Time Value of Money

15.511 Corporate Accounting

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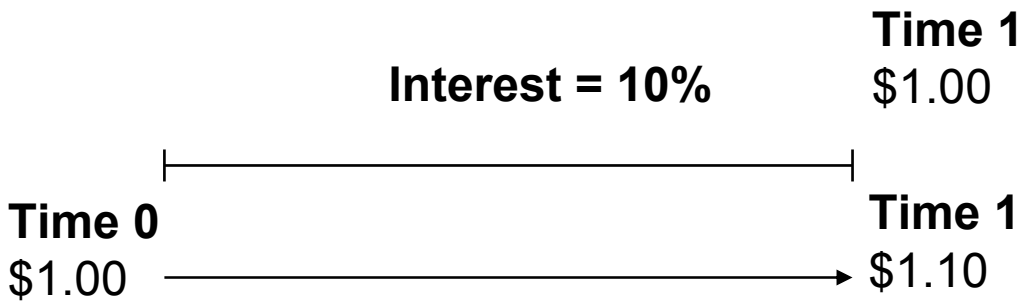
LIABILITIES: Current Liabilities

- Obligations that must be discharged in a short period of time (generally less than one year)
- Reported on balance sheet at **nominal value**
- Examples:
  - Accounts payable
  - Short-term borrowings
  - Current portion of long-term debt
  - Deposits
  - Warranties
  - Deferred Revenues / Income

LIABILITIES: Long-term Liabilities

- Obligations spanning a longer period of time (generally more than one year)
- Generally reported on the balance sheet at **present value** based on interest rate when initiated
- Examples:
  - Bonds
  - Long-term loans
  - Mortgages
  - Capital Leases
- How do we compute present values? And interest expense?

Time Value Of Money



Future value of $ 1.00 today = $1.00 (1+10%) = $1.10 at the end of one year.

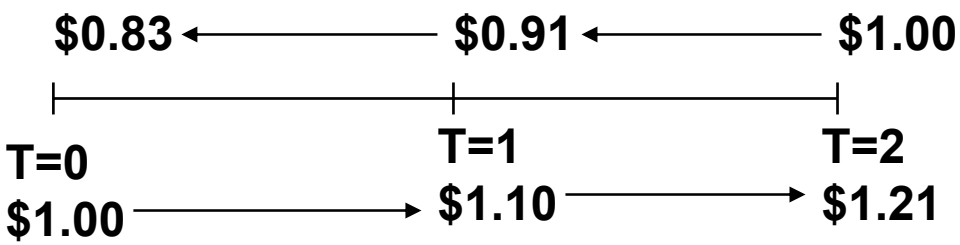
What is the present value of $1.10 to be received one year from now?

Present value of $1.10 one year from now = $1.10/(1+10%) = $1.00

What is the present value of $1.00 to be received one year from now?

Present value of $1.00 one year from now = $1.00/(1.10) = $0.91

Time Value Of Money



Future value of $1.00 two years from now = $1.00*(1+10%)*(1+10%)
= $1.00*(1.10)^2 = $1.21

Present value of $1.00 to be received two years from now
= $1.00/[(1.10)^2] = $0.83

RECALL: PV of $1.00 to be received a year from now = $0.91

Calculating present values: An example

You have just won a lottery. The lottery board offers you three different options for collecting your winnings:

