Basic Principles of Financial Valuation

Discounting

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Based on lecture materials from J. Weston, Rice University

Money Now VS Later

- Money now:
  - allows me to invest in assets like stocks, bonds, real estate
  - allows me to pay my debt, to go out party etc.
- Money later
  - I need to be compensated for these lost opportunities to invest and spend
  - Things get expensive overtime
  - I may not be here or you may go broke

Time Value of Money: Opportunity Cost

- Opportunity cost represents the potential benefits an individual, investor, or business misses out on when choosing one alternative over another
  - One alternative: money now
  - The other alternative: money later
- I need to get more if you want me to be patient and give up all the opportunities to spend and invest now

Time Value for Money: Inflation

- Over time, prices tend to rise and money become less valuable over time

- If you want to give me money later, there has to be a little extra to account for the fact that the money will not buy as much in the future

Time Value of Money: Risk

- No one knows what will happen tomorrow!
- I am at risk for being patient as things can change in the future for the worse
- Hence, greater risk needs to be accommodated with more compensation

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Interest Rate

- If I am willing to wait and get money later, how much does this worth?

- Instead of getting $100 now:

- At some point, you will accept and we have put a price on time

- That price is the interest rate, and it incorporates opportunity costs, inflation expectations, and risk.

Interest rate = what you charge to wait

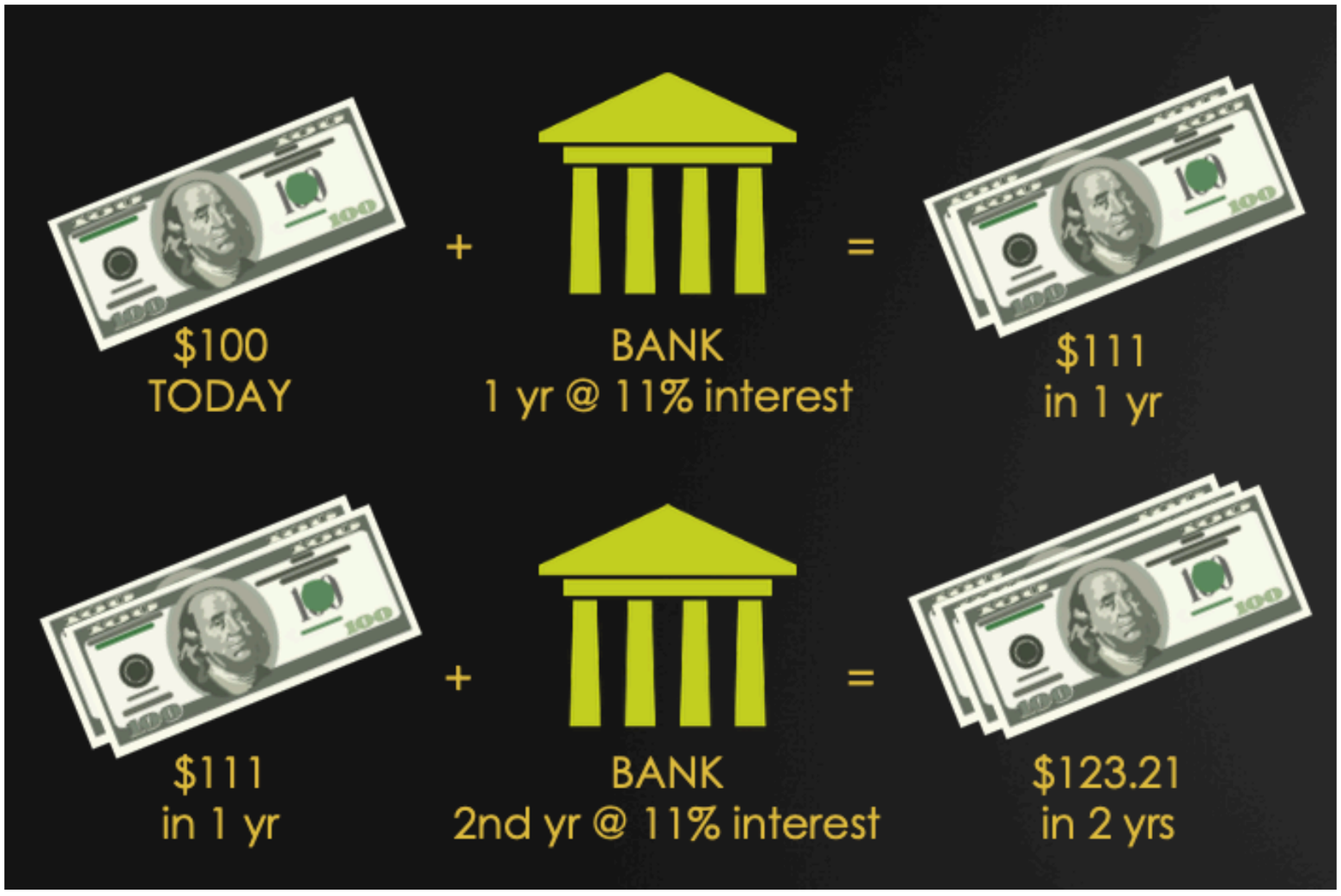
Changes in Real World Interest Rates

- Changes in opportunity costs
    - Better economic growth
- Changes in inflation expectations
    - Government prints more money
- Changes in risk
    - Wars, disasters, etc...

