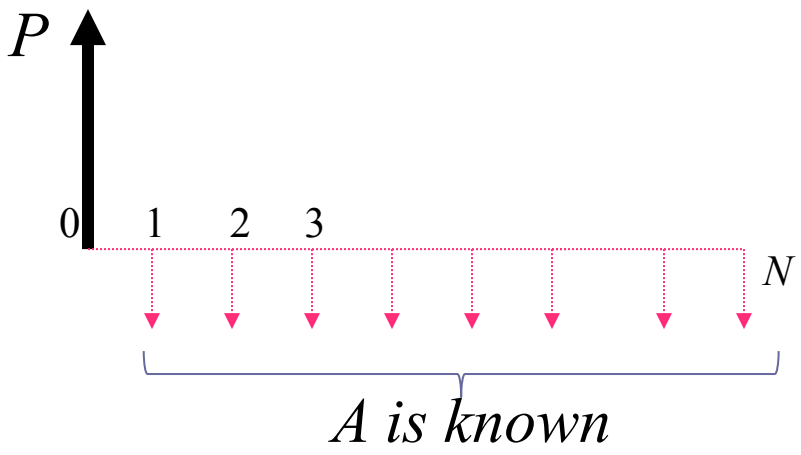
Yıldız Technical University
Civil Engineering Department
Construction Management Division

Engineering Economy- 2

Uniform-series Present Worth Factor (Eşit Geri Ödemeli Birikim Fonu)



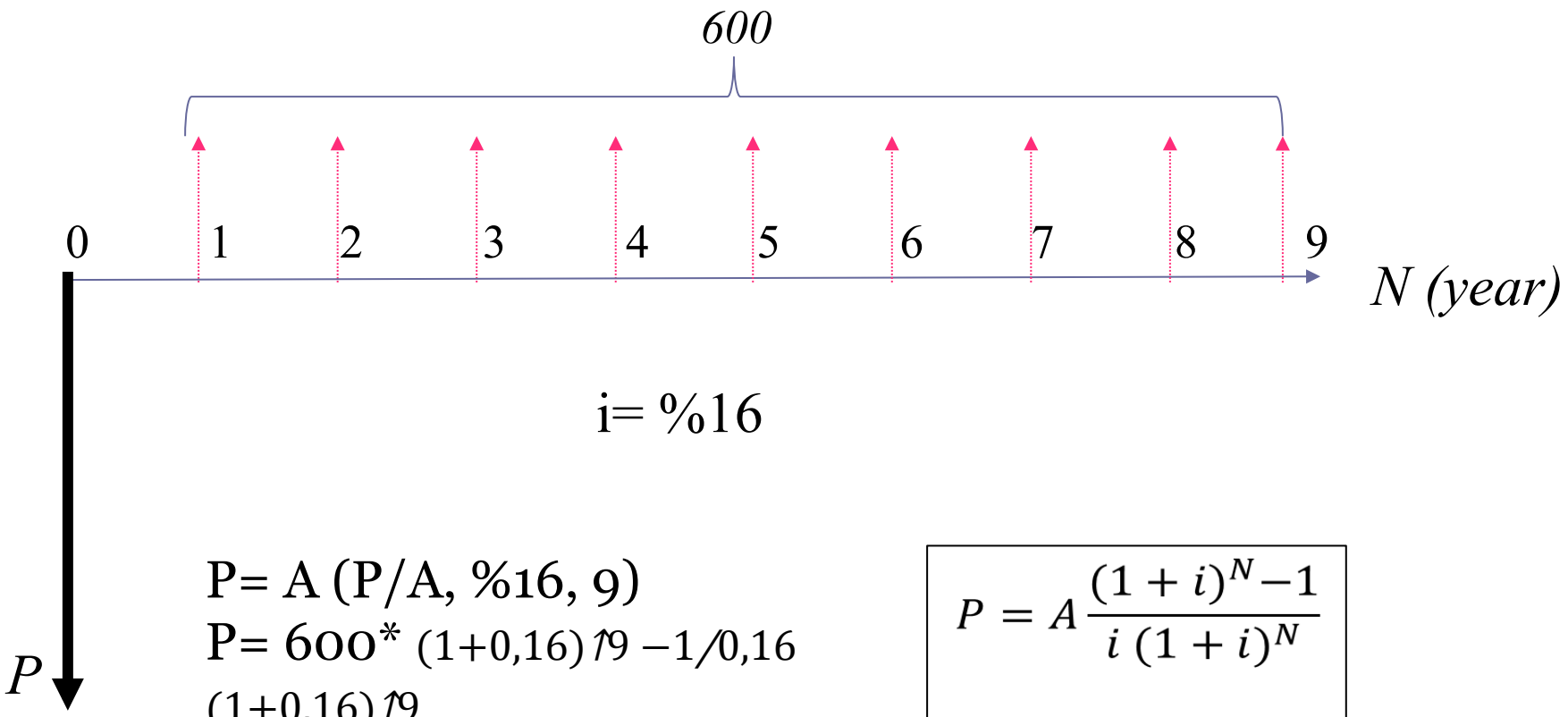
$$P = A\frac{(1+i)^N - 1}{i\,(1+i)^N}$$

$$P = A(P/A, i\%, N)$$

- **When A, i and N are known, calculation of P value:** The equivalent present worth P of a uniform series A end of period cash flows N at an interest rate i.

Example -1

- How much money should you be willing to pay now for a guaranteed $600 per year for 9 years starting next year, at a rate of return of 16% per year?



i= %16

P= A (P/A, %16, 9)

P= 600* (1+0,16)↑9 −1/0,16 (1+0,16)↑9

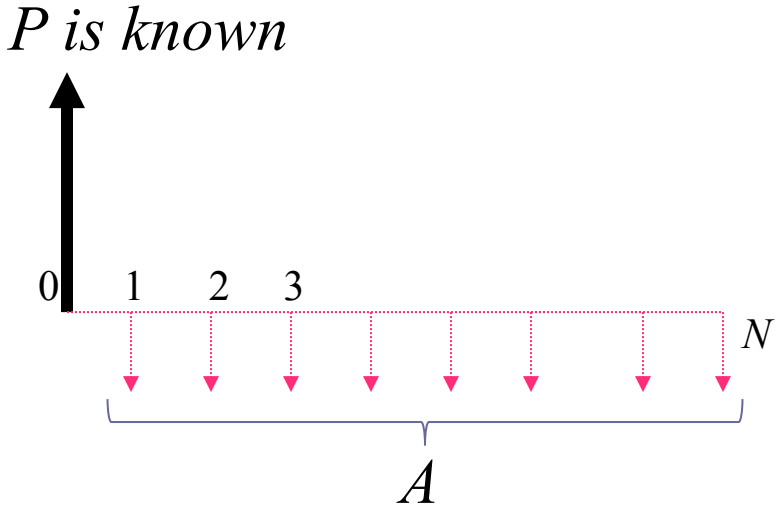
P=600*4,6065

P= 2763,9 TL

$$P = A\frac{(1+i)^N - 1}{i\,(1+i)^N}$$

$$P = A(P/A, i\%, N)$$

Capital Recovery Factor (Eşit Seri Ödemeli Kapital Geri Kazanım)



