1 Week 3

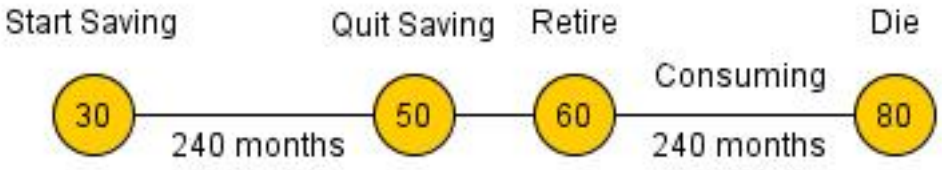
1.1 Recap Week 2

pv, fv, timeline

pmt - we don't have to keep it the same every period.

Ex.:

Suppose you are exactly 30 years old. You believe that you will be able to save for the next 20 years, until you are 50. For 10 years following that, and till your retirement at age 60, you will have a spike in your expenses due to your kids' college expenses, weddings, etc., and you will not be able to save. If you want to guarantee yourself $8,000 per month starting one month after your 60th birthday, how much should you save every year, for the next 20 years, starting at the end of this month. Assume that your investments are expected to yield 8% and you are likely to live till 80.



$PMT = 8000$

$m = 240$

$r = 0.08$

What is PV_{60}

Excel:

=pv(0.08/12, 240, 8000)

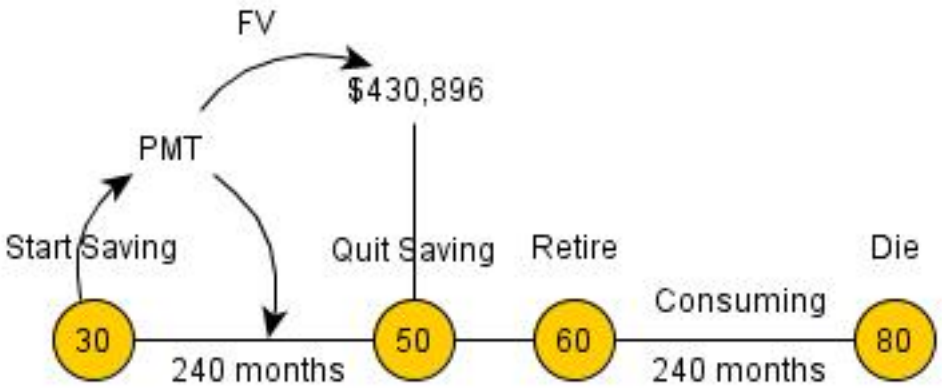
= 956434.33

10 years but 120 months between 60 and 50

=pv(0.08/12, 120, 0, 956434.33)

$= 430,896$

Now we calculate PMTs between 30 and 50 for the future value that we just calculated at age 50.



=pmt(0.08/12, 240, 0, 430896)

= $731.55

1.2 Decision Criteria: NPV

How does one decide if one is creating value.

1.2.1 Context Building

- Start with an idea/project.
- A collection of ideas/projects is a firm/company.
- Value creation only through good ideas/projects.
- how do you determine what is a good idea/project?

Company - a collection of ideas/projects.

1.2.2 Properties of a Good Decision Criteria

- Makes sense (benefits exceed cost) - not necessarily monetary gain.
- Unit of measurement
- Benchmark obvious - easy to communicate, not plug and chug calculate
- Easy to compare different ideas/projects - how does the criterion let you compare the ideas
- Easy to calculate

1.2.3 Net Present Value (NPV)

Assume an interest rate of $r = 10\%$; what is the NPV of this idea?

Year	**Cash Flow**	**Years to Discount: n**	**Present Value**
0	-$1,000	0	-1000
1	$1,320	1	+1200
NPV			$200

1 period has elapsed between year 0 and 1.

What's happening?

At time 0, you are making an investment of $1,000, the sign is important (also in Excel), it means **outflow**.

After 1 year, there's a positive **inflow** of $1,320.

What is the value of -$1000 today? How many years of discounting do you have to do? None, so it's -$1000.

