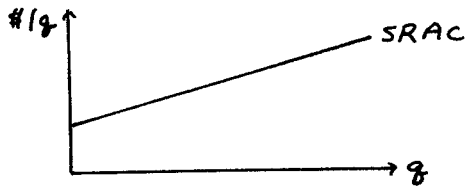
ECO 601
2nd Test
Fall 2003

5 questions, 100 points total.

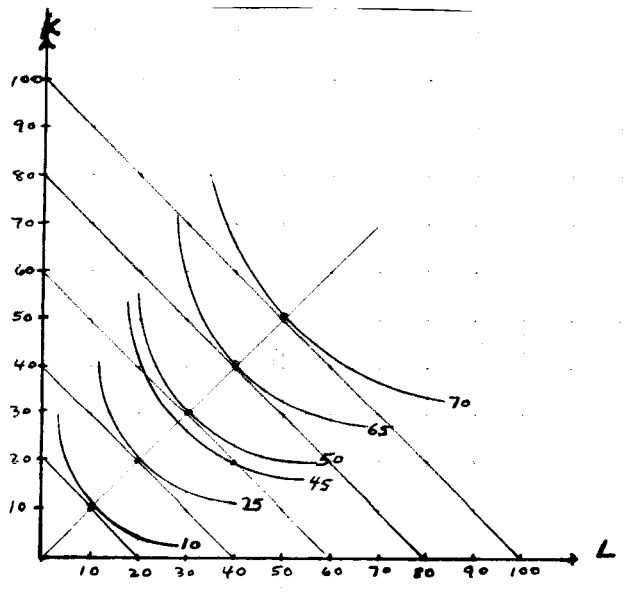
1. (10pts.) What is wrong with this picture? In your answer you should explain the relationship between cost and output implied in the diagram.



2. (20 pts.) Suppose the total cost function can be expressed as $TC = 2Q^2w^{.5}v^{.5}$, where Q is output, and w and v represent per unit prices of labor and capital.
   a) What can you say about economies or diseconomies of scale? Briefly explain.
   b) Is this cost function homogeneous of degree one in input prices? Briefly prove your answer.

3. (20 pts.) You own a company that produces plastic products. A major product is plastic drinking cups. The production function for these cups is given by $Q = 600K^2L^2 - K^3L^3$, where Q is output and K and L are capital and labor inputs, respectively.
   a) Derive expressions for MP_L and AP_L. Graph these functions on the attached graph paper for K = 10, emphasizing the critical points.
   b) Would you ever use the combination K = 15 and L = 30 to produce plastic cups? Hint: remember the concept of ridge lines in explaining your answer.

4. (20 pts.) The expansion path of a firm is illustrated in the diagram below. Isoquants are illustrated for various outputs. The firm faces input prices of w = $2 and v = $2.
   a) On the attached graph paper, graph five points on the firm's long-run total cost curve.
   b) Graph five points on the firm's long-run average cost curve.
   c) Graph three points on the firm's short-run total cost curve if capital is fixed at K = 20.
   d) Graph three points on the firm's short-run average cost curve if capital is fixed at K = 20.



5. (30 pts.) Along with your brother Moe and your sister Curly Sue, you own a carpentry company that constructs the wooden frame structures for new custom-built houses. This is a competitive industry, and there are many other firms like yours that frame new houses. The product is homogeneous and there are no entry barriers. Your long-run total cost function is given by $TC = 40q - 6q^2 + \frac{1}{3}q^3$, where q is your annual output. Market demand for framing houses is given $Q = 2200 - 100P$, where Q is aggregate market output and P is market price. Assume that the market is initially in long-run equilibrium.
    a) On the attached graph paper, illustrate your firm's average and marginal cost curves.
    b) What will price be and how many houses will you frame per year if the market is in long-run equilibrium? How many firms will there be in this market?
    c) Suppose that you join with all of the other firms in the market and form a cartel. You convince the city government not to allow any new firms to enter the market. You also are able to convince each firm in the market to reduce their output by one unit per year. What will the new market price be? How much profit will each firm earn under this cartel arrangement? Illustrate in your diagram.