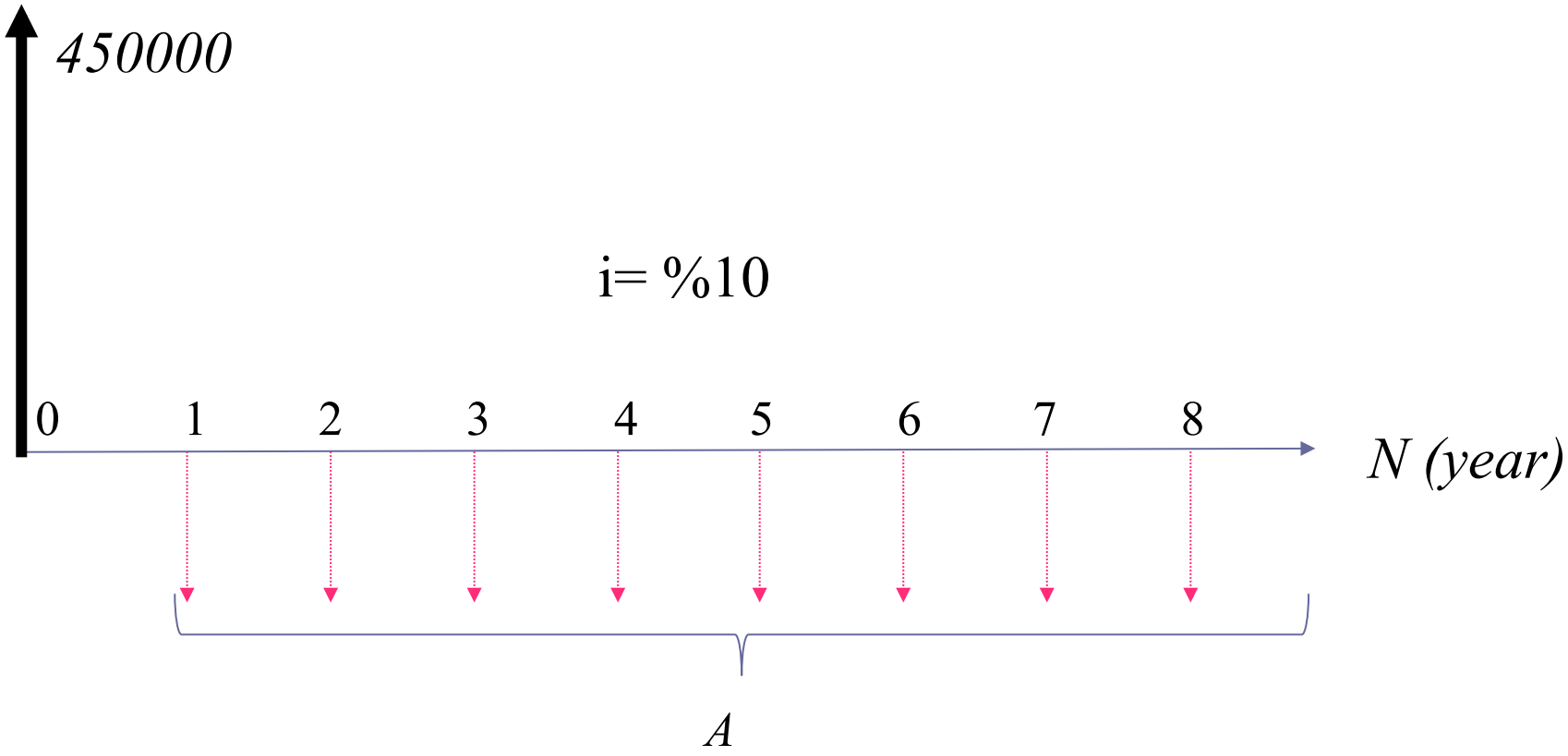
$$A = P\frac{i\,(1+i)^N}{(1+i)^N - 1}$$

$$A = P(A/P, i\%, N)$$

- **When P, i and N are known, calculation of value of A:** the present worth *P* is known and the equivalent uniform-series amount *A* is sought throughout a period *N* at an interest rate *i*.
- The payback of house and car credits are some of the examples of capital recovery factors.

Example - 2

- Company A borrows 450 000 TL for buying laboratory equipment at a rate of return of %10 per year for 8 years starting next year. What should the company pay annually throughout the credit period?

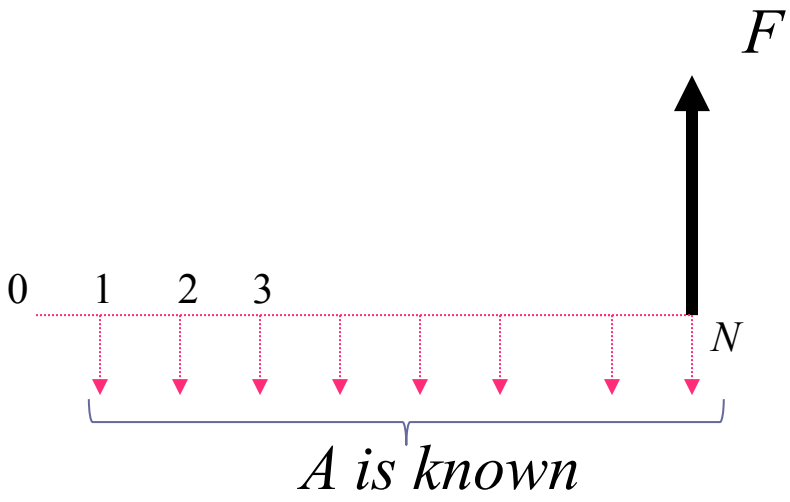


A= P (A/P, %10, 8)
A= 4500000* 0,10 (1+0,10)↑8 / (1+0,10)↑8 −1
A=450000*0,1874
A= 84330 TL

$$A = P\frac{i\,(1+i)^N}{(1+i)^N - 1}$$

$$A = P(A/P, i\%, N)$$

Uniform Series Compound Amount (Eşit Ödemeli Seri - Bileşik Değer Faktörü)



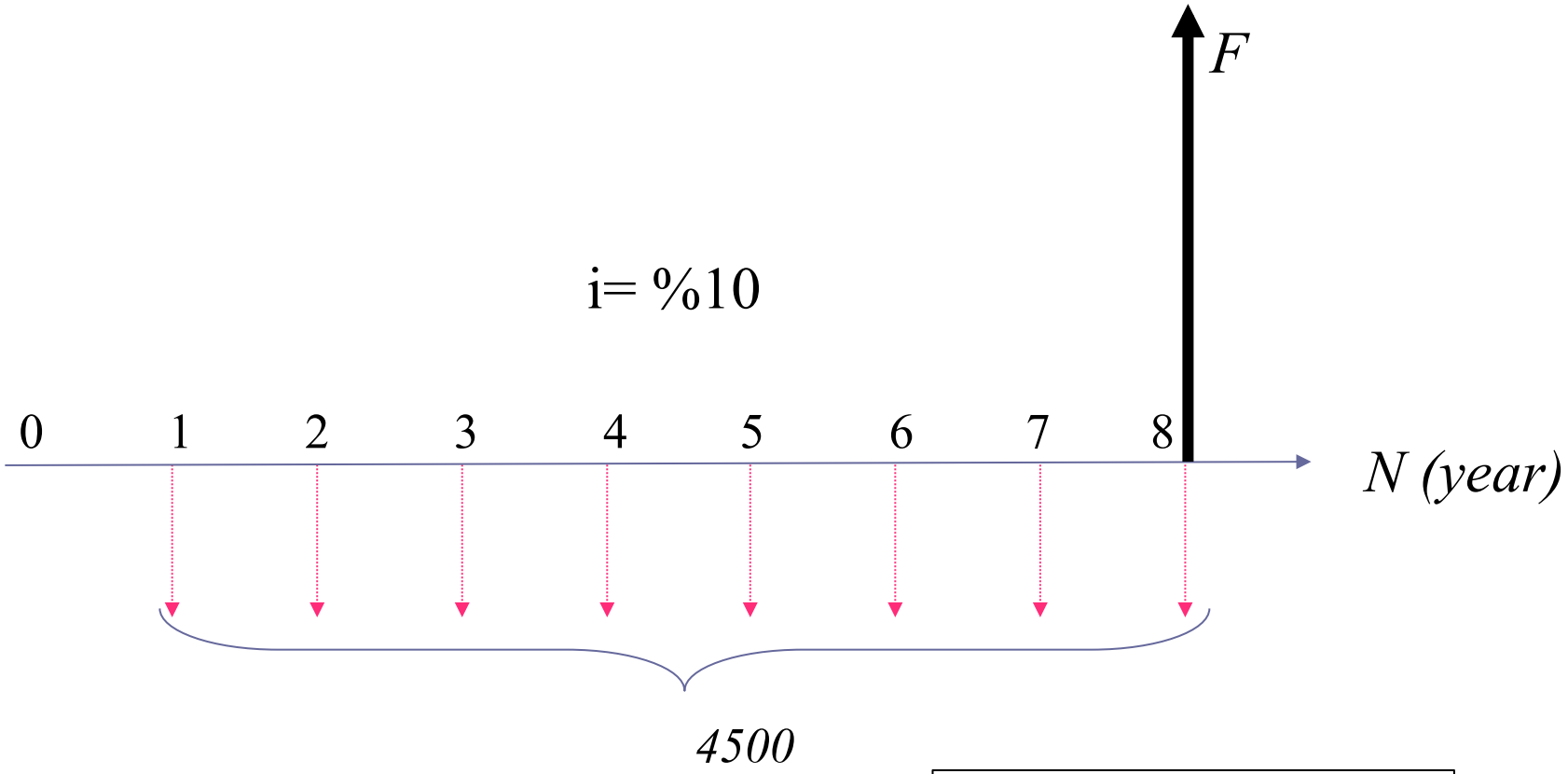
$$F = A\frac{(1+i)^N - 1}{i}$$

$$F = A(F/A, i\%, N)$$

- **When A, i and N are known, calculation of F value:** The equivalent future worth F of a uniform series A end of period cash flows N at an interest rate i.

Example - 3

At the end of each year, 4500 TL is deposited throughout 8 years at an interest rate of %10 per year. What is the amount of the money which can be withdrawn at the end of 8^{th} year?



