BEE/CSS 371 Business of Technology
Winter 2017
Lecture 14

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Tonight's agenda

1. Final exam
2. Presentations
3. Review session
4. Time value of money

Final exam

1. Monday, March 13
   5:45 pm to 7:45 pm
2. Unproctored, closed book, closed notes, no cellphones or computers, calculator only.
3. If you are an ESL student, you may have a standard translation dictionary.
4. You will be asked to copy and sign an honor statement that you have neither given nor received unauthorized aid.

Final

1. Everything since the midterm.
2. Probably 20 questions, each worth 5 points.
3. Answer as many as you can.
4. Some will be easy, some will be hard.
5. Answers are intended to be very short.

Who's getting my calculators

1. Hans
2. Regina
3. Austen
4. Son
5. Brandon*
6. Dean*

Presentations

1. We have 10 teams and only 2 hours.
2. Only 12 minutes/team without a break.
3. Let's try *really hard* for 5 min/team.
4. Easiest is if you have your presentation in PowerPoint on a thumb drives, all of them copied onto the podium computer before we start.

The order

1. BEES	STEM Subscription Box
2. The Right Stuff	Pain et Patisserie
3. Asian Pirates	Bothell Hub
4. Enamelton Labs	WasteStream
5. Banana Split	Clothing Simulator
6. GITIT	Japanese Restaurant
7. The Resistance	ASH (Automated Smart Home) Inc.
8. 4.0 Squad	SitWait
9. Team Furious	Wilderness Survival Classes
10. StarTech	TACO Food Truck

Review session

Is there a time we can agree?

Either way, I will post some review slides.

Time value of money

Net present value (NPV)

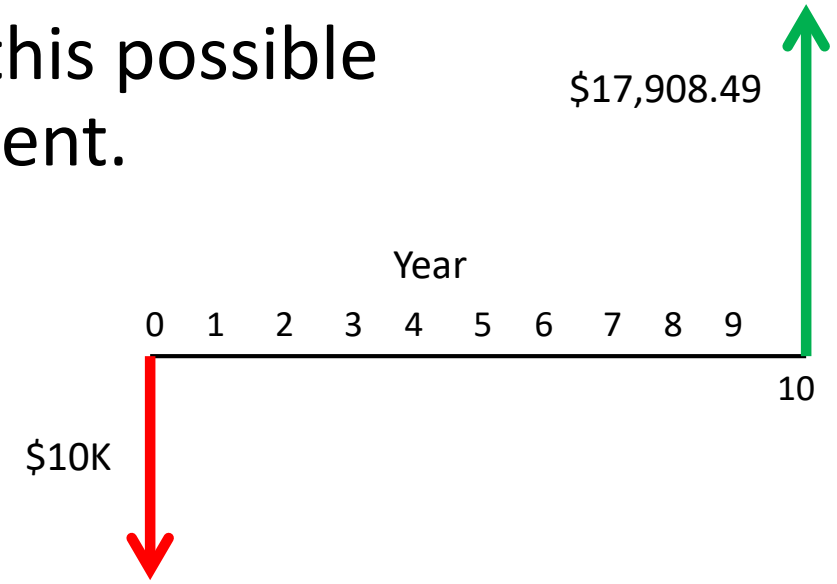
Net sum of all the discounted inflows and outflows.

$$NPV = \sum_{j=0}^{n} \left(CF_j \right) \left(\left. \frac{P}{F} \right|_{i,j} \right)$$

Could be either positive or negative.

At the ***internal rate of return (IRR)***, the NPV is zero.

Consider this possible investment.



At 6% $$\frac{P}{F} = \frac{1}{(1+i)^n} = \frac{1}{(1+.06)^{10}} = 0.558395$$

$$NPV = (17{,}908.49)(0.558395) - 10{,}000 = 0$$

Similarly,

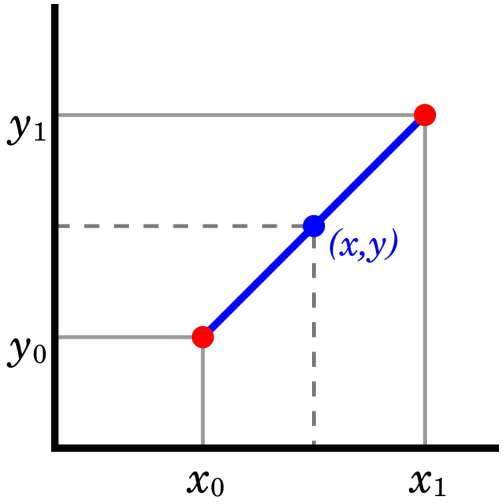
At 5% NPV = $994.26

At 7% NPV = -$896.23

Calculating IRR

1. Calculate NPV at interest rates expected to be above and below the actual IRR, then interpolate.
2. Use a calculator or a spreadsheet that provides an IRR function.

Simple interpolation
Approximating with a straight line



Choose the points on either side of the point you'd like to estimate.

$$\frac{y - y0}{x - x0} = \frac{y1 - y0}{x1 - x0}$$

Given the desired x:

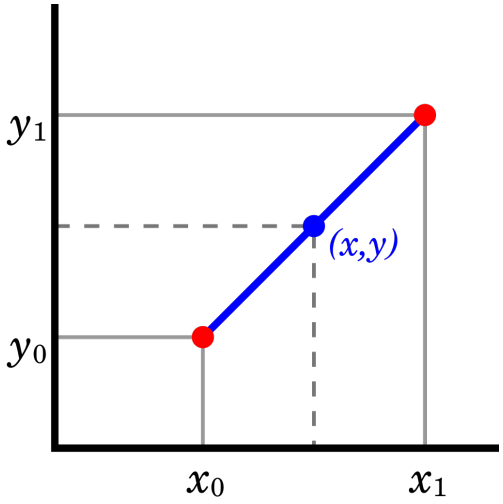
$$y = y0 + (y1 - y0)\left(\frac{x - x0}{x1 - x0}\right)$$

Given the desired y:

$$x = x0 + (x1 - x0)\left(\frac{y - y0}{y1 - y0}\right)$$

Image source: https://en.wikipedia.org/wiki/File:LinearInterpolation.svg

Interpolating



At 5% NPV = $994.26

At 7% NPV = -$896.23

x = interest rate y = NPV

x0 = 5% y0 =994.26

x1 = 7% y1 = -896.23

Find the x (interest rate) at which y (NPV) = 0

$$x = x0 + (x1 - x0)\left(\frac{y - y0}{y1 - y0}\right)$$

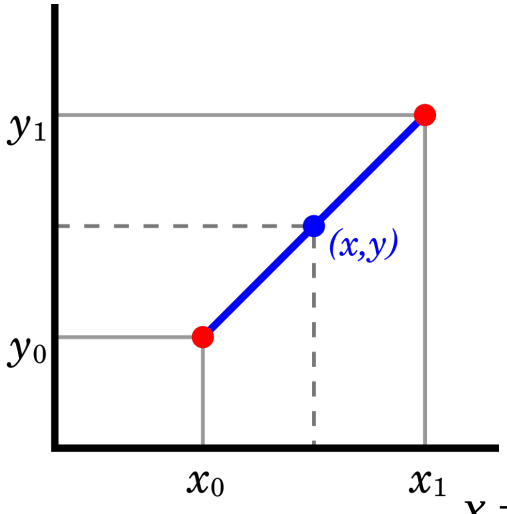
$$x = 5 + (7 - 5)\left(\frac{0 - 994.26}{-896.23 - 994.26}\right) = 6.051854$$

$$\frac{P}{F} = \frac{1}{(1+i)^n} = \frac{1}{(1+.06051854)^{10}} = 0.555670$$

$$NPV = (17{,}908.49)(0.555670) - 10{,}000$$

$$= -\$48.780528$$

Next iteration



x = interest rate y = NPV

x0 = 5% y0 =994.26

x1 = 6.0518954% y1 = -48.780528

Find the x (interest rate) at which y (NPV) = 0

$$x = x0 + (x1 - x0)\left(\frac{y - y0}{y1 - y0}\right)$$

$$x = 5 + (6.051854 - 5)\left(\frac{0 - 994.26}{-48.780528 - 994.26}\right) = 6.002661$$

