

IEGR 350: Engineering Economy
 Fall 2015
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Assignment 3 Solution Key

- Plot the cash flow diagram based on the following set of payments.
- Find the equivalent annual payments for the problem.
- Find the equivalent arithmetic gradient series between years 8 and 14 with $A = \$125$ for the project.

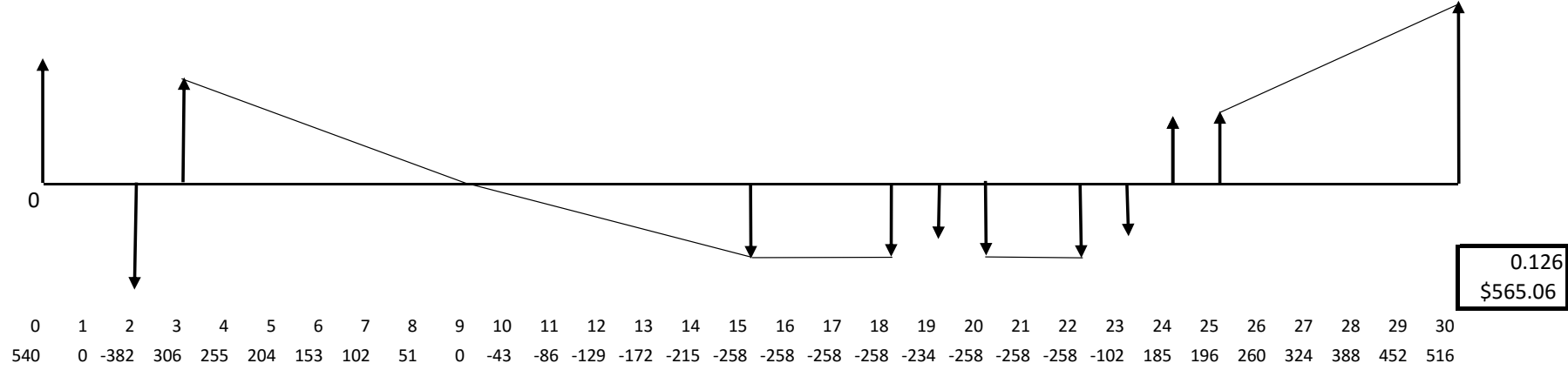
Requirements:
 Limit the use of (P/F, i, n); use (P/G, i, n) & (P/A, i, n) when possible.
 Use 12.6% interest rate, compounded annually.

i	1+i
0.126	1.126

Year	0									
Payme	540									
Year	1	2	3	4	5	6	7	8	9	10
Payme	0	-382	306	255	204	153	102	51	0	-43
Year	11	12	13	14	15	16	17	18	19	20
Payme	-86	-129	-172	-215	-258	-258	-258	-258	-234	-258
Year	21	22	23	24	25	26	27	28	29	30
Payme	-258	-258	-102	185	196	260	324	388	452	516

Year	Payment		Payment(P/F,i,n)	PW	
0	540	0	540	1.0000	540.00
1	0	0	0	0.8881	0.00
2	-382	0	-382	0.7887	-301.29
3	306	51	306	0.7005	214.34
4	306	51	255	0.6221	158.63
5	306	51	204	0.5525	112.70
6	306	51	153	0.4906	75.07
7	306	51	102	0.4357	44.45
8	306	51	51	0.3870	19.74
9	306	51	0	0.3437	0.00
10	0	43	-43	0.3052	-13.12
11	0	43	-86	0.2711	-23.31
12	0	43	-129	0.2407	-31.05
13	0	43	-172	0.2138	-36.77
14	0	43	-215	0.1899	-40.82
15	0	43	-258	0.1686	-43.51
16	-258	0	-258	0.1498	-38.64
17	-258	0	-258	0.1330	-34.31
18	-258	0	-258	0.1181	-30.47
19	-258	24	-234	0.1049	-24.55
20	-258	0	-258	0.0932	-24.04
21	-258	0	-258	0.0827	-21.35
22	-258	0	-258	0.0735	-18.96
23	-102	0	-102	0.0653	-6.66
24	185	0	185	0.0580	10.72
25	196	64	196	0.0515	10.09
26	196	64	260	0.0457	11.88
27	196	64	324	0.0406	13.15
28	196	64	388	0.0361	13.99
29	196	64	452	0.0320	14.47
30	196	64	516	0.0284	14.67