F= A (F/A, %10, 8)

F= 4500*(1+0,10)^8 −1/0,10

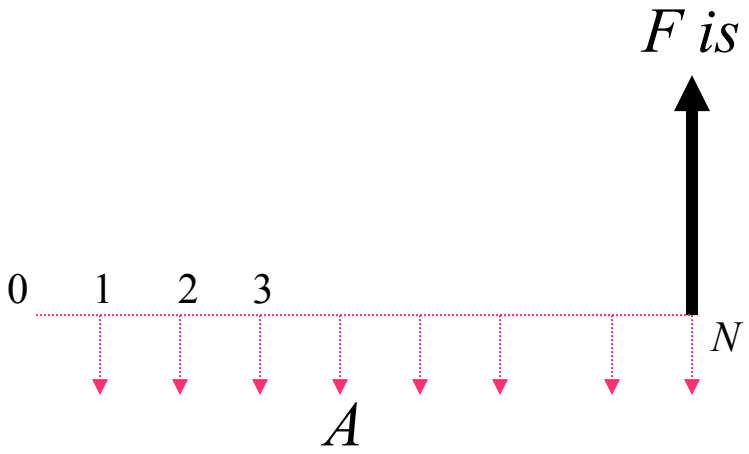
F=4500*11,4359

F= 51461,55 TL

$$F = A\frac{(1+i)^N - 1}{i}$$

$$F = A(F/A, i\%, N)$$

Sinking Fund Factor (Eşit Ödemeli Seri - Birikim Hesabı)



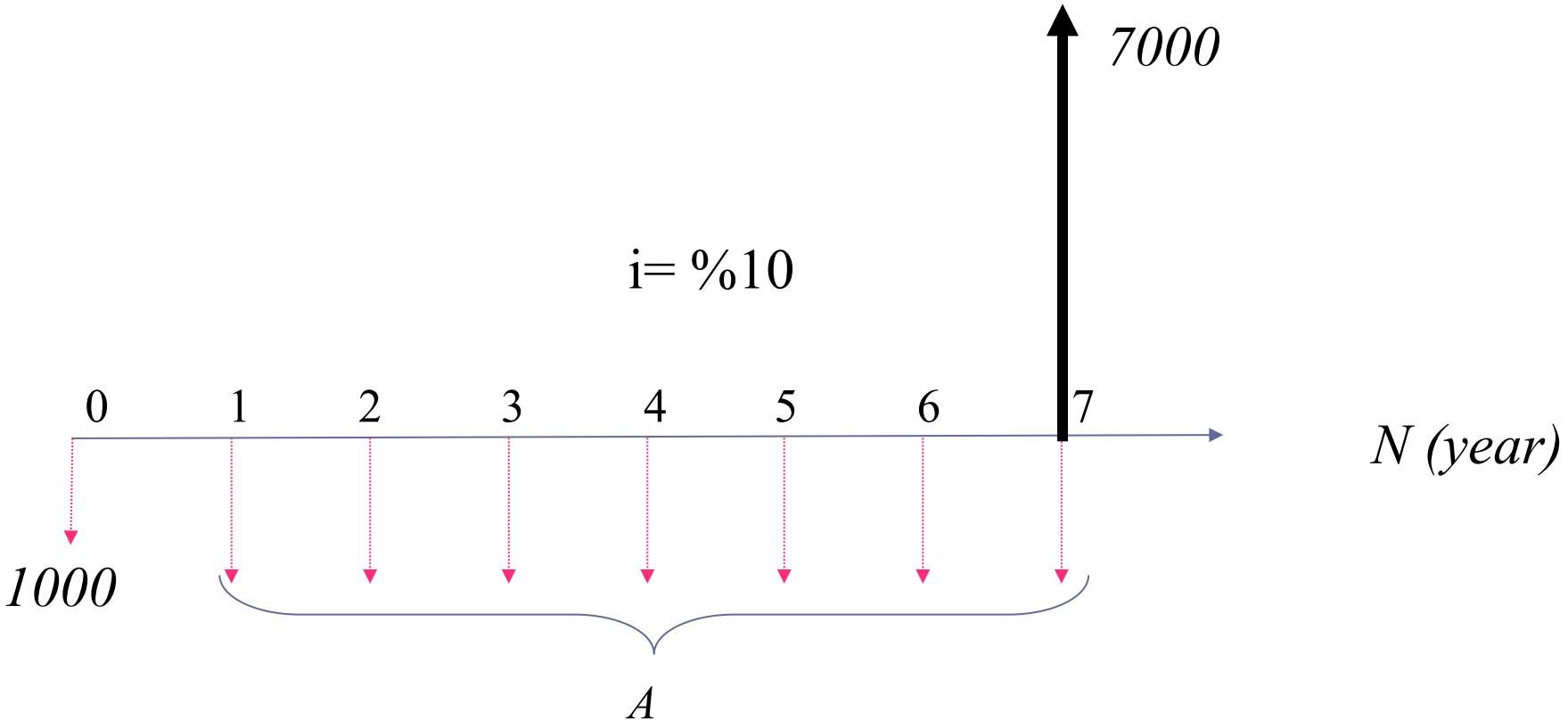
$$A = F\frac{i}{(1+i)^N - 1}$$

$$A = F(A/F, i\%, N)$$

- **When F, i and N are known, calculation of A value:** This function determines the A value for n years, given F in year n, at a given interest rate.
- These calculations are performed for determining the periodically deposited amount required to replace the fixed assets.

Example - 4

- At the present time, a father proposes to give 1000 TL to his son who wants to collect 7000 TL at the end of 7^{th} year. He deposits this money to a bank. On the other hand, the son is planning to deposit equal amount of money earned by working at a part time job at the end of each year. If the interest rate is %10 per year, how much money should he earn?



A= F(A/F,10%,7)-P (A/P, %10, 7)

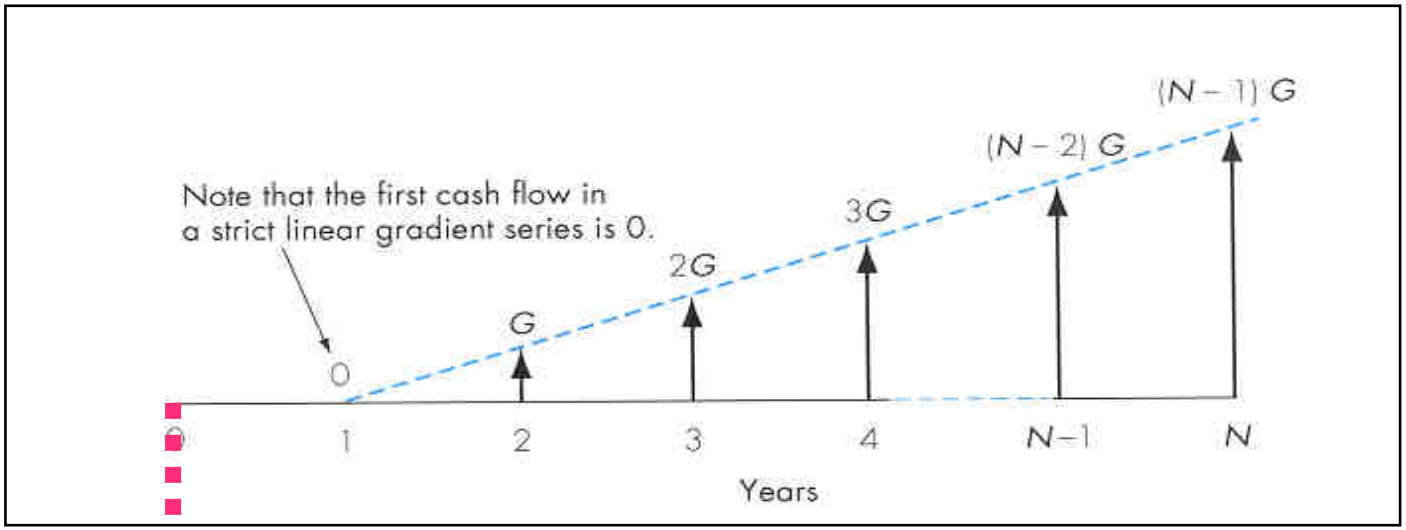
A= 7000*0,10/(1+0,10)↑7 −1 - 1000*0,10 (1+0,10)↑7 /(1+0,10)↑7 −1

A=7000*0,1054-1000*0,2054

A= 532,4 TL

Arithmetic Gradient Factors

An arithmetic gradient is a cash flow series that either increases or decreases by a constant amount. The amount of the increase or decrease is the gradient.

