

# Engineering Economics and Problem Solving, 4N4, 2013

## Tutorial/Assignment 4

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**AIM:** *To confirm your understanding of capital cost estimation.*

For capital cost estimation using correlations, we always follow this approach:

1. Look up the correlation to estimate the capital cost. Is it the one that applies to your case?
2. Does the range match the situation we are dealing with?
3. Read of the value of the base cost and base year for the correlation.
4. It's unlikely the capacity matches your case. Inflate for capacity, using the exponent  $n$ .
5. Adjust the price, if required, for materials of construction, pressure, and temperature.
6. Calculate the bare module cost, using the bare module factor.
7. The last calculation is to inflate the price into today's dollars.
8. Finally, report the value as a range, rather than a point estimate. Note, these are just estimates, so they have error.

The correlations in this assignment are from [Woods, "Cost Estimation for the Process Industries", 1993 \[30 Mb PDF\]](#). You will also require access to the various indexes used to inflate costs to different points in time, which are on the course website.

### Question 1

Explain clearly why, in the absence of a given time value of money rates,  $i_{TVM}$ , using the company's MARR would be a reasonable choice.

### Question 2

What would be an estimate of the capital costs for a plant built in Argentina that has annual sales of CAD \$32 million.

### Question 3

Consider the heat exchanger example covered in class last week. Follow the 8 step process to calculate the cost of a fully installed and operating heat exchanger in 1970, for a carbon steel, floating head exchanger that has a surface area of  $200\text{m}^2$  made up of bare tubes (check slide 127 in the course notes, and also reference page 5-5 in the Woods book). The exchanger operates at ambient conditions.

What components are included in the error range (i.e. why is the error at 40%)?

### Question 4

Now follow the 8 step approach for a different type of heat exchanger. Estimate the cost in 2011 for a fully installed and operating floating head, finned tube exchanger, made from carbon steel, with area of  $100\text{m}^2$ . The exchanger operates at ambient conditions.

Use the Marshall & Swift as well as CEPCI cost correlation to inflate to 2011 dollars. Compare the two inflated values.

### Question 5

1. For the course project we will determine the cost of several flash vessels. Calculate the cost of a vertical flash vessel, made from carbon steel. We assume the vessel has height of 3 m, and diameter of 0.5 m. We will assume operation of the vessel is at ambient conditions.
2. Calculate the same cost, but for a unit of 20ft height, and diameter of 3 ft.

*Cite the correlation used, and the parameters in it.*

### Question 6

Learn and describe what factors make up the CEPCI index (don't just Google a description, find the source for the information and cite it appropriately).

### Question 7

In the course project you are welcome to use Aspen's capital cost estimation tool. But to do so, you must first accurately answer these questions:

- Which sources of information does Aspen's software use to determine the capital costs?
- How does Aspen account for different capacity units?
- How does Aspen inflate for prior/future years?
- What is the level of error associated with the Aspen estimates?

Cite your sources, ensuring they are credible.

### Question 8

The cost indices can be seen as another way we account for time value of money, except the indexes have changing values from year to year.

Consider a piece of equipment purchased in 1970 for \$100. Calculate its price in 1971, 1972, ... up to 2011 and plot this.

Now use the TVM equations learned in the course, and superimpose on the plot the inflated price of the equipment over time for a chosen interest rate. Choose the interest rate so that the two curves match the "closest". Report the interest rate, how you calculated it, and show the two curves on the plot.

You should select either the CEPCI or Marshall and Swift index; *bonus* if you repeat the question with both indexes.

### Question 9

1. What is the gross annual salary of an operator in a typical chemical plant?
2. How much does his supervisor (potentially *you*) earn?

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