IEGR 350: Engineering Economy
Spring 2016
M. Salimian **Your Name:**

Quiz 2

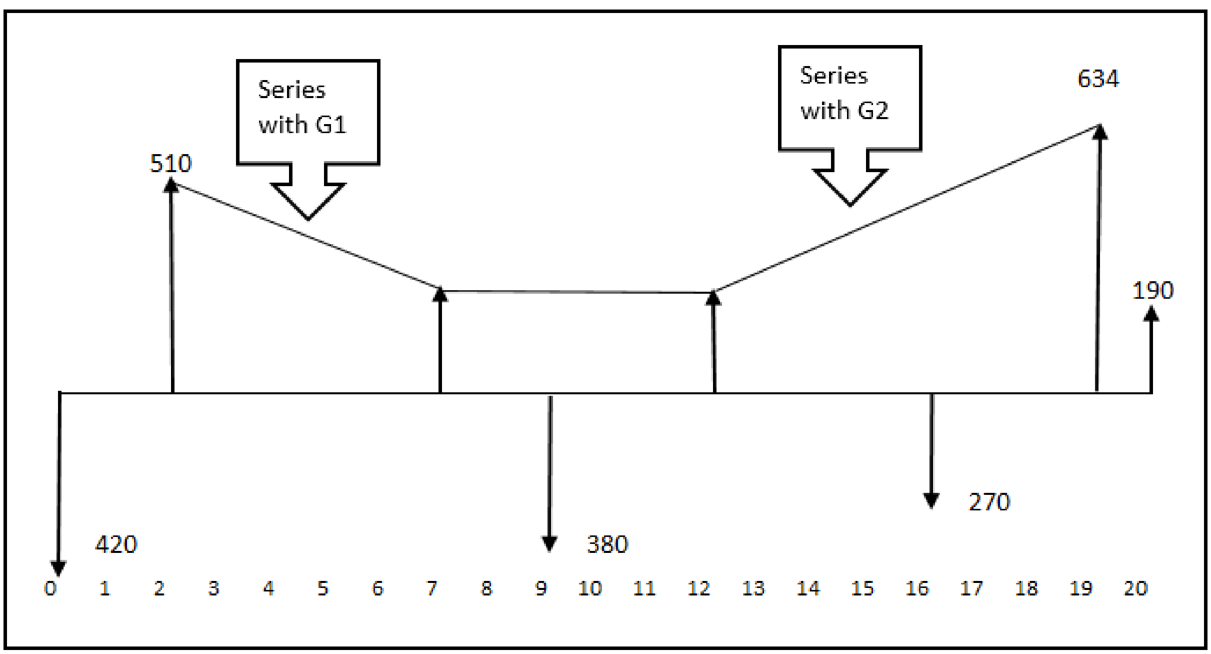
100 Points (Time: 30:00 Minutes)

Explain and show your work. No use of computer or cell phone allowed. Use of printed formula sheet and table for 12% is allowed. Non-digital textbook for use of 12% table (not the formula) is allowed.

PROBLEM:

1. Given the cash flow and for the interest rate of 12% compounded annually, calculate G1 and G2 if the present worth of the project is $1880.93 and the combined values of the gradients is $100. (80 pts)

2. Engineering Economy tables usually provide only the (P/G, i, n) factor values. Develop a formula for (F/G, i, n).



SOLUTION KEY:

When analyzing the cash flow, we notice that payments at year 7 and 12 are common between two series. And we must make a decision of assigning them to only one of the series. In here, I have assigned them to the gradient series.