The idea is going to make money, $1320 1 year from now. What is its present value?

$$\frac{1320}{1+r} = \frac{1320}{1.10} = 1200$$

After you have purged the effects of time you can add numbers, so

$$-1000 + 1200 = 200$$

The expression Net Present Value comes from the fact that we have to substract our investment.

1.3 NPV: Intuition & Beauty

1.3.1 Cash flows belong to the project.

Where do the "cash flows" come from? Cash flows, idea, benefit, cost is the same thing, because otherwise the idea is meaningless.

1.3.2 Where does r come from?

r captures **opportunity cost** of investing in an idea. A lot of people pull it out of thin air, however it comes from the next best use of investment on a similar project. r that return that is coming from investing in, say, a competitor. So r can be said to not belong to your project.

1.3.3 What does the final number mean?

How much value have you created.

1.3.4 Should you pursue this idea/project?

Yes, you're creating positive value (previous example)

1.3.5 What if you do not have the resources to do so?

Markets come to your help, not lenders (banks). Fair resources available to you. If you have a good idea, resources will come.

1.3.6 Net Present value: Essence

Value is always incremental! To what?

$r = 10\% \rightarrow$compare to idea that exists

Suppose you take \$1000 and put it in a similar business, how much would you make

\$1000 0 ———- 1 \$1100 $=P(1+r)$

if your idea says that on a \$1000 investment you get \$1320 1 year from now

\$1000 0 ———- 1 \$1320

then if you take $1100 - 1320 = 220$, so we've been able to create value of \$220 on the same idea. But which year is the \$220? It's in the future, year 1. If we bring this back today

$$\frac{220}{1.10} = 200 = NPV$$

Ex 2:

Year	Cash Flow	Years to Discount: n	Present Value
0	-\$1,000	0	-1000
1	\$1,320	1	$\frac{1320}{1.1} = 1200$
2	\$1,452	2	$\frac{1452}{1.1^2} = 1200$
NPV=			\$1400

Excel:

A	B	C
-\$1,000	1320	1452

=npv(0.1, B1:C1)+A1

Don't include time 0 investment in the calculation.

1.4 NPV: Properties & Formula

NPV starts off with an investment

definition:

$$NPV = -I_0 + \frac{C_1}{1+r} + \frac{C_2}{(1+r)^2} + \dots \frac{C_n}{(1+r)^n}$$

where I_0 (or C_0) is the investment cost of the project and C_n is the cash flow in period n.

1.4.1 Properties of NPV

- Makes sense?
  We're trying to figure out if this is a value creating idea. We're getting the discounting rate.
  Benefits - Cost (Time Value of Money)
- Unit of measurement?
  Dollars, number is based on the predictions of the future.
- Benchmark obvious?
  We'll do the project when $NPV > 0$
- Easy to communicate?
  Yes, because all of the above.
- Easy to compare ideas/projects?
  Yes, the project that creates most value wins
- Easy to calculate?
  Not necessarily, but is with Excel
- However, NPV misses one component, it has a static vie of the world after today. We're missing out on flexibility (which comes with options, future lectures)

1.5 Decision Criteria: Payback

1.5.1 Comparing Criteria: Payback Period

What is the payback period of the following idea:

Year	Cash Flow	Years to Discount: n
0	-$1,000	0
1	$300	1
2	$700	2
3	$2000	3
Payback = 2		

Suppose at year to cash flow is $500

Year	Cash Flow	Years to Discount: n
0	-$1,000	0
1	$300	1
2	$500	2
3	$2000	3
Payback = 2.1=2+$\frac{200}{2000}$		

Discounted payback

Year	Cash Flow	Years to Discount: n
0	-$1,000	0
1	$300	1
2	$700	2
3	$2000	3
Payback = 2		

the answer will be > 2, because the cash flow will be discounted.

- Makes sense?
  You'd want the money back to reinvest it, there may be situations when you need to worry about it but most of the time not
- Unit of measurement
  Years/time/months

1.6 Decision Criteria: IRR

1.6.1 Competing Criteria: Internal Rate of Return

What is the IRR of this idea?