At 5% NPV = $994.26

At 6.051854%

NPV = -$48.780528

$$\frac{P}{F} = \frac{1}{(1+i)^n} = \frac{1}{(1+.06002661)^{10}} = 0.558255$$

$$NPV = (17{,}908.49)(0.558255) - 10{,}000$$

$$= -\$2.503025$$

Hurdle rates

For a consumer, the cost of funds is whatever interest rate they're paying on debt.

But big corporations will often establish ***hurdle rates***.

A hurdle rate is the minimum expected IRR the corporation expects from projects it will fund.

Hurdle rates are intended to be related to the firm's cost of capital, overall risk and other factors.

A typical corporate hurdle rate is 12% but could be 30% or higher.

Irregular cash flows

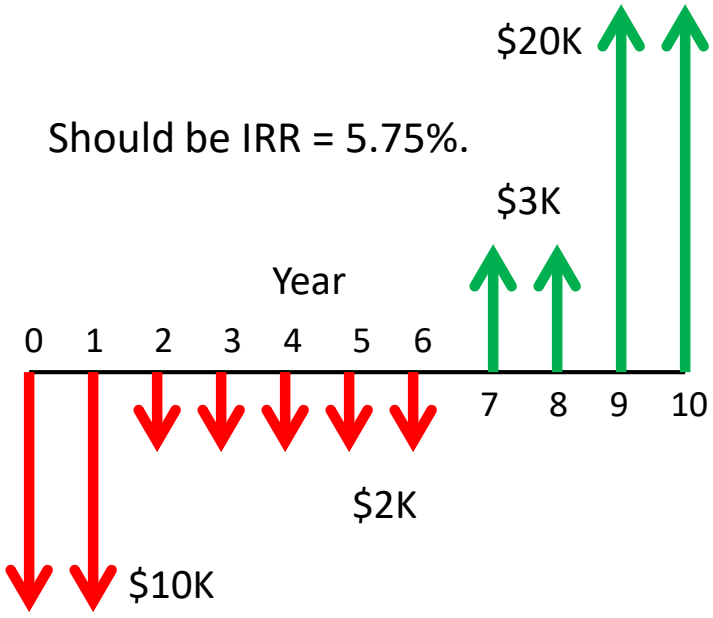
When the cash flows in/out aren't uniform like an annuity, it's called an irregular cash flow.

Is this a good deal?

Is this a good deal?

j	Cf_j	N_j
0	-10,000.00	1
1	-10,000.00	1
2	-2,000.00	5
3	3,000.00	2
4	20,000.00	2

IRR for an irregular cash flow.



Financial registers

0	n	1	N0	-10K	CF0 (R0)
0	i	1	N1	-10K	CF1 (R1)
0	PV	5	N2	-2K	CF2 (R2)
0	PMT	2	N3	3K	CF3 (R3)
0	FV	2	N4	20K	CF4 (R4)
		⋮		⋮	
			N20		CF20 (R.9)

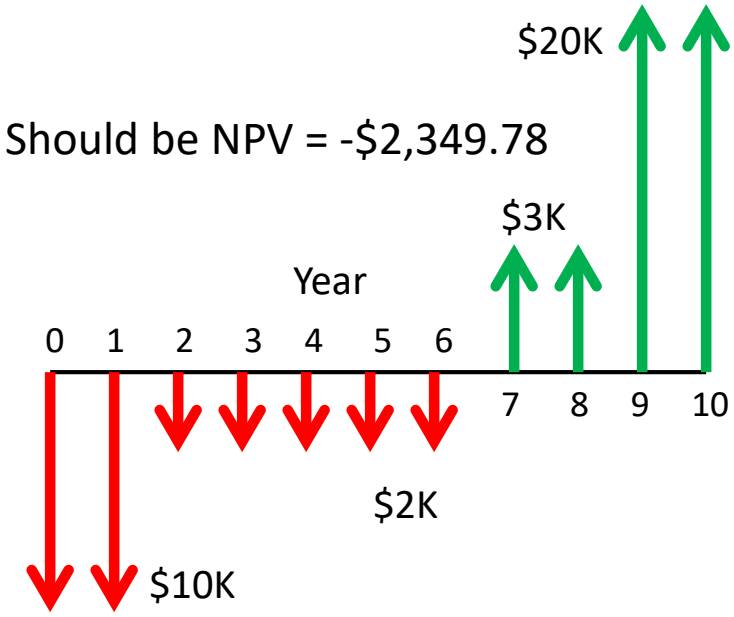
Procedure:

1. Clear the registers.
2. CF0 = -10,000.
3. Enter CF1 = -10,000, N1 = 1.
4. Repeat for CF2 thru CF4.
5. Press IRR.

NPV for an irregular cash flow at 7%

Financial registers

0	n	1	N0	-10K	CF0 (R0)
0	i	1	N1	-10K	CF1 (R1)
0	PV	5	N2	-2K	CF2 (R2)
0	PMT	2	N3	3K	CF3 (R3)
0	FV	2	N4	20K	CF4 (R4)
		⋮		⋮	
			N20		CF20 (R.9)



Procedure:

1. Clear the registers.
2. CF0 = -10,000.
3. Enter CF1 = -10,000, N1 = 1.
4. Repeat for CF2 thru CF4.
5. Enter i = 7%.
6. Press NPV

