

Discounted Cash Flow Analysis Factors

Intuition, Illustration, Calculation & Excel

Note: “i” is the appropriate discount rate (MARR, etc.).

Chris Willmore, October 2022

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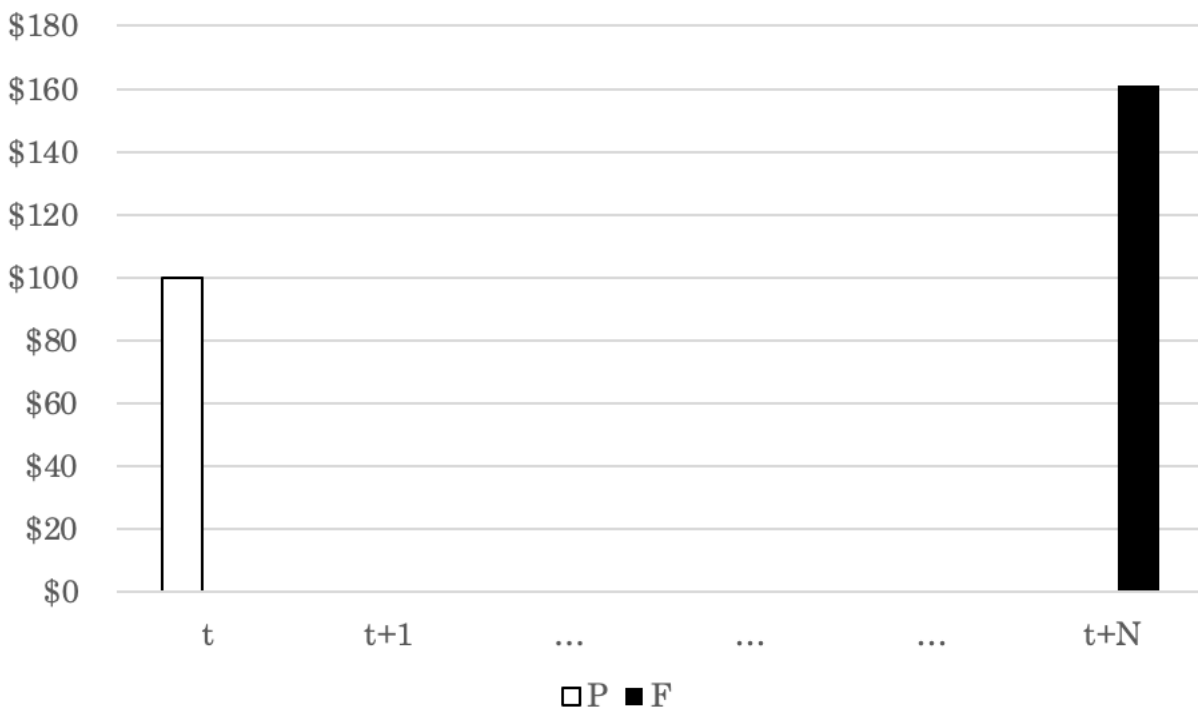
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$$F = P \times (F/P, i, N) \text{ (Move right on the timeline)}$$

INTUITION

- Start: A single payment of magnitude P , at time t
- End: A single payment of magnitude $P \times (F/P, i, N)$, at time $t + N$.

