

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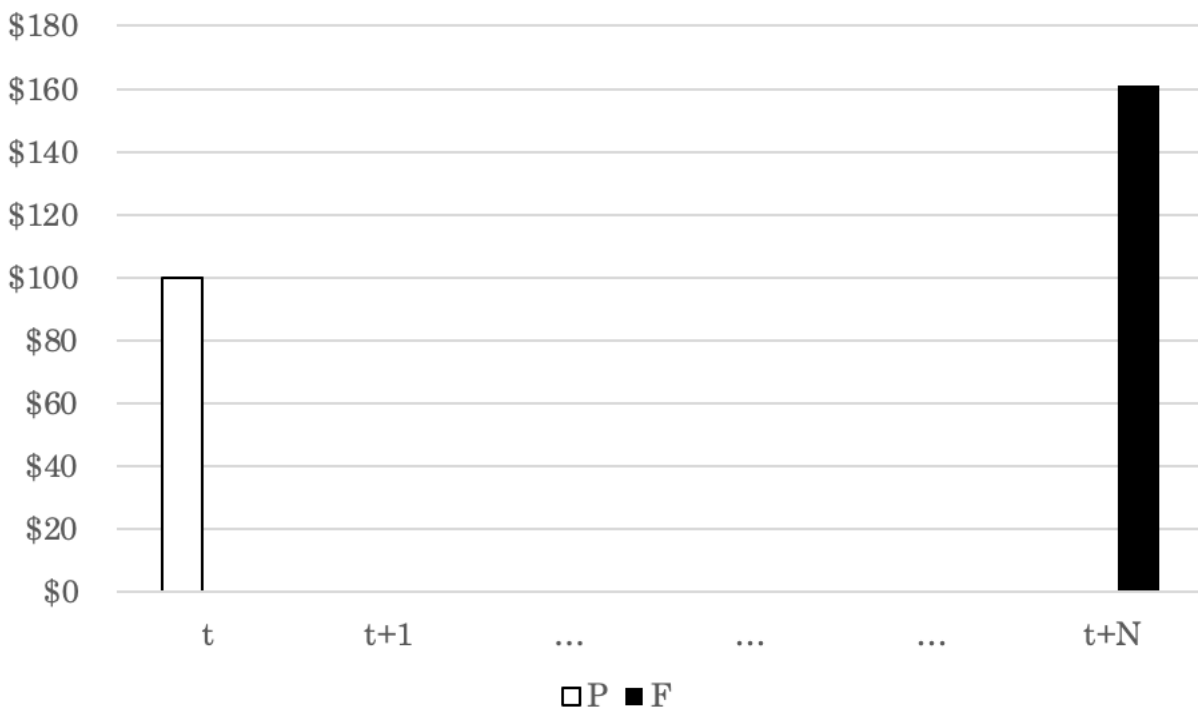
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$$F = P \times (F/P, i, N) \text{ (Move right on the timeline)}$$