Comparing alternatives

1. Calculate the NPV of each alternative at your discount rate, then choose the one with highest NPV.

2. Calculate the IRR for each alternative, then choose the one with the highest IRR.

3. Calculate the NPV of the differences between the two alternatives.

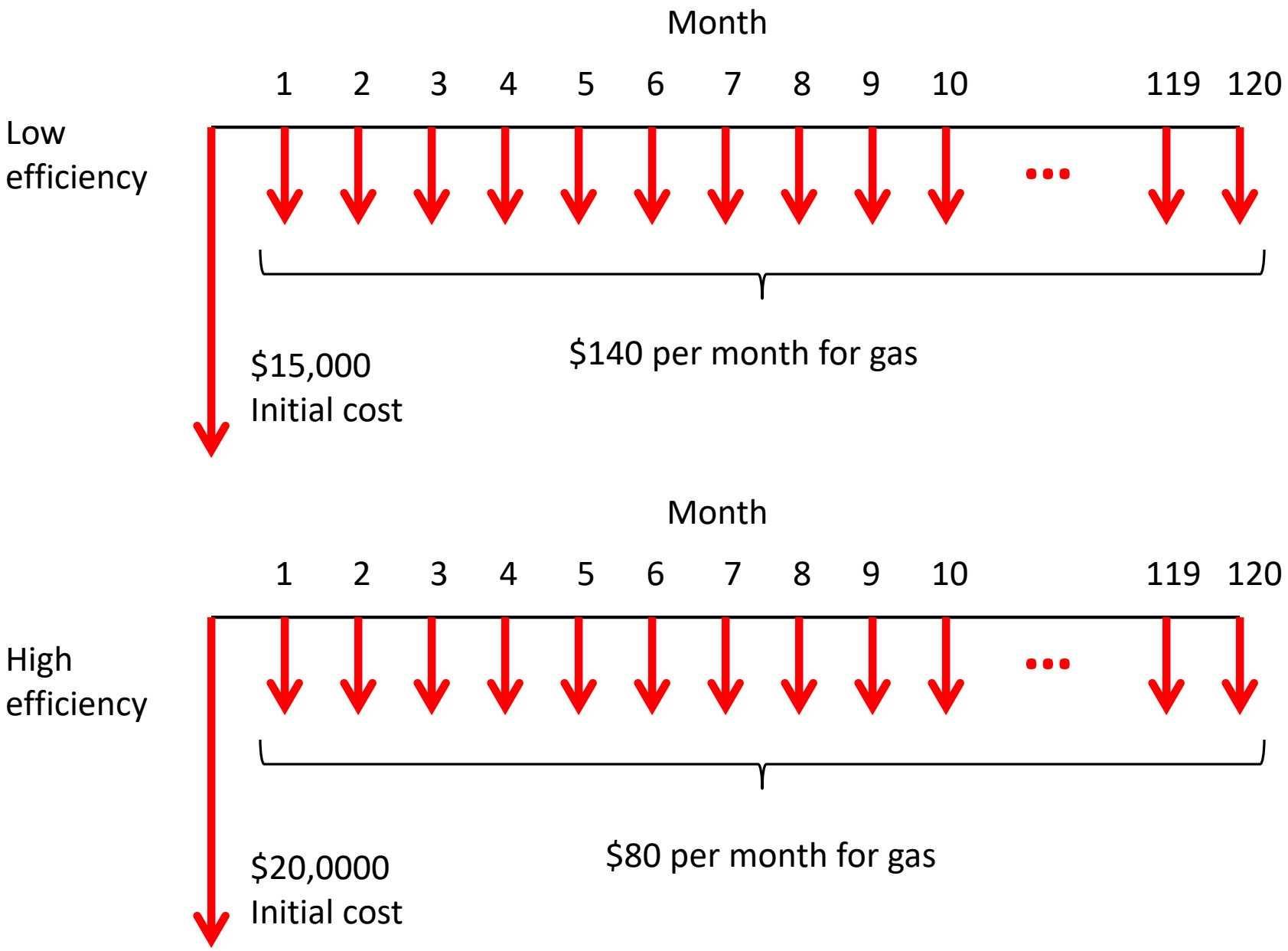
Exercise

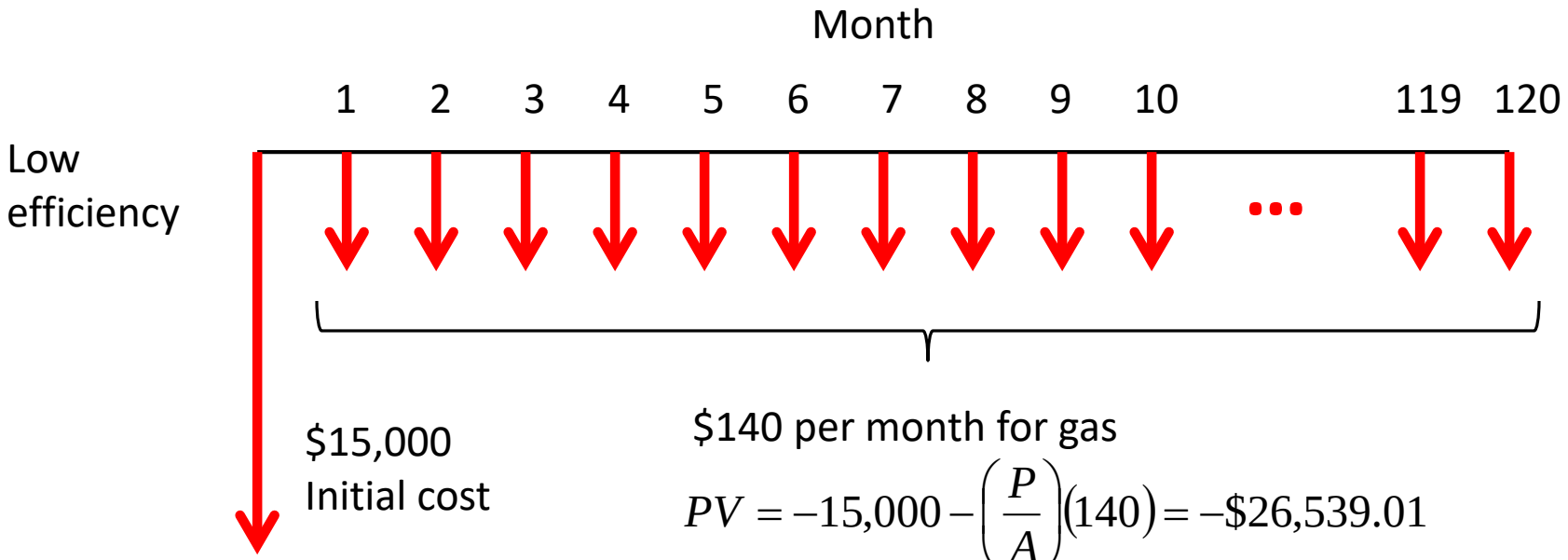
You need to replace your furnace. You have two options.

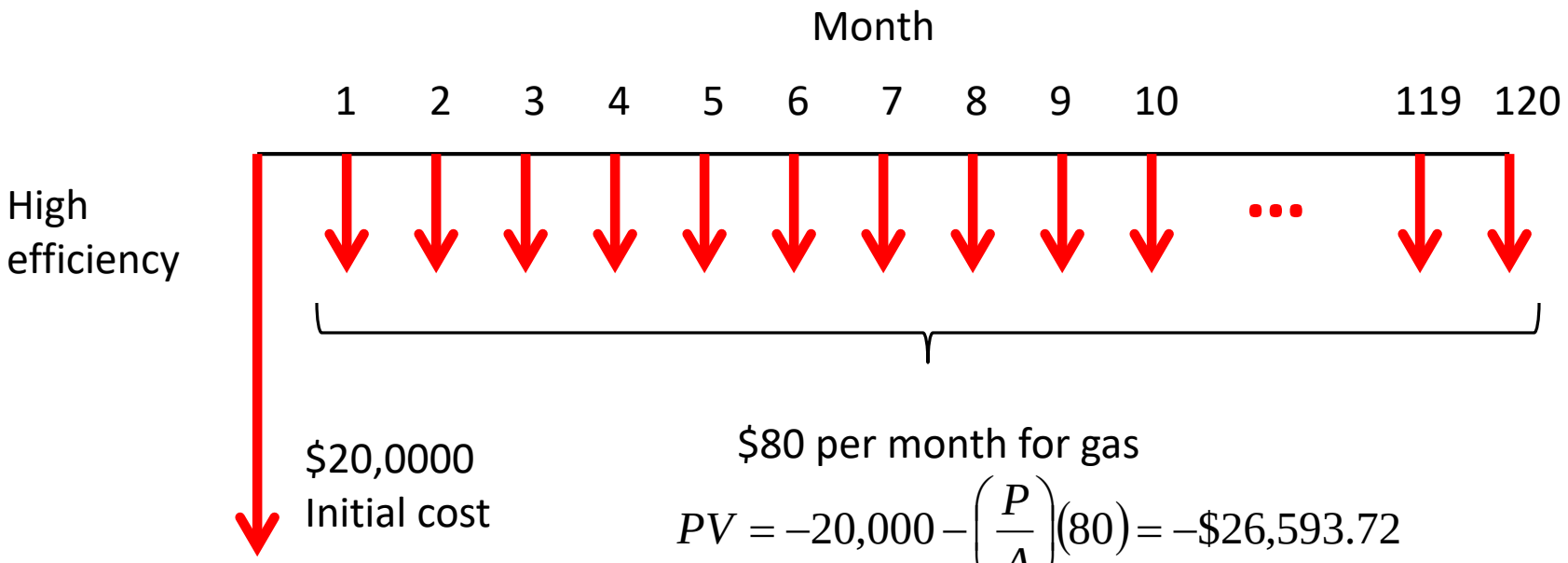
1. For $15K, you can buy a low efficiency unit that will cost you $140/mo in gas.
2. For $20K, you can buy a high efficiency unit that will cost you $80/mo in gas.