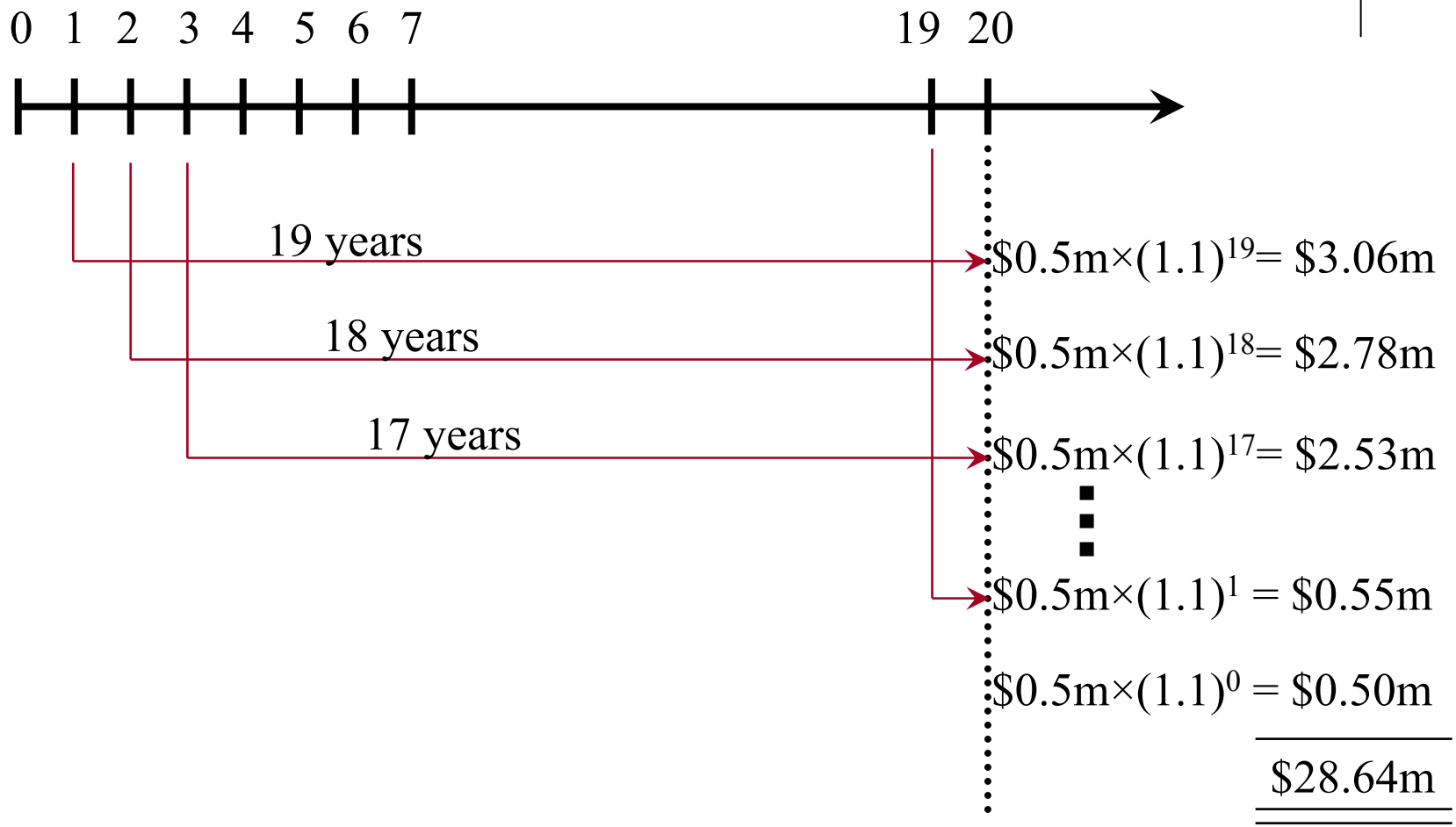
(1) Payments of $500,000 at the end of each year for 20 years.

(2) Lump-sum payment of $4,500,000 today.