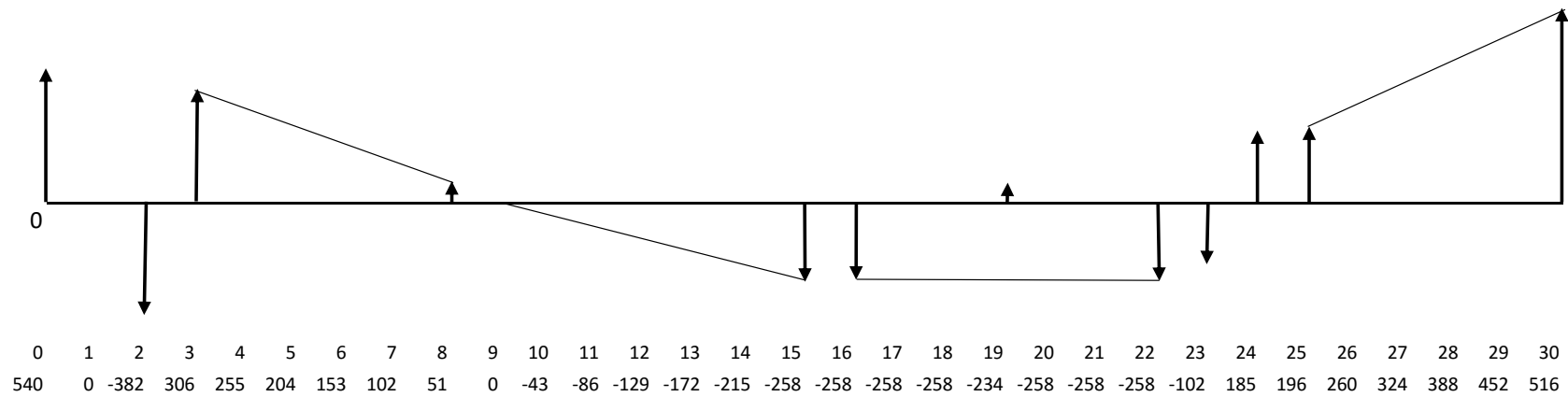
First, let's analyze the transactions and find patterns in them.
 At first glance it looks that we are dealing with
 4 individual transactions that will not fit into a known pattern, 3 arithmetic gradient series, and 2 annuities.



565.06

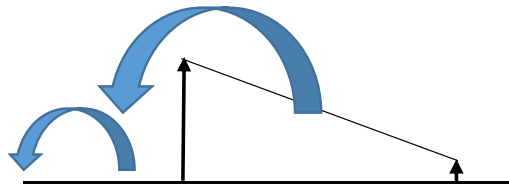
It is always a good practice to check the value of present worth of the project with EXCEL using NPV function to get the exact value and then check your calculations against that result.
 Present worth of the cash flow according to EXCEL is \$565.06.

Further analyzing the cash flow can reduce the calculations by combining two annuities. To do that, we can add and subtract 24 units to single transaction at year 19. We also have to address the transactions at year 15 and 9 that are joined between two different series. The re-drawn cash flow is presented below.



Calculating present worth of all individual transactions
 $PW1 = 540 - 382 (P/F, 12.6\%, 2) + 24 (P/F, 12.6\%, 19) - 102 (P/F, 12.6\%, 23) + 185 (P/F, 12.6, 24)$
 $PW1 = 540 - 382 (0.7887) + 24 (0.1049) - 102 (0.0653) + 185 (0.0580) = \245.30

