Engineering Economy

[2-4]
Time Value of Money

Geometric Gradient Series

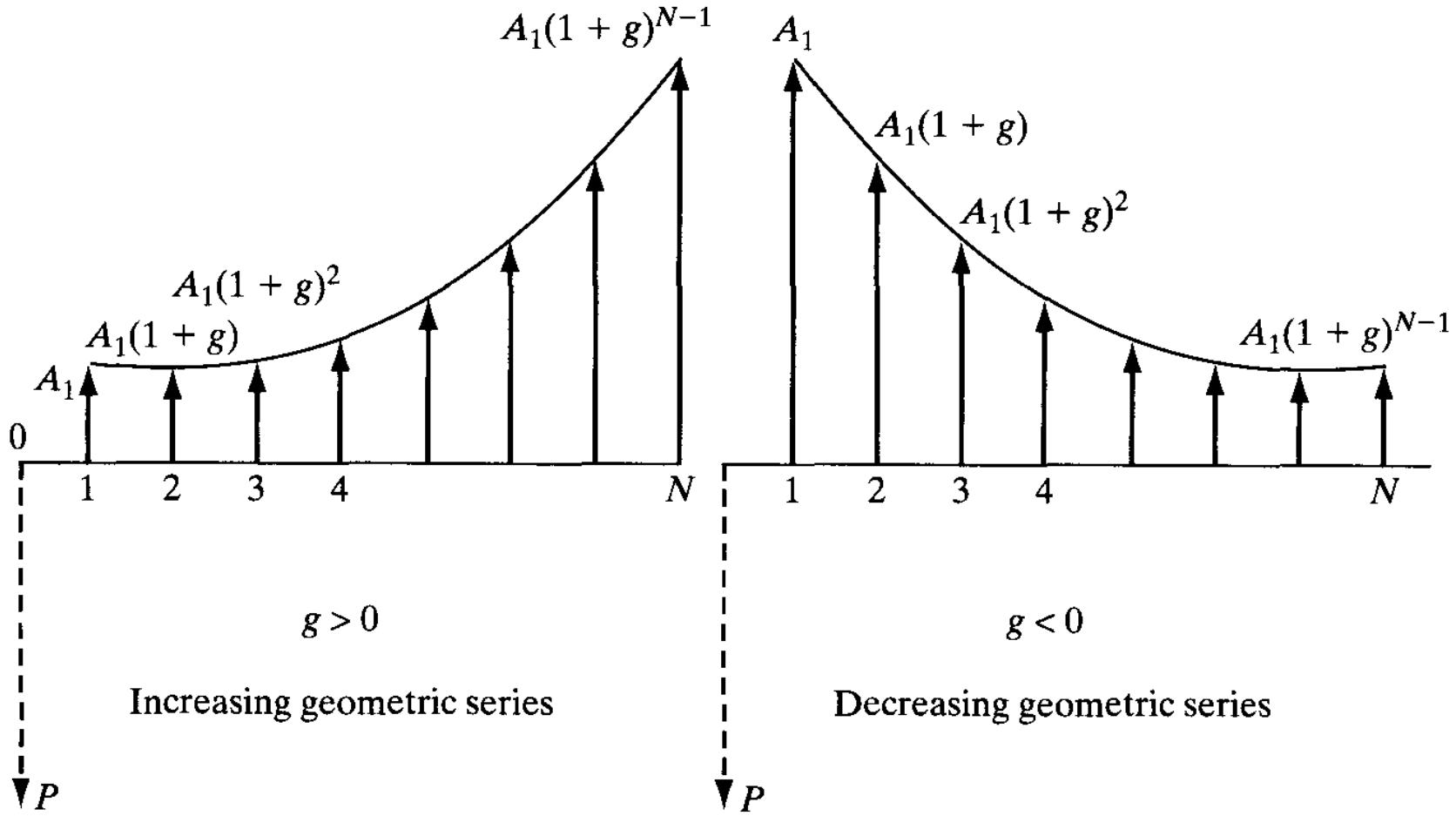
Geometric Gradient Series

- In geometric gradient series, cash flow increases or decreases from period to period by a constant percentage

- This uniform rate of change defines a *geometric gradient* series of cash flows

- We will use the term g which is the constant rate of change by which amounts increase or decrease from one period to the next

Geometric Gradient Series



Geometric Gradient Series

- We need to find the value of the present worth at time = 0 based on geometric gradient series cash flows starting by the end of period 1 by an amount A1 and ***increasing*** by a constant rate of g each period

- P = A1 (P/A,g,i,n)

$$(P/A,g,i,n) = \begin{cases} \dfrac{1-\left(\dfrac{1+g}{1+i}\right)^{n}}{i-g} & \text{when } g \neq i \\ \dfrac{n}{1+i} & \text{when } g = i \end{cases}$$

