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Economic Analysis of Engineering Projects (CPEN 481)
Assignment 8

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1 Problem 1

Question: A company is considering purchasing equipment that will cost $1,050,000. The equipment is classified at a CCA rate of 25%. The equipment will add $95,000 in production costs each year and will produce revenues of $375,000 per year. The equipment will be used for seven years than sold for $45,000. Money will be borrowed to help pay for the equipment: $700,000 will be borrowed, at 7% interest. This loan must be repair in seven equal annual payments. The applicable tax rate is 32%, and a discount rate of 12% should be used, as this is the MARR of the firm.

Calculate the loan repayment schedule, the CCA schedule, and the loss or gain on disposal. Calculate all revenues and expenses, and calculate the Net Present Worth of the proposed project.

Solution: The loan repayment schedule is as follows:

Loan Repayment Schedule

Year	Yearly Starting Principle	Payments	Interest Paid	Principle Paid	Remaining Principle
1	$700,000.00	$129,887.25	$49,000.00	$80,887.25	$619,112.75
2	$619,112.75	$129,887.25	$43,337.89	$86,549.36	$532,563.38
3	$532,563.38	$129,887.25	$37,279.44	$92,607.82	$439,955.57
4	$439,955.57	$129,887.25	$30,796.89	$99,090.36	$340,865.20
5	$340,865.20	$129,887.25	$23,860.56	$106,026.69	$234,838.51
6	$234,838.51	$129,887.25	$16,438.70	$113,448.56	$121,389.96
7	$121,389.96	$129,887.25	$8,497.30	$121,389.96	-$0.00

The CCA schedule is as follows:

CCA Schedule

Year	Book Value at Start	Rate of Depreciation	Depreciation Amount	Book Value at
1	$1,050,000.00	12.50%	$131,250.00	$918,750.00
2	$918,750.00	25.00%	$229,687.50	$689,062.50
3	$689,062.50	25.00%	$172,265.63	$516,796.88
4	$516,796.88	25.00%	$129,199.22	$387,597.66
5	$387,597.66	25.00%	$96,899.41	$290,698.24
6	$290,698.24	25.00%	$72,674.56	$218,023.68
7	$218,023.68	25.00%	$54,505.92	$163,517.76

We can then describe the loss or gain on disposal as follows:

$$\begin{aligned}\text{Profit/loss on disposal} &= \text{Salvage Value} - \text{Ending Book Value} \\ &= \$45,000 - \$163,517.76 \\ &= \$118,517.76\end{aligned}$$

The Net Present Worth Analysis is as follows:

Year	NPW Analysis Dwn Pmt	Svg Value	Net Annual Rev	Prin Paid	Interest Paid	Dep Rate	Dep Amt	CG on Sale	Taxable Income	Tax Paid	After tax CF	PW @ 12% M
0	$350,000.00								$0.00	$0.00	-$350,000.00	-$350,000.00
1			$280,000.00	$80,887.25	$49,000.00	12.50%	$131,250.00		$99,750.00	$31,920.00	$118,192.75	$105,529.24
2			$280,000.00	$86,549.36	$43,337.89	25.00%	$229,687.50		$6,974.61	$2,231.87	$147,880.87	$117,889.73
3			$280,000.00	$92,607.82	$37,279.44	25.00%	$172,265.63		$70,454.94	$22,545.58	$127,567.17	$90,799.79
4			$280,000.00	$99,090.36	$30,796.89	25.00%	$129,199.22		$120,003.89	$38,401.25	$111,711.50	$70,994.68
5			$280,000.00	$106,026.69	$23,860.56	25.00%	$96,899.41		$159,240.02	$50,956.81	$99,155.94	$56,263.74
6			$280,000.00	$113,448.56	$16,438.70	25.00%	$72,674.56		$190,886.74	$61,083.76	$89,028.99	$45,104.86
7			$280,000.00	$121,389.96	$8,497.30	25.00%	$54,505.92		$216,996.78	$69,438.97	$80,673.78	$36,492.72
	7	$45,000.00						-$118,517.76	-$118,517.76	-$37,925.68	$82,925.68	$37,511.37
											NPW	$210,586.12

2 Problem 2

Question: A machine has a first (capital) cost of $13,000. The repair costs are covered by the warranty in year 1, then they increase by $650 per year. Assume an interest rate of 12%.

(a) Calculate the EUAC for the first 10 years of the machine's use, rounding to the nearest dollar.

(b) Identify the minimum EUAC for this machine, and the year it occurs.

(c) Based on this value, according to the techniques we have learned, how many years should the machine be used before it is sold?

