

TIE2140 Engineering Economy Tutorial #4 (Financial Decision on Multiple Projects)

Question 1 (based Sullivan *et al* 2020, P6-4)

Three mutually exclusive design alternatives are being considered. The estimated sales and cost data for each alternative are given below:

	A	B	C
Investment cost	\$30,000	\$60,000	\$50,000
Estimated units to be sold/year	15,000	20,000	18,000
Unit selling price, \$/unit	\$3.50	\$4.40	\$4.10
Variable costs, \$/unit	\$1.00	\$1.40	\$1.15
Annual expenses (fixed)	\$15,000	\$30,000	\$26,000
Market value	0	\$20,000	\$15,000
Useful life	10 years	10 years	10 years

The *MARR* is 20% per year. Annual revenues are based on the number of units sold and the selling price. Annual expenses are based on fixed and variable costs. Determine which selection is preferable based on *AW*. State your assumptions.

Question 2 (based Sullivan *et al* 2020, P6-32)

As the supervisor of a facilities engineering department, you consider mobile cranes to be critical equipment. The purchase of a new medium-sized truck-mounted crane is being evaluated. The economic estimates for the two best alternatives *A* and *B* are shown in the table below.

	Alternative	
	<i>A</i>	<i>B</i>
Capital investment	\$272,000	\$346,000
Annual expenses*	\$28,800	\$19,300
Useful life (years)	6	9
Market value (at end of life)	\$25,000	\$40,000

*Excludes the cost of an operator, which is the same for both alternatives.

You have selected the longest useful life (9 years) for the study period and would lease a crane for the final 3 years under Alternative *A*. On the basis of previous experience, the estimated annual leasing cost at that time will be \$66,000 per year (plus the annual expenses of \$28,800 per year). The *MARR* is 15% per year. Show that the same selection is made with

- (a) The *PW* method.
- (b) The *IRR* method.
- (c) Would leasing crane *A* for 9 years, assuming the same costs per year as for 3 years, be preferred over your selection?

Question 3 (based Sullivan *et al* 2014, P6-35)

Your plant must add another boiler to its steam generating system. Bids have been obtained from two boiler manufacturers as follows:

	Boiler A	Boiler B
Capital investment	\$50,000	\$100,000
Useful life, N	20 years	40 years
Market value at EOY N	\$10,000	\$20,000
Annual operating costs	\$9,000	\$3,000, increasing \$300 per year after first year

If the $MARR$ is 10% per year, which boiler would you recommend? Use the repeatability assumption.

Question 4 (based Sullivan *et al* 2020, 6-41)

Two mutually exclusive alternatives are being considered for the environmental protection equipment at a petroleum refinery. One of these alternatives must be selected. The estimated cash flows for each alternative are as follows:

	Alternative A	Alternative B
Capital investment	\$20,000	\$38,000
Annual expenses	5,500	4,000
Market value at end of useful life	1,000	4,200
Useful life	5 years	10 years

- (a) Which environmental protection equipment alternative should be selected? The firm's $MARR$ is 20% per year. Assume the equipment will be needed indefinitely.
- (b) Assume the study period shortened to five years. The market value of Alternative B after five years is estimated to be \$15,000. Which alternative would you recommend?

Question 5 (based Sullivan et al 2020, 10-19)

A state-sponsored Forest Management Bureau is evaluating alternative routes for a new road into a formerly inaccessible region. Three mutually exclusive plans for routing the road provide different benefits, as indicated in Table P10-19. The roads are assumed to have an economic life of 50 years, and *MARR* is 8% per year. Which route should be selected according to the B-C ratio method if

- (a) the project is considered as a cost or service project?
- (b) the project is considered as an investment project?

Route	Construction costs	Annual maintenance cost	Annual Savings in fire damage	Annual recreational benefit	Annual Time access benefit
A	\$185,000	\$2,000	\$5,000	\$3,000	\$500
B	\$220,000	\$3,000	\$7,000	\$6,500	\$1,500
C	\$290,000	\$4,000	\$12,000	\$6,000	\$2,800