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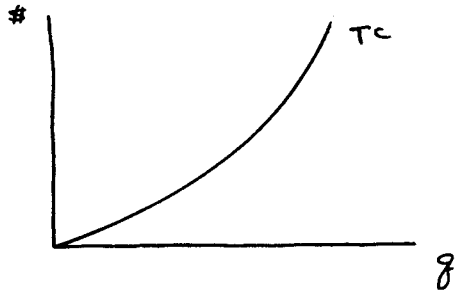
1. The total cost curve that gives rise to the illustrated SRAC curve must look like:



Since it goes through the origin, there are no fixed costs. Hence it really isn't a short-run curve.

2. (a) $TC = 2Q^2 w^{1/2} v^{1/2}$

Total cost increases quadratically with increases in output, so average cost is increasing with increases in output. This means diseconomies of scale.

(b) for given w and v, $TC = 2Q^2 w^{1/2} v^{1/2}$

w and v change by same proportion m:

$$TC = 2Q^2 (mw)^{1/2} (mv)^{1/2} = m \cdot 2Q^2 w^{1/2} v^{1/2}$$

so this cost function is homogeneous of degree one in input prices.

3. $Q = 600K^2L^2 - K^3L^3$

(a) $MP_L = \frac{dQ}{dL} = 1200K^2L - 3K^3L^2$

$AP_L = \frac{Q}{L} = 600K^2L - K^3L^2$

if $K = 10$, $MP_L = 120{,}000L - 3000L^2$

and $AP_L = 60{,}000L - 1000L^2$

critical points:

max MP_L: $\frac{dMP_L}{dL} = 120{,}000 - 6000L = 0$, $L = 20$

max AP_L: $\frac{dAP_L}{dL} = 60{,}000 - 2000L = 0$, $L = 30$

$MP_L = 0$: $120{,}000L - 3000L^2 = 0$, $L = 40$

(b) It is uneconomic to use the input combination $K = 15$, $L = 30$ if either or both MP_L and MP_K are negative. Since both are negative when $K = 15$ and $L = 30$, you would never use that combination:

$MP_L = 1200K^2L - 3K^3L^2$

$= (1200)(225)(30) - (3)(3375)(900)$

$8{,}100{,}000 - 9{,}112{,}500 = -1{,}012{,}500$

$MP_K = 1200KL^2 - 3K^2L^3$

$= (1200)(15)(900) - (3)(27000)(225)$

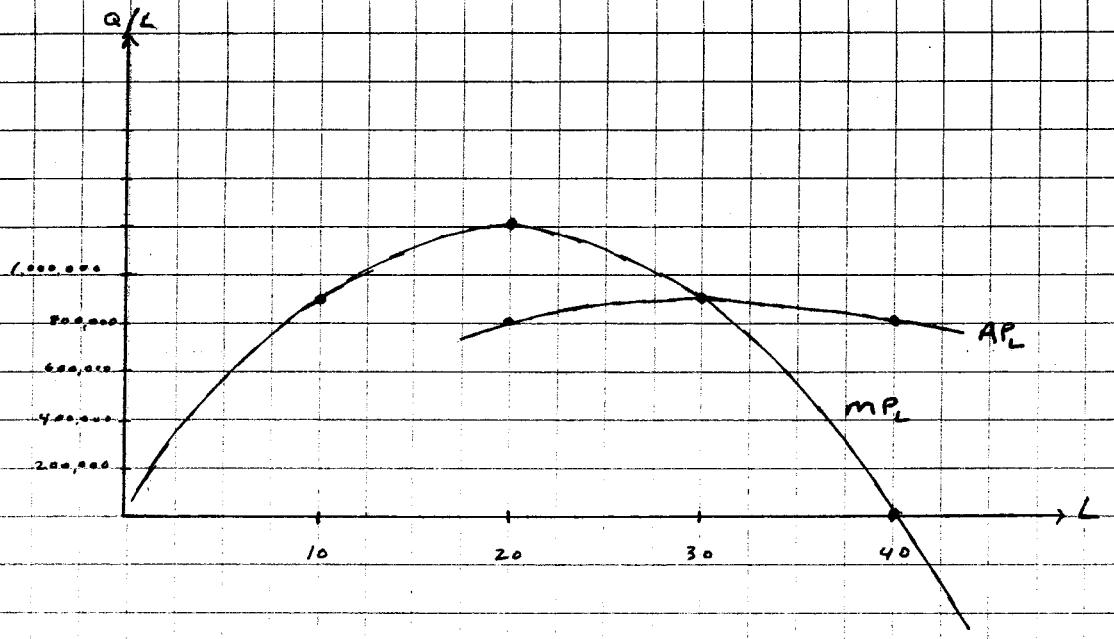
$= 16{,}200{,}000 - 18{,}225{,}000 = -2{,}025{,}000$