You expect either will have a 10 year lifetime.

1. Draw the two cash flow diagrams.
2. You expect to pay for the new furnace with a loan at 8% APR. Which would you choose?


Month
1 2 3 4 5 6 7 8 9 10 119 120
Low efficiency
$15,000
Initial cost
$140 per month for gas
Month
1 2 3 4 5 6 7 8 9 10 119 120
High efficiency
$20,0000
Initial cost
$80 per month for gas


Month
1 2 3 4 5 6 7 8 9 10 ... 119 120
Low efficiency
$15,000
Initial cost
$140 per month for gas
$PV = -15{,}000 - \left(\frac{P}{A}\right)(140) = -\$26{,}539.01$


Month
1 2 3 4 5 6 7 8 9 10 ... 119 120
High efficiency
$20,0000
Initial cost
$80 per month for gas
$PV = -20{,}000 - \left(\frac{P}{A}\right)(80) = -\$26{,}593.72$

In this completely made-up example, the low efficiency furnace is slightly cheaper:

$26,593.72 – 26,539.07 = $54.72 savings

If the difference was that small, a lot of people would probably choose high efficiency.

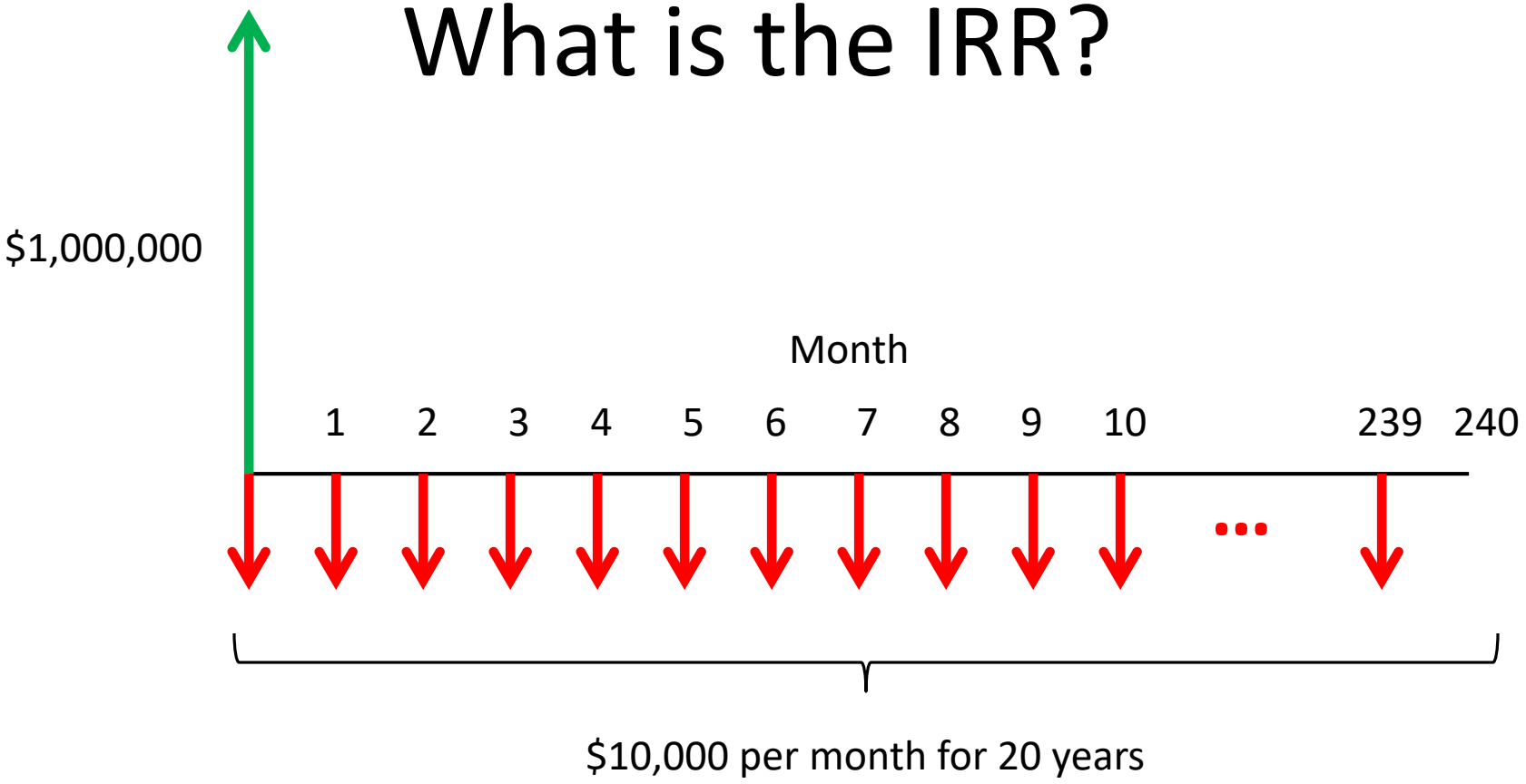
1. Risk of energy costs rising,
2. Resale value
3. Social consciousness.

Exercise

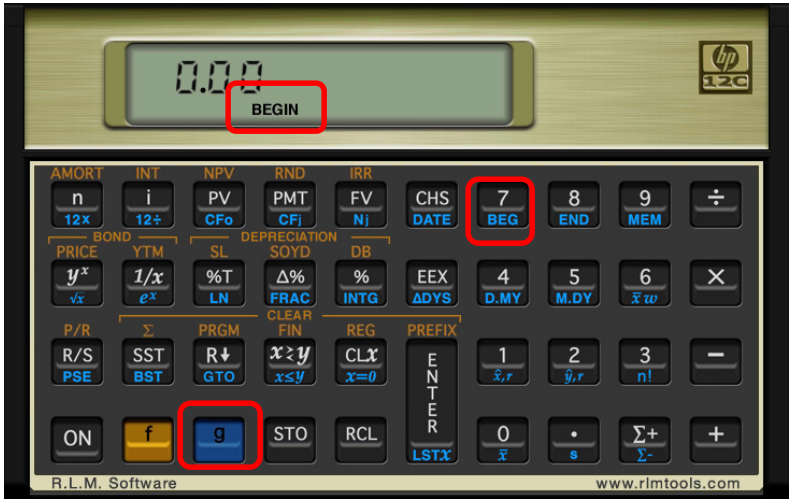
Ed McMahon has risen from the dead and is standing on your doorstep, offering you a check for $1,000,000 now or $10,000/month for 20 years. Tax-free.