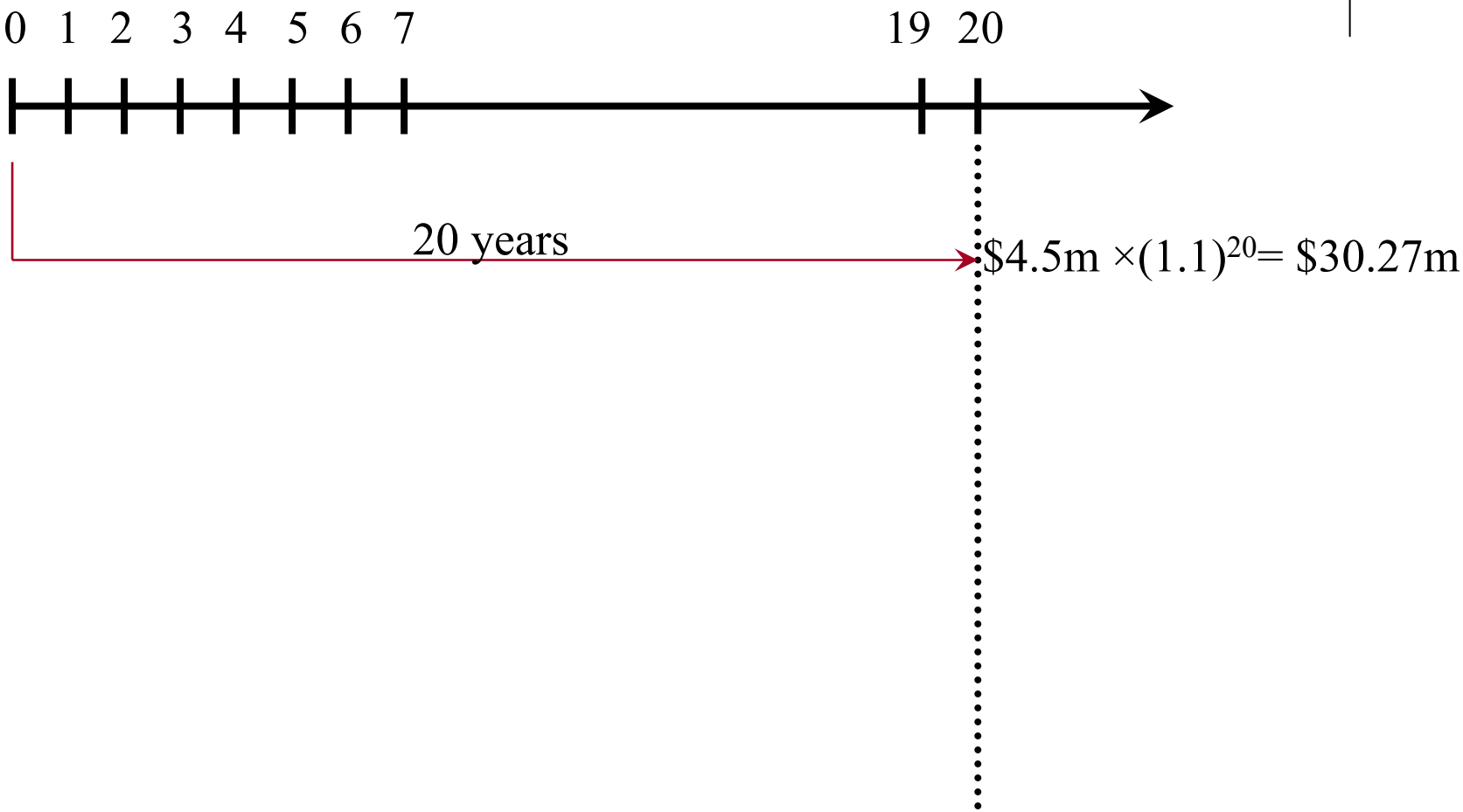
(3) Lump-sum payment of $1 million today, followed by $2,100,000 at the end of years 5, 6, and 7.

Assume all earnings can be invested at a 10 percent annual rate. Ignoring any tax effects, which option should you choose and why?

