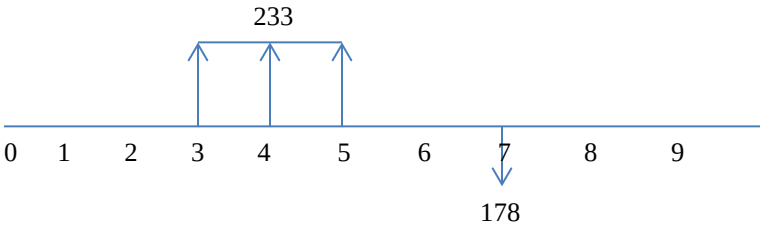
Name (please print) Hine Mytee
ENG 106 – Engineering Economics Midterm Winter 2013

You may use three sheets of hand-written notes. No other reference materials, calculators or other electronic devices are allowed. State any assumptions, show all your work and explain where appropriate. Please use shorthand notation, e.g., (A/G, 5%, 3), where helpful.

The test has four pages and 100 points.

The following data apply to every problem on the exam: the inflation-free interest rate, i', is 5.0%/yr, and the market interest rate, i, is 7.1%/yr. The inflation rate, f, is 2.0%/yr.

1. The amounts on the following cash flow diagram are stated in constant year-zero dollars. To repeat, i' = 5.0%/yr, i = 7.1%/yr, and f = 2.0%/yr.



a) (10 pts) Set up all the relationships needed to calculate the net worth at EOY 0 of the diagrammed cash flow, in year-zero dollars. A more efficient set of relationships is worth more points.

Net worth @ EOY 0 = 233(P/A, i', 3)(P/F, i', 2) – 178(P/F, i', 7)
Less efficient: Discount each of the 233 amounts individually rather than using (P/A…)

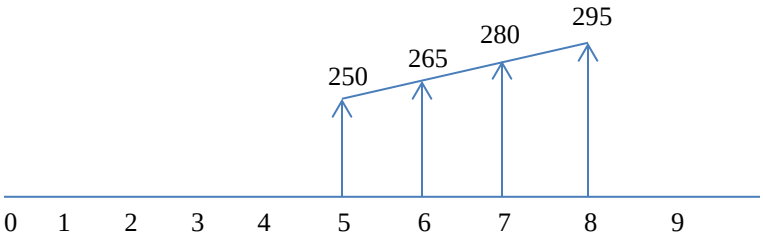
b) (10 pts) Set up all the relationships needed to calculate the net worth at EOY 2 of the diagrammed cash flow, in year-zero dollars. You may begin with either the values on the cash flow diagram or your result from (a).

Easiest: Net worth @ EOY 2 in yr-0 $ = (Net worth @ EOY 0)(F/P, i', 2)
Efficient: = 233(P/A, i', 3) – 178(P/F, i', 5)
Less efficient: Discount each of the 233 amounts individually rather than using (P/A…)

c) (10 pts) Set up all the relationships needed to calculate the net worth at EOY 2 of the diagrammed cash flow, in year-two dollars. You may begin with either the values on the cash flow diagram or your result from (a) or (b).

Easiest: Net worth @ EOY 2 in yr-2 $ = (Net worth @ EOY 0)(F/P, i, 2)
or = (Net worth @ EOY 2 in yr-0$)(F/P, f, 2)
Reasonably efficient: = [233(P/A, i', 3) – 178(P/F, i', 5)](F/P, f, 2)
Less efficient: Approaches that convert the constant-dollar flows to actual, then discount

2. (20 pts) The amounts on the following cash flow diagram are stated in constant year-zero dollars. To repeat, i' = 5.0%/yr, i = 7.1%/yr, and f = 2.0%/yr.



Set up all the relationships needed to calculate the net worth at EOY 0 of the diagrammed cash flow, in year-zero dollars. A more efficient set is worth more points.

Net worth @ EOY 0 = [250(P/A, i', 4) + 15(P/G, i', 4)](P/F, i', 4)
Less efficient: Discount each of the four amounts individually rather than using series rels.

3. You've been given the following data on two mutually exclusive "do-something" alternatives that BizNuZ is considering pursuing. BizNuZ might also choose to do nothing (DN), in which case there would be no costs or benefits.

Alternative:	PurchaseMe (PM)	LeaseMe (LM)
Purchase Price	$5k (in yr-0 $)	
Annual Cost	$1k (in yr-0 $) @ EOY 1-5	2.2k (actual $ in each year) @ EOY 0-2
Life	5 years (of the purchased equipment)	3 years (of the lease contract)
Salvage Value	$0.6k (in yr-0 $) @ EOY 5	
Annual Benefit	$3k (in yr-0 $) @ EOY 1-5	$3.3k in yr-1 $ @ EOY 1, then increasing by 2% each year over the previous year through EOY 3, in actual $

The technology is stable for both the alternatives, and BiZNuZ anticipates continuing indefinitely with one of the do-something alternatives if it chooses one rather than doing nothing. The annual cost for the lease would be fixed for the initial three-year life of the contract. It would be expected to increase with inflation for the second and any subsequent renewals of the contract, as would the annual benefit.
To repeat, i' = 5.0%/yr, i = 7.1%/yr, and f = 2.0%/yr.

a) (5 pts) Given the unequal lives, what analysis period should be used, explicitly or implicitly, when comparing these alternatives? Explain in one complete sentence.

With a long period of need and stable technology, the least common multiple of lives – 15 years in this case – is a good option because both do-something alternatives will then end at the same time, avoiding leaving out some uncommon benefits or costs.

b) (20 pts) Set up relationships needed to properly select the best of the three alternatives with the present worth basis.

For PM
NPW of first copy = -$5k + ($3k-$1k)(P/A, i', 5) + $0.6k(P/F, i', 5)
NPW of all three copies = (NPW of first copy)[1 + (P/F, i', 5) + (P/F, i', 10)]
= (NPW of first copy)[1 + (P/A, i'effective for 5 yrs, 2)]
where i'effective for 5 yrs = $(1 + i')^5 - 1$

For LM
NPW of first copy = -$2.2k[1 + (P/A, i, 2)] + $3.3k($P/A_1$, 2%, i, 3)
NPW of all five copies = (NPW of first copy)[1 + (P/F, i', 3) + (P/F, i', 6) + (P/F, i', 9) + (P/F, i', 12)]
= (NPW of first copy)[1 + (P/A, i'effective for 3 yrs, 4)]
where i'effective for 3 yrs = $(1 + i')^3 - 1$

For Do Nothing
PW = 0-0

c) (5 pts) State the decision rule for the values you would calculate from the relationships in (b).

Select the alternative with the largest NPW.

d) (20 pts) Working from the raw data rather than the results from (b), set up efficient relationships needed to properly select the best of the three alternatives using the annual equivalent worth basis and implicitly (rather than explicitly) using a proper common analysis period.

Need AEWs of first copies in constant yr-0 $ so the magnitudes will repeat for the later copies.

For PM
AEW of first copy = -$5k(A/P, i', 5) + ($3k-$1k) + $0.6k(A/F, i', 5)

For LM
Since the flows are in actual $, probably easiest to first use the market interest rate to bring them to EOY 0 where an actual $ and yr-0 $ are the same, then spread out uniformly over the three years using the inflation-free interest rate so the uniform annual amounts are in constant $:
AEW of first copy = {-$2.2k[1 + (P/A, i, 2)] + $3.3k($P/A_1$, 2%, i, 3)}(A/P, i', 3)

For Do Nothing
AEW = 0-0