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## Economic Analysis of Engineering Projects (CPEN 481)

### Assignment 5

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## 1 Problem 1

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

- (a) Using the analysis method most commonly used by private firms, determine which project(s) should be funded.
- (b) 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) In using LibreOffice Calc's Goal Seek function with the following parameters,

Formula Cell: Sum of project's future benefits

Target Value: 0

Variable Cell: Rate of return of project

We can see from the following spreadsheet that the respective rate of returns of projects A,B,C and D, are 10.14%, 10.36%, 11.47%, 7.92%.

Project	Capital Cost	Annual Benefits	Life (years)	Salvage value	Calculated Rate of Return	Rankings
A	50000	8000	10	3000	10.14%	3
B	50000	12500	5	5000	10.36%	2
C	50000	10500	7	3000	11.47%	1
D	50000	8500	8	2000	7.92%	4

PW Cash Flow	Projects			
years	A	B	C	D
0	-\$50,000.00	-\$50,000.00	-\$50,000.00	-\$50,000.00
1	7,263.35	11,326.06	9,419.87	7,876.12
2	6,594.54	10,262.38	8,450.86	7,298.03
3	5,987.31	9,298.59	7,581.53	6,762.37
4	5,435.99	8,425.31	6,801.62	6,266.03
5	4,935.44	10,687.67	6,101.94	5,806.12
6	4,480.98		5,474.24	5,379.96
7	4,068.37		6,169.94	4,985.08
8	3,693.75			5,626.29
9	3,353.63			
10	4,186.63			
Total	0.00	0.00	0.00	0.00

It then follows that the firm should prioritize projects B and C.

- (b) Consequently, the opportunity cost would then be 10.14% as project A would be next in the rankings of rates of returns.

## 2 Problem 2

**Question:** 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:** Similarly to the last question, we will use the Goal Seek function to determine the rates of return for each project with the following parameters:

Formula Cell: Sum of project's future benefits

Target Value: 0

Variable Cell: Rate of return of project

Projects	Initial Cost	Uniform Annual Benefit	Rate of Return	Rankings
1	20000	9500	20.04%	4
2	35000	14000	9.70%	6
3	10000	6000	36.31%	1
4	7000	2400	1.42%	7
5	20000	10000	23.38%	3
6	15000	7000	18.91%	5
7	40000	21000	26.67%	2

PW Cash Flow	Projects						
Year	1	2	3	4	5	6	7
0	-20,000.00	-35,000.00	-10,000.00	-7,000.00	-20,000.00	-15,000.00	-40,000.00
1	7,914.23	12,761.96	4,401.74	2,366.35	8,105.36	5,886.64	16,578.78
2	6,593.16	11,633.40	3,229.22	2,333.18	6,569.68	4,950.36	13,088.38
3	5,492.61	10,604.64	2,369.03	2,300.47	5,324.96	4,163.00	10,332.83
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00

We can then see that projects 3,5,7 should be funded and that the opportunity cost of that would be 20.04%.

## 3 Problem 3

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

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

Table 1: Example of Risk Adjusted Interest MARR values in Manufacturing

You are considering a project with the following information: Capital cost \$50,000, annual benefits \$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:** We determine the IRR to be 10.14% and seeing as this is below the MARR for desired project of 16%, the project should not be done.

Year	Cash Flow	IRR:	10.14%
0	-\$50,000.00		
1	8000		
2	8000		
3	8000		
4	8000		
5	8000		
6	8000		
7	8000		
8	8000		
9	8000		
10	11000		

## 4 Problem 4

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	4.3	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

- On the basis of a MARR value of 12%, which projects should be considered further?
- 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) On the basis of a MARR value of 12%, all but projects D,E, and H should be considered.
- (b) See spreadsheet below
- (c) See spreadsheet below

Projects	Year						NPW	NPW/PW cost Ratio
	0	1	2	3	4	5		
A	-\$20,000.00	\$5,357.14	\$4,783.16	\$4,270.68	\$3,813.11	\$3,404.56	\$1,628.66	0.08
B	-\$15,000.00	\$3,839.29	\$3,427.93	\$3,060.66	\$2,732.73	\$2,439.94	\$500.54	0.03
C	-\$5,000.00	\$1,250.00	\$1,116.07	\$996.49	\$889.73	\$794.40	\$46.69	0.01
D	-\$20,000.00	\$4,910.71	\$4,384.57	\$3,914.79	\$3,495.35	\$3,120.85	-\$173.73	-0.01
E	-\$15,000.00	\$3,660.71	\$3,268.49	\$2,918.30	\$2,605.62	\$2,326.45	-\$220.42	-0.01
F	-\$30,000.00	\$8,928.57	\$7,971.94	\$7,117.80	\$6,355.18	\$5,674.27	\$6,047.76	0.20
G	-\$5,000.00	\$1,428.57	\$1,275.51	\$1,138.85	\$1,016.83	\$907.88	\$767.64	0.15
H	-\$10,000.00	\$2,232.14	\$1,992.98	\$1,779.45	\$1,588.80	\$1,418.57	-\$988.06	-0.10
I	-\$25,000.00	\$7,589.29	\$6,776.15	\$6,050.13	\$5,401.90	\$4,823.13	\$5,640.60	0.23
J	-\$10,000.00	\$2,946.43	\$2,630.74	\$2,348.87	\$2,097.21	\$1,872.51	\$1,895.76	0.19

Rank Order	
Project	Ratio
I	0.23
F	0.20
J	0.19
G	0.15
A	0.08
B	0.03
C	0.01
D	-0.01
E	-0.01
H	-0.10

- (d) If we consider purely on the basis of the ratio of NPW to the Present Worth of the cost of each project, then projects I,F,J, and G should be approved. With \$15,000 leftover, we may choose either project B or C depending on if we want to maximize NPW or IRR respectively.