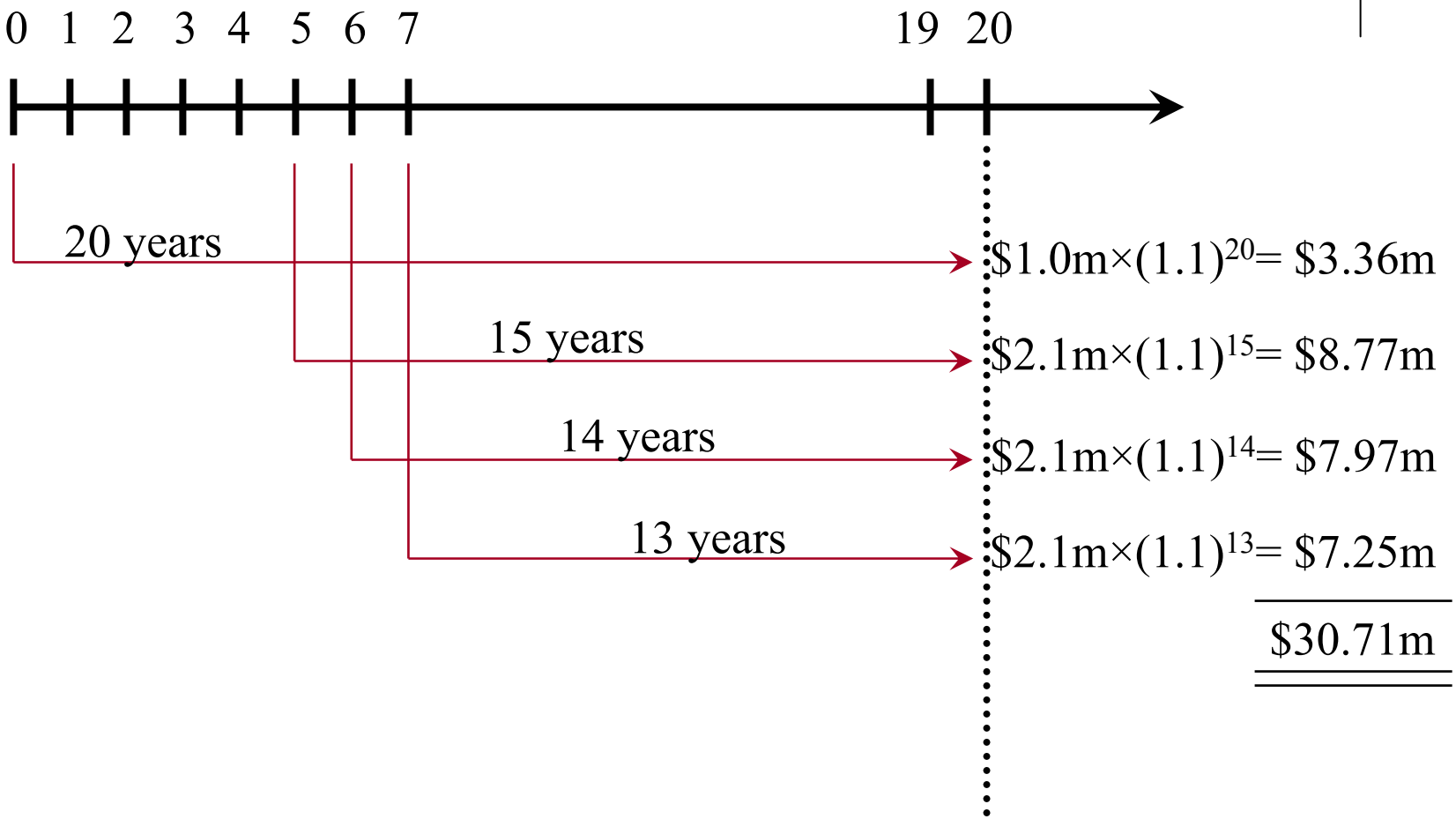
Future Value of Option 1: $500,000 at the end of each year for 20 years.



Future Value of Option 2: Lump-sum payment of $4,500,000 today



Future Value of Option 3: $1m today, and $2.1m at the end of years 5, 6, and 7.



Future Values

- If you invest all lottery receipts at 10% per year, how much will you have in 20 years?