Interest Rates in the Economy

- The most important price in the economy
- The price of time
- The basis for all other prices

Compounding



- In the second year, you earn interest on the interest you earned in the first year - that is **compound interest**

FUTURE VALUE: MONEY IN THE BANK

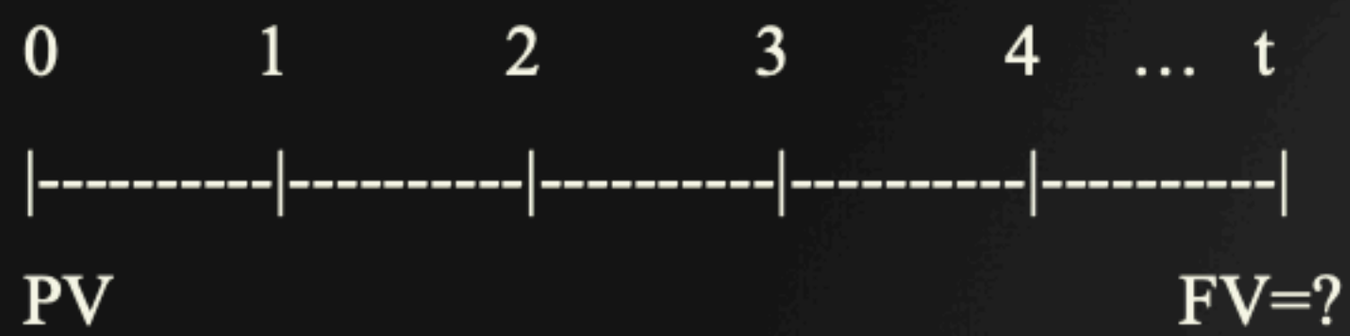
Interest rate = 11%

$1,000 in bank for 5 years

Year	Amount
0	$1,000
1	$1,110 = $1,000 + $1,000 * 11% = $1,000 * (1+11%)
2	$1,232 = $1,110 * (1+11%) = $1,000 * $(1+11\%)^2$
3	$1,368 = $1,232 * (1+11%) = $1,000 * $(1+11\%)^3$
4	$1,518 = $1,368 * (1+11%) = $1,000 * $(1+11\%)^4$
5	$1,685 = $1,518 * (1+11%) = $1,000 * $(1+11\%)^5$

$1,685

FUTURE VALUE



$$FV = PV(1+r)^t$$

FV = Future Value

PV = Present Value

r = interest rate

t = time

In-class Exercises

- Suppose you put $500 into a savings account today that will pay 8% interest for five years. How much will you have at the end of five years?

- What if I bought a painting for $700 and then 3 years later sold it for $825. How much did I earn on the painting on an annual basis?

Effective vs Nominal Rates

- Nominal = periodic rate times the number of periods
- Effective = compounded rate
- Example: monthly compounding
  - Nominal interest rate 6% per year (a.k.a 6% APR)
  - That is 6% / 12 = 0.5% per month
  - Effective rate = $(1 + 0.5\%)^{12} = 1.0617$ or 6.17%

EFFECTIVE VS. NOMINAL RATES

Generally:

