Assignment 5

EECE/CPEN 481

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Selected problems, drawing in part on material from the textbook (Engineering Economic Analysis: Fourth Canadian Edition).

Problems are drawn mainly from material in Chapters 8 and 9.

1. Based on Problem 9-9
2. Based on Problem 9-10
3. Problem 9-13 (0.5x value)
4. Based on Problem 9-16 (1.5x value)

Solutions given in blue type.

Assignment 5 Solutions

1. **Based on Problem 9-9**

A private firm has a $100,000 capital budget for new investments in its factory.

1. Using the analysis method most commonly used by private firms, determine which project(s) should be funded.
2. Determine the opportunity cost of capital.

Project	Capital cost	Annual benefits	Life (years)	Salvage value
A	$50,000	$ 8,000	10	$3,000
B	$50,000	$12,500	5	$5,000
C	$50,000	$10,500	7	$3,000
D	$50,000	$ 8,500	8	$2,000

Solution:

a) Because it is a private firm, the best approach will be to calculate the IRR for each project, rank projects from best to worst IRR, and commit funds starting with the best project, continuing until you run out of capital. Projects C and B are the top two projects, so should be funded. That uses up the entire budget.

Project	IRR
A	10.1%
B	10.4%
C	11.6%
D	8.0%

b) The opportunity cost of capital is the rate of the return of the next best project that they weren't able to fund. That is project A, with a rate of return of 10.1%.

2. Based on Problem 9-10

Chips USA is considering the following projects to improve its production process. Chips uses a three-year horizon for evaluation.

(a) If Chips has a budget of $70,000, which projects should be done?
(b) What is the opportunity cost of capital?

Project	Initial Cost	Uniform Annual Benefit
1	$20,000	$9,500
2	35,000	14,000
3	10,000	6,000
4	7,000	2,400
5	20,000	10,000
6	15,000	7,000
7	40,000	21,000

Solution:

(a)

The IRR for each project is calculated using the Excel function, which requires setting up the (simple) annual cash flows. Then the table is sorted with IRR as the key.

Project	IRR	Ranked	Enough funds for:
1	20.0%	5	$20,000
2	9.7%	7	$35,000
3	36.3%	1	$10,000
4	1.4%	4	$7,000
5	23.4%	3	$20,000
6	18.9%	6	$15,000
7	26.7%	2	$40,000

Do projects 3, 7 and 5 with a budget of $70,000.

(b) The opportunity cost of capital is 20.0%, which is the IRR of the next best project (the first project rejected).

3. **Problem 9-13**

Use the examples of risk-adjusted interest rates for manufacturing projects in the table below (which is copied from the textbook).

Table 9-2: Example of Risk-Adjusted Interest MARR Values in Manufacturing

Rate (%)	Applies to:
6	Equipment replacement
8	New equipment
10	New product in normal market
12	New product in related market
16	New product in new market
20	New product in foreign market

You are considering a project with the following information: Capital cost $50,000, annual benefits of $8,000, a 10 year life, and a $3,000 salvage value. The project is a new project in a new market. What is the MARR interest rate for evaluating this project? Based on this MARR, should the project be done?

Solution:

Assume a "new product in a new market." From Table 9-2 the MARR rate that should be used to evaluate this project is 16%.

IRR of A = 10.1% (which was calculated in Problem 1).
10.1%< 16%, so, the project should NOT be done.

4. **Based on Problem 9-16**

Ten capital spending proposals have been made to the budget committee as the members prepare the annual budget for their firm. Each independent project has a five-year life and no salvage value.

Project	Initial Cost ($ thousands)	Uniform Annual Benefit ($ thousands)	Computed Rate of Return (%)
A	$20	$6.0	15.2
B	15	4.3	13.3
C	5	1.4	12.4
D	20	5.5	11.6
E	15	4.1	11.4
F	30	10	19.9
G	5	1.6	18.0
H	10	2.5	7.9
I	25	8.5	20.8
J	10	3.3	19.4

(a) On the basis of a MARR value of 12%, which projects should be considered further?
(b) For each option, calculate the Net Present Worth, and the ratio of NPW to the Present Worth of the cost (both rounded to 2 decimal places).
(c) Rank-order all the projects in order of desirability, using the ratio calculated above.
(d) If only $85,000 is available to invest for initial costs, which projects should be approved?

Solution:

(a) Sort projects by rate of return, and select those with IRR>MARR%. Meaning, approve all projects except D, E and H.

(b) Calculated ratios NPW/Cost

Project	NPW	NPW / cost
A	1.63	0.08
B	0.50	0.03
C	0.05	0.01
D	(0.17)	(0.01)
E	(0.22)	(0.01)
F	6.05	0.20
G	0.77	0.15
H	(0.99)	(0.10)
I	5.64	0.23
J	1.90	0.19

3. Ranking based on NPW / Cost

Project	NPW	NPW / cost
I	5.64	0.23
F	6.05	0.20
J	1.90	0.19
G	0.77	0.15
A	1.63	0.08
B	0.50	0.03
C	0.05	0.01
D	(0.17)	(0.01)
E	(0.22)	(0.01)
H	(0.99)	(0.10)

(d)

Project	NPW	NPW / cost	Total cumulative capital spent
I	5.6	0.23	$25
F	6.0	0.20	$55
J	1.9	0.19	$65
G	0.8	0.15	$70
A	1.6	0.08	$90
B	0.5	0.03	$105
C	0.0	0.01	$110
D	-0.2	-0.01	$130
E	-0.2	-0.01	$145
H	-1.0	-0.10	$155

Budget = $85,000. The first four projects (I, F, J and G) would cost $70,000. There is not enough money to add A, but there is enough to add B. Alternately, one could not include G and instead add A. So there are two possible ways to complete the set:

Add B (and keep G): extra NPW will be $500.
Add A and remove G: extra NPW will be $861.

The second option adds more NPW.
So the best set of projects to invest in given this capital spending cap is I, F, J, and A.