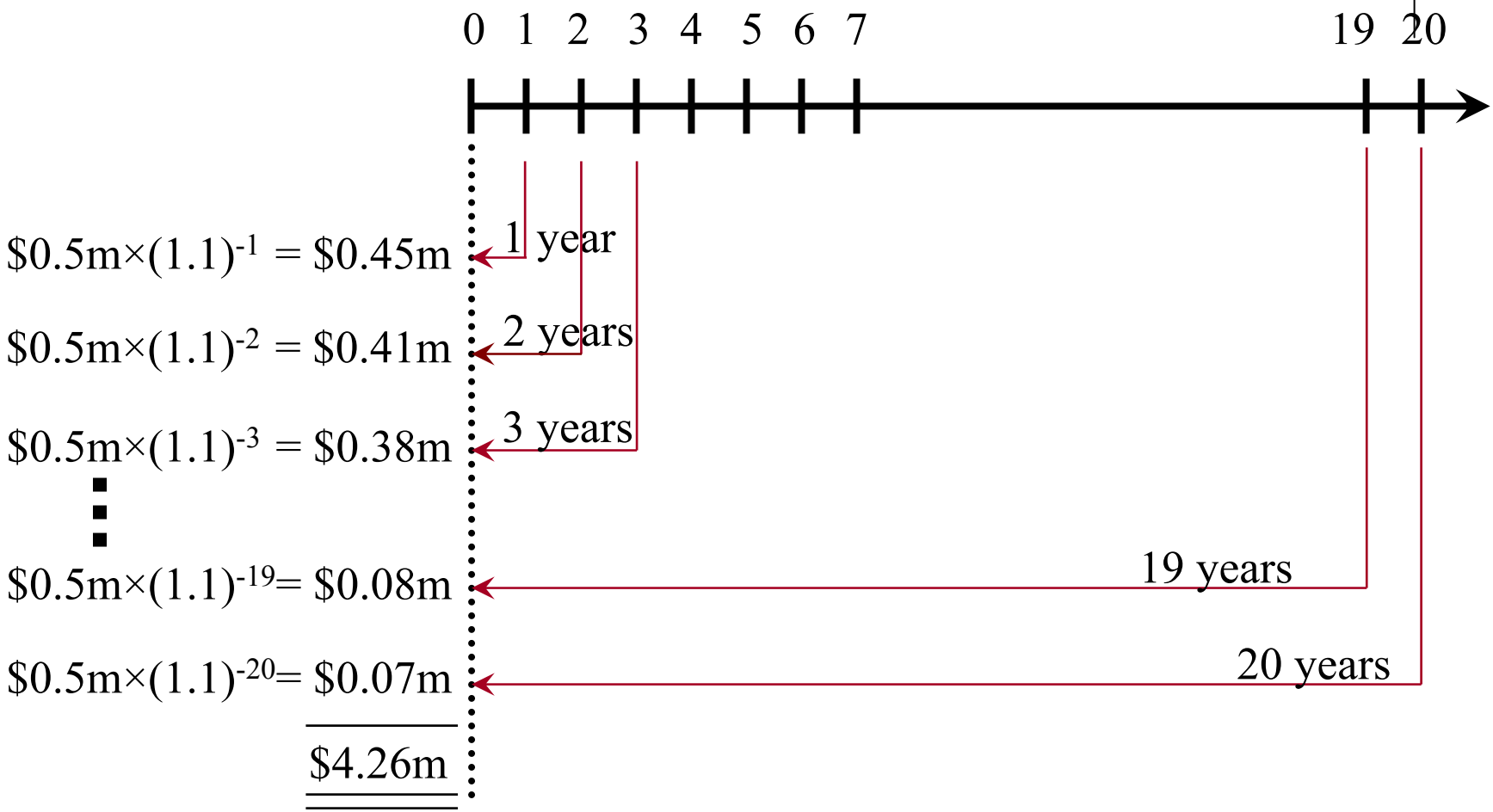
1. $\$500K \times (1.10)^{19} + \$500K \times (1.10)^{18} + \ldots$
   $\ldots + \$500K \times (1.10)^{1} + \$500K = \$28.64m$