Which is the better deal?

What is the IRR?

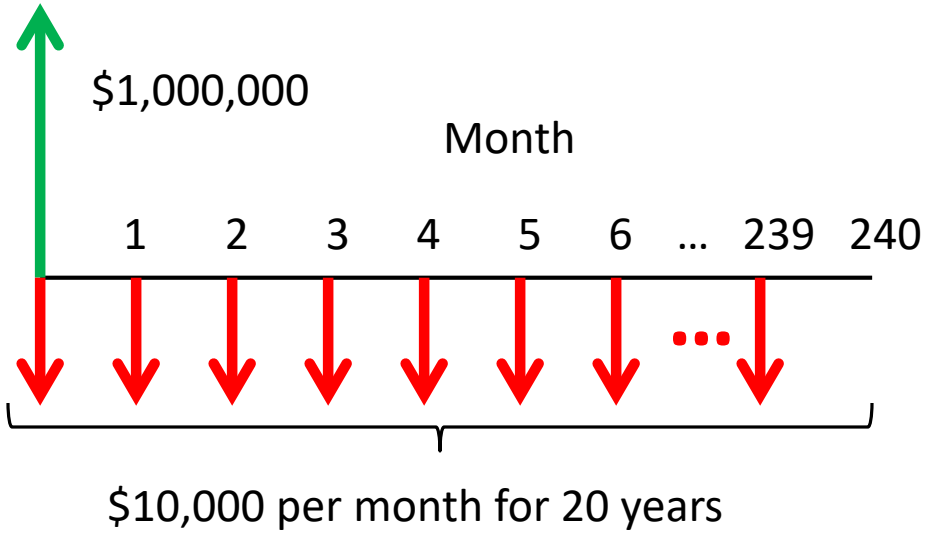


Finding IRR



Financial registers

240	n		N0		CF0 (R0)
	i		N1		CF1 (R1)
1M	PV		N2		CF2 (R2)
-10K	PMT		N3		CF3 (R3)
0	FV		N4		CF4 (R4)
		⋮		⋮	
			N20		CF20 (R.9)



Procedure:

1. Clear the registers.
2. Set in BEGIN mode.
3. Enter n = 240.
4. Enter PV and PMT.
5. Press i (rate per month)

Depends on your discount rate

IRR = 10.66% APR = 11.19% effective

At 8%, the annuity is worth $1,203,513.20

At 12%, the annuity is worth $917,276.11

If you prefer cash now, you'll choose the $1M.