so $MP_L < 0$ and $MP_K < 0$

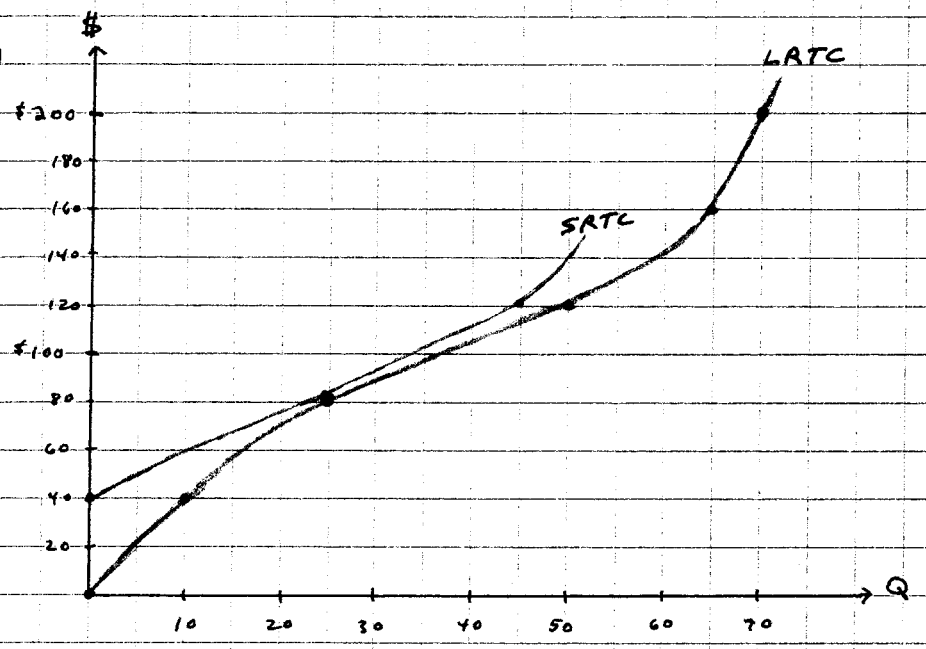
4.

Q	0	10	25	45	50	65	70
LRTC	\$0	\$40	\$80		\$120	\$160	\$200
LRAC	-	\$4	\$3.20		\$2.40	\$2.46	\$2.86
for K=20 SRTC	\$40		\$80	\$120			
for K=20 SRAC	-		\$3.20	\$2.67			

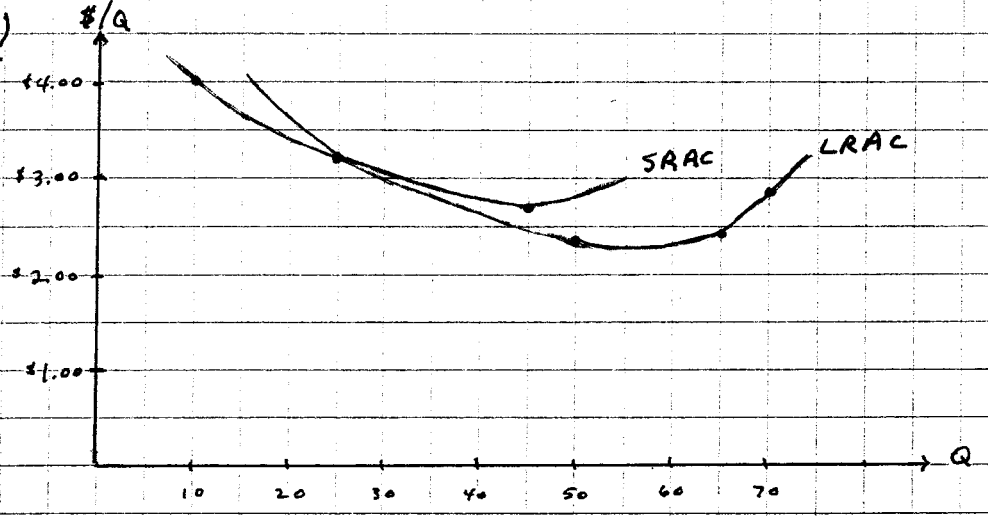
3(a)