2. $\$4{,}500{,}000 \times (1.10)^{20} = \$30.27m$

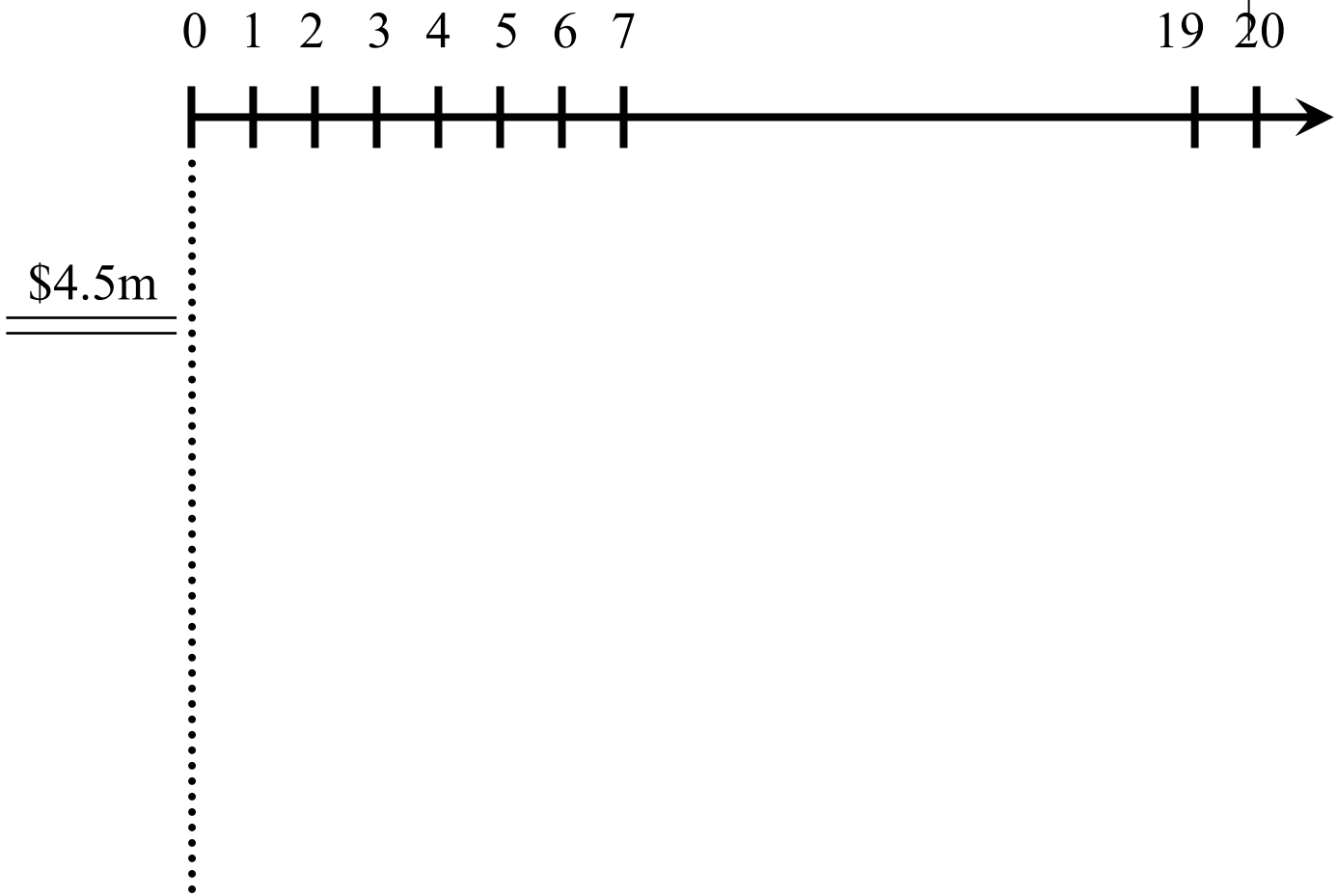
3. $\$1m \times (1.10)^{20} + \$2.1m \times (1.10)^{15} +$
   $\$2.1m \times (1.10)^{14} + \$2.1m \times (1.10)^{13} = \$30.71m$

➔ FV(Option 1) < FV(Option 2) < FV(Option 3)

Present Value of Option 1: $500,000 at the end of each year for 20 years.



