$P = -500 \cdot 7^2 + 7000 \cdot 7 - 24000$
$= 500$

$P' = -.004q + 2 = 0$

$\frac{-.004q}{-.004} = \frac{-2}{-.004}$

i $q = 500$

ii. $P = -.002 \cdot 500 + 8$
$= 7$

$P = -.002 \cdot 500^2 + 2 \cdot 500$
$= 500$

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9. a. Given the demand function: $q = 30{,}000 - 4000p$

and a per-item cost (no overhead) of \$2 per item, find a profit function for this situation (using your favorite strategy from #8)

$R = (30{,}000 - 4000p)p = 30000p - 4000p^2$

$C = 2q = 2(30{,}000 - 4000p)$
$= 60{,}000 - 8000p$

$P = 30{,}000p - 4000p^2 - (60{,}000 - 8000p)$
$= 30{,}000p - 4000p^2 - 60{,}000 + 8000p$
$= 38{,}000p - 4000p^2 - 60{,}000$

$q = 30{,}000 - 4000p$

$\frac{q - 30{,}000}{-4000} = \frac{-4000p}{-4000}$

$-.00025q + 7.5 = p$

$R = (-.00025q + 7.5)q$
$= -.00025q^2 + 7.5q$

$P = -.00025q^2 + 7.5q - 2q$
$= -.00025q^2 + 5.5q$

Use a to maximize the profit

i. What production quantity maximizes the profit?

ii. What price point maximizes the profit?

iii. What is the maximum profit?

$P' = 38{,}000 - 8000p^2 = 0$

$\frac{38{,}000}{8000} = \frac{8000p}{8000}$

$\$4.75 = p \to$ price (ii)

$q = 30{,}000 - 4000p$
$30{,}000 - 4000 \cdot 4.75 = 11{,}000$ (i)

$P = 38{,}000p - 4000p^2 - 60{,}000$
$= 38{,}000 \cdot 4.75 - 4000 \cdot 4.75^2 - 60{,}000$
$P = \$30{,}250$ (iii)

$P' = -.0005q + 5.5 = 0$

$\frac{5.5}{.0005} = \frac{.0005q}{.0005}$

$11{,}000 = q \leftarrow$ (i)

$p = -.00025q + 7.5$
$= -.00025 \cdot 11{,}000 + 7.5$
$= \$4.75$ (ii)

$P = -.00025q^2 + 5.5q$
$= -.00025 \cdot 11{,}000^2 + 5.5 \cdot 11{,}000$
$= \$30{,}250$

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9. c. Given the demand function: $q = 30,000 - 4000p$

and a per-item cost of \$2 per item, *and* an overhead fixed cost of \$3000 find a profit function for this situation

$R = (30,000 - 4000p)p = 30000p - 4000p^2$

$C = 2q = 2(30,000 - 4000p) + 3000$

$= 63,000 - 8000p$

$P = 30,000p - 4000p^2 - (63,000 - 8000p)$

$= 30,000p - 4000p^2 - 63,000 + 8000p$

$= 38,000p - 4000p^2 - 63,000$

$q = 30,000 - 4000p$

$\frac{q - 30,000}{-4000} = \frac{-4000p}{-4000}$

$-.00025q + 7.5 = p$

$R = (-.00025q + 7.5)q$

$= -.00025q^2 + 7.5q$

$P = -.00025q^2 + 7.5q - 2q - 3000$

$= -.00025q^2 + 5.5q - 3000$

Use a to maximize the profit

i. What production quantity maximizes the profit?

ii. What price point maximizes the profit?

iii. What is the maximum profit?

$P' = 38,000 - 8000p = 0$

$\frac{38,000}{8000} = \frac{8000p}{8000}$

$\$4.75 = p \rightarrow$ price (ii)

$q = 30,000 - 4000p$

$30,000 - 4000 \cdot 4.75 = 11,000$ (i)

$P = 38,000p - 4000p^2 - 63,000$

$= 38,000 \cdot 4.75 - 4000 \cdot 4.75^2 - 63,000$

$P = \$27,250$ (iii)

$P' = -.0005q + 5.5 = 0$

$\frac{5.5}{.0005} = \frac{.0005q}{.0005}$

$11,000 = q \leftarrow$ (i)

$p = -.00025q + 7.5$

$= -.00025 \cdot 11,000 + 7.5$

$= \$4.75$ (ii)

$P = -.00025q^2 + 5.5q - 3000$

$= -.00025 \cdot 11,000^2 + 5.5 \cdot 11,000 - 3000$

$= \$27,250$

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