Q/L
1,000,000
800,000
600,000
400,000
200,000
AP_L
MP_L
L
10
20
30
40

4 (a, c)


$
$200
180
160
140
120
$100
80
60
40
20
LRTC
SRTC
Q
10
20
30
40
50
60
70

4 (b, d)


$/Q
$4.00
$3.00
$2.00
$1.00
SRAC
LRAC
Q
10
20
30
40
50
60
70

5. (a) $TC = 40q - 6q^2 + 1/3\, q^3$

$MC = 40 - 12q + q^2$

$AC = 40 - 6q + 1/3\, q^2$

$AC = MC$ where $40 - 12q + q^2 = 40 - 6q + 1/3\, q^2$

or where $\frac{2}{3} q^2 - 6q = 0$, or $q = 9$

min $AC = \$13$ at $q = 9$. [see graph]

(b) In long-run equilibrium $P = \min AC = \$13$.

If market price = \$13 then market demand is:

$Q = 2200 - 100P = 2200 - 1300 = 900$

$\sum_{i=1}^{n} q_i = Q_i$, $q_i = 9$, $Q_i = 900$, so $n = 100$

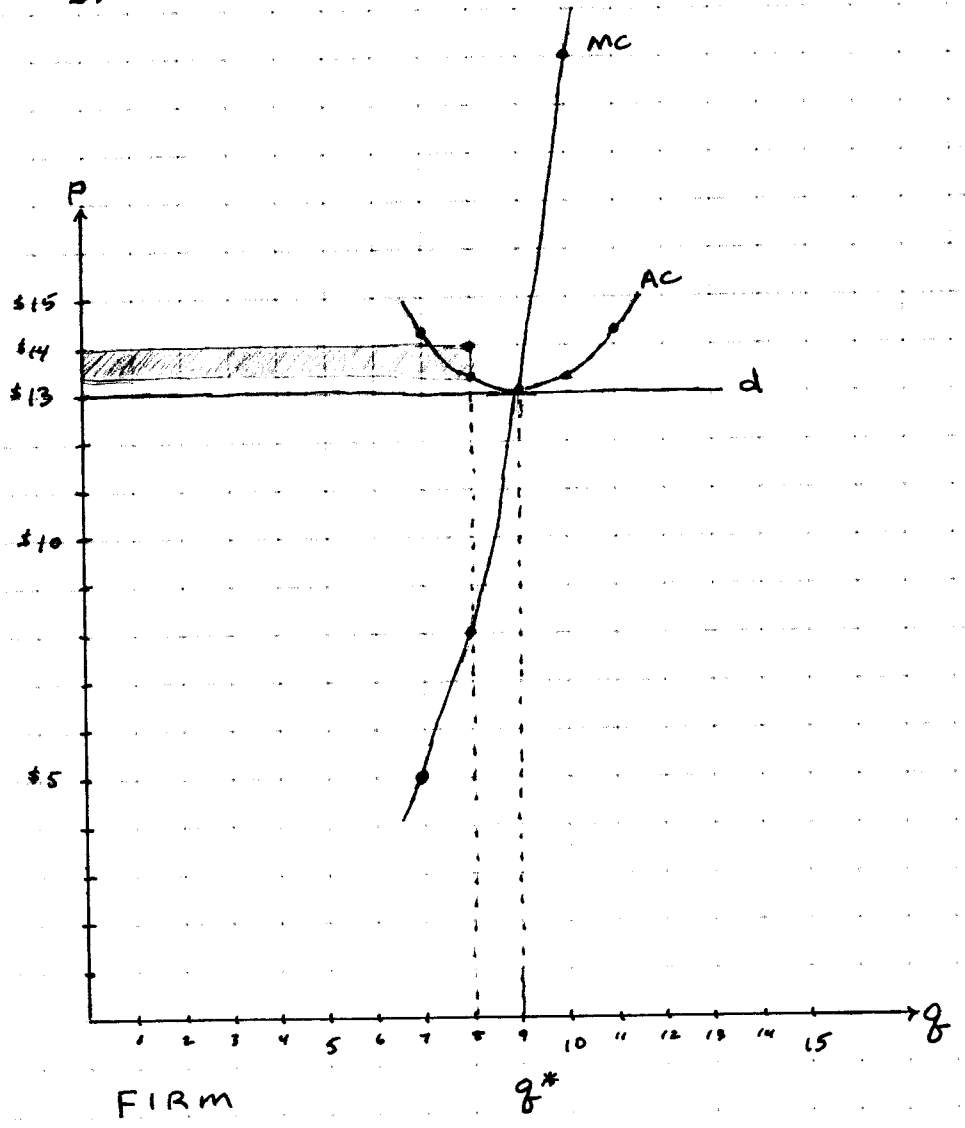
(c) n is fixed at $n = 100$. Each firm reduces its output from $q = 9$ to $q = 8$, so market output declines to 800. If $Q = 800$, then market price will be $Q = 2200 - 100P$,