Present Value of Option 2: Lump-sum payment of $4,500,000 today



Present Value of Option 3: $1m today, and $2.1m at the end of years 5, 6, and 7.

$\$1.0m \times (1.1)^{0} = \$1.00m$

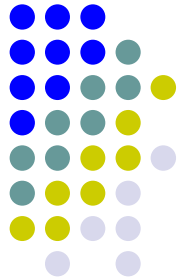
$\$2.1m \times (1.1)^{-5} = \$1.30m$ 5 years

$\$2.1m \times (1.1)^{-6} = \$1.19m$ 6 years

$\$2.1m \times (1.1)^{-7} = \$1.08m$ 7 years

$\$4.57m$

Present Values



- If all lottery receipts can be invested at 10% per year, what is the ***present value*** of each option?

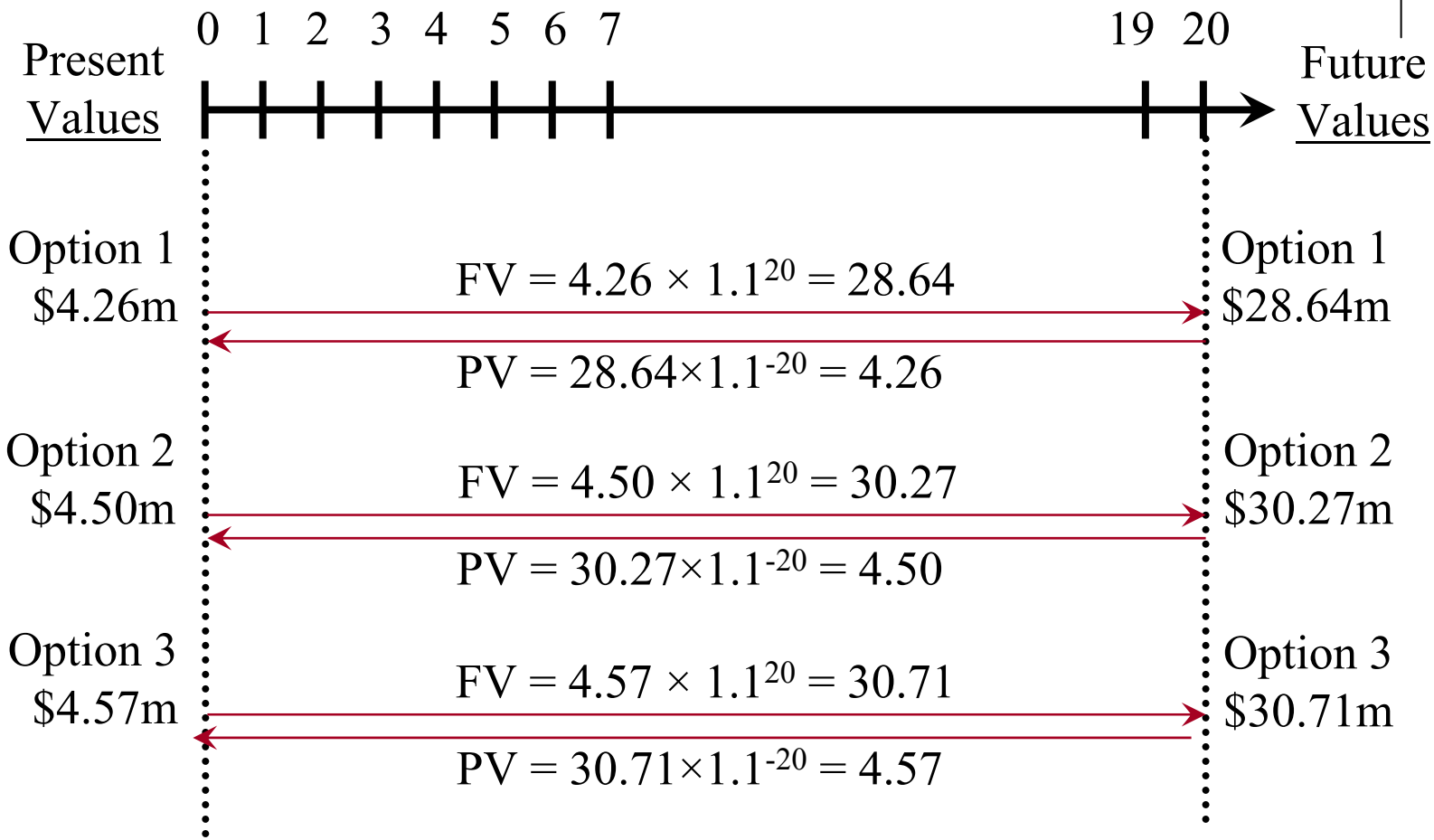
1. $\$500K \times (1.10)^{-20} + \$500K \times (1.10)^{-19} + \ldots$
   $\ldots + \$500K \times (1.10)^{-2} + \$500K \times (1.10)^{-1} = \$4.26m$