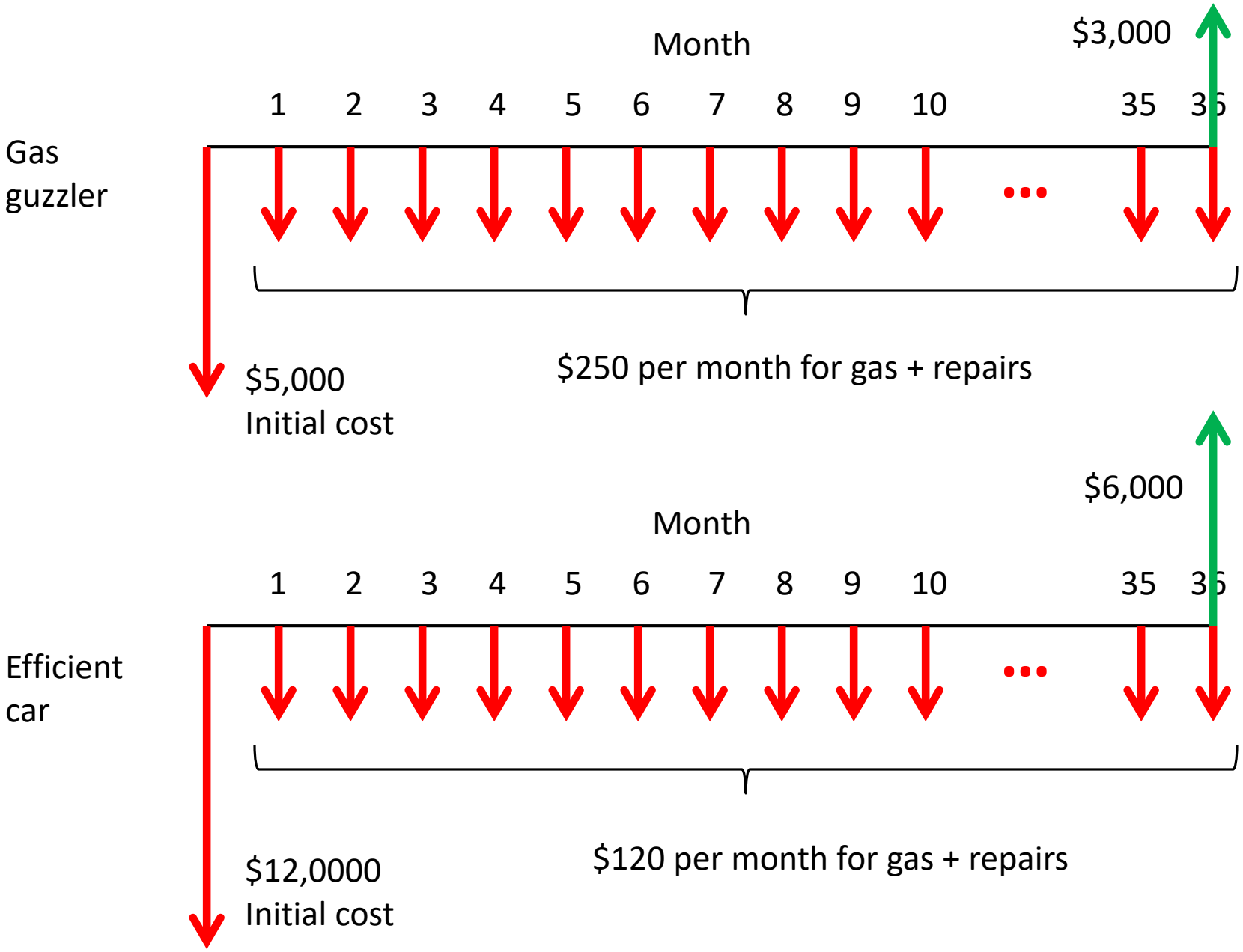
Exercise

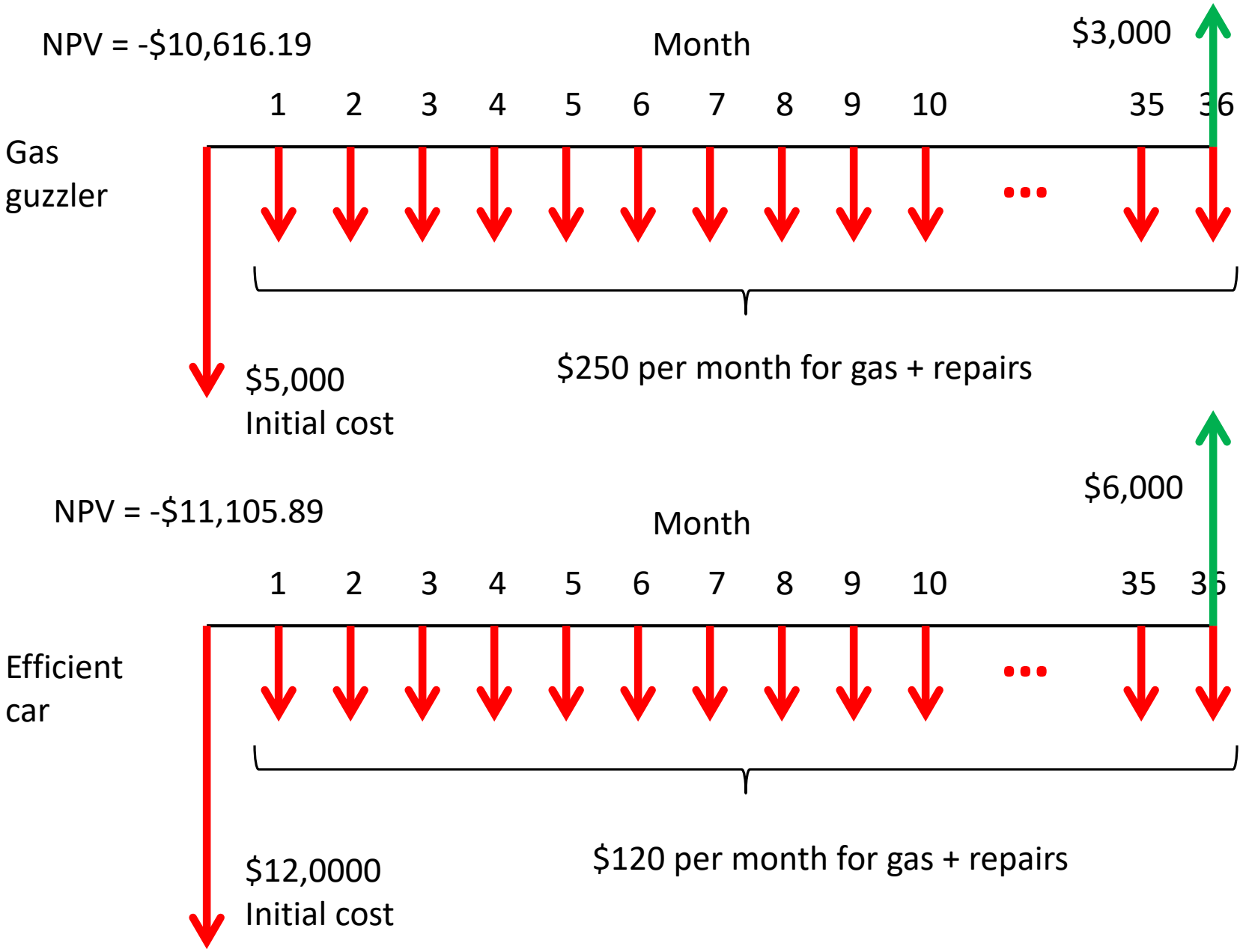
You need a car for the next 3 years and you're considering two alternatives.

1. An older gas guzzler for $5,000 which you estimate will require $150/month for gas and $100/month on repairs. After 3 years, you expect it could be sold for $3,000.

2. A newer, more efficient car that for $12,000 that would need only $80/month in gas and $40/ month for repairs. After 3 years, you expect it could be sold for $6,000.

You're living on money you're borrowing at 8% APR. Which is the better deal?


Gas guzzler
Month
1 2 3 4 5 6 7 8 9 10 35 36
$3,000
$5,000
Initial cost
$250 per month for gas + repairs
Efficient car
Month
1 2 3 4 5 6 7 8 9 10 35 36
$6,000
$12,0000
Initial cost
$120 per month for gas + repairs


NPV = -$10,616.19
Month
$3,000
1 2 3 4 5 6 7 8 9 10 35 36
Gas guzzler
$5,000
Initial cost
$250 per month for gas + repairs
NPV = -$11,105.89
Month
$6,000
1 2 3 4 5 6 7 8 9 10 35 36
Efficient car
$12,0000
Initial cost
$120 per month for gas + repairs

Exercise

You need to replace your furnace. You have two options.

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2. For $20K, you can buy a high efficiency unit that will cost you $80/mo in gas.

