Due Thursday, May 2nd at 11 AM in class.

Be legible and please print.

Label your graph.

Your target audience is not me but your peers. A successful answer is the one that convinces your peers that your answer is correct without further explanation. If they don’t buy your argument, your answer is incomplete even when the end result is correct. Unless otherwise stated, your job is not only to leave the answer but explain why your answer is correct.

Show your intermediate work whenever possible. This will help with partial credits in case you did not reach the correct answer.

1 randomly chosen section out of section 1, section 3 or section 4 will be graded. The entire section 2 is optional. Make sure you review them all with the suggested solution to be posted though. You might meet any one of them again in the exam.

The ones marked [Optional] do not count towards the score. Math freaks or economics aficionados, go ahead. Otherwise, you can skip them and review the suggested solution later.

Some questions are easy and some are challenging (otherwise you will get bored). I marked each question as follows for your convenience:

 emojis You can solve this blindfold. This is meant to test your basic understanding of the material.

 emojis You might want to take off your blindfold.

 emojis This one calls for a light bulb moment. Think it through till your light comes on.
1  CMP in the Long Run and Short Run

A. Impressed with Chazman’s apt hiring and investment decision in Q2 on Problem Set #4, Delta is now asking him to reduce the baggage loss rate down to 4 percent. Factor price remains the same as before at \( w = (w_H, w_T) = (1, 2) \). Write his cost minimization problem.

B. Find the solution \( x^* = (x_H^*, x_T^*) \) to item A. (Tip: You’ll have \( \sqrt{5} \) somewhere in your answer).

C. How much does \( x^* \) in item B cost?

D. What is the marginal cost at \( y = 4? \) (Tip: You have already computed total cost at \( y = 5 \) in Problem Set #4. What is the cost increase from \( y = 4 \) to \( y = 5 \)? Also, \( \sqrt{5} \approx 2.2 \)).

E. Your marginal cost in item D should be a negative value (yes, go ahead and redo item D). Explain why.

F. How much of marginal cost in item D comes from baggage handlers? (Tip: Chazman already knows \( x \) when \( y = 5 \) in Problem Set #4. Compare this to item B).

G. What would be the total cost associated with item G and how much of it is fixed cost?

H. Suppose that Delta imposed hiring freeze so that Chazman has to keep to \( x_H = 2 \) and still achieve 4 percent baggage loss rate. Which version of tracking software should he use?

I. Suppose that hiring freeze is still in place. Compute the total cost when \( y = 20 \) and 80 and sketch it on a graph (along with \( y = 4 \) and 5 from above).

J. Suppose that Delta lifted hiring freeze. Compute Chazman’s total cost at \( y = 20 \) and 80 and sketch it on the same graph you drew in item I (along with \( y = 4 \) and 5 from above).

K. You should be able to see how total costs are related on a graph in item J. Compute MRTS\(^1\) at item G and compare it to relative (factor) price. Discuss why Chazman’s total cost in item G is different from item C without using equations.

2  PMP and Supply Curve [Optional]

Tom’s total cost of production is given by

\[
TC(y) = \frac{1}{2} y^3 + 18,
\]

where \( y \) denotes a number of cheesecakes he produces. Marginal cost is

\[
MC(y) = y^2.
\]

A. What are his fixed cost \( FC \) and variable cost \( VC(y) \)?

B. What are his average cost \( AC(y) \) and average variable cost \( AVC(y) \)?

C. What is his minimum efficient scale \( y^{MIS} \) and break-even price? (Tip: Use Proposition 2.8 on p.28 in Chapter 21. Also note \( 27 = 3^3 \)).

D. Denoting the price of cheesecake by \( p \), write his (long-run) profit maximization problem in terms of \( y \).

E. Suppose that current price is \( p = 16 \). Show that \( y = 5 \) is not a profit maximizer by comparing marginal cost to marginal revenue.

F. Find a solution \( y^* \) to item D when \( p = 16 \).

G. Distracted by NFL draft, Tom forgot to complete the second step in twofold decision making process and accidentally sold \( y^* \) cheesecakes according to marginal condition when \( p = 4 \). Compute his profit.

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\(^1\)It is left on Problem Set #4.
3 Recast from CMP to PMP

Blair owns a bakery and she bakes cheesecakes according to the production function

\[ f(x) = \sqrt{x_C} + \sqrt{x_K}, \]  

(1)

where \( x_C \) is hours worked and \( x_K \) is units of kitchen. Both factors of production are not predetermined. Factor price is \( w = (w_C, x_K) = (4, 2) \). Marginal rate of technical substitution at \( x \) is

\[ MRTS(x_C, x_K) = \frac{-\sqrt{x_K}}{\sqrt{x_C}}. \]

A. What is her returns to scale? (Tip: \( \sqrt{2} < 2 \)).

B. What is the opportunity cost of an hour of work measured in terms of kitchen units?

C. When Blair produces at \( x = (1, 4) \), how many kitchen units can she forgo by extending hours worked by one hour without disrupting the output level?

D. Suppose that she has to bake \( y \) cheesecakes. Write her cost minimization problem.

E. State her tangency condition.

F. Find the solution \( x^* = (x^*_C, x^*_K) \) to item D when \( y = 3, 6 \) and 9 each. Do not quote item G but you can use it to confirm your answer).

G. [Optional] Find the solution \( x^* = (x^*_C, x^*_K) \) to item D. (Tip: The answer is \( x^* = \left( \frac{y^2}{9}, \frac{4y^2}{9} \right) \).

Show intermediate steps).

H. What is the total cost of producing \( y = 3, 6 \) and 9 cheesecakes?

I. [Optional] Construct total cost function \( TC(y) \) from item G.

J. Her total cost written in terms of \( y \) is

\[ TC(y) = \frac{4}{3}y^2. \]  

(2)

Denote the output price by \( p \) and write her profit maximization problem in terms of \( y \).

K. What is her marginal revenue?

L. Marginal cost of (2) is

\[ MC(y) = \frac{8}{3}y. \]

State marginal condition.

M. Find the solution \( y^* \) to item J when \( p = 8, 16 \) and 24 each. (Tip: minimum efficient scale is \( y^{MES} = 0 \). Quote her break-even price for the second part of her decision making).

N. What input bundle does she choose to produce each \( y^* \) in item M?

O. Sketch her supply function.

P. What is her average cost \( AC(y) \)?

Q. Does \( AC(y) \) increase or decrease with \( y \)? Explain why without using equations. (Tip: Refer to item A and Section 4 in Ch 20: CMP slides).

4 Profit Maximization

Read Landsburg Chapter 5. On p.44, he argues "If our goal is to maximize profits without regard to the effort involved, then most Americans should probably be in forced labor camps". While it is true that consumer’s objective is to maximize utility level and by extension, consume as much as possible, profit maximization will not send everyone to forced labor camp. Review how firms make their decision and explain why having employees work to their limit will not be the solution to profit maximization problem.