### 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

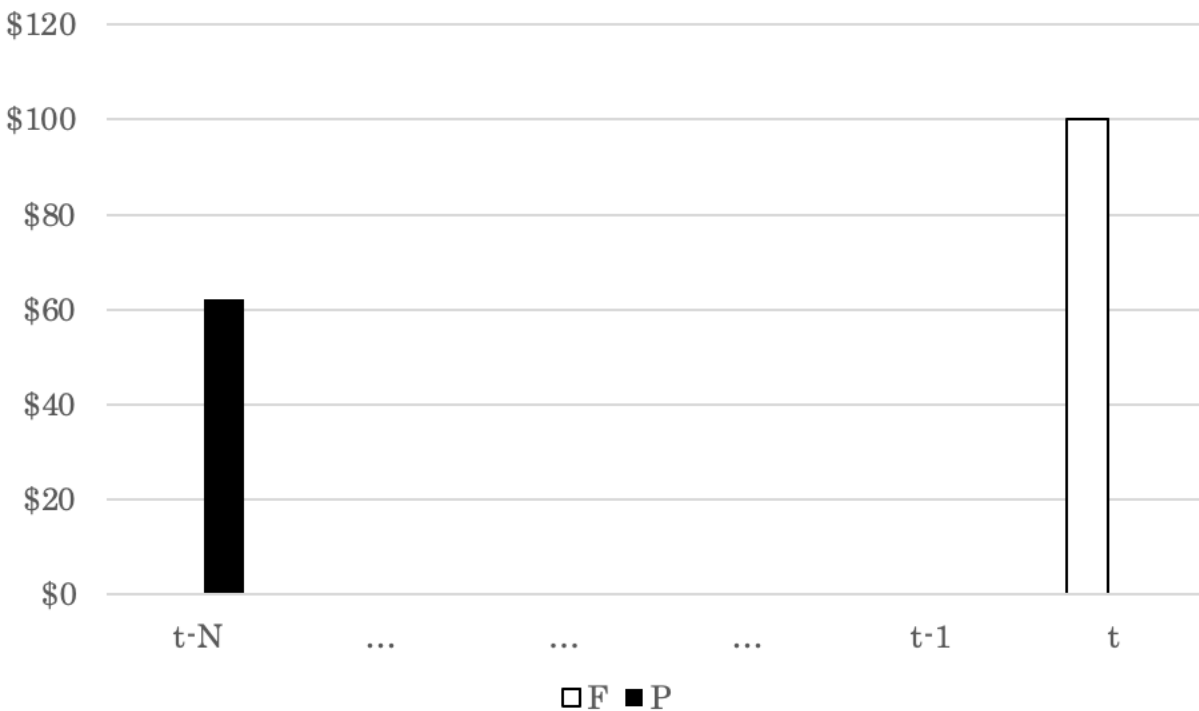
$$P \times (F/P, i, N) = \text{FV}(i, N, -, P)$$

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

### 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

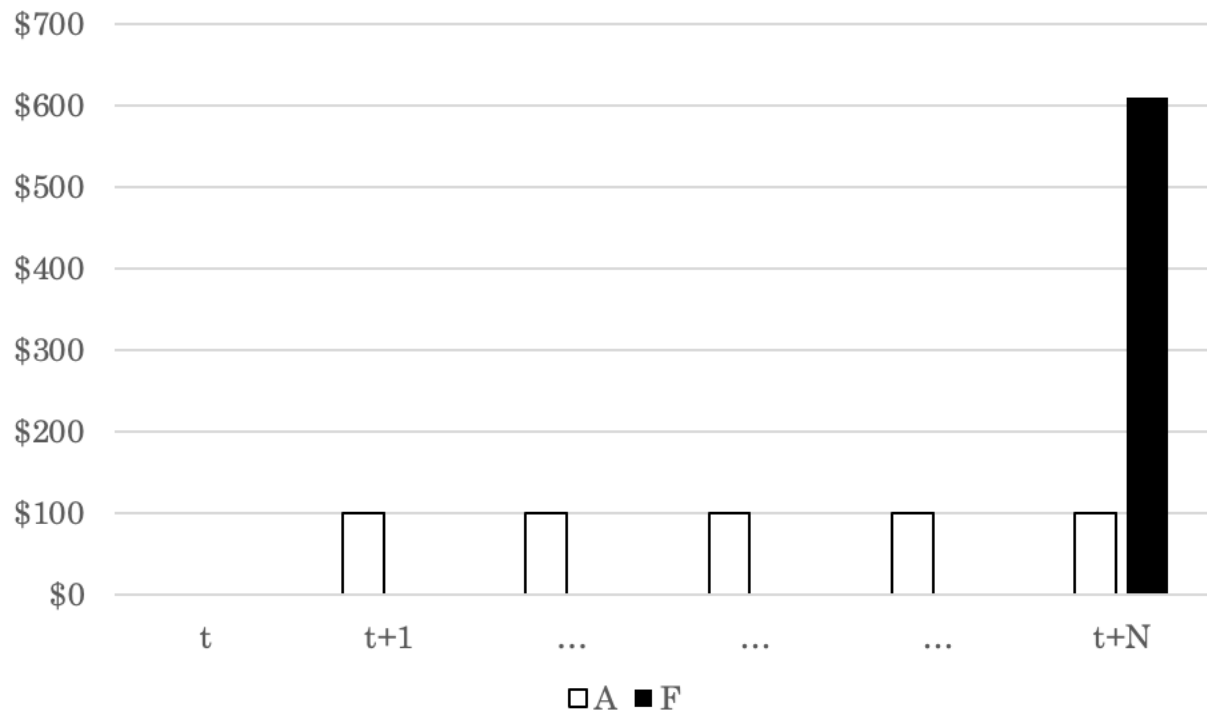
$$F \times (P/F, i, N) = \text{PV}(i, N, -, F)$$