ILLUSTRATION



Drawn for $P = \$100$, $N = 5$, $i = 10\%$. Start: White, End: Black

FORMULA

$$P \times (F/P, i, N) = P \times (1 + i)^N$$

EXCEL EQUIVALENT

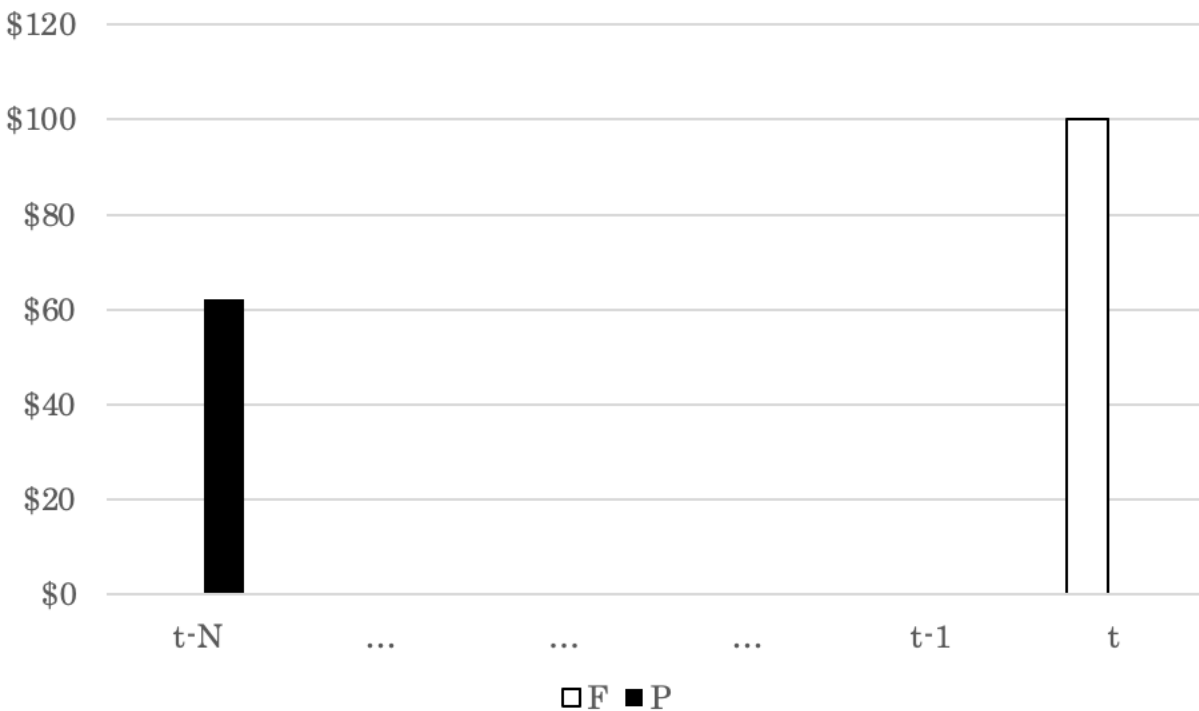
$$P \times (F/P, i, N) = \text{FV}(i, N, -, P)$$

$$P = F \times (P/F, i, N) \text{ (Move left on the timeline)}$$

INTUITION

- Start: A single payment of magnitude F , at time t .
- End: A single payment of magnitude $F \times (P/F, i, N)$, at time $(t - N)$.