Year	Cash Flow	Years to Discount: n
0	-$100	0
1	$110	1

IRR is 10%

we made $\frac{110-100}{100} = 10\%/year$

$$r = \frac{FV - PV}{PV}$$

or,

$$r = \frac{\text{Final Sum - Initial Sum}}{\text{Initial Sum}} = \frac{Profit}{Investment}$$

1.6.2 IRR: Intuition

What is the NPV of the idea if you use the IRR to calculate it?

$$-100 + \frac{110}{1+r} = 0$$

Is this a good idea?

No benchmark built into IRR, so it's hard to tell.

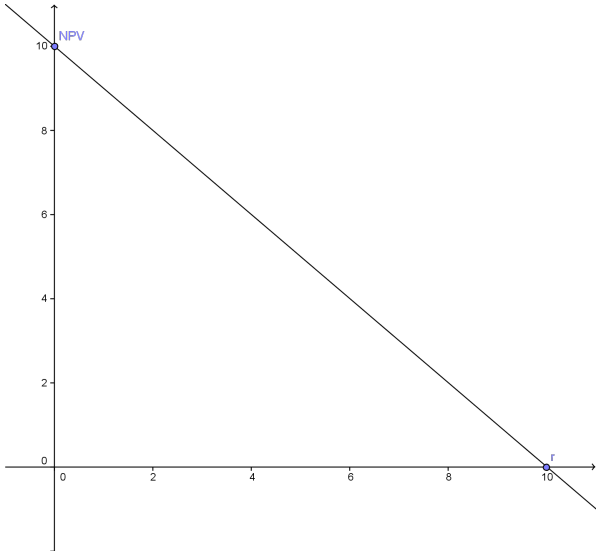
What if others in this type of buisness are making 8%?

Yes, $NPV > 0$

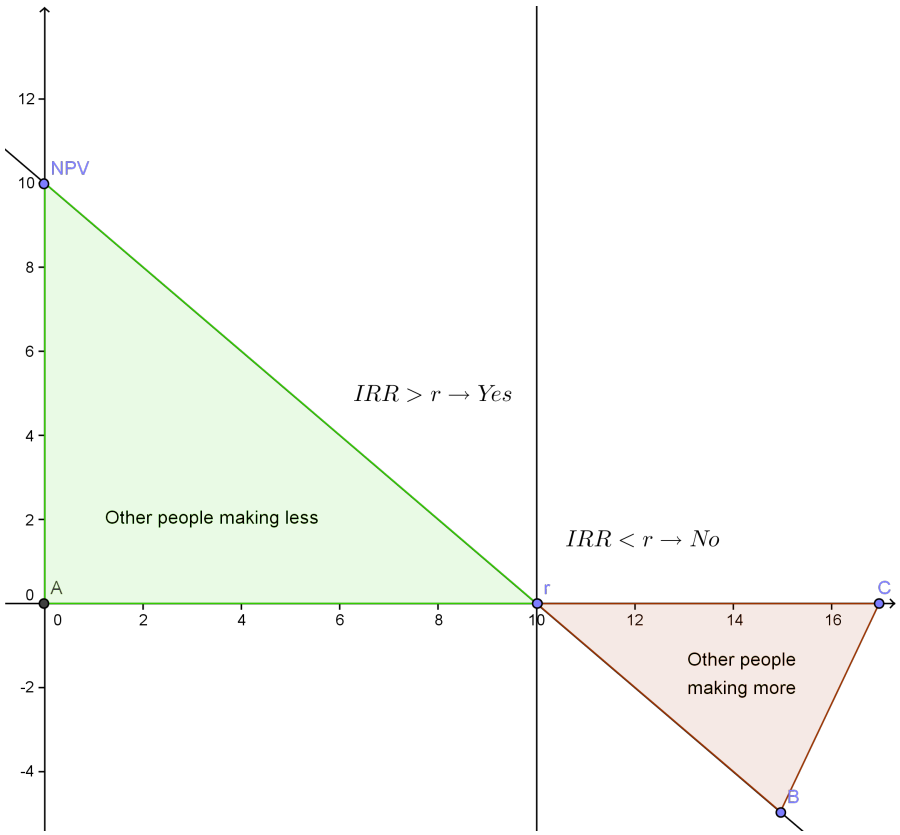
What if they are making 12%?