## $F = A \times (F/A, i, N)$ (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

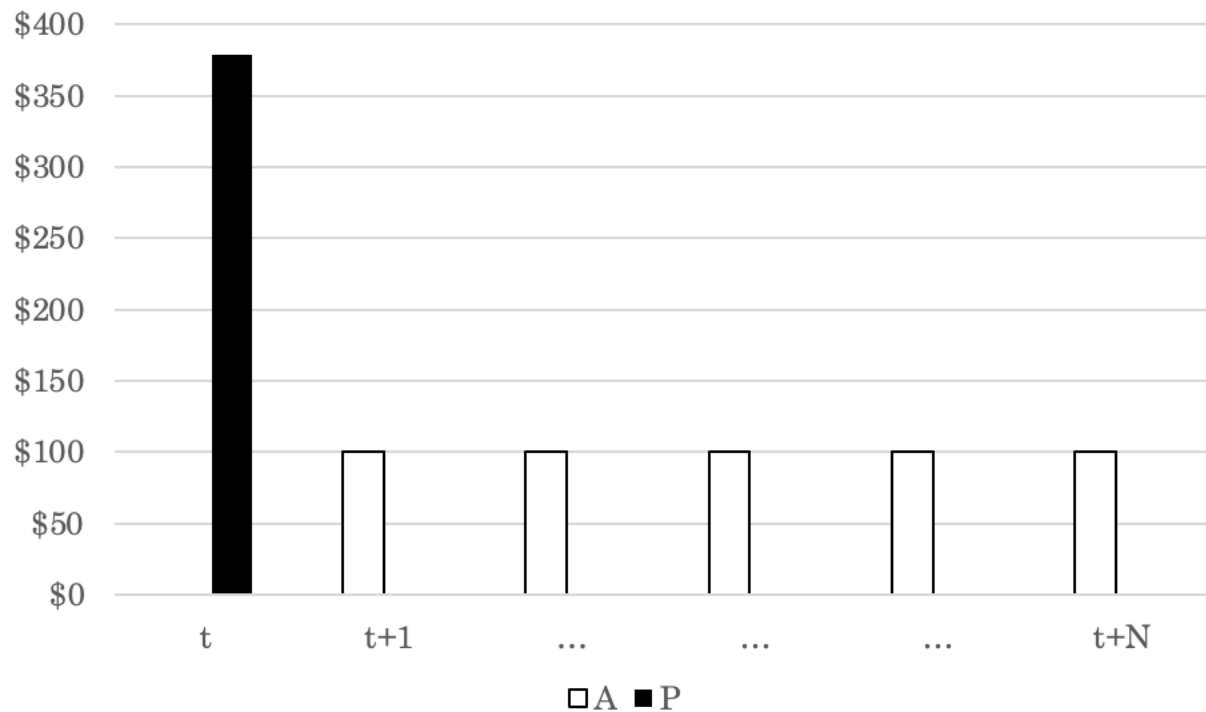
$$A \times (F/A, i, N) = \text{FV}(i, N, -A)$$