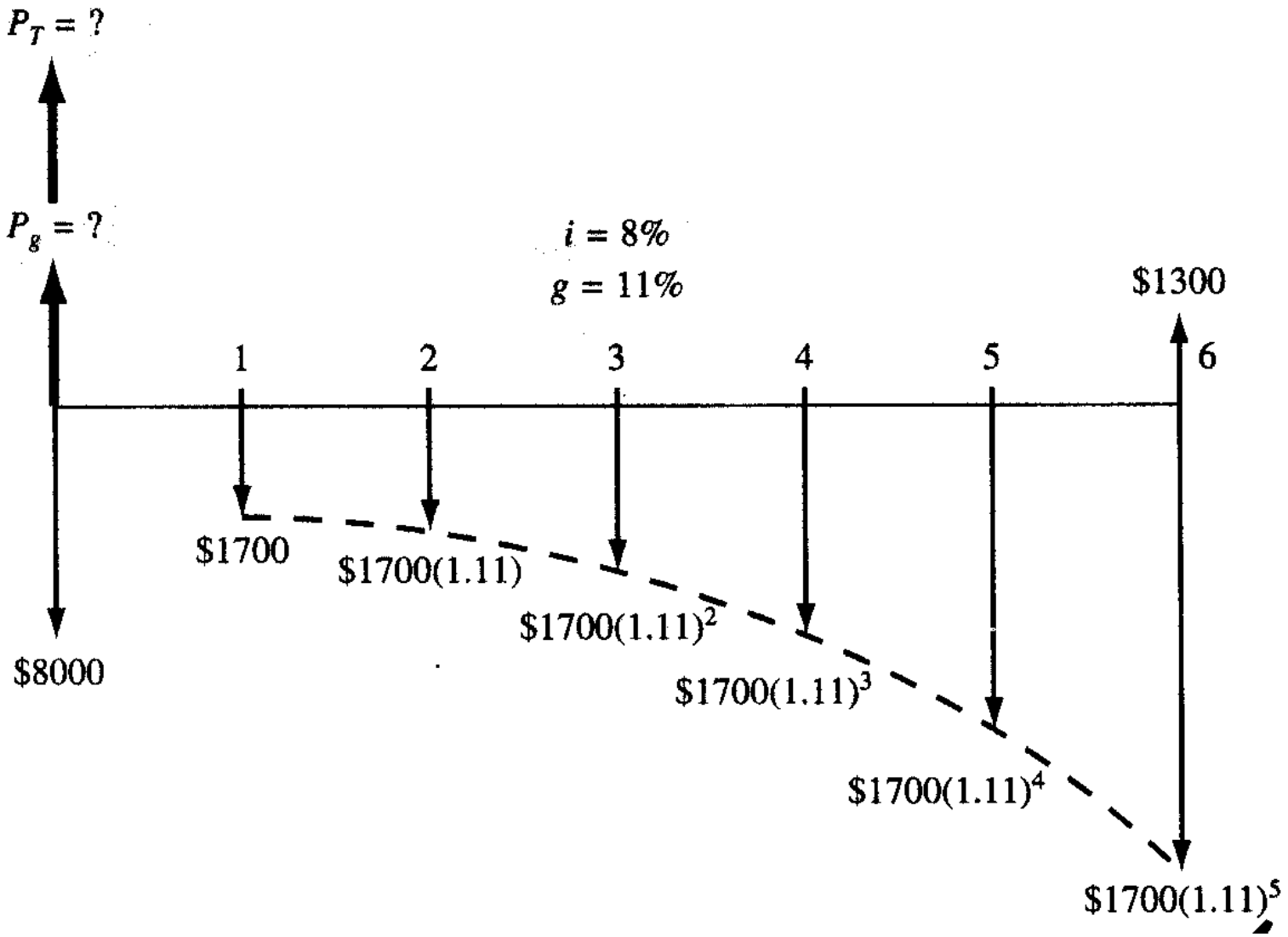
Geometric Gradient Series

Example

- Engineers at a specific company need to make some modifications to an existing machine
- The *modification* costs only $8,000 and is expected to last 6 years with a $1,300 *salvage* value
- The *maintenance* cost is expected to be high at $1,700 the first year, increasing by 11% per year thereafter
- Determine the equivalent present worth of the modification and maintenance cost. The interest rate is 8% per year

Geometric Gradient Series

Example



- Solution:

- PT = -8000 – Pg + 1300(p/f, 8%, 6)

Geometric Gradient Series

Example

- The present worth value is comprised of three components:
  - ✓The present modification cost = $8,000
  - ✓The present value of the future salvage value
  - ✓The present value of all the maintenance values throughout the 6 years and these are represented by the geometric gradient series

- $P_T = -8{,}000 + 1{,}300(P/F,8\%,6) - P_g$
- $P_g = A1(P/A,g,i,n) \rightarrow (P/A,11\%,8\%,6) = \dfrac{1-\left(\dfrac{1+0.11}{1+0.08}\right)^6}{0.08-0.11}$
- $P_T = -8{,}000 + 819.26 - 1{,}700 \times 5.9559$
  $= \$ -17{,}305.85$