Assignment 8 Solutions

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 12, 13 and 15.

1. Problem 1 (2 points)
2. Problem 2 (2 points)
3. Problem 3
4. Problem 4
5. Problem 5 (2 points)

Answers in blue.

1. Problem 1

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:

Calculations

1. Loan payment ($129,887)

2. Loan repayment

Year	Amt owing start of yr	Interest	Principal	Amt owing end of yr
1	$ 700,000	$49,000	$80,887	$619,113
2	$619,113	$43,338	$86,549	$532,563
3	$532,563	$37,279	$92,608	$439,956
4	$439,956	$30,797	$99,090	$340,865
5	$340,865	$23,861	$106,027	$234,839
6	$234,839	$16,439	$113,449	$121,390
7	$121,390	$8,497	$121,390	$0

3. CCA Schedule

Year	Starting book value	eligible depr	Remaining book value
1	$ 1,050,000	$ 131,250	$ 918,750
2	$ 918,750	$ 229,688	$ 689,063
3	$ 689,063	$ 172,266	$ 516,797
4	$ 516,797	$ 129,199	$ 387,598
5	$ 387,598	$ 96,899	$ 290,698
6	$ 290,698	$ 72,675	$ 218,024
7	$ 218,024	$ 54,506	$ 163,518

Loss on disposal $ 118,518

4. Salvage value options:

(a) Closed books salvage (which applies in this case):

NSV = after-tax net proceeds from asset disposal

= S + (Bd-S) * t

= S*(1-t)+Bd * t

$ 82,926 of which:

savings on tax $ 37,926

salvage revenue $ 45,000

This NSV is the same as 'proceeds from disposal of assets'.

5. Revenues & Expenses								
Year	0	1	2	3	4	5	6	7
Revenues		$ 375,000	$ 375,000	$ 375,000	$ 375,000	$ 375,000	$ 375,000	$ 375,000
- costs		$ 95,000	$ 95,000	$ 95,000	$ 95,000	$ 95,000	$ 95,000	$ 95,000
= Before-Tax Cash Flow		*$ 280,000*	*$ 280,000*	*$ 280,000*	*$ 280,000*	*$ 280,000*	*$ 280,000*	*$ 280,000*
- CCA		$ 131,250	$ 229,688	$ 172,266	$ 129,199	$ 96,899	$ 72,675	$ 54,506
- Loan interest		$ 49,000	$ 43,338	$ 37,279	$ 30,797	$ 23,861	$ 16,439	$ 8,497
= Taxable income		$ 99,750	$ 6,975	$ 70,455	$ 120,004	$ 159,240	$ 190,887	$ 216,997
- Income tax		$ 31,920	$ 2,232	$ 22,546	$ 38,401	$ 50,957	$ 61,084	$ 69,439
= Net profit		$ 67,830	$ 4,743	$ 47,909	$ 81,603	$ 108,283	$ 129,803	$ 147,558
+ CCA		$ 131,250	$ 229,688	$ 172,266	$ 129,199	$ 96,899	$ 72,675	$ 54,506
+ Loan interest		$ 49,000	$ 43,338	$ 37,279	$ 30,797	$ 23,861	$ 16,439	$ 8,497
= ATCF from operations		$ 248,080	$ 277,768	$ 257,454	$ 241,599	$ 229,043	$ 218,916	$ 210,561
- Loan interest		$ 49,000	$ 43,338	$ 37,279	$ 30,797	$ 23,861	$ 16,439	$ 8,497
Net funds from operations		$ 199,080	$ 234,430	$ 220,175	$ 210,802	$ 205,183	$ 202,478	$ 202,064

6. Cash Flow for Business Decision:								
Net funds from operations		$ 199,080	$ 234,430	$ 220,175	$ 210,802	$ 205,183	$ 202,478	$ 202,064
- Cap investment	$ (1,050,000)							
+/- Loan (repayment)	$ 700,000	($80,887)	($86,549)	($92,608)	($99,090)	($106,027)	($113,449)	($121,390)
+/- Proceeds from disposal of assets								$ 82,926
= Net cash flow	$ (350,000)	$ 118,193	$ 147,881	$ 127,567	$ 111,712	$ 99,156	$ 89,029	$ 163,599
Discounted net cash flow:	$ (350,000)	$ 105,529	$ 117,890	$ 90,800	$ 70,995	$ 56,264	$ 45,105	$ 74,004
NPW	$ 210,586							
EUAC	$46,143							
IRR	30%							

Items marked in blue cells are NOT part of cash flow

Note that income tax is affected by non-cash flow items. That's why we add in, then subtract out again, those items in step 5.