## $P = A \times (P/A, i, N)$ (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

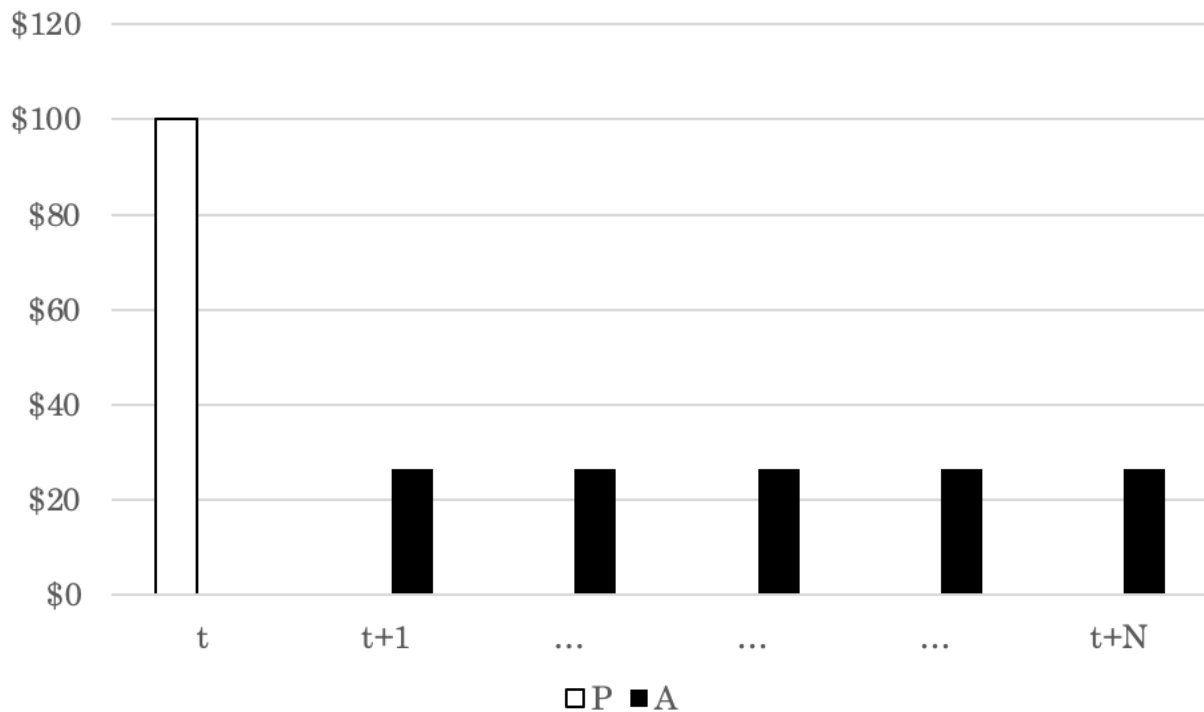
$$A \times (P/A, i, N) = \text{PV}(i, N, -A)$$