ILLUSTRATION



Drawn for $F = \$100$, $N = 5$, $i = 10\%$. Start: White, End: Black

FORMULA

$$F \times (P/F, i, N) = F / (F/P, i, N) = F / (1+i)^N$$

EXCEL EQUIVALENT

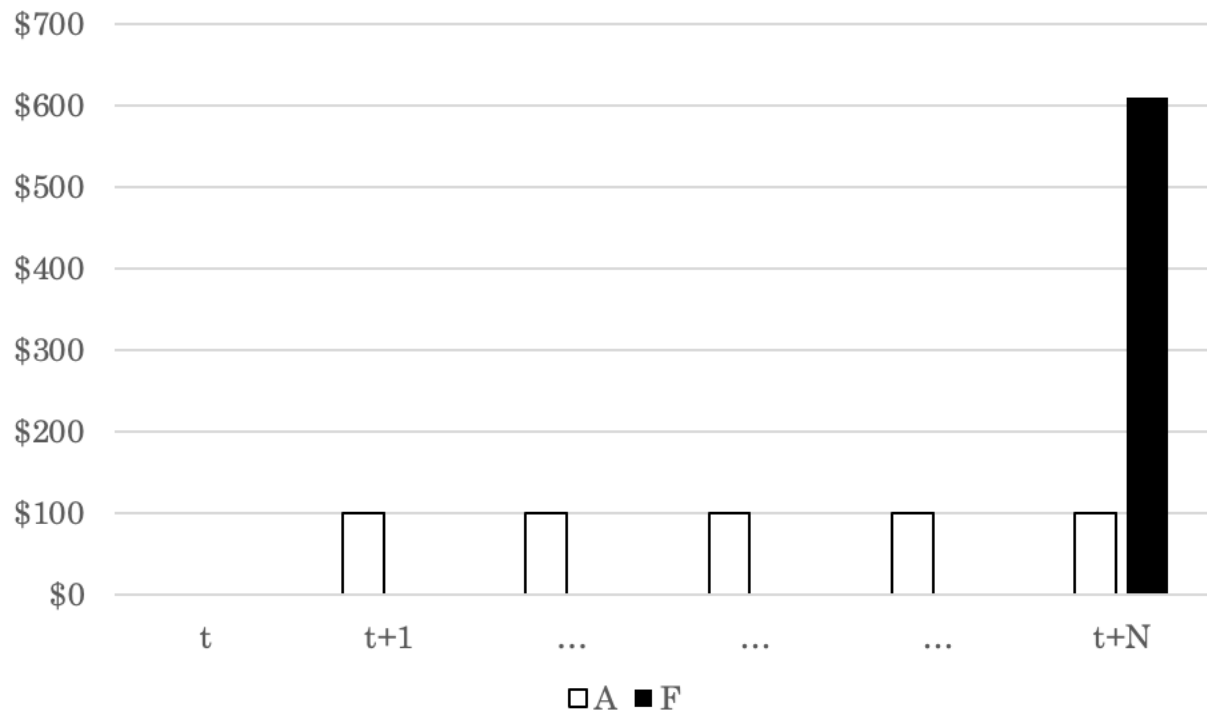
$$F \times (P/F, i, N) = \text{PV}(i, N, -, F)$$

$F = A \times (F/A, i, N)$ (Sequence to Single Payment on Right)

INTUITION

- Start: N payments of magnitude A. The last payment is at time $t+N$.
- End: A single payment of magnitude $A \times (F/A, i, N)$, at time $t+N$.

ILLUSTRATION



Drawn for $A = \$100$, $N = 5$, $i = 10\%$. Start: White, End: Black

FORMULA

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

EXCEL EQUIVALENT

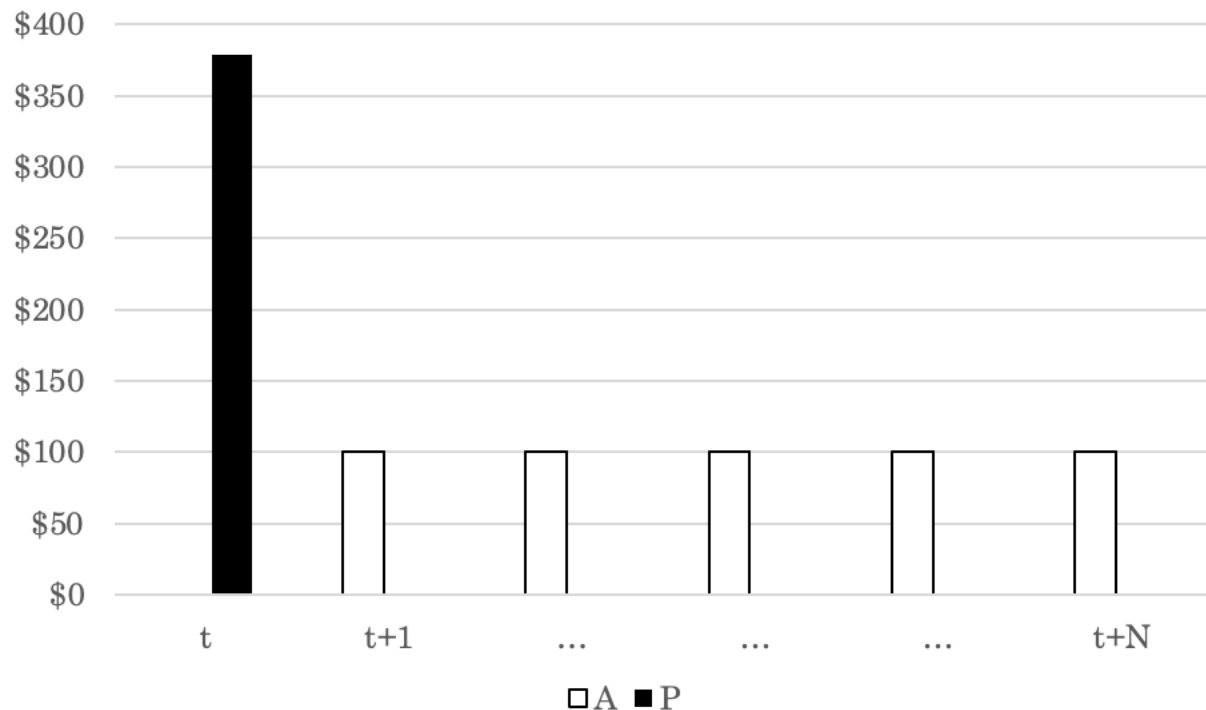
$$A \times (F/A, i, N) = \text{FV}(i, N, -A)$$