2. Problem 2

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:

Initial cost = $13,000
Annual increase in maintenance cost = $650; i = 12%

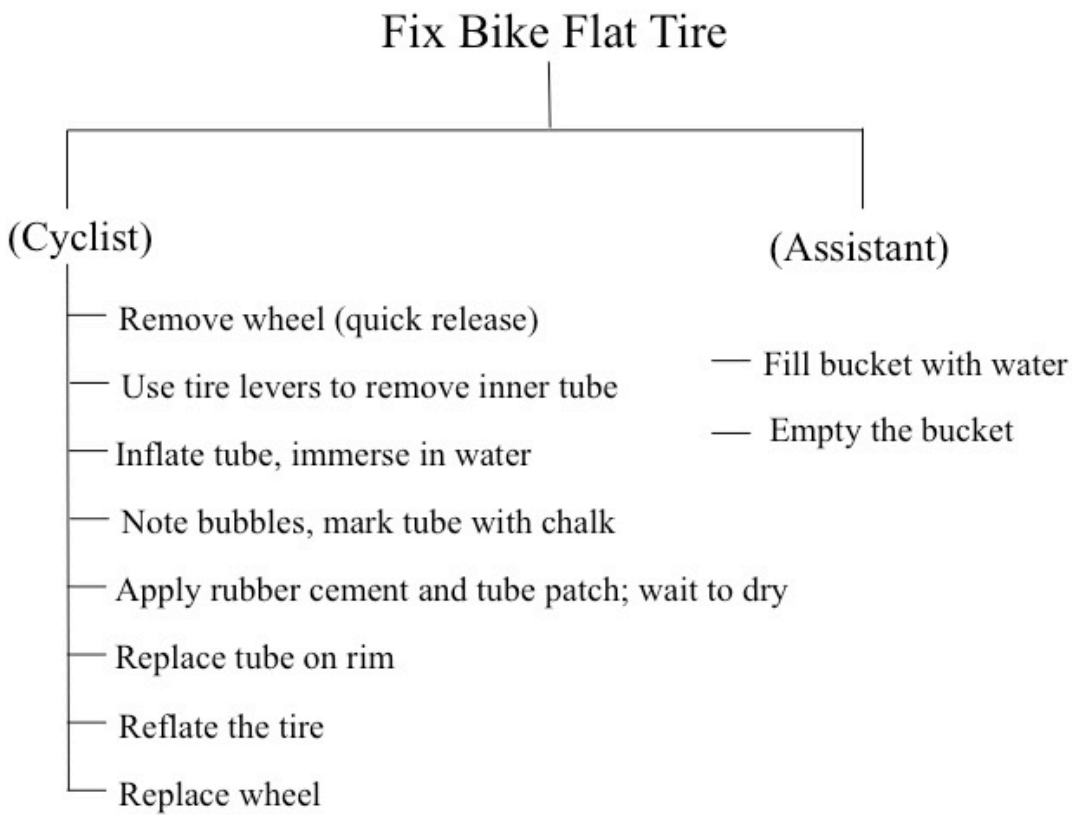
Year	Capital value	(A/P, i, n)	EUAC of capital recovery costs		Maint	(A/G, i, n)	EUAC of Maint Costs	EUAC
0	$ 13,000							——
1	$11,440	1.120	$ 14,560		0			$ 14,560
2	$10,067	0.592	7,692		650	0.472	307	7,999
3	$8,859	0.416	5,413		1,300	0.925	601	6,014
4	$7,796	0.329	4,280		1,950	1.359	883	5,163
5	$6,861	0.277	3,606		2,600	1.775	1,153	4,760
6	$6,037	0.243	3,162		3,250	2.172	1,412	4,574
7	$5,313	0.219	2,849		3,900	2.551	1,658	**4,507**
8	$4,675	0.201	2,617		4,550	2.913	1,894	4,510
9	$4,114	0.188	2,440		5,200	3.257	2,117	4,557
10	$3,621	0.177	2,301		5,850	3.585	2,330	4,631

a) EUAC data points are in rightmost column.
b) EUAC minimum is $4,507, which occurs in year 7.
c) This problem is an example of analysis technique 3, in which we don't have any information about the defender's marginal costs.
WE DON'T KNOW how many years the machine should be used. We need other information: the minimum EUAC of the challenger. We could then compare the defender's EUAC in each year with the minimum EUAC of the challenger.