2. $\$4{,}500{,}000 \times (1.10)^{0} = \$4.5m$

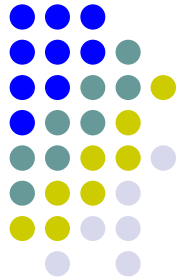
3. $\$1m \times (1.10)^{0} + \$2.1m \times (1.10)^{-5} +$
   $\$2.1m \times (1.10)^{-6} + \$2.1m \times (1.10)^{-7} = \$4.57m$

➔ PV(Option 1) < PV(Option 2) < PV(Option 3)

Converting Present and Future Values

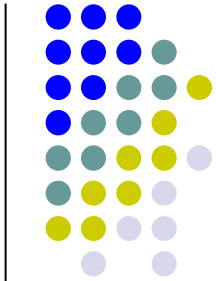


Using PV and FV Tables (Appendix)



- Table 1: Future Value of $1
  - A one-time payment to be received now and held (reinvested) for N periods
  - Compounded at interest rate r%
  - Multiply the dollar amount received by the factor in Row N, Column r%
- Table 2: Present Value of $1
  - A one-time payment to be received N periods from now
  - Discounted at interest rate r
  - Multiply the dollar amount to be received by the factor in Row N, Column r

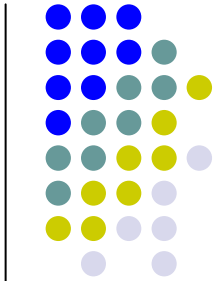
Time Value of Money Terminology



- Annuity: a stream of fixed-dollar payments made at regular intervals of time
  - Ordinary Annuity (annuity in arrears): payments occur at the ***end*** of the period
  - Annuity due (annuity in advance): payments occur at the ***beginning*** of the period

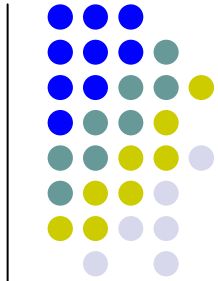
- Formulas:
  - FV(a) = { [((1+r)^N) - 1] / r} * Fixed Period Cash Flow
  - PV(a) = { [(1 - (1+r)^(-N))] / r] } * Fixed Period Cash Flow

Using PV and FV Tables (Appendix)



- Table 3: Future Value of $1 ordinary annuity (annuity in arrears)
  - Regular payments to be received at **end** of year for N years and held (reinvested) until time N
  - Compounded at interest rate r%
  - Multiply the dollar amount received by the factor in Row N, Column r%
- FV of $1 annuity due (annuity in advance) = (FV of an ordinary annuity for N+1 years) - $1

Using PV and FV Tables (Appendix)



- Table 4: Present Value of $1 ordinary annuity (annuity in arrears)
  - Regular payments to be received at end of year for N years
  - Discounted at interest rate r%
  - Multiply the dollar amount to be received by the factor in Row N, Column r
- PV of $1 annuity due (annuity in advance) = (PV of an ordinary annuity for N-1 years) + $1