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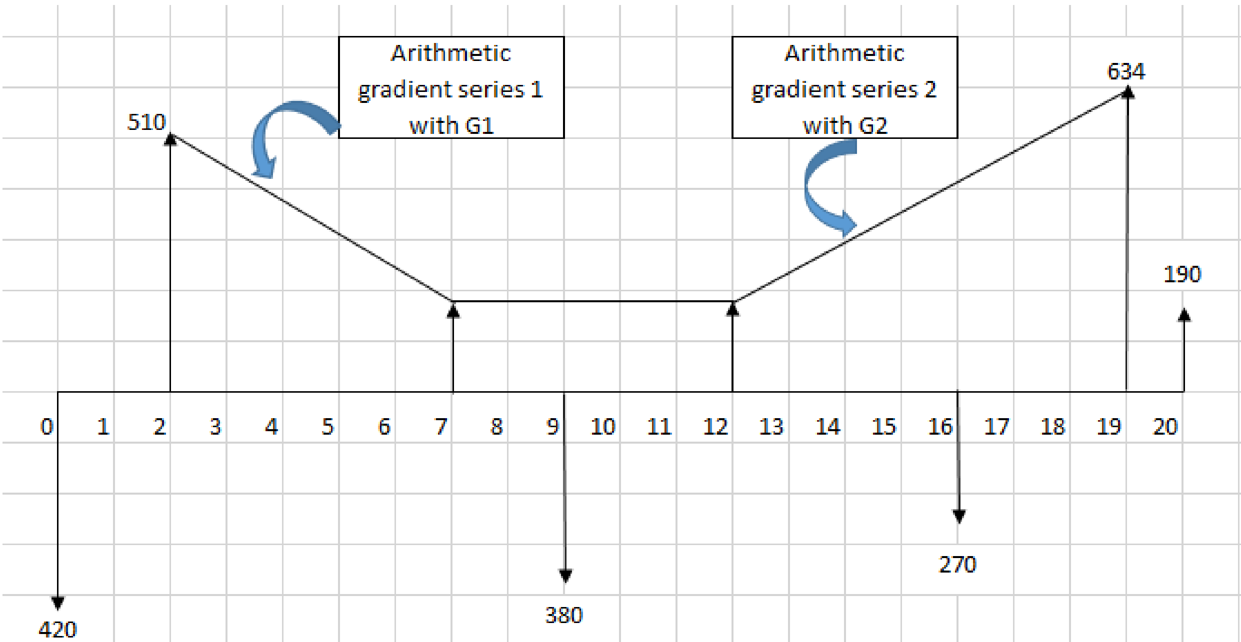
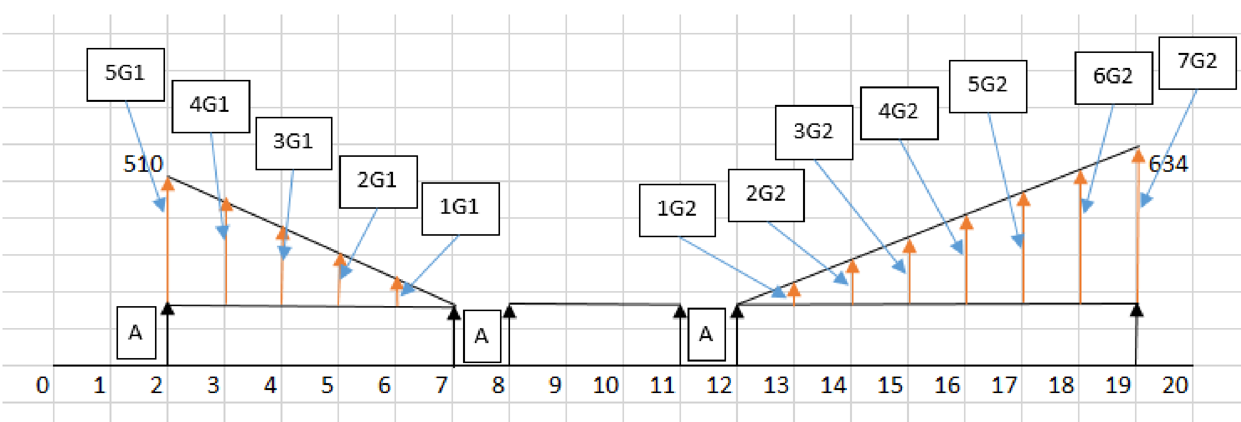


The present worth of the cash flow is given as 1880.93, so we can find the present worth of the cash flow and set it equal to the given value of 1880.93. However, the present worth of the first gradient series will involve an unknown value of G1 and the second series will involve a not only an unknown value of G2 but also an unknown value of A (initial payment of second gradient series which is the same for the annuities too).

Can we find A based on G1 or G2? Let's look at the first series.



Initial payment of the first gradient series can be written as 510 = 5G1+A

Solving for A, we have:

A = 510 – 5 G1

Now the present worth of the complete cash flow can be written as:

P0 = **- 420**

P1 = [510 (P/A, 12%, 6) – G1 (P/G, 12%, 6)] (P/F, 12%, 1)

[510 (4.1114) – G1 (8.9302)] (0.8929) = **1872.24 – 7.9738 G1**

P2 = (510 – 5 G1) (P/A, 12%, 4) (P/F, 12%, 7)

(510 – 5 G1) (3.0373) (0.4523) = **700.62 – 6.8689 G1**

P3 = - 380 (P/F, 12%, 9) = - 380 (0.3606) = **- 137.03**

P4 = [(510 – 5 G1) (P/A, 12%, 8) + G2 (P/G, 12%, 8)] (P/F, 12%, 11) =

[(510 – 5 G1) (4.9676) + G2 (14.4714)] (0.2875) =

[2533.47 – 24.838 G1 + 14.4714 G2] (0.2875) =

728.37 – 7.1409 G1 + 4.1605 G2

P5 = - 270 (P/F, 12%, 16) = - 270 (0.1631) = **- 44.04**

P6 = 190 (P/F, 12%, 20) = 190 (0.1037) = **19.70**

PW = - 420 + 1872.24 – 7.9738 G1+700.62 – 6.8689 G1 - 137.03

+ 728.37 – 7.1409 G1 + 4.1605 G2 - 44.04 + 19.70 =

2719.86 – 21.9831 G1 + 4.1605 G2

Setting it equal to 1880.93 we will have an equation involving two unknowns G1 and G2.

2719.86 – 21.9831 G1 + 4.1605 G2= 1880.93

– 21.9831 G1 + 4.1605 G2= 1880.93 – 2719.86 = - 838.93

Additionally, we are provided with the information that G1 + G2 = 100. Solving the linear system of equations, we will have,

– 21.9831 G1 + 4.1605 G2 = - 838.93

G1 + G2 = 100

Find G1 from second equation and substitute in the first equation.

G1 = 100 – G2

– 21.9831 G1 + 4.1605 (100 – G1) = - 838.93

– 21.9831 G1 + 416.05 – 4.1605 G1 = - 838.93

- 26.1436 G1 = - 1254.98

G1 = 48

G2 = 100 -48 = 52

Part 2: Developing a formula for (F/G, i, n)

The easiest and most convenient approach is to find the present worth using the (P/G, i, n) and the find the future worth of that value using (F/P, i, n) factor. Formula for (P/G, i, n) is given as:

$$\left(\frac{\mathrm{P}}{\mathrm{G}}, \mathrm{i}, \mathrm{n}\right) = \frac{(1+i)^n - in - 1}{i^2(1+i)^n}$$

To find its future value at year n, we just need to multiply it by $(1+i)^n$

Which will be crossed out by the same value in the denominator. So,

$$\left(\frac{\mathrm{F}}{\mathrm{G}}, \mathrm{i}, \mathrm{n}\right) = \frac{(1+i)^n - in - 1}{i^2}$$