$P = A \times (P/A, i, N)$ (Sequence to Single Payment on Left)

INTUITION

- Start: A sequence of N payments of magnitude A . First payment: time $t+1$.
- End: A single payment of $A \times (P/A, i, N)$, at time t .

ILLUSTRATION



Drawn for $A = \$100$, $N = 5$, $i = 10\%$. Start: White, End: Black

FORMULA

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

EXCEL EQUIVALENT

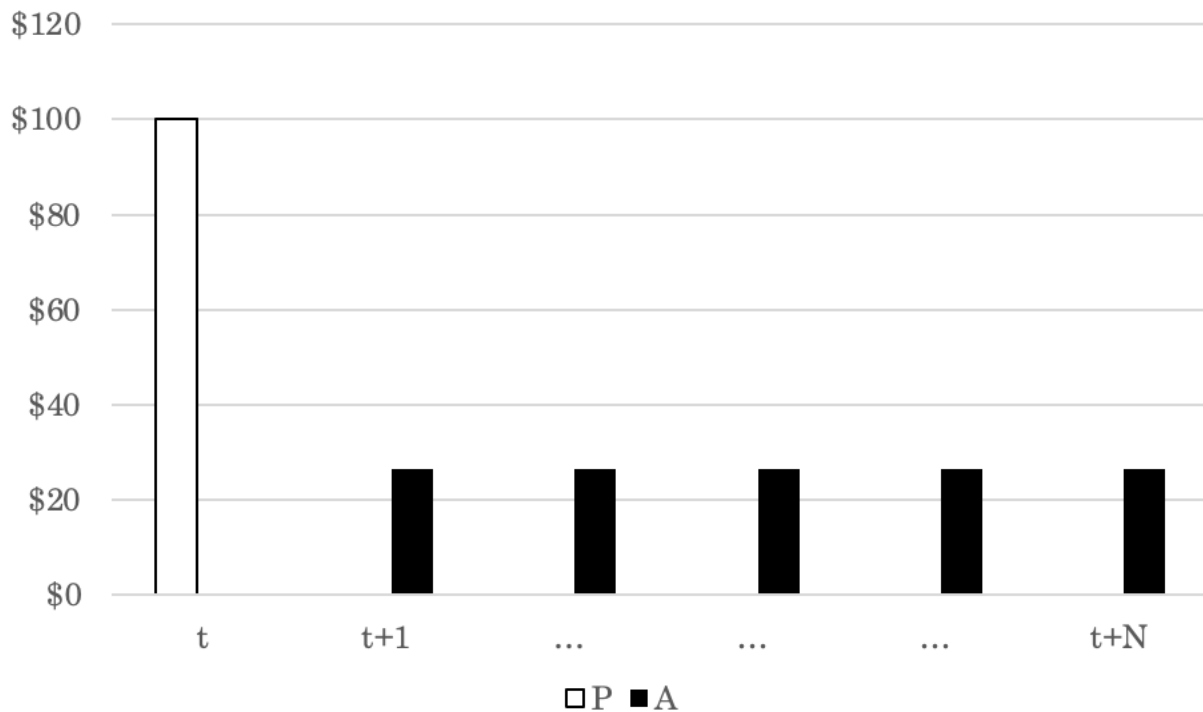
$$A \times (P/A, i, N) = \text{PV}(i, N, -A)$$

