ECE 472 Tutorial Review Questions for Chapter 2b

Question 1 – Cost Structures

Textbook question 2-4
This question allows you to explore the relationships between the various costs shown in Figure 2.1 in the textbook. Note the differences between direct, indirect and overhead costs. Remember that in a competitive market place, the market determines the selling price. Companies' cost structures must be such that all costs are covered plus a profit at the price offered in the marketplace.

Question 2 – Estimation

Textbook question 2-6
Note that if different data points are used to calculate the slope, the estimate will be slightly different. The estimate will be equally valid assuming that the points chosen are not outliers (i.e., a great distance from the fitted line).

Question 3 – Estimation

Textbook question 2-9
If there were no cost-capacity data available, one could still use M = 0.6 (the average value for M) to obtain a less accurate but possibly still useful estimate.

Question 4 – Manufacturing Process Cost Functions

Manufacturing Process A:

Fixed Cost: 7 500 000
Variable Cost: $50x + 0.0004x^2$

Manufacturing Process B:

Fixed Cost: 2 500 000
Variable Cost: $80y + 0.0001y^2$

Determine the following:

1. Total Cost Function
2. Average Cost Function
3. Marginal Cost Function for each process
4. Discuss how to get the lowest cost operating point, assuming that you keep both production lines - assume that you need to keep both because neither one alone is capable of producing the volume required.
5. Find the lowest cost operating point for 100 000 units.
6. Show that at this point the marginal costs are indeed equal.
7. Demonstrate that the solution found in Part 5 is the lowest cost operating point by choosing another operating point and showing how moving toward the optimal point reduces costs by shifting production from a high cost process to a lower cost process. You can use a cost table to show how the total costs are minimized at the optimal point and show that they rise on either side.

Question 5 – Estimation & Inflationary Price Increases

The City of Toronto is expecting to experience electricity shortages this summer due the air conditioning peak demands. Toronto Hydro is planning to purchase a number of natural gas powered 750-KW generators. The engineer in charge of the project has managed four similar projects in the past during 2007 and 2010 and the total costs are given below:

Power Output (KW)	Total Cost ($000)	Year
250	325.0	2007
275	344.4	2007
1 200	968.1	2010
1 250	992.2	2010

Electrical Equipment Cost Index

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
132.2	136.8	141.5	146.3	151.5	158.0	163.1	168.4	173.9	180.2

Prepare a preliminary cost estimate of installing the new 750 KW generators in 2016.

Question 6 – Profit Margin

A good customer of Precision Manufacturers desperately needs another 1 200 units of a given product. He has told the company's sales representative that he will pay $100 per unit if delivery can be made within ten days. You have been asked to prepare an estimate. You have been told by the manager of production that 10-day delivery is possible but there has to be a very high profit margin on the order to justify juggling the production schedules.
It takes twenty minutes to produce one unit. The average labour rate is $15 per hour. The materials cost $24 per unit. Variable overhead for an additional 1 200 units is estimated at 40% of direct labour costs and setting up the production machine for the additional 1 200 units is $30 000. Business overhead at Precision Manufacturers is 10% of cost of goods manufactured. What is the profit margin (in a percentage) on this order?

Question 7 – Fixed/Variable Costs

Textbook problem 2-1

Question 8 – Life-cycle costs

Textbook problem 2-3

Question 9 – Cost-Capacity Relationships

Textbook problem 2-8

Question 1 – Textbook 2-4 Solution

Note: figure 2.1 on page 25 is very important here

See solutions to suggested practice problems.

Question 2 – Textbook 2-6 Solution

See solutions to suggested practice problems.

Question 3 – Textbook 2-9 Solution

See solutions to suggested practice problems.

