

SysEng 6103 Systems Life Cycle Costing - Summer 2020**Homework 1 - Partial Solutions****Assigned:** June 17, 2020**Due:** June 24, 2020 until midnight CST**1. _____ [36 points]**

[Include in the PDF file only.] A cable manufacturer produces various types of aluminum and copper cables which it sells directly to retail outlets through its distribution channels. The manufacturing process for producing cables includes a process called wire draw in which the aluminum and copper rods are pulled through a series of synthetic dies, which gradually decrease in size. The wires are then passed through an extruder, where either a single or a double coating of plastic is applied. These insulated wires are twisted into pairs by the Twisting and Stranding Department. The final shape is given to the wires by the Jacketing and Packaging department after carrying out the process of quality control. For each cost listed below, indicate whether it is a direct variable, direct fixed, indirect variable, or indirect fixed cost, assuming that the "units of production of each kind of wire" is the cost object.

Cost	Direct or Indirect?	Variable or Fixed?
(a) Aluminum and copper rods	D	V
(b) Insulating materials	D	V
(c) Wages for wire draw	D	V
(d) Depreciation on machineries	I	F (V if based on number of units, though rare.)
(e) Depreciation on factory building	I	F (V if based on number of units, though rare.)
(f) Insurance on factory building	I	F
(g) Consumable stores and dies	I	F
(h) Wages for machine operators	D	V (F if paid a monthly salary.)
(i) Power bill from a single meter	I	V
(j) Quality control	I	F (combination sometimes if quality control changes with units produced.)
(k) Repairs & maintenance of machines	I	F+V
(l) Normal wastage and spoilage	D (I if cannot be directly traced to each specific type of wire.)	V
(m) Store-keeper's salary	I	F
(n) Material testing	D (I if cannot be directly traced to each specific type of wire.)	V (F if not changing with units produced.)
(o) Materials used by jacketing and packaging department	I	V
(p) Factory general utilities	I	V
(q) Fuel for factory generator	I	V
(r) Supervisors' salaries	I	F

2. _____ [44 points]

[Set up relations using factor notation and then use analytical solution, and include in the PDF file only.]

Each part below is independent.

- (a) [10 points] A manufacturer of off-road vehicles is considering the purchase of dual-axis inclinometers for installation in a new line of tractors. The distributor of the inclinometers is temporarily overstocked and is offering them at a 40% discount from the regular cost of \$142. If the purchaser gets them now instead of 2 years from now, which is when they will be needed, what is the present worth of the savings per unit? The company would pay the regular price, if purchased in 2 years. Assume the interest rate is 10% per year.

Solution:

$$\begin{aligned} PW_{\text{savings per unit}} &= PW_{\text{unit cost 2 years from now}} - PW_{\text{unit cost now}} \\ &= 142(P/F, 10\%, 2) - 0.60 \times 142 \\ &= \frac{142}{(1 + 0.10)^2} - 85.2 \cong \boxed{\$32.15} \end{aligned}$$

- (b) [10 points] The Moller Skycar M400 is a flying car known as a personal air vehicle (PAV) that is expected to be FAA-certified. The cost is \$985,000, and a \$100,000 deposit will hold one of the first 100 "cars." Assume a buyer pays the \$885,000 balance 3 years after making the \$100,000 deposit. At an interest rate of 10% per year, what is the effective total cost of the PAV in year 3?

Solution:

$$\begin{aligned} F &= 100,000(F/P, 10\%, 3) + 885,000 \\ &= 100,000(1 + 0.1)^3 + 885,000 = \boxed{\$1,018,100} \end{aligned}$$

- (c) [10 points] A company that sells high-purity laboratory chemicals is considering investing in new equipment that will reduce cardboard costs by better matching the size of the products to be shipped to the size of the shipping container. If the new equipment will cost \$220,000 to purchase and install, how much must the company save each year for three years in order to justify the investment, if the interest rate is 10% per year?