No, others are doing better. $NPV < 0$

1.7 IRR: Graphical Representation



We have to compare it to cost of capital, r. So is this project valuable? Yes, other people are making less.



1.7.1 Ex.: What is the IRR of this idea

Year	Cash Flow	Years from today: n
0	-$100	0
1	$0	1
2	$110	2
IRR over 2 yers = 10%		
IRR per year $NPV = 0 = 100 + \frac{0}{1+IRR} + \frac{110}{(1+IRR)^2}$		

For second example, it's difficult to calculate IRR, it will be $< 5\%$.

IRR is the return that solves this equation

$$I_0 = \frac{C_1}{1+IRR} + \frac{C_2}{(1+IRR)^2} + \dots \frac{C_n}{(1+IRR)^n}$$

Or "guess" till $NPV = 0$!

$$NPV = I_0 + \frac{C_1}{1+IRR} + \frac{C_2}{(1+IRR)^2} + \dots \frac{C_n}{(1+IRR)^n}$$

back to example

A	B	C
-100	0	110

=irr(a1:c1)= 4.88%

to check

=pv(0.0488, 2, 0, 110)=$100

1.8 IRR: A Practical Issue

We're trying to make $IRR = 0$ (?)

1.8.1 Issues with IRR: Multiple IRRs

Ex.:

What is the IRR of this idea:

Cash flows can change sign over the years.

Year	Cash Flow	Years from today: n
0	-$100	0
1	$230	1
2	$-132	2

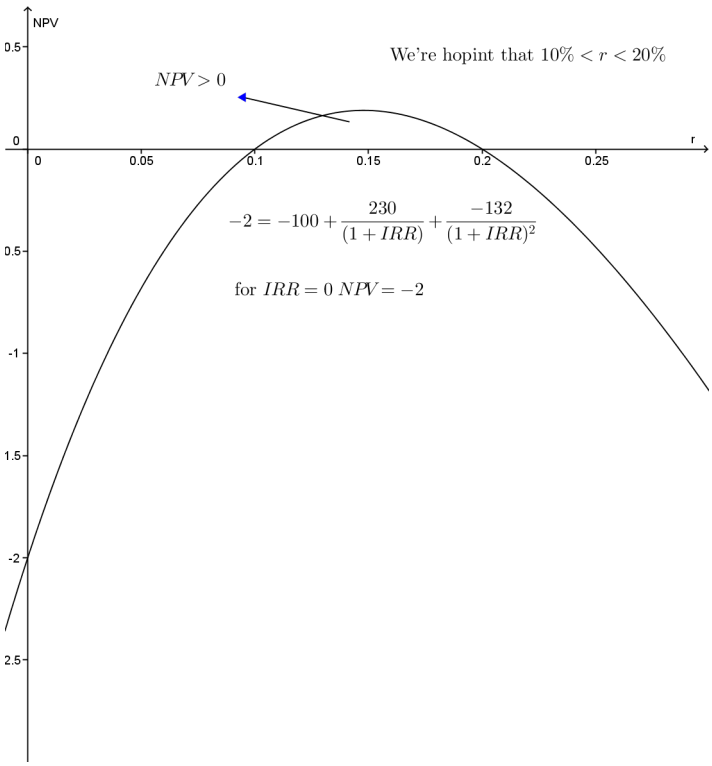
A	B	C
-100	230	-132

=irr(a1:c1)= 10%

Now, second parameter is guess (0.20=20%)

=irr(a1:c1,0.20)= 20%

The guess apparently works. So what to do now?



An intuitive decision rule when comparing mutually exclusive projects, would be to accept the project with the highest IRR. This rule is, unfortunately, incorrect as the following example demonstrates.