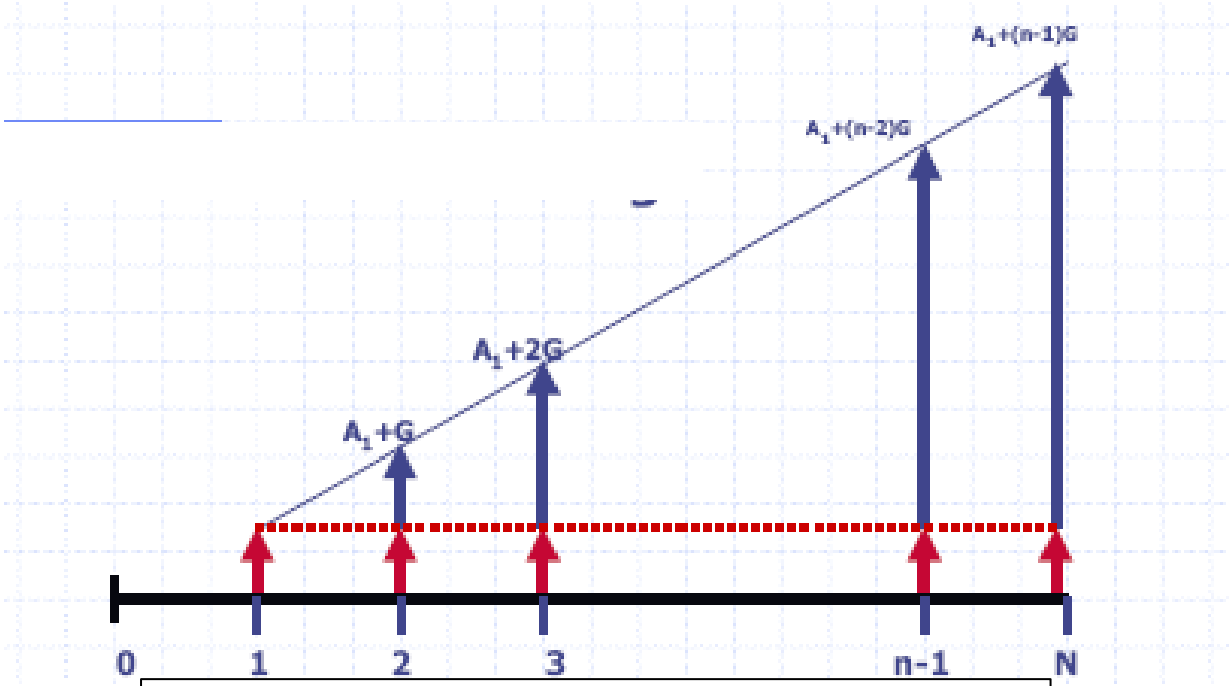


Gradient
Present Worth

$$P = G\frac{(1+i)^N - iN - 1}{i^2 * (1+i)^N}$$

$$P = G(P/G, i, N)$$

Gradient uniform series (Sürekli Artan/Azalan Seri Ödemeler)

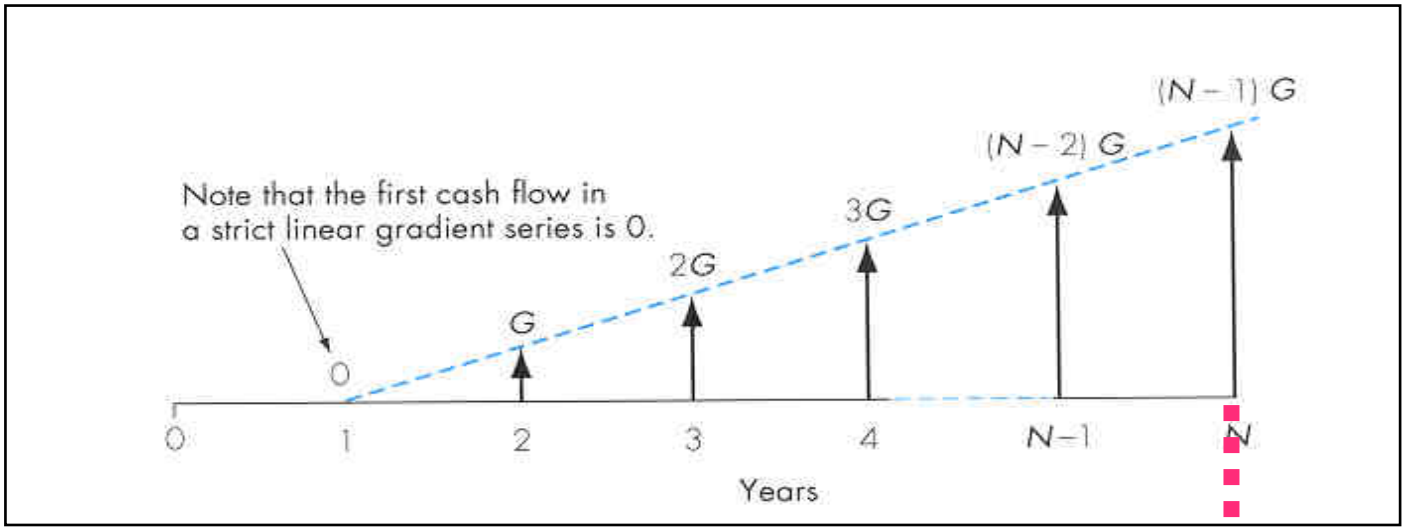


Gradient Uniform Serie

$$A = A_1 + G\left[\frac{1}{i} - \frac{N}{(1+i)^N - 1}\right]$$

$$A = A_1 + G(A/G, i\%, N)$$

Gradient uniform series



Gradient
Future Worth

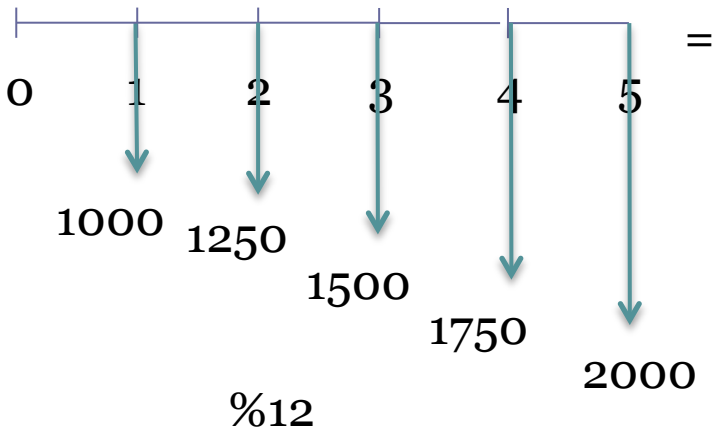
$$F = \frac{G}{i}\left[\frac{(1+i)^N - 1}{i} - N\right]$$

$$F = G(F/G, i, N)$$

F

Example - 5

- A textile company wants to buy a manufacturing machine whose economic life is 5 years. The engineers predict that the operating and maintenance expenses of this machine will be $1000. These expenses are expected to increase $250 each year uniformly and it is assumed that these expenses occurred at the end of the year. If the company wants to deposit an amount of money at %12 interest rate to compensate these expenses. Then how much money should they deposit?



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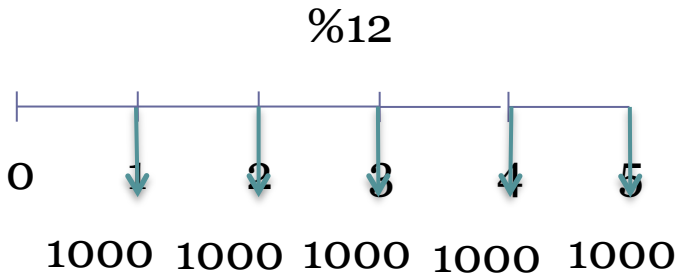
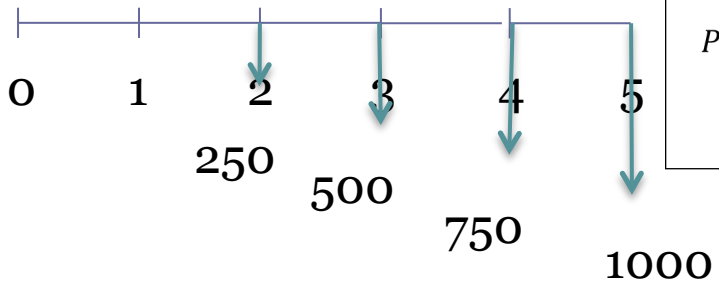


$$P = A\frac{(1+i)^N - 1}{i\,(1+i)^N}$$

$$P = A(P/A, i\%, N)$$

Uniform Series Present Worth

+



$$P = G\frac{(1+i)^N - iN - 1}{i^2 * (1+i)^N}$$

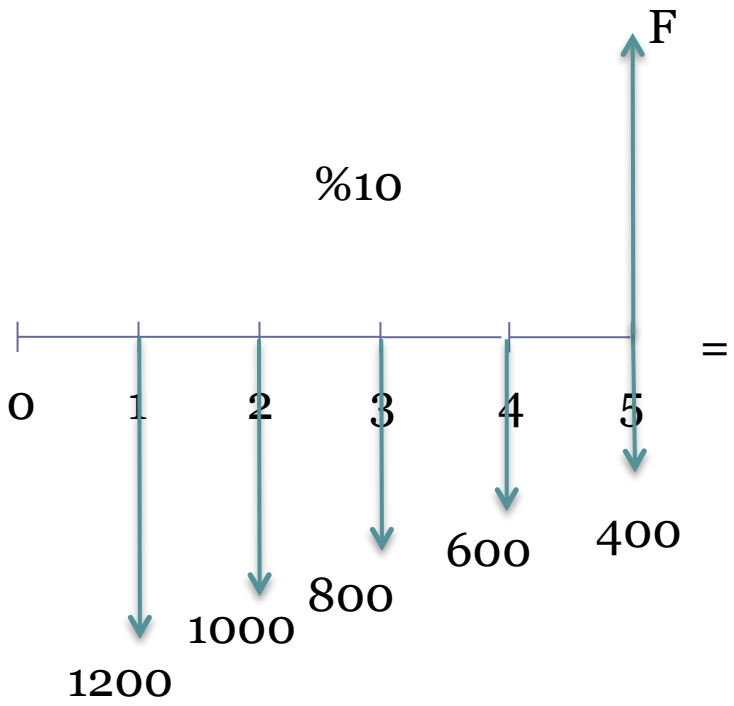
$$P = G(P/G, i, N)$$

Arithmetic Gradient Factors

P = A(P/A, 12%, 5) + G (P/G, 12%, 5)
P= 1000*3,6048+250*6,3970
P= $5204,05

Example - 6

- A company wants to deposit money to a bank at %10 interest rate. The money deposited at the end of first year is $1200, and it will decrease by $200 per year for 4 years. What is the amount of money will the company earn at the end of 5^{th} year?