## $A = P \times (A/P, i, N)$ (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

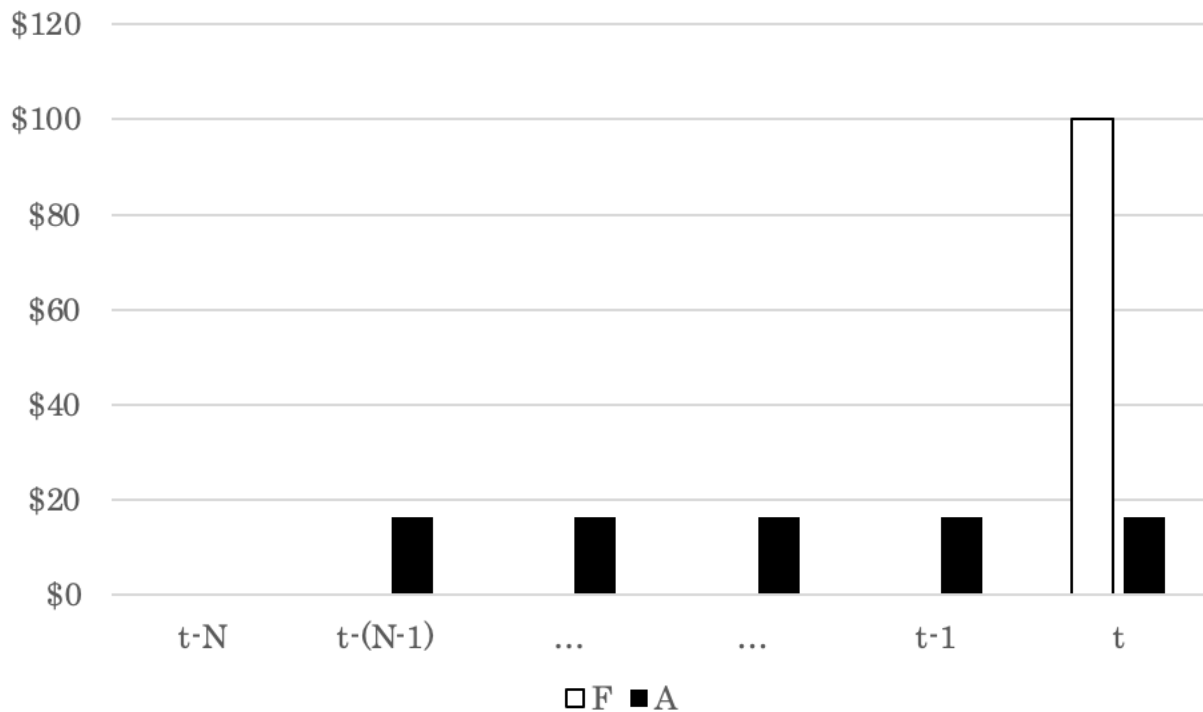
$$P \times (A/P, i, N) = \text{PMT}(i, N, -P)$$