Question 4 – Manufacturing Process Cost Functions – Solution

Manufacturing Example

① $TC(x,y) = TC_A(x) + TC_B(y)$
$= 10{,}000{,}000 + 50x + 80y + .0004x^2 + .0001y^2$

② $AC(x,y) = \frac{TC(x,y)}{(x+y)}$

③ $MC_A(x) = d/dx\, TC(x) = 50 + .0008x$
$MC_B(y) = d/dy\, TC(y) = 80 + .0002y$

④ Lowest Cost Operating Point
- marginal costs are equal at lowest cost point

⑤ Eqn ① $x + y = 100{,}000$
Eqn ② $MC_A(x) = MC_B(y) \Rightarrow 50 + 0.0008x = 80 + 0.0002y$
Solving ①+② yields $\boxed{x = 50{,}000 \text{ and } y = 50{,}000}$

⑥ And $MC_A(50{,}000) = \$90$
$MC_B(50{,}000) = \$90$
} equal as expected.

⑦ To show this 50,000/50,000 point is lowest cost.
① Start with another point.
② Marginal costs will be different,
③ Show how moving production from the line with higher marginal cost will reduce costs by moving that production to lower marginal cost line.
④ Stop when $MC_A = MC_B$ – can't lower costs further

① At (50,000, 50,000) Total Cost = $17.75 Million
Choose another point say ($x = 40{,}000$, $y = 60{,}000$)
TC (40,000, 60,000) = $17.8 Million

② and $MC_A = \$82.00$
$MC_B = 92.00$.

③ Transfer production from higher marginal cost Process B to Process A.
What is the savings on that one unit?
Not producing it on Process B saves $92.00
Producing it on Process A costs $82.00
∴ Net Savings of $10.00

④ As one continues to shift production from B to A, MC A starts to go up and MC B starts to go down. When they are equal at $90.00 you can do no better.
At this point costs are $17.75 Million
- a savings of $50,000 over the starting point of (40,000, 60,000).

Manufacturing Example Cost Table

x	y	TC_A	TC_B	TC	MC_A	MC_B
10 000	90 000	8 040 000	10 510 000	18 550 000	58.00	98.00
20 000	80 000	8 660 000	9 540 000	18 200 000	66.00	96.00
30 000	70 000	9 360 000	8 590 000	17 950 000	74.00	94.00
40 000	60 000	10 140 000	7 660 000	17 800 000	82.00	92.00
50 000	50 000	11 000 000	6 750 000	**17 750 000**	**90.00**	**90.00**
60 000	40 000	11 940 000	5 860 000	17 800 000	98.00	88.00
70 000	30 000	12 960 000	4 990 000	17 950 000	106.00	86.00
80 000	20 000	14 060 000	4 140 000	18 200 000	114.00	84.00
90 000	10 000	15 240 000	3 310 000	18 550 000	122.00	82.00

Note that the lowest Total Cost does indeed occur when the Marginal Costs are equal.

Question 5 – Estimation & Inflationary Price Increases – Solution

Step 1. Use the Cost Index to bring 2007/2010 project to current price levels in 2014.

				Price 2014
250	325	180.2/141.5	1.2735	413.9
275	344.4	180.2/141.5	1.2735	438.6
1200	968.1	180.2/158.0	1.1405	1104.1
1250	992.2	180.2/158.0	1.1405	1131.6

Step 2. Use the cost capacity relationship to determine 750 KW cost. To get the best estimate use one of the 250/275 and one of the 1200/1250 data points to estimate the slope of the line (M).

$$C_{1200} = C_{250}\left(\frac{Q_{1200}}{Q_{250}}\right)^M$$

$$\left(\frac{1104.1}{413.9}\right) = \left(\frac{1200}{250}\right)^M \Rightarrow 2.668 = 4.8^M \Rightarrow M = \frac{\log(2.668)}{\log(4.8)} = 0.6255$$