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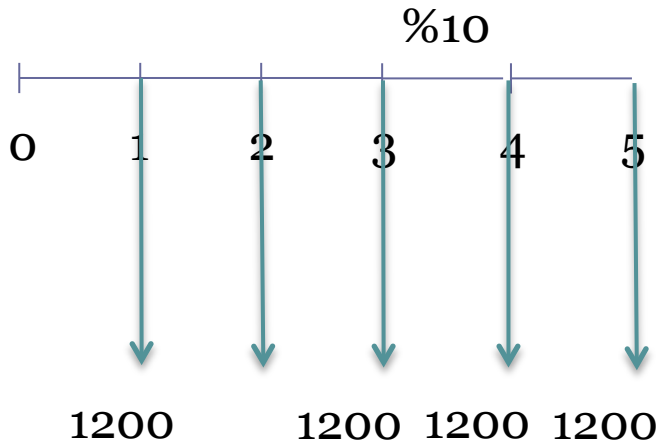
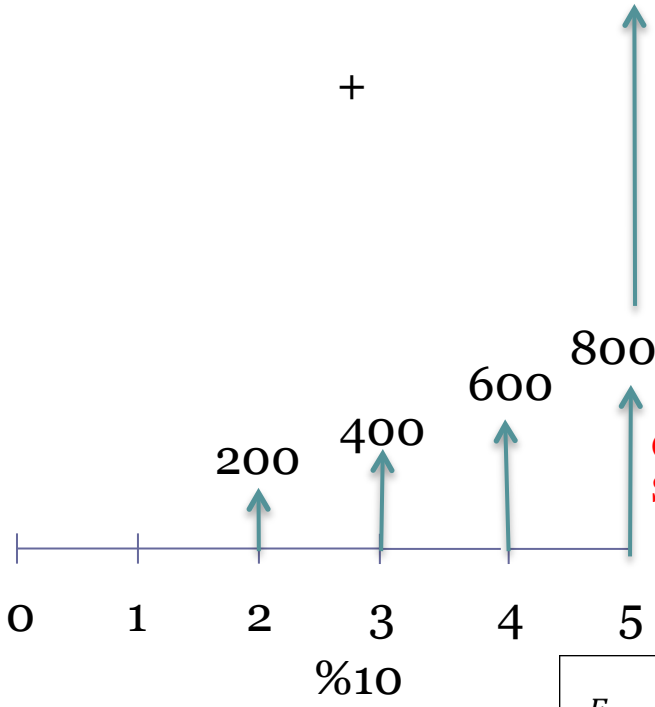


$$F = A\frac{(1+i)^N - 1}{i}$$

$$F = A(F/A, i\%, N)$$

+



$$F = \frac{G}{i}\left[\frac{(1+i)^N - 1}{i} - N\right]$$

$$F = G(F/G, i, N)$$

F= A(F/A,%10, 5)- G(F/G,%10,5)

F=1200*6,1051- 2210,2

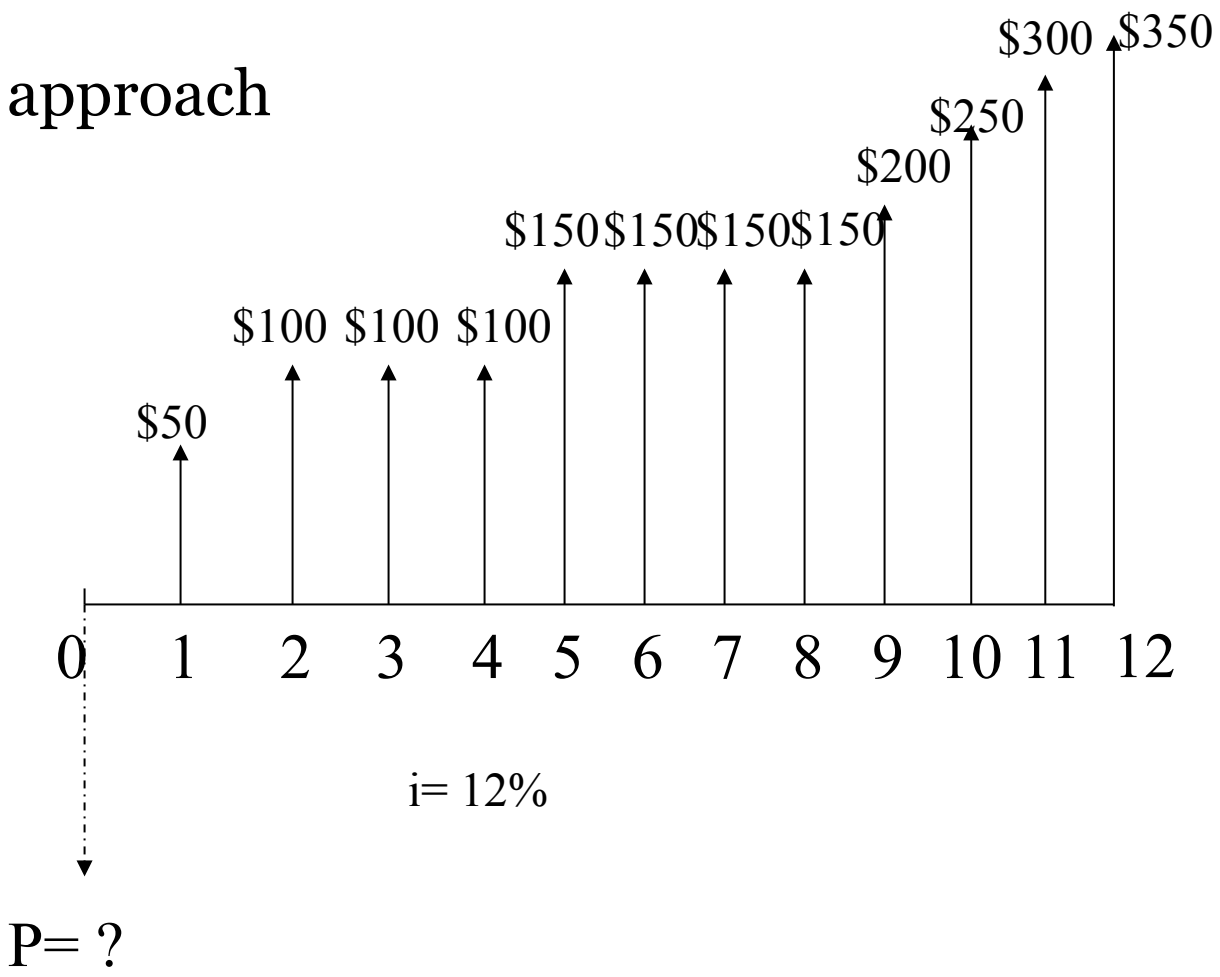
F=$5115,92

Composite Cash Flows (Karışık Nakit Akışları)

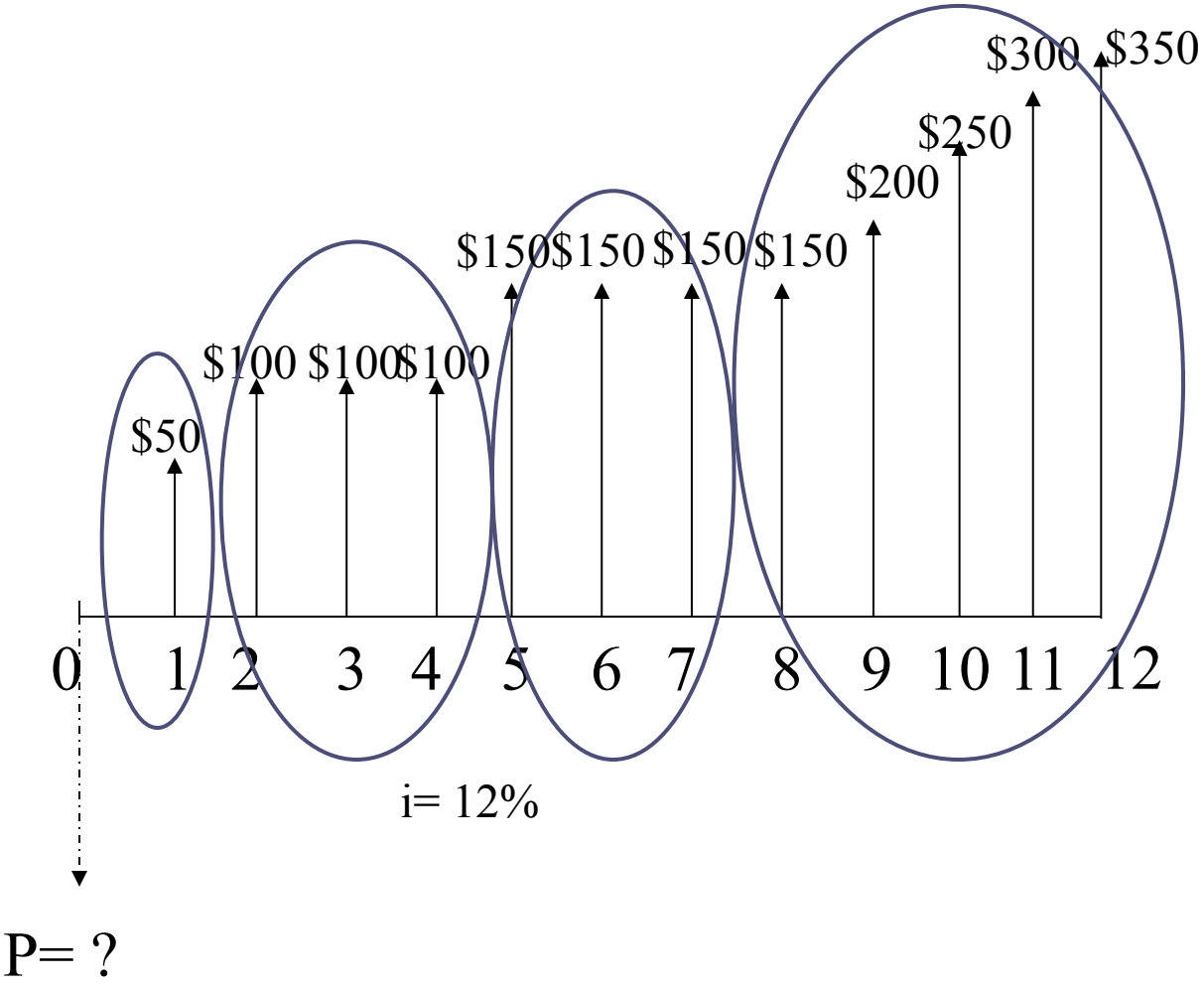
- Carrying all inflows and outflows one by one