$A = P \times (A/P, i, N)$ (Single Payment to Sequence on Right)

INTUITION

- Start: A single payment of magnitude P , at time t .
- End: N payments of magnitude $P \times (A/P, i, N)$. The first payment is at time $t+1$.

ILLUSTRATION



Drawn for $P = \$100$, $N = 5$, $i = 10\%$. Start: White, End: Black

FORMULA

$$P \times (A/P, i, N) = A / (P/A, i, N) = F/(1+i)^N$$

EXCEL EQUIVALENT

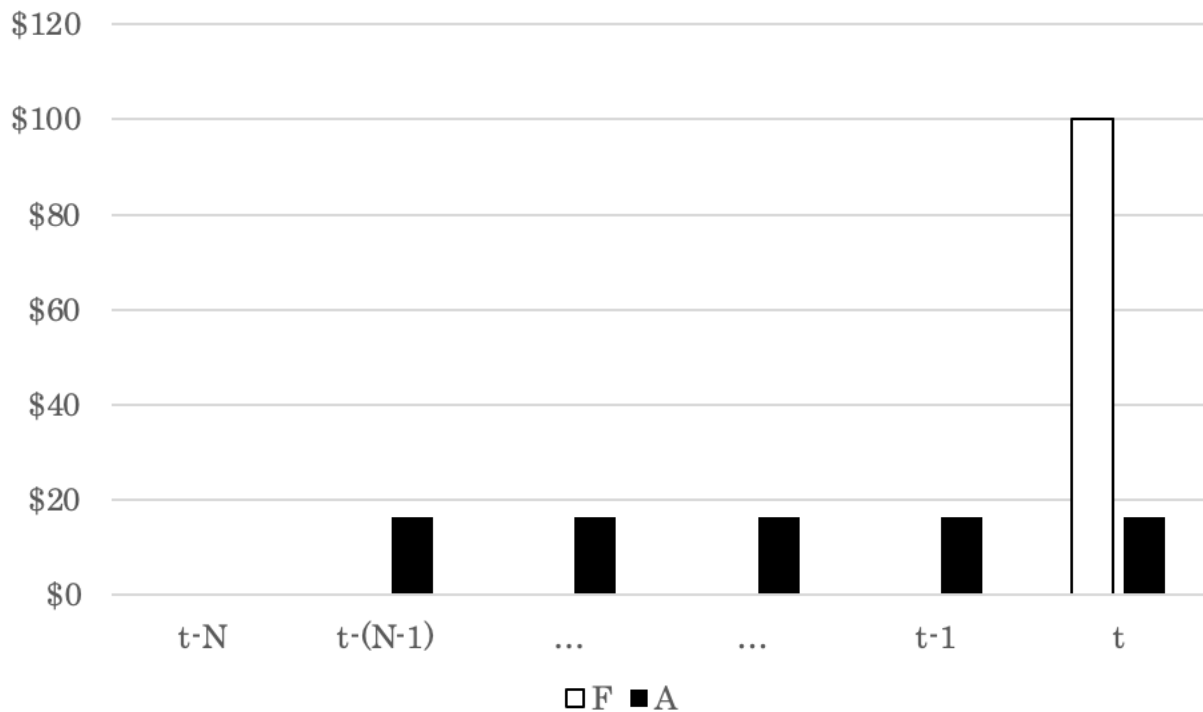
$$P \times (A/P, i, N) = \text{PMT}(i, N, -P)$$

$A = F \times (A/F, i, N)$ (Single Payment to Sequence on Left)

INTUITION

- Start: A single payment of magnitude F , at time t .
- End: N payments of magnitude A . The last payment is at time t .