3. Problem 3

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:



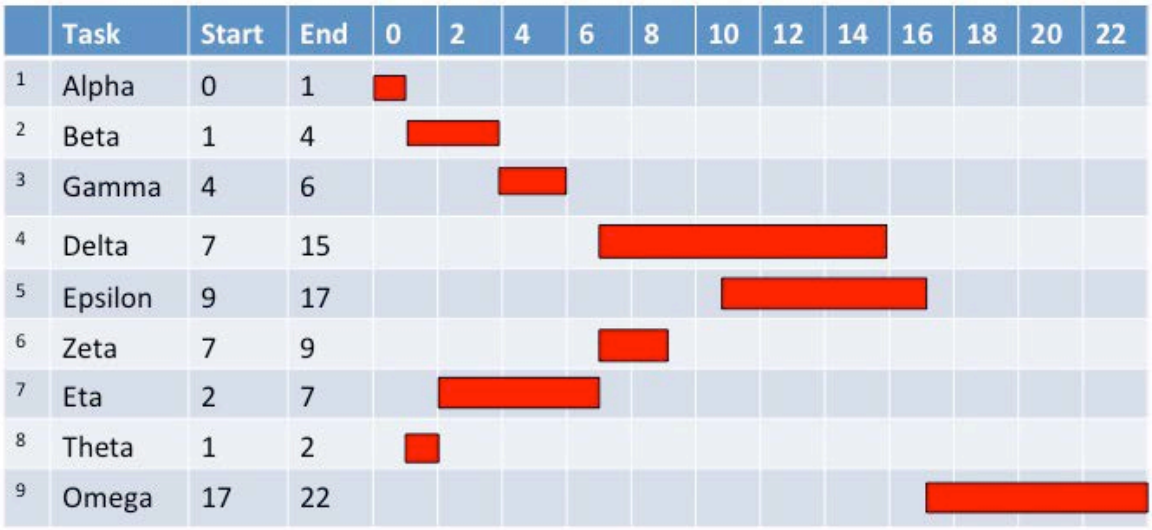
Tools and parts required: Tire levers (2 or, preferably, 3); rubber cement; rubber patch; bucket; water; chalk; bicycle pump.

4. Problem 4

Study the following table and construct a Gantt chart. If no activity can commence until all its prerequisites are completed, what is the shortest tim 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:



A Gantt Chart for Question 15.9

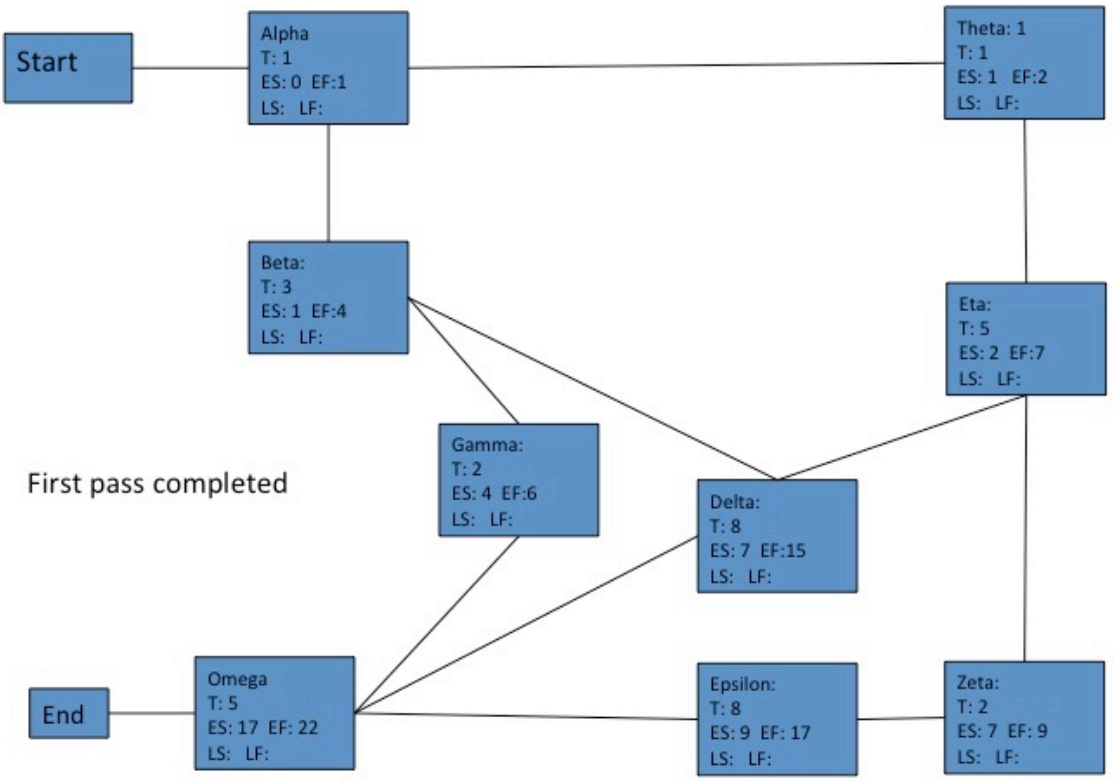
Shortest time in which project can be completed is 22 weeks.