or

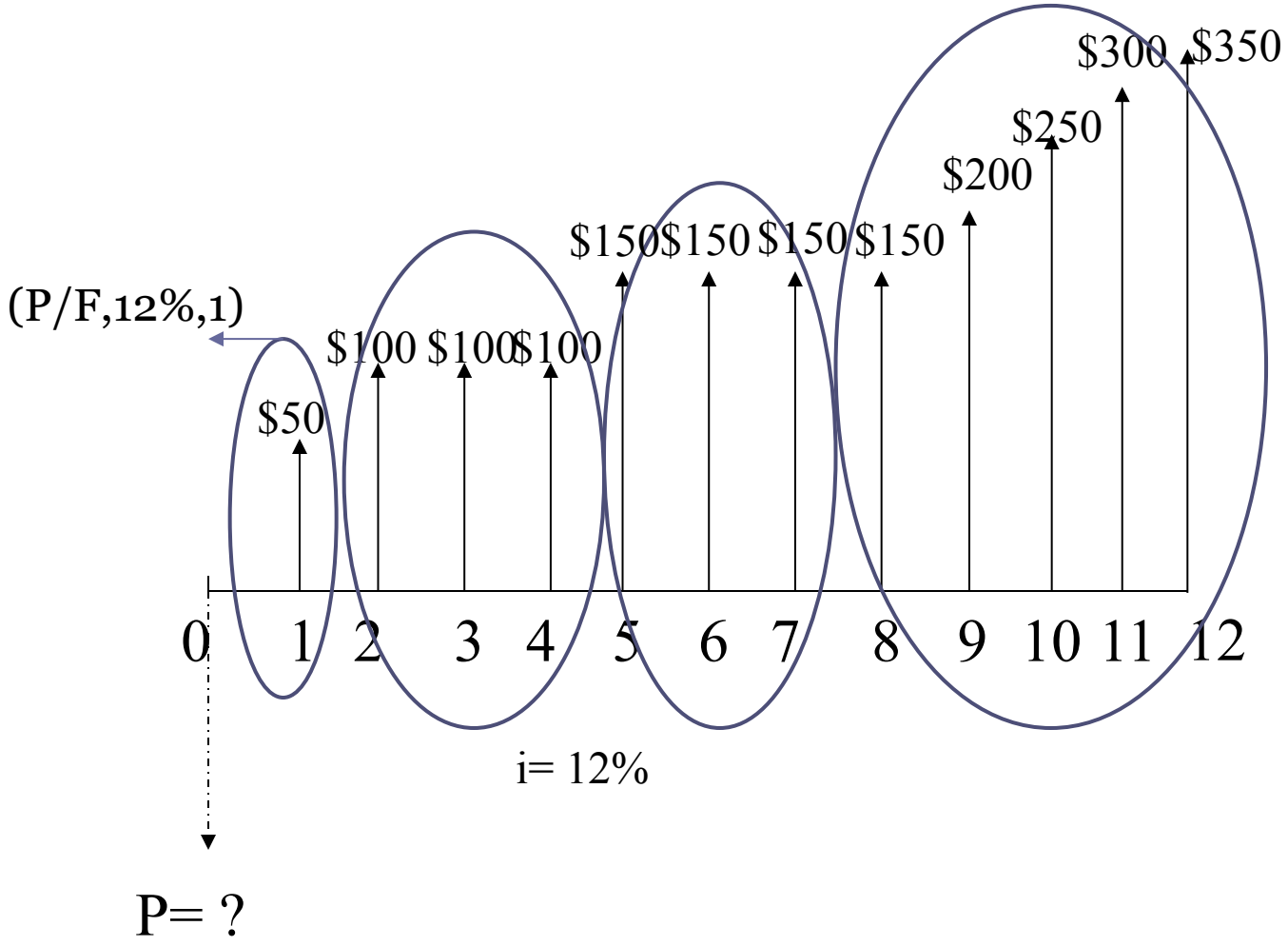
- Grouping approach



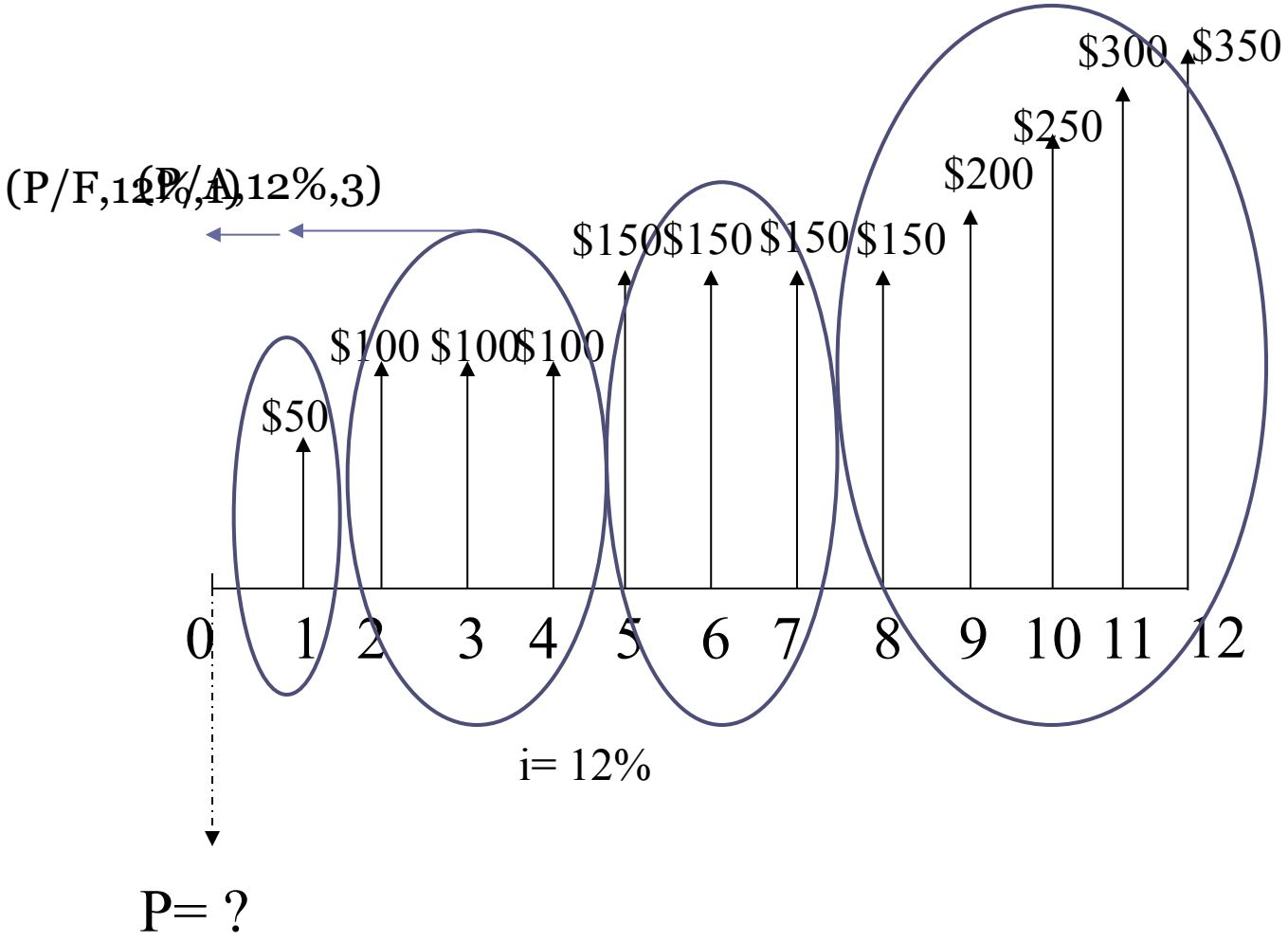
Composite Cash Flows



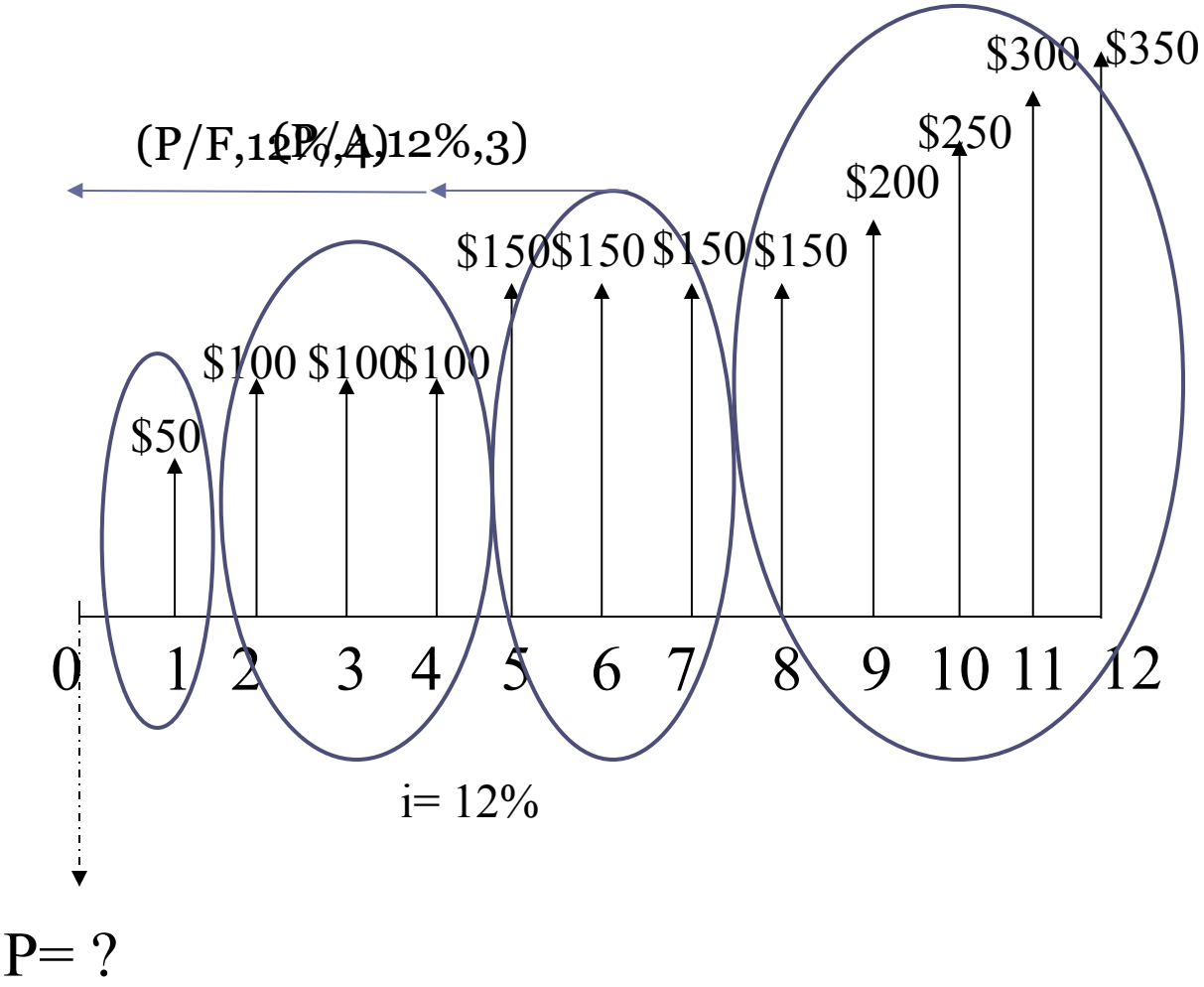
Composite Cash Flows



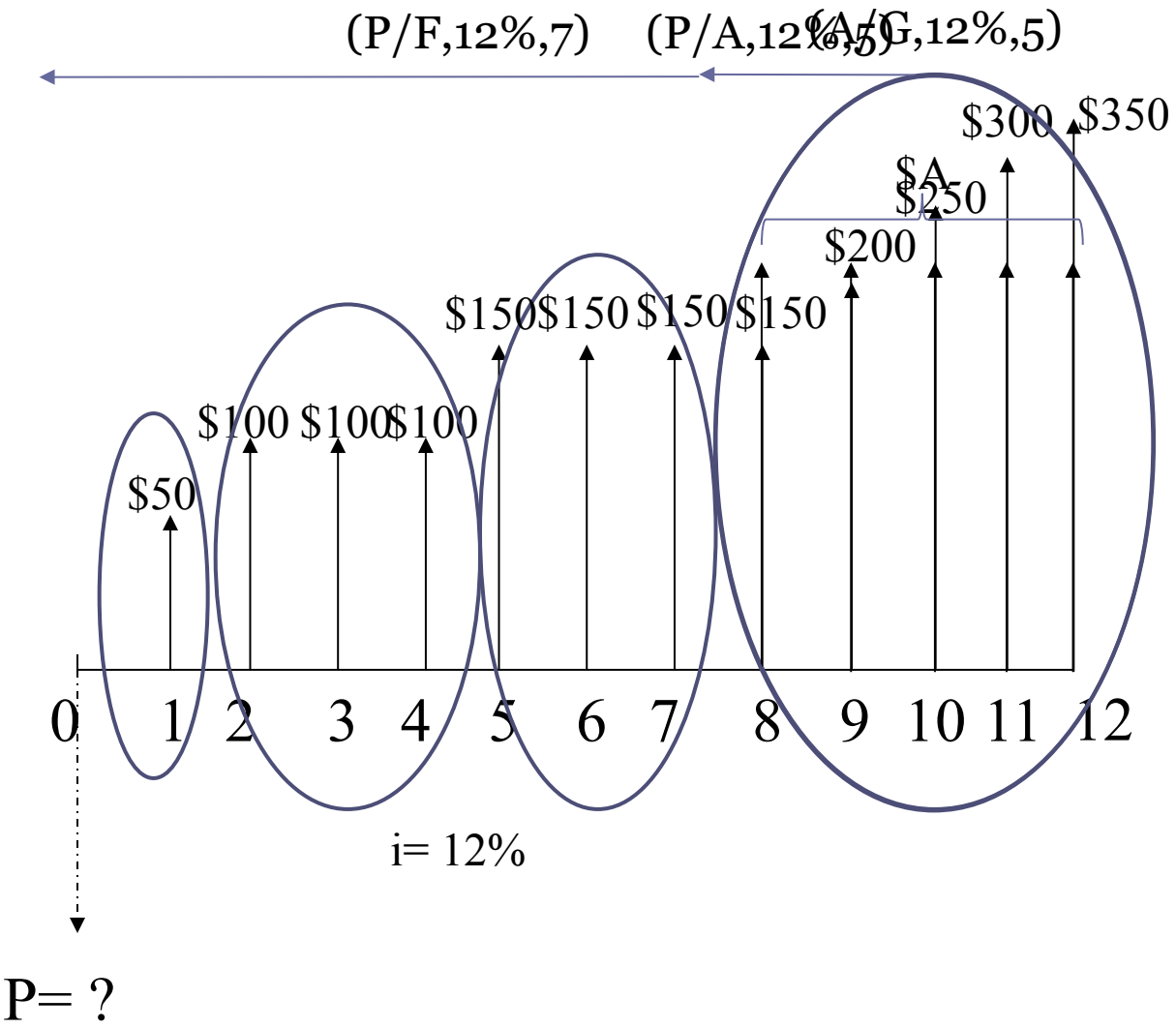
Composite Cash Flows



Composite Cash Flows



Composite Cash Flows



$P= F\,(P/F,\%12,1)+ A_1\,(P/A, \%12, 3)^* (P/F,\%12,1)+ A_2\,(P/A, \%12, 3)^* (P/F,\%12,4)+(A_3+G(A/G,\%12,5))^*(P/A,12\%,5)^*(P/F,12\%,7)$