ILLUSTRATION



Drawn for $F = \$100$, $N = 5$, $i = 10\%$. Start: White, End: Black

FORMULA

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

EXCEL EQUIVALENT

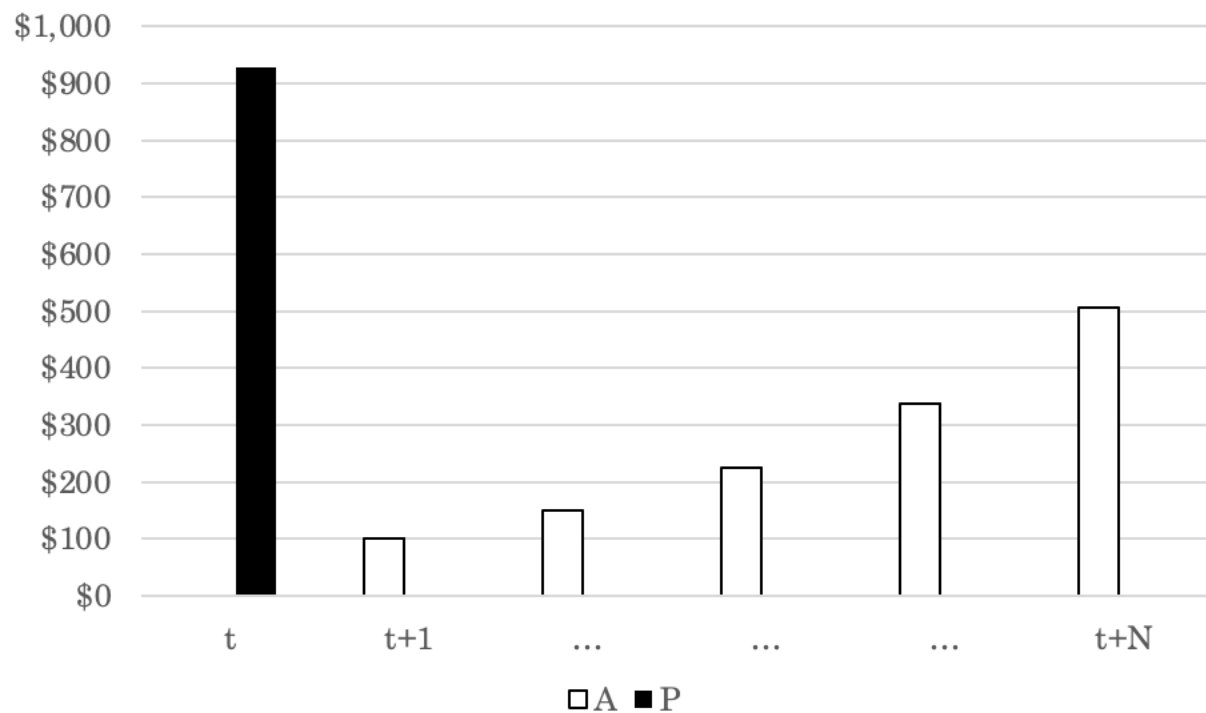
$$F \times (A/F, i, N) = \text{PMT}(i, N, -F)$$

$P = A \times (P/A, g, i, N)$ (Geometric Gradient to Single Payment)

INTUITION

- Start: A sequence of N payments. The first payment is at time $t+1$, and has magnitude A . Each payment is greater than the last by a factor of $(1+g)$.
- End: A single payment of magnitude $A \times (P/A, g, i, N)$, at time t .