Solution:

Year	Cost	PV factor @12%	PV of costs	Cumulated PV of costs	Annuity Factor	EUAC
0	-13000	1.0000	-$13,000.00	-$13,000.00	0.0000	NaN
1	0	0.8929	$0.00	-$13,000.00	0.8929	-$14,560
2	-650	0.7972	-$518.18	-$13,518.18	1.6901	-$7,999
3	-1300	0.7118	-$925.31	-$14,443.49	2.4018	-$6,014
4	-1950	0.6355	-$1,239.26	-$15,682.75	3.0373	-$5,163
5	-2600	0.5674	-$1,475.31	-$17,158.06	3.6048	-$4,760
6	-3250	0.5066	-$1,646.55	-$18,804.61	4.1114	-$4,574
7	-3900	0.4523	-$1,764.16	-$20,568.77	4.5638	-$4,507
8	-4550	0.4039	-$1,837.67	-$22,406.44	4.9676	-$4,510
9	-5200	0.3606	-$1,875.17	-$24,281.61	5.3282	-$4,557
10	-5850	0.3220	-$1,883.54	-$26,165.16	5.6502	-$4,631

(a)

(b) We can see that the minimum EUAC is in year 7, at $4,507.

(c) Based on this, we should use the machine for 7 years, as the EUAC decreases after each year. Then after year 7, since the EUAC starts to increase, we should stop using it.

3 Problem 3

Question: Write down a work breakdown structure for the task of repairing a puncture in a bicycle tire. Assume that you have no spare tire, though you do have rubber cement and a rubber patch. Indicate which activities could be done in parallel, supposing you had an assistant. Write a separate list of the tools and parts required.

Solution:

1. Take the tire off.
2. Remove tire from rim.
3. Check rim for any damage or sharp pieces of metal which may damage the tire when inflated at high pressure
4. Dig out smaller pieces of glass, small debris, and check micro tears in the tire.
5. Clean tube with rubbing alcohol.
6. Rough up the surface of the tube with sandpaper.
7. Clean again with alcohol.
8. Make sure patch is smooth.
9. Thin out the rubber with the sandpaper to allow it to stretch more on the tube.
10. Coat the patch with thin layer of contact cement.
11. Apply cement to the area of the tube which needs to be covered.
12. Apply patch, and squeeze.
13. Cover the top and sides of the patch with cement.
14. (Optional) Cover the patch with a section of a plastic bag and work out any air bubbles from the cement.
15. Put tube back into the tire, ensuring that the valve stem is straight.
16. Inflate tire to max PSI to have even pressure over the cement.
17. Let the tire sit overnight
18. Deflate to running PSI.

Steps 3 and 4 can be done in parallel with the tube begin addressed. Steps 6 and 8 can be done in parallel. Steps 10 and 11 can be done in parallel.

Tools and parts required:

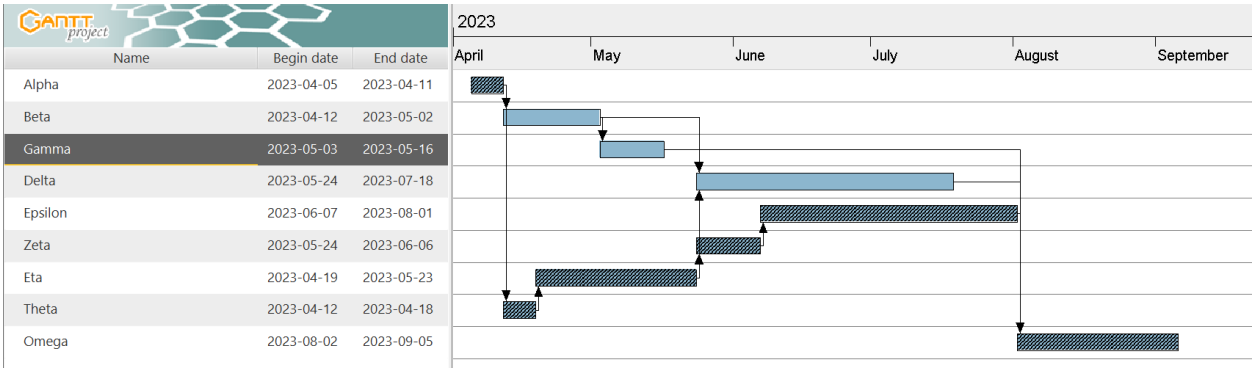
1. Scissors
2. Rough grit sandpaper
3. Rubber cement
4. Rubber patch
5. Isopropyl alcohol
6. Bicycle pump

4 Problem 4

Question: Study the following table and construct a Gantt chart. If no activity can commence until all its prerequisites are completed, what is the shortest time in which the overall project could be completed?

Activity	Duration (weeks)	Prerequisite
Alpha	1	None
Beta	3	Alpha
Gamma	2	Beta
Delta	8	Beta, Eta
Epsilon	8	Zeta
Zeta	2	Eta
Eta	5	Theta
Theta	1	Alpha
Omega	5	Gamma, Epsilon, Delta

Solution:



From this Gantt chart, we can see that it will take 22 weeks to complete the project.

5 Problem 5

Question: Referring to the previous problem, apply CPM to the data provided and identify the critical path. Which activity has the greatest slack?

Solution: Our critical path being $Alpha- > Theta- > Eta- > Zeta- > Epsilon- > Omega$. Activity Gamma has 12 weeks of slack.