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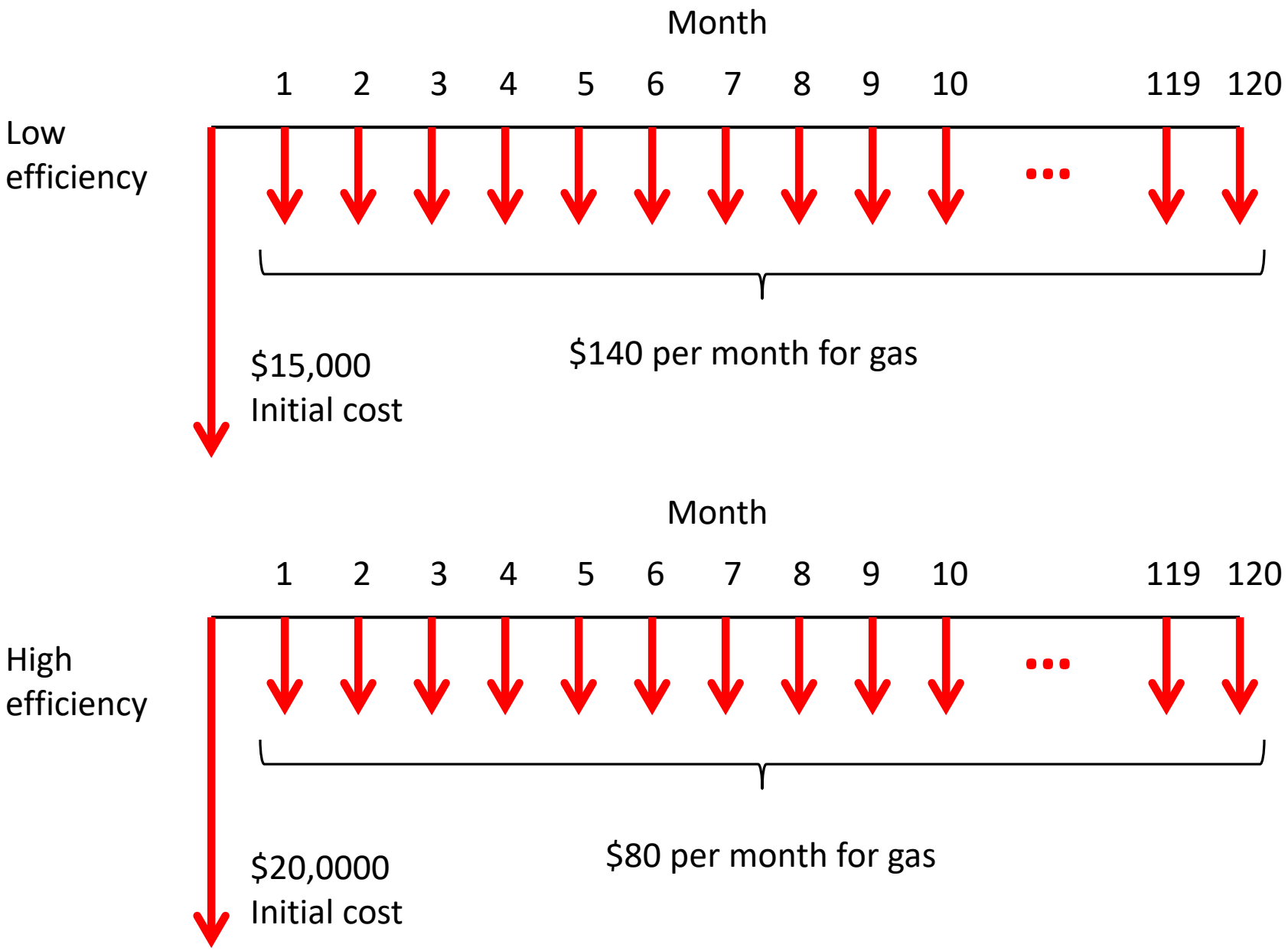
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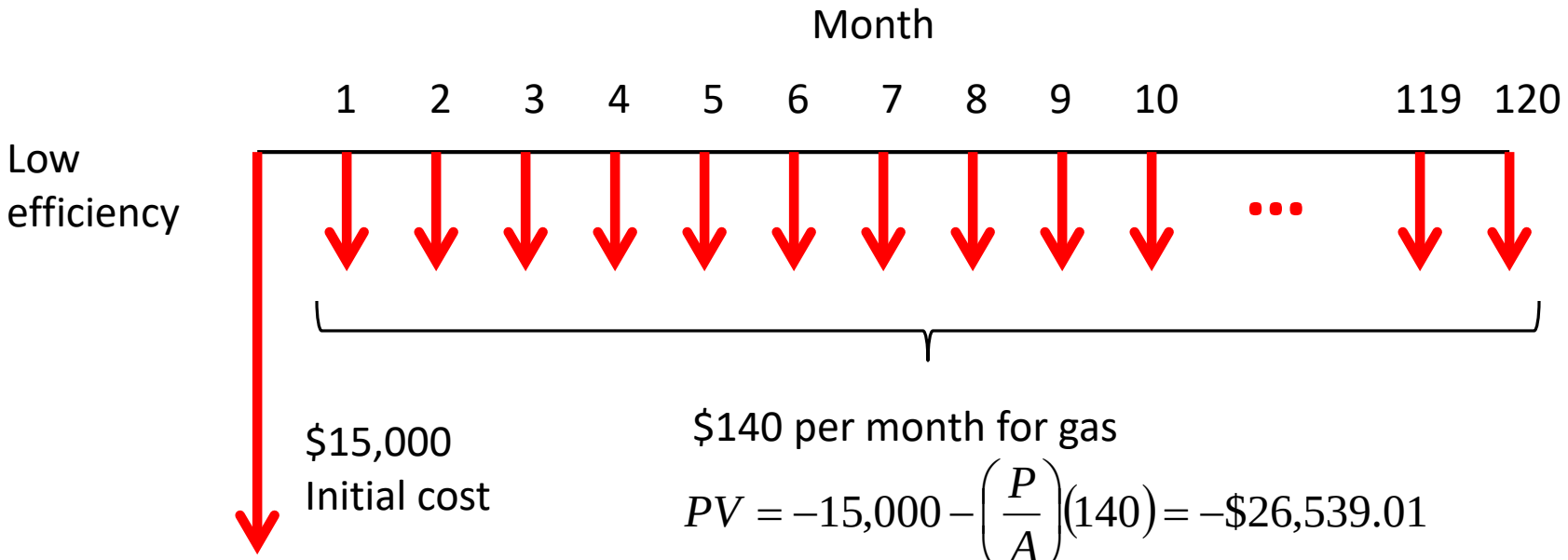
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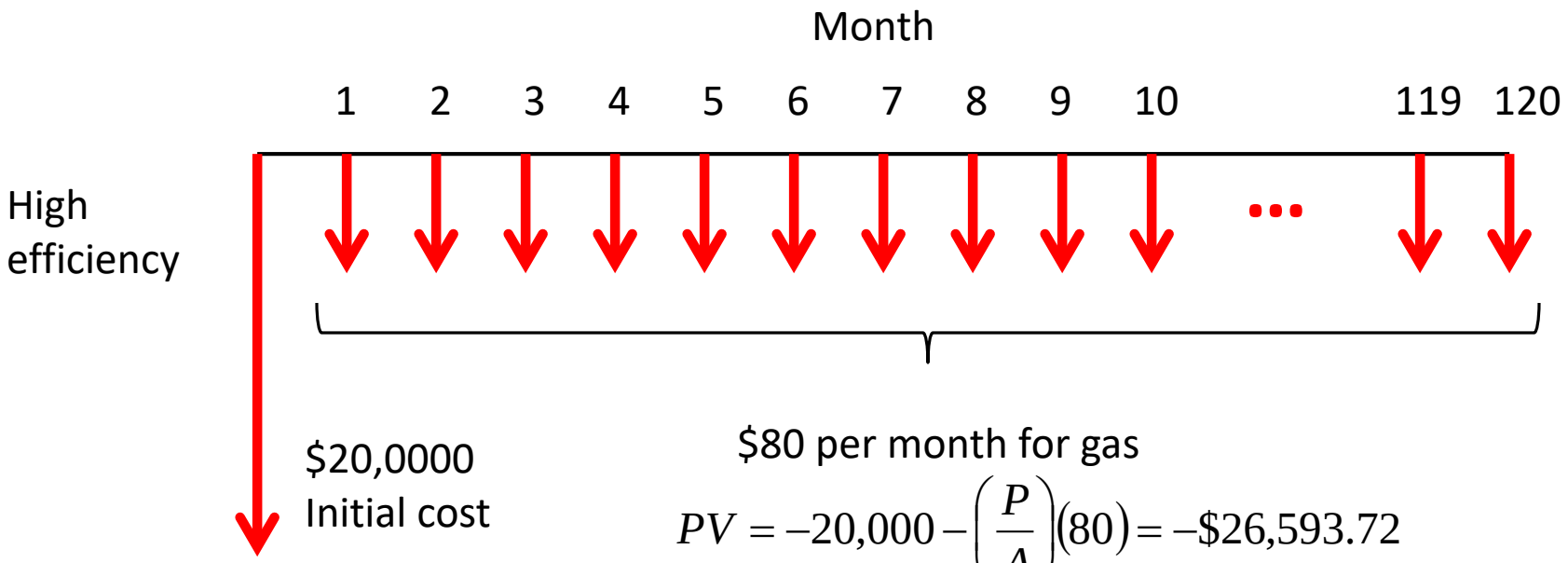
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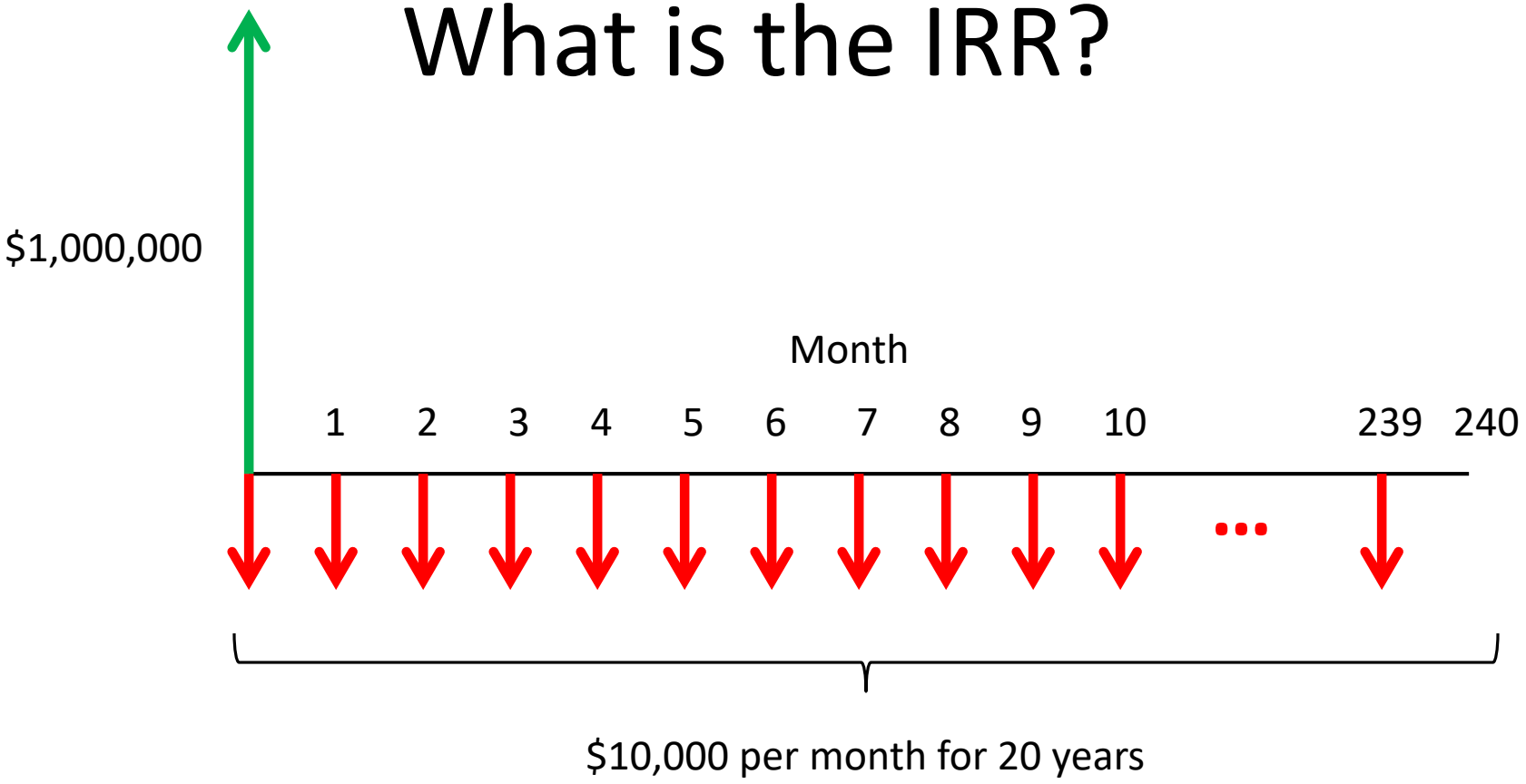