Solution:

$$\begin{aligned} A &= 220,000(A/P, 10\%, 3) = 220,000 \left(\frac{0.10(1 + 0.1)^3}{(1 + 0.1)^3 - 1} \right) \\ &\cong \boxed{\$88,465.26} \end{aligned}$$

- (d) [14 points] The Owner of Blue Bayou Café usually pays his appliance (refrigerators, dish washers, and freezers) maintenance contract by the year. If he projects the annual costs shown, find the equivalent A value for years 1 through 5.

Year	Cash Flow (\$/year)	Estimated i per year
0	0	-
1–3	5,000	10%
4–5	7,000	12%

Solution:

First convert all cash flows into either a present or a future equivalent amount:

$$P = 5,000 \cdot (P/A, 10\%, 3) + 7,000 \cdot (P/A, 12\%, 2) \cdot (P/F, 10\%, 3) \cong \$21,322.58$$

Then, substitute A for cash values in the same relation set up above and solve for A :

$$P = A \cdot (P/A, 10\%, 3) + A \cdot (P/A, 12\%, 2) \cdot (P/F, 10\%, 3)$$

$$21,322.58 = A \left(\frac{1.1^3 - 1}{0.10 \times 1.1^3} \right) + A \left(\frac{1.12^2 - 1}{0.12 \times 1.12^2} \right) \cdot \frac{1}{1.1^3}$$

$$\Rightarrow A = \frac{21,322.58}{3.7566} \cong \$5,676.03$$

3. _____ [20 points]

[Use Excel built-in functions as indicated and include in the Excel file only.]

A machine that is acquired with an initial cost of \$29,000 has a life of 10 years, no salvage value, and an annual operating cost of \$13,000 for the first 4 years, increasing by 10% per year thereafter. Assume an interest rate of 10% per year.

- (a) **[14 points]** Prepare a cash flow table, then find the equivalent value at time 0 (i.e., the present value) using Excel built-in function NPV.

	A	B	C	D
	Annual interest rate	Geometric gradient series		
1	i	g		
2	10%	10%		
3				
4				
5	Year (t)	CF (\$)		
6	0	-\$29,000.00		
7	1	-\$13,000.00		
8	2	-\$13,000.00		
9	3	-\$13,000.00		
10	4	-\$13,000.00		
11	5	-\$14,300.00	=B10*1.1	
12	6	-\$15,730.00		
13	7	-\$17,303.00		
14	8	-\$19,033.30		
15	9	-\$20,936.63		
16	10	-\$23,030.29		
17	P =	-\$123,483.30	=B6+NPV(A3,B7:B16)	
18				
19				

Solution:

- (b) **[3 points]** Find the equivalent annual worth in each year over 10 years using Excel built-in function PMT. *Hint: Use the present worth in the previous part and then use PMT on that.*

	A	B	C	D
	Annual interest	Geometric		
1	rate	gradient series		
2	i	g		
3	10%	10%		
4				
5	Year (t)	CF (\$)		
6	0	-\$29,000.00		
7	1	-\$13,000.00		
8	2	-\$13,000.00		
9	3	-\$13,000.00		
10	4	-\$13,000.00		
11	5	-\$14,300.00		
12	6	-\$15,730.00		
13	7	-\$17,303.00		
14	8	-\$19,033.30		
15	9	-\$20,936.63		
16	10	-\$23,030.29		
17	P =	-\$123,483.30		
18	A =	-\$20,096.34		=PMT(A3,A16,B17)
19				

Solution: 3a 3b 3c +

- (c) **[3 points]** Find the equivalent future value in year 10 using Excel built-in function FV. *Hint: Use either the present worth or the annual worth you found previously and apply FV on that.*

	A	B	C	D
	Annual interest	Geometric		
1	rate	gradient series		
2	i	g		
3	10%	10%		
4				
5	Year (t)	CF (\$)		
6	0	-\$29,000.00		
7	1	-\$13,000.00		
8	2	-\$13,000.00		
9	3	-\$13,000.00		
10	4	-\$13,000.00		
11	5	-\$14,300.00		
12	6	-\$15,730.00		
13	7	-\$17,303.00		
14	8	-\$19,033.30		
15	9	-\$20,936.63		
16	10	-\$23,030.29		
17	P =	-\$123,483.30		
18	F =	-\$320,283.88		=FV(A3,A16,,B17)
19				

Solution: 3a 3b 3c +