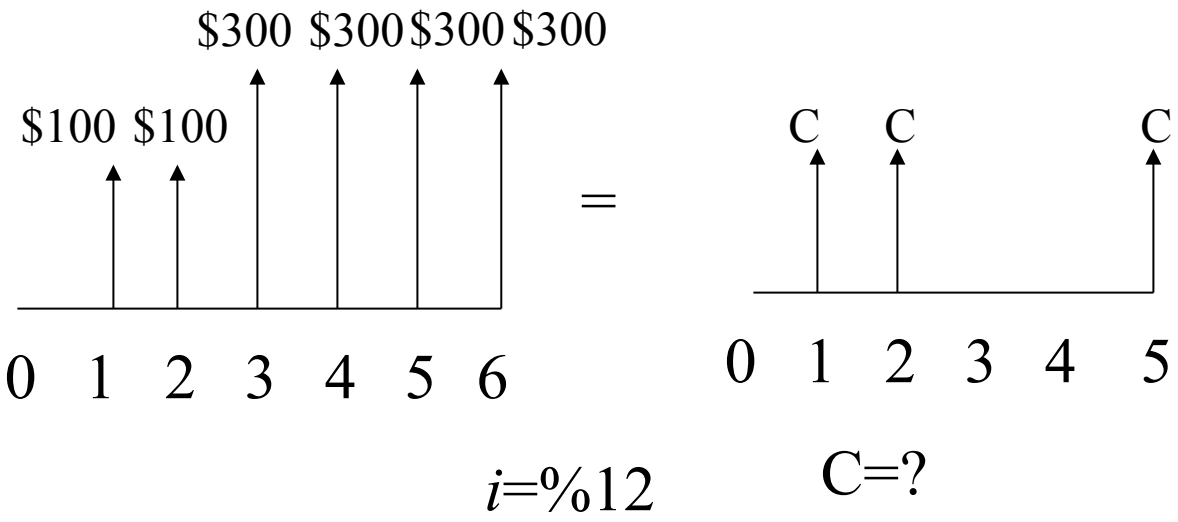
$P= 50\,(P/F,\%12,1)+ 100\,(P/A, \%12, 3)^* (P/F,\%12,1)+ 150\,(P/A, \%12, 3)^* (P/F,\%12,4)+(150+50(A/G,\%12,5))^*(P/A,12\%,5)^*(P/F,12\%,7)$

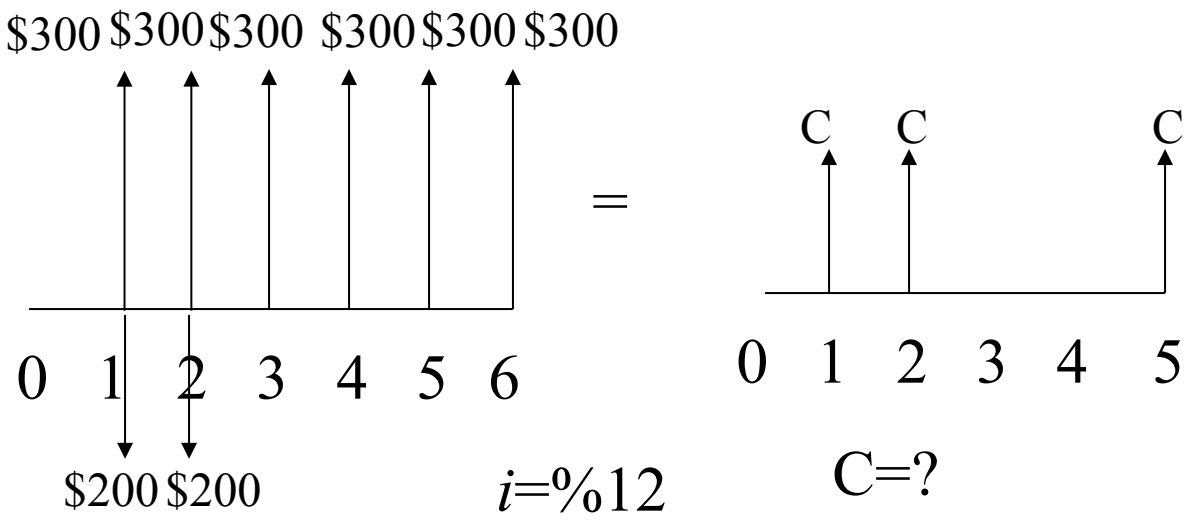
$P= 50^*0{,}8929+100^*2{,}4018^*0{,}8929+150^*2{,}4018^*0{,}6355+(150+50^*1{,}7746)^*3{,}6048^*0{,}4523$

$P= \$\ 877{,}29$

Composite Cash Flows

Example 2: In order to satisfy the equivalent of these two cash flows, what should be the value of C?





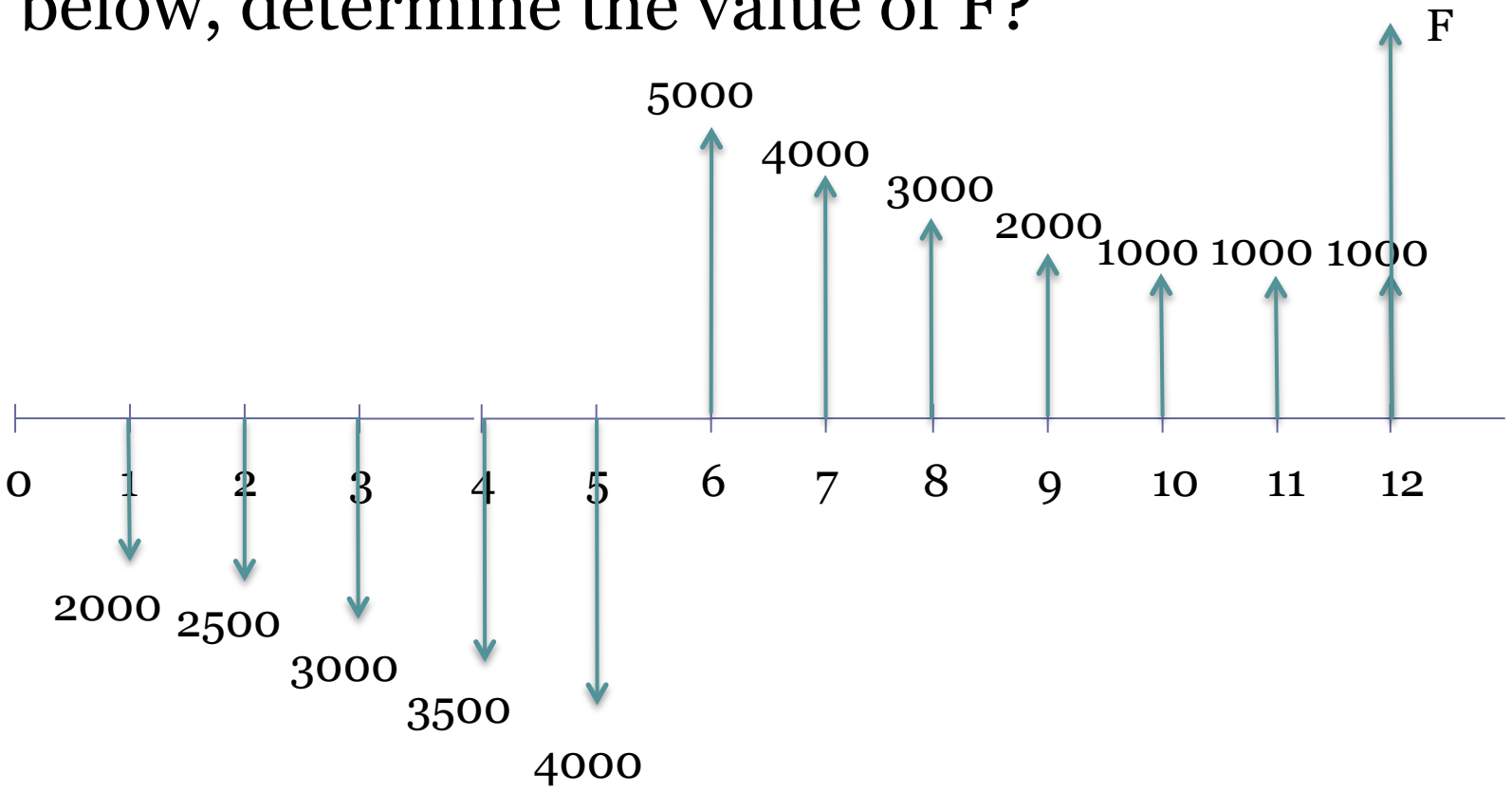
$P_1 = A_1 (P/A, \%12, 6) - A_2 (P/A, \%12, 2)$
$P_1 = 300*4{,}1114 - 200*1{,}6901$
$P_1 = \$895.4$

$P_2 = A (P/A, \%12, 2) + F (P/F, \%12, 5)$
$P_2 = C*1{,}6901 + C*0{,}5674$
$P_2 = 2{,}2575C$

$P_1 = P_2$
$C = \$396.73$

Composite Cash Flows

Example 3:According to the cash flow given below, determine the value of F?



$F= (A_1 + G_1(A/G,7\%,5))*(F/A,7\%,5)*(F/P,7\%,7)- (A_2 – G_2 (A/G,7\%,5))* (F/A, 7\%,5)* (F/P,7\%,2)- A (F/A, 7\%, 2)$

$F= (2000+500(A/G,7\%,5))*(F/A,7\%,5)*(F/P,7\%,7)-(5000–1000(A/G,7\%,5)) *(F/A,7\%,5)* (F/P,7\%,2)- 1000 (F/A, 7\%, 2)$

$F= (2000+500*1,8650)*5,7507*1,6058- (5000-1000*1,8650)*5,7507*1,1449-1000*2,0700$

$F= 4369,33$