E355 Engineering Economics Spring 2022
Homework #3

"I pledge my honor that I have abided by the Stevens Honor System"

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3.1 Catherine, owner of the The Great Gyn Factory, needs to replace its Hulu equipment at all of its' locations. The investment will cost $145,000 and will generate $60,000 revenue per year for 5 years. The salvage value will be $12,000 after the 5 years. Assume Catherine has a MARR of 18%.

a) Determine the IRR for the investment using linear interpolation. [8 points]

$$\sum_{0}^{n} FW = 0$$

$$FW = -P(\tfrac{F}{P}, i, N) + A(\tfrac{F}{A}, i, N) + S = 0$$

$$A(\tfrac{F}{A}, i, N) + S - P(\tfrac{F}{P}, i, N) = 0$$

$$60000(\tfrac{F}{A}, i, 5) + 12000 - 145000(\tfrac{F}{P}, i, 5) = 0$$

At i=30% and n=5, table returns $\frac{F}{P} = 3.713$ and $\frac{F}{A} = 9.043$

$$60000(9.043) + 12000 - 145000(3.713) = \$16195$$

At i=35% and n=5, table returns $\frac{F}{P} = 4.484$ and $\frac{F}{A} = 9.954$

$$60000(9.954) + 12000 - 145000(4.484) = -\$40940$$

Interpolate:

IRR = 30% + $\frac{(0-16195)(35\%-30\%)}{(-40940-16195)}$ **= 31.42%**

b) Since The Great Company requires at least a 18% return on the investment, should the machine be purchased? Why? [1 point + 1 point]

If IRR > MARR ➔ ACCEPT

If IRR = MARR ➔ INDIFFERENT

If IRR < MARR ➔ REJECT

IRR = 31.42%
MARR = 18%

Since 31.42% > 18%, the company should purchase the machine, as their return will be greater than the minimum expectations.

3.2 Two locations of Catherine's new palaces are evaluated, with the projected life of each facility being 25 years. She anticipates running it like a museum and charging guests to look around. The cash flows are as follows:

Alternative	A	B
First Cost	$ 15,900,000	$ 16,500,000
Maintenance & Operating Costs	$ 350,000	$ 400,000
Annual Benefits	$ 1,000,000	$ 1,400,000
Salvage Value	$ 5,600,000	$ 4,800,000
Project life	25	25

The company uses a MARR of 20%. Using internal rate of return analysis, answer the following questions.

a) List the table of Incremental Cash Flow based on the two alternatives. Obs.: Label the columns accordingly. [3 points]

Year	A	B	Incremental (B-A)
0	-$15,900,000	-$16,500,000	-$600,000
O&M Yr 1-25	$350,000	$400,000	$50,000
Benefits Yr 1-25	$1,000,000	$1,400,000	$400,000
Salvage	$5,600,000	$4,800,000	-$800,000

b) Write the NPW equation for the incremental cash flow. [2 point]

$$NPW = P + A(\frac{P}{A}, 20\%, 25) - S(\frac{P}{F}, 20\%, 25)$$

$$NPW = 350000(\frac{P}{A}, 20\%, 25) - 800000(\frac{P}{F}, 20\%, 25) - 600000$$

$$NPW = 350000(4.948) - 800000(0.0105) - 600000$$

$$NPW = \$1,123,400$$

c) Calculate the Incremental IRR for system investment. [7 points]

$$PW = P + A(\frac{P}{A}, i, 25) - S(\frac{P}{F}, i, 25) = 0$$

$$PW = 350000(\frac{P}{A}, i, 25) - 800000(\frac{P}{F}, i, 25) - 600000 = 0$$

At i=45% and n=25, table returns $\frac{P}{A} = 2.222$ and $\frac{P}{F} = 0.00009$

$$350000(2.222) - 800000(0.00009) - 600000 = \$177,628$$

At i=60% and n=25, table returns $\frac{P}{A} = 1.667$ and $\frac{P}{F} = 0.00001$

$$350000(1.667) - 800000(0.00001) - 600000 = -\$16,558$$

Interpolate:

$IRR_{B-A} = 45\% + \frac{(0-177628)(60\%-45\%)}{(-16558-177628)} =$ **58.72%**

d) Which alternative should be chosen? Why? [1 point + 1 point]

If IRR_{B-A} > MARR ➔ select B

If IRR_{B-A} = MARR ➔ select either project

If IRR_{B-A} < MARR ➔ select A

IRR_{B-A} = 58.72%

MARR = 20%

Since 31.42% > 18%, the company should choose alternative B.