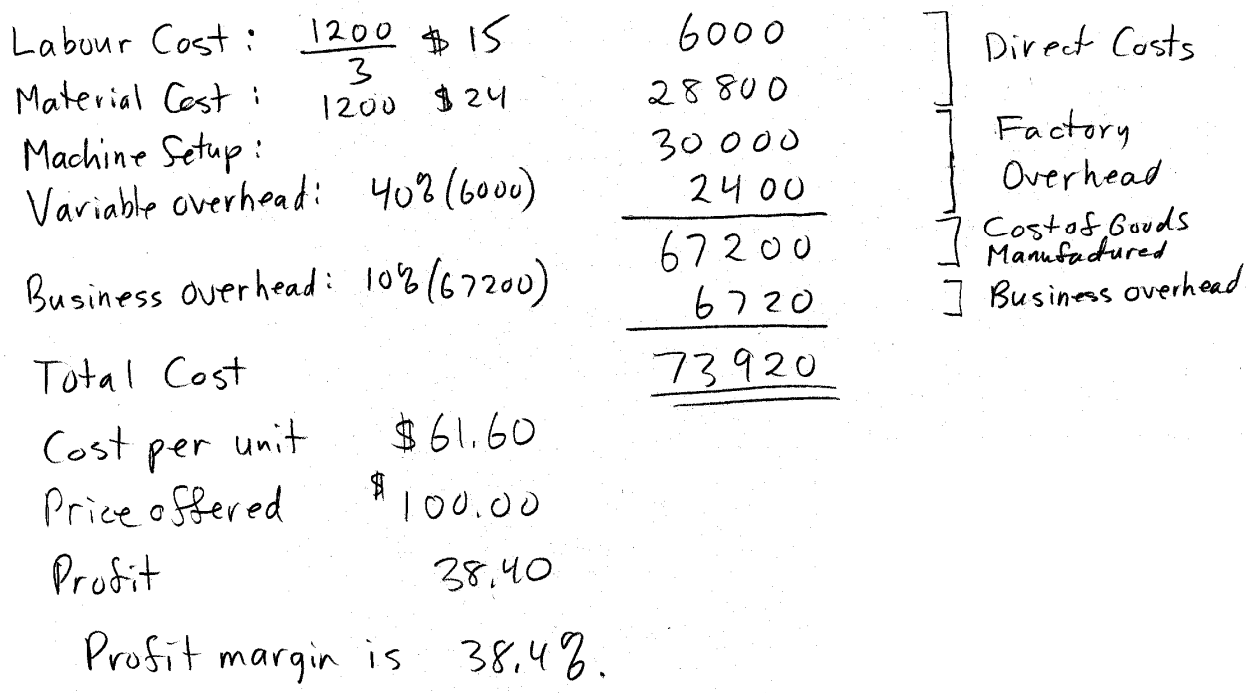
$$\therefore \quad C_{750} = C_{250}\left(\frac{Q_{750}}{Q_{250}}\right)^{0.6255}$$

$$= 413.9\left(3\right)^{0.6255} = \$822\,877.$$

or \$823 K.

Note that the availability of a price index often lags. In this case, one must estimate the inflation rate for generators in 2015 and 2016 to arrive at the 2016 estimated price.

Question 6 – Profit Margin – Solution



Question 7 – Textbook 2-1 – Solution

a) Yearly fixed = TC(0) = $3m
b) Variable unit cost = d/dx TC(x) = 50
c) Total cost = TC(700,000) = $3m + 50 * 700k = $38m
d) Average cost = TC(x)/x = $38m/700k = $54.3 per tonne

Question 8 – Textbook 2-3 – Solution

Life-cycle costs: first cost, annual operation & maintenance (O&M), and final-year disposal/salvage

First cost: 240k machine + 18k foundation/electrical + 36.5k fixtures + training 12.5k = $307k

Annual O&M: 2.5k maintenance + 48k operating (labour) = 50.5k per year

Final: disposal $0 (assume) – salvage $55k

Question 9 – Textbook 2-8 – Solution

a) When no value given, assume 0.6 for cost-capacity exponent
   240k x $(300/200)^{0.6}$ = $306.1k

b) Now with the new value, compute
240k x $(300/200)^{\wedge 0.68}$ = \$316.2k (a 3% difference)