IEGR 350: Engineering Economy
Fall 2015
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Assignment 5 Solution Key

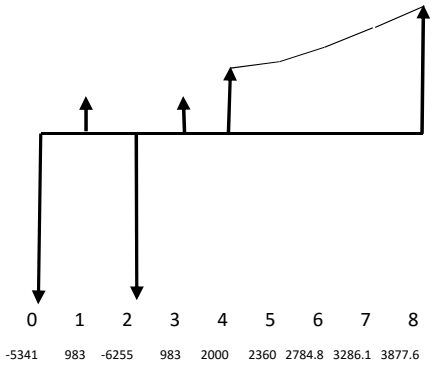
A company has 3 competing alternatives for an investment it plans to undertake. The company uses 12% as the internal rate of return for this project.

Alternative 1: Invest twice, $5,341 now and $6255 two years from now; withdraw $983 a year from now and 3 years from now then $2,000 four years from now increasing each year by 18%. Project life is 8 years and can be renewed with the same cashflow structure. Interest is compounded annually.

Alternative 2: Invest $10,506 now; withdrawals of $300 at the end of first month and gradually increasing by $50 each month to month 24 and then gradually decreasing by a specific fixed amount so that the last withdrawal is $500. Project life is 3 years and can be renewed with the same cashflow structure. Interest is compounded monthly.

Alternative 3: Invest gradually from year 0 to year 5 beginning with $4,274 and gradually decreasing it by $500 every year. Withdraw $2,905 every 6 months. Project life is 6 years and can be renewed at 5% increase rate for all expenses and 4% for all withdrawals with the same cashflow structure. Interest is compounded every 3 months.

Use present worth calculations to recommend the most appropriate alternative of the three to the company. Will the company implement the alternative you recommend? Why or why not?



Alternative 1

PW(4 single payments) = - 5341 + 983(P/F, 12%, 1) - 6255(P/F, 12%, 2) + 983(P/F, 12%, 3)

PW(single payments) = - 5341 + 983(0.8929) - 6255(0.7972) + 983(0.7118) = - 8750.06

PW(geometric gradient series) = A1 (P/ A1, g, i, n) (P/F, 12%, 3)

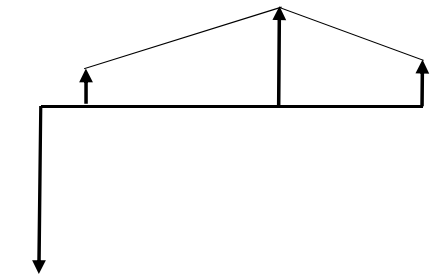
PW(geometric gradient series) = $\{A1 [1 – ((1 + g)/(1 + i))^{n}] / (i – g)\}$ (P/F, 12%, 3)

PW(geometric gradient series) = $\{2000 [1 – ((1 + 0.18)/(1 + 0.12))^{5}] / (0.12 – 0.18)\}$ (0.7118)

PW(geometric gradient series) = 7073.75

PW(alternative 1) = - 8750.06 + 7073.75 = -1676.31

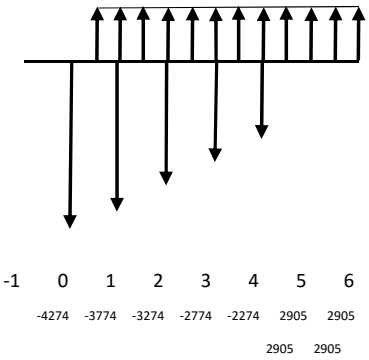
(Note that the project cash flow has a negative present worth)



Alternative 2

0 1 24 36

PW(arithmetic series 1)=300(P/A, 1%, 23)+50(P/G, 1%, 23)=300(20.4558)+50(216.066) =16940.06
PW(arithmetic series 2)=[1450(P/A, 1%, 13)-79.17(P/G, 1%, 13)](P/F, 1%, 23)
PW(arithmetic series 2)=[1450(12.1337)-79.17(71.113)](0.7954)=9516.04
PW = -10000 + 16940.06 + 9516.04 = 16456.10
(Note that periods are assumed 1 month and interest rate is 0.12/12 = 0.01 or 1%)
(Note that in the above, I kept the payment at month 24 with the second series)



Alternative 3

Calculating effective interest rates (yearly):
Nominal: 12%, ,seasonal compounding (SC)
$r = (1 + i/n)^n - 1 = (1+0.12/4)^4 - 1 = 0.1255$ or 12.55%
PW(arith. series 1)=[-4274(P/A, 12.55%, 5)+500(P/G, 12.55%, 5)](F/P, 12.55%, 1)
=[-4247(3.5562)+500(6.2766)](1.1255) =-13466.47
PW(single payment every 6 month)=?
The best way to calculate this present worth is to calculate the effective interest rate in 6 two periods where each period has the interest rate of 3%. ==> (1+0.03)2 - 1 = 0.61 or 6.10%
Now we can consider the series of equal payments over 12 intervals with i=6.1%
2905(P/A, 6.1%, 12) = 2905(8.3381) = 24222.18
PW = -13466.47 + 24222.18 = 10755.71

Since only alternatives 2 and 3 yield a positive present worth we will compare those two. Alternative 2 has 3 years life, and 3 has 6 years life. Thus we renew alternative 2 for another 3 years and compare it with alternative 3.
PW(Alternative 2 for 6 years)=16456.1+16456.1(P/F,1%,36)
16456.1+16456.1(.6989)= 27957.26
This value is smaller than PW for alternative 3 (10755.71) so alternative 3 is recommended.
The company should follow the recommendation because based on the same rate of return they have set for the project, alternative 3 creates best positive present worth.