$$R_{effective} = \left(1 + \frac{R_{nominal}}{n}\right)^{n}$$

The effective rate > nominal

Bringing the Future into the Present

$$FV = PV(1+r)^t$$

$$PV = \frac{FV}{(1+r)^t}$$

Present Value

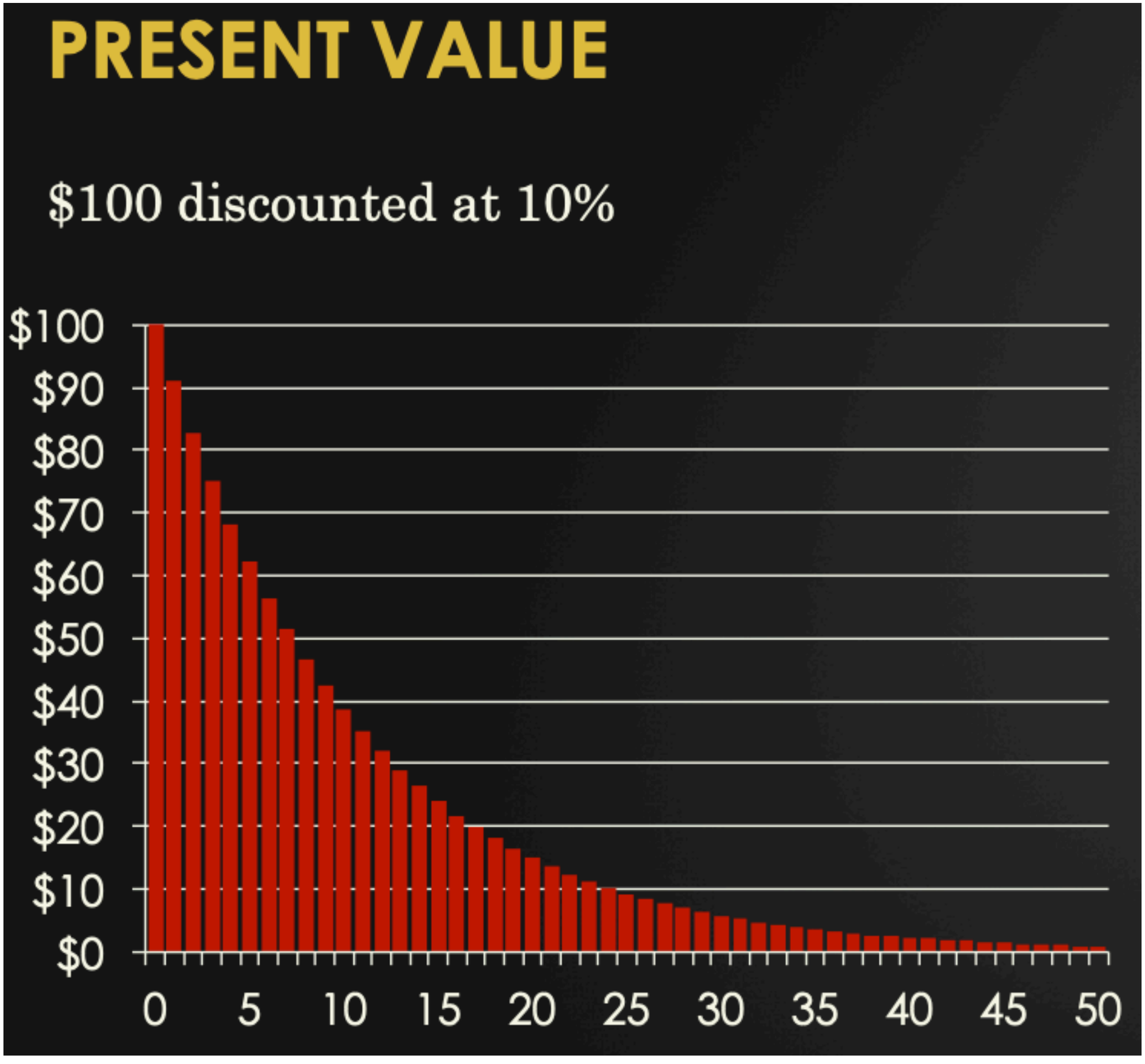
- If I offered you $175 payable 5 years from now, how much would you pay for that offer today if interest rates were 4%?

Today					5 years from now
0	1	2	3	4	5
$175/(1+4%)^5$	$175/(1+4%)^4$	$175/(1+4%)^3$	$175/(1+4%)^2$	$175/(1+4%)^1$	
$ 143.84	$ 149.59	$ 155.57	$ 161.80	$ 168.27	$ 175.00

ANSWER: $143.84

Present Value

- How much FV is discounted back to PV depends on:
  - How far out is the cash
  - How big is the interest rate


PRESENT VALUE
$100 discounted at 10%
$100
$90
$80
$70
$60
$50
$40
$30
$20
$10
$0
0
5
10
15
20
25
30
35
40
45
50

Discounted Cash Flows (DCF)

- Method of valuing an investment
- Uses all anticipated future cash flows
- Discounts all cash flows back to present value

Valuation by DCF

- Why do investors buy different assets?
    - Real estate, stocks, or bonds
- Because they want to earn a return and use the money later

What Gives an Investment Value

- How much cash is coming in?
- When is the cash coming in?
- With these two answers, we can put value on anything

Bond

- Contract between an issuer and a bondholder
- Buyer of bond lends money (principal) to issuer
- Issuer pays interest on loan and repays principal at maturity

DCF: Simple Bond

- Consider