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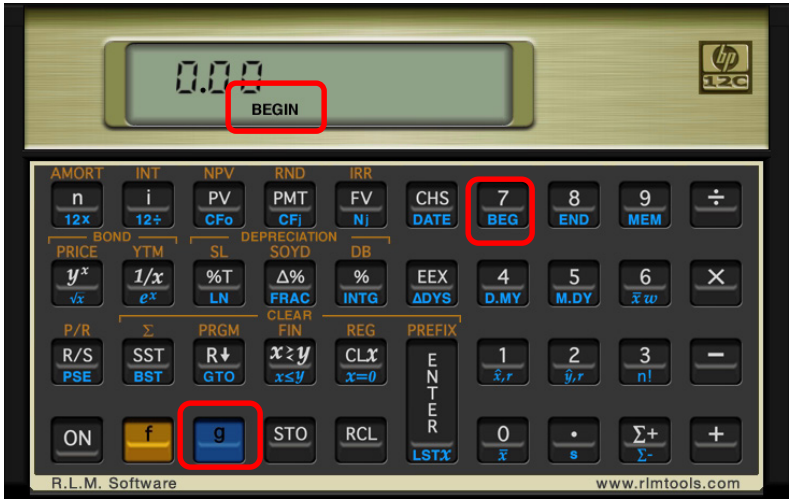

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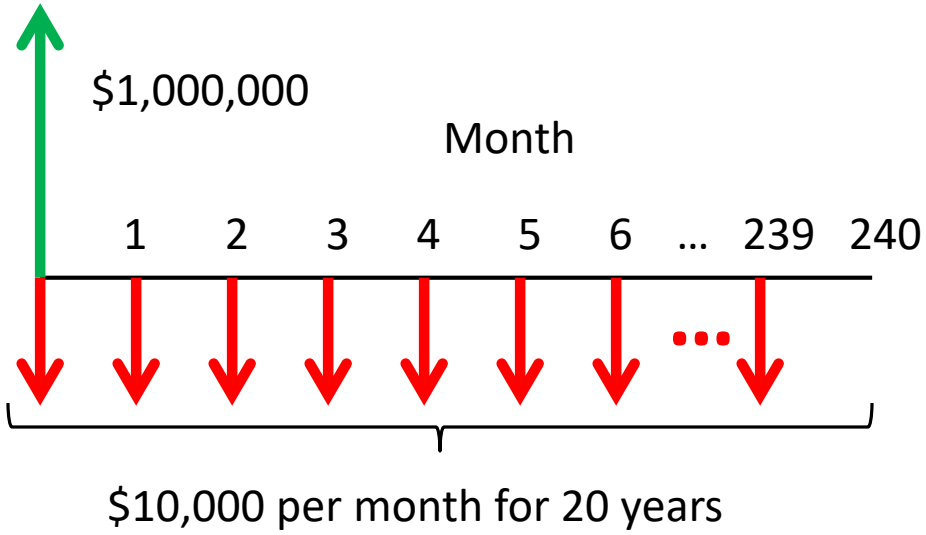
0	FV		N4		CF4 (R4)
		⋮		⋮	
			N20		CF20 (R.9)



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At 8%, the annuity is worth $1,195,542.92

At 12%, the annuity is worth $908,194.16

If you prefer cash now, you'll choose the $1M.

Depreciation

- Used to be simple.
  - Straight line (SL)
  - Sum of years digits (SOYD)
  - Declining balance (DB)
- Replaced by MACRS (Modified Accelerated Cost Recovery System) in the US.

Straight line

- The cost of the asset is spread evenly across all the years of the expected lifetime.
- Example:
  - $1000 machine
  - 10-year expected lifetime
  - $1000/10 = $100/year depreciation

Declining balance

The straight line rate is multiplied by a declining balance factor, typically 125%, 150% or 200%.

Each year:

Depreciation = Book value * SL Rate * DB factor

Book value for the next year is reduced by the depreciation.

Example:

- $1000 machine
- 10-year expected lifetime
- SL rate = .1
- DB factor = 200%
- First year depreciation = 1000*.1*2 = 200
- Second year = 800*.1*2 = 160

SOYD

- Years are numbered 1 to n
- Year numbers are summed.
- Numbers reversed and depreciation each year is that number/SOYD.
- Example
  - $1000 machine
  - 5-year expected lifetime
  - 1 + 2 + 3 + 4 + 5 = 15
  - First year depreciation = 1000*(5/15) = $333.33
  - Second year = 1000*(4/15) = $266.67

MACRS

Government defines lifetimes for various classes of assets of 3, 5, 7, 15 or 20 years.

First year only depreciate for half the year.

Each following year:

Depreciation = Book value * A / Lifetime

Where A = 100%, 150% or 200%.

Most people just use the IRS tables.