## $A = F \times (A/F, i, N)$ (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

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

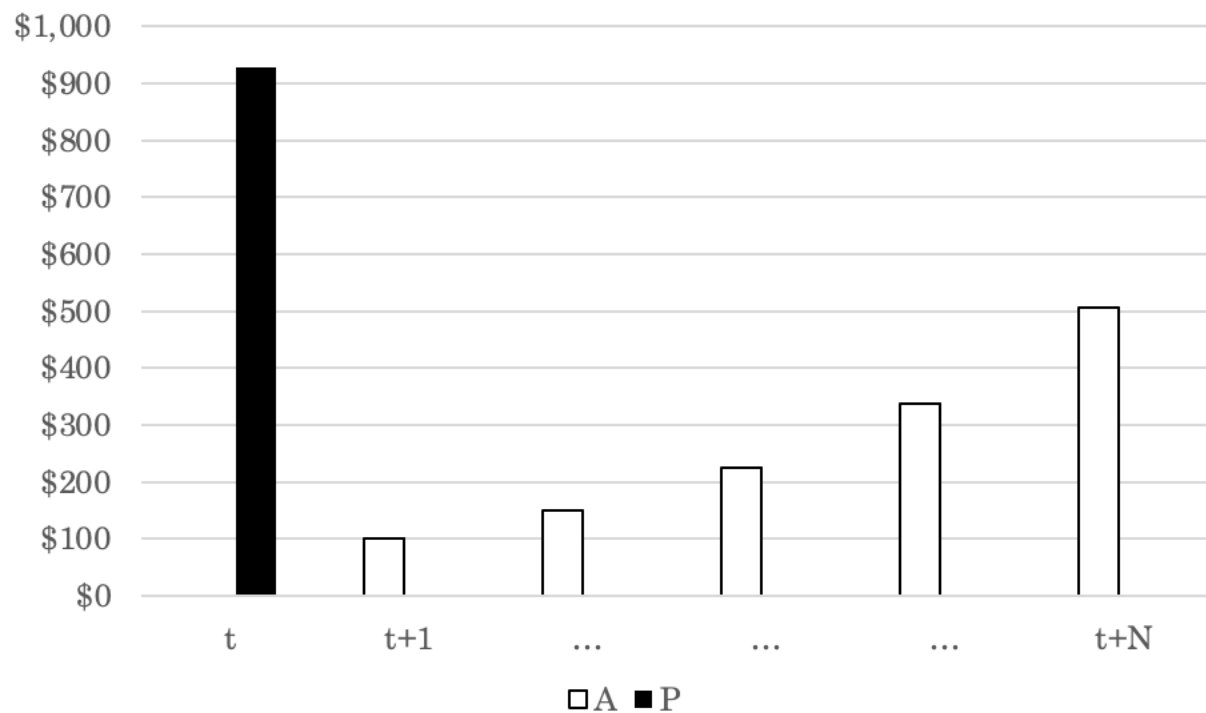


## $P = A \times (P/A, g, i, N)$ (Geometric Gradient to Single Payment)

### 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

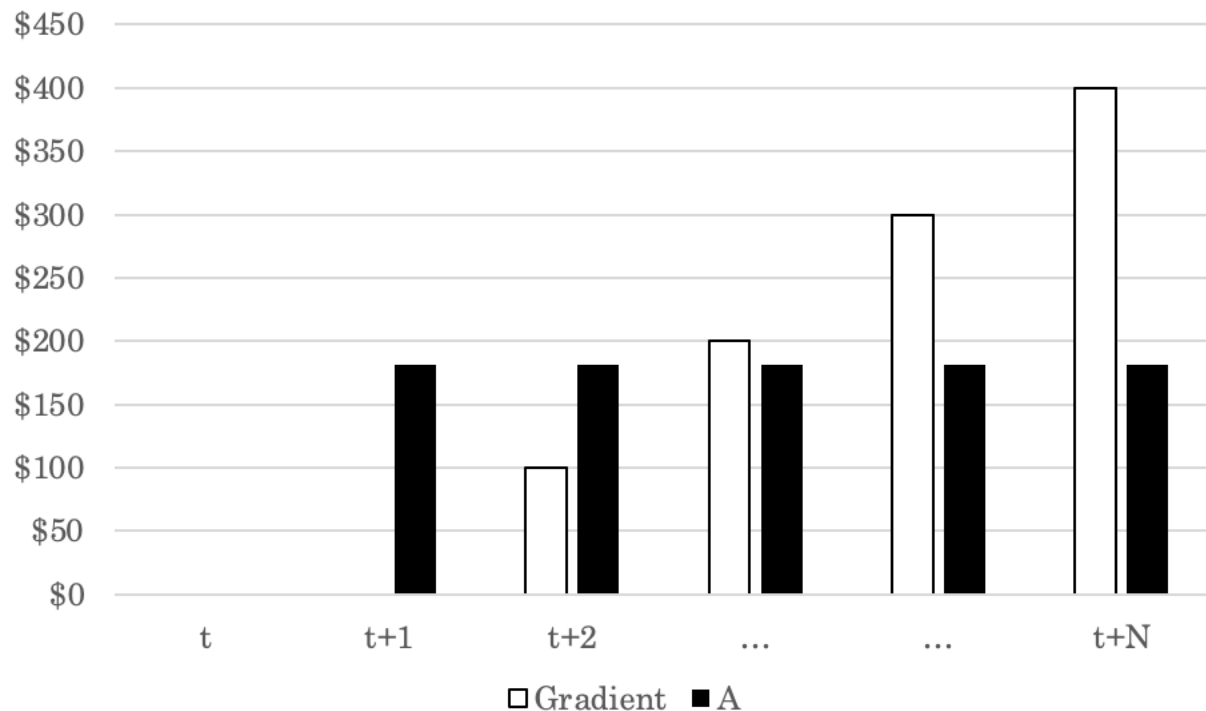
$$A \times (P/A, g, i, N) = \text{PV}(((1+i)/(1+g)-1), N, -A)/(1+g)$$

## $G \times (A/G, i, N)$ (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

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

### EXCEL EQUIVALENT

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