ILLUSTRATION



Drawn for $A = \$100$, $N = 5$, $i = 10\%$, $g = 50\%$. Start: White, End: Black

FORMULA

$$A \times (P/A, g, i, N) = A \times (P/A, i^0, N) / (1+g), \text{ where } i^0 = (1+i)/(1+g) - 1$$

EXCEL EQUIVALENT

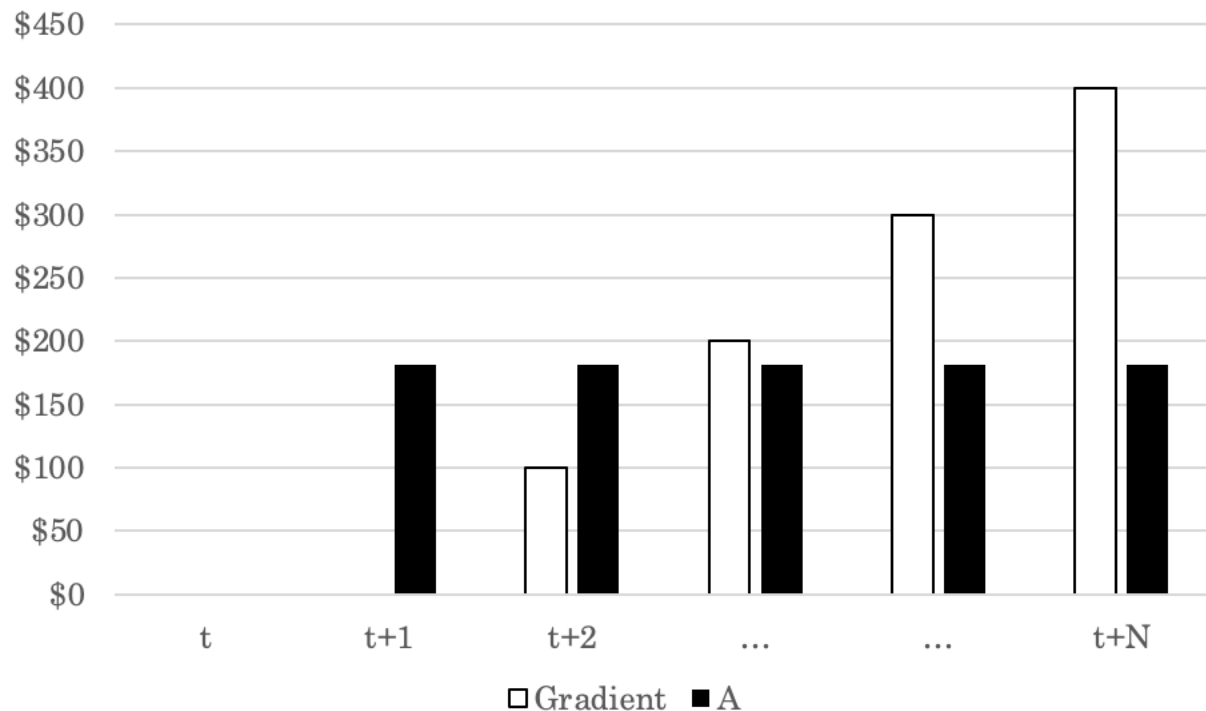
$$A \times (P/A, g, i, N) = \text{PV}(((1+i)/(1+g)-1), N, -A) / (1+g)$$

$A = G \times (A/G, i, N)$ (Arithmetic Gradient to Sequence)

INTUITION

- Start: A sequence of $(N - 1)$ payments. The first payment is at time $t+2$, and has magnitude G . Each payment is greater than the last by G .
- End: A sequence of N payments of magnitude $G \times (A/G, i, N)$. The first payment is at time $(t+1)$.

ILLUSTRATION



Drawn for $G = \$100$, $N = 5$, $i = 10\%$. Start: White, End: Black

FORMULA

$$G \times (A/G, i, N) = G \times \left(\frac{1}{i} - \frac{N}{(1+i)^N - 1} \right)$$

EXCEL EQUIVALENT

$$G \times (A/G, i, N) = G * ((1/i) - (N / ((1+i)^N - 1)))$$