5. Problem 5

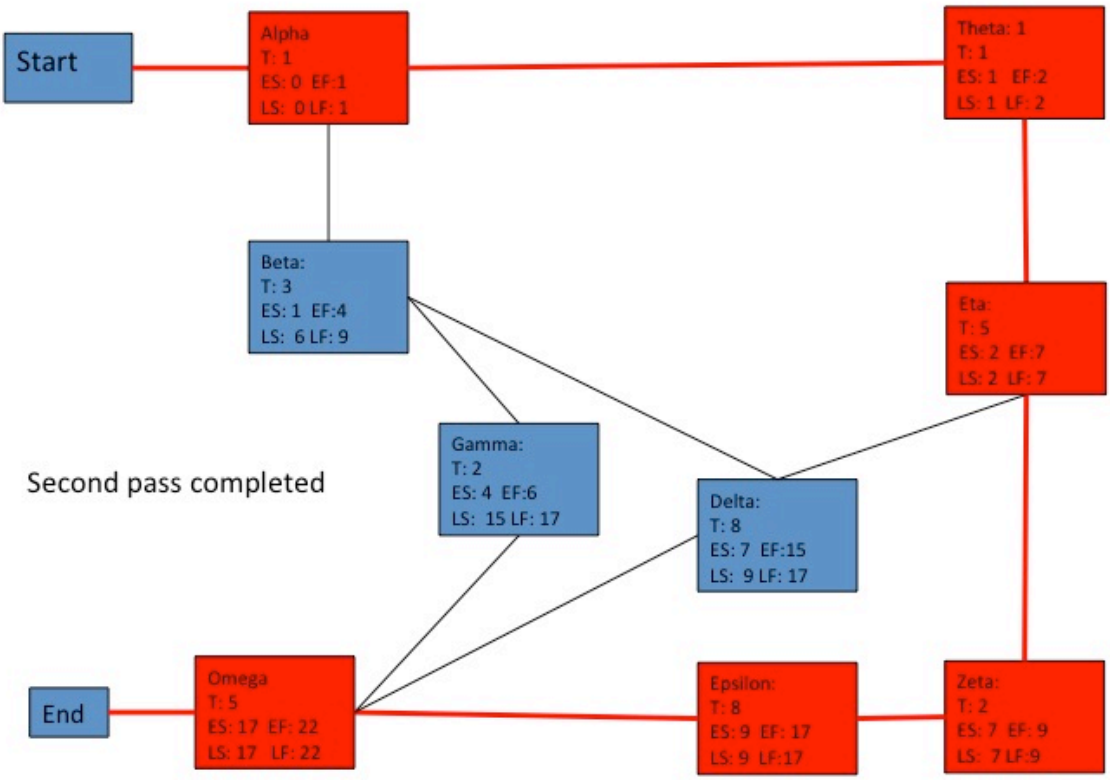
Referring to the previous problem, apply CPM to the data provided and identify the critical path. Which activity has the greatest slack?

Solution:

The first pass through the figure yields this:



We then work backwards through the figure. The earliest Activity Omega can be completed is 22 weeks after the start of the project. So Omega must be begun at 17 weeks after the start of the project. This in turn implies that the three pre-requisites for Omega, namely Gamma, Delta and Epsilon, must all be completed by the 17-week deadline. 17 weeks is the earliest that we can complete Activity Epsilon, so it is on the critical path, but the earliest we can complete Delta is at 15 weeks, so we have two weeks of slack for this activity. Activity Gamma has 11 weeks of slack. We continue working back through the diagram until we reach the state shown below:



The critical path is shown in red.