245.3036



0 1 2 3 4 5 6 7 8
 0 1 2 3 4 5 6

$$PW2 = \{ 306 (P/A, 12.6\%, 6) - 51 (P/G, 12.6\%, 6) \} (P/F, 12.6\%, 2)$$

$$PW2 = \{ 306 (4.0425) - 51 (8.7190) \} (0.7887) = \$624.92$$

624.9154

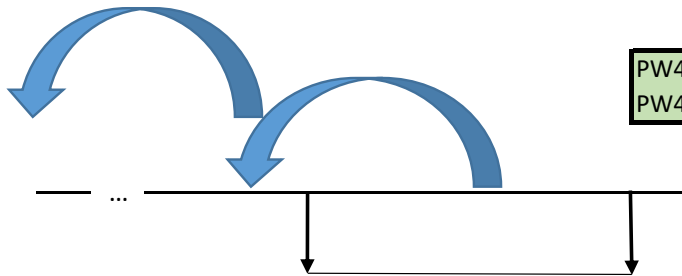


0
 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
 0 1 2 3 4 5 6 7

$$PW3 = - \{ 43 (P/G, 12.6\%, 7) \} (P/F, 12.6\%, 8)$$

$$PW3 = - \{ 43 (11.3335) \} (0.3870) = - \$188.60$$

-188.6008

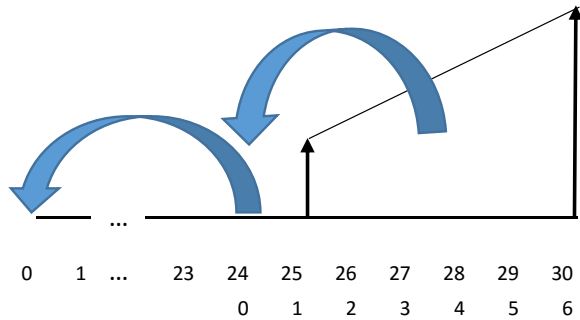


0 1 ... 14 15 16 17 18 19 20 21 22
 0 1 2 3 4 5 6 7

$$PW4 = - \{ 258 (P/A, 12.6\%, 7) \} (P/F, 12.6\%, 15)$$

$$PW4 = - \{ 258 (4.4782) \} (0.1686) = - \$194.80$$

-194.7963



$$PW5 = \{ 196 (P/A, 12.6\%, 6) + 64 (P/G, 12.6\%, 6) \} (P/F, 12.6\%, 24)$$

$$PW5 = \{ 196 (4.0425) + 64 (8.7190) \} (0.0580) = \$78.32$$

78.32007

$$PW = PW1 + PW2 + PW3 + PW4 + PW5$$

$$PW = \$245.30 + \$624.92 - \$188.60 - \$194.80 + \$78.32 = \$565.14$$

Comparing to direct individual calculation result, we see a small difference of \$0.08 between Calculated PW value of \$565.14 and the EXCEL calculated value of \$565.06 which is due to the use of full decimals in EXCEL.

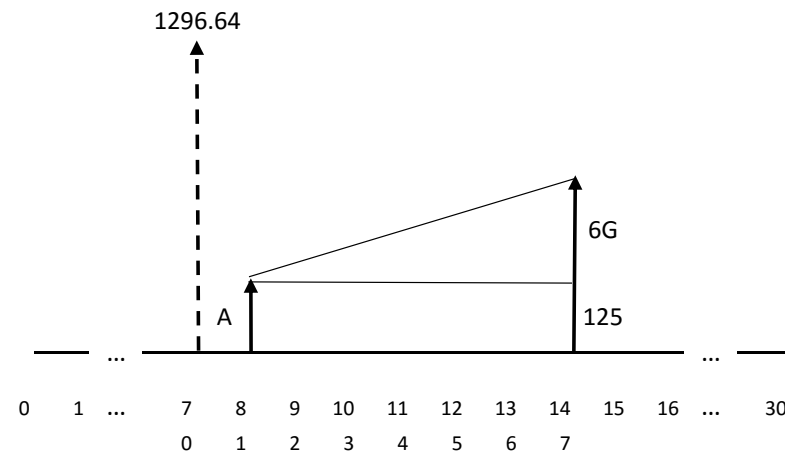
$$A = P (A/P, 12.6\%, 30) = \$565.14 (0.1297) = \$73.30$$

565.14

73.29866

Last part of the assignment is asking for an equivalent arithmetic series to the current cash flow between years 8 and 14 beginning with A = \$125. Thus we need to find the G value of the series.
 First we find the future worth of the calculated present worth of the given cash flow at year 7. Note that year 7 will act as the year 0 for the gradient series.
 $F \text{ (at year 7)} = P \text{ (at year 0 for gradient series)} = 565.14 (F/P, 12.6\%, 7) = 565.14 (2.2949) = \1296.94

1296.94



We do not know whether G is positive or negative. But, it does not make a difference because in the calculations it will show its sign. We will find the present worth of the arithmetic gradient series and then set it up to 1296.64 to find G .

$$1296.64 = 125 (P/A, 12.6\%, 7) + G (P/G, 12.6\%, 7) = 125 (4.4782) + G (11.3335) = 559.77 + 11.3335 G$$

$$11.3335 G = 1296.64 - 559.77 = 736.87$$

$$G = 736.87 / 11.3335 = 65.02$$

559.775
736.87
65.01699