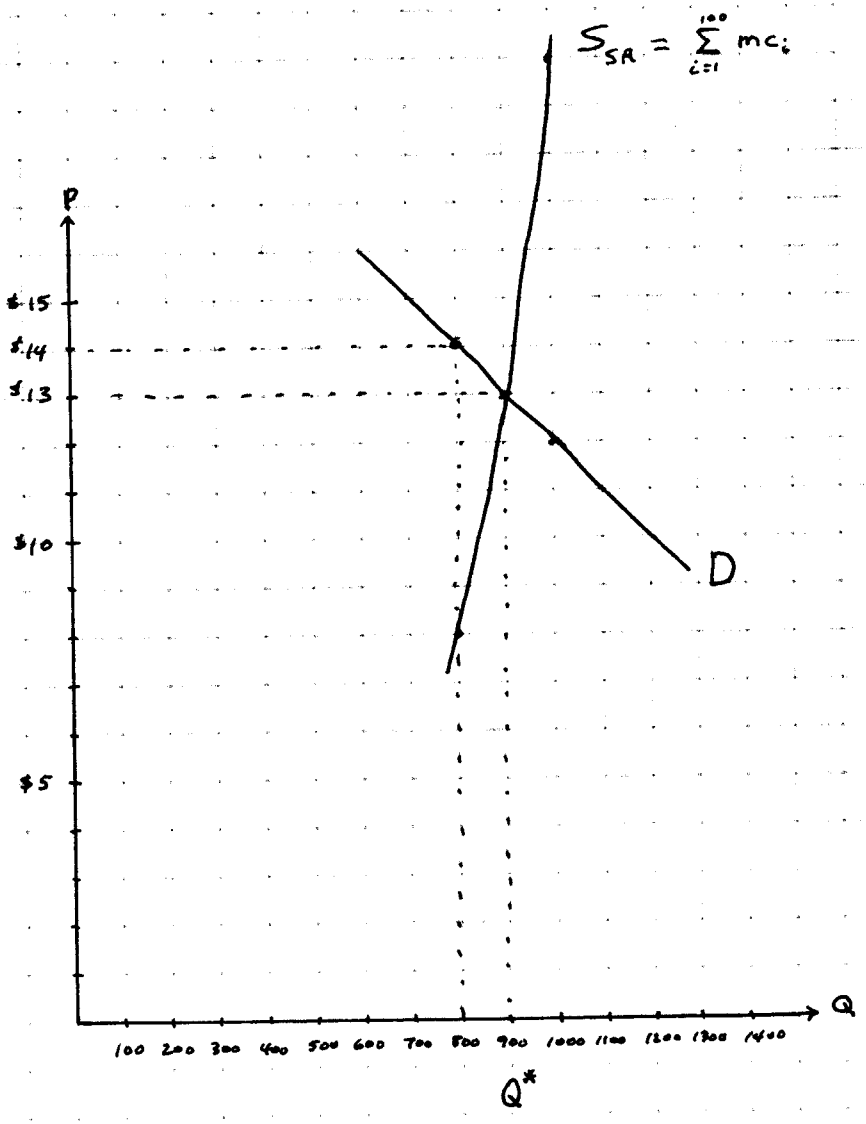
or $800 = 2200 - 100P$, $P = \$14$

if $q = 8$, $AC = 40 - 6(8) + \frac{1}{3}(8)^2 = \$13.33$

Firm's profit $= (P - AC)\, q = \$5.33$

5.


MC
AC
d
P
$15
$14
$13
$10
$5
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
q
FIRM
q*


$S_{SR} = \sum_{i=1}^{100} mc_i$
P
$15
$14
$13
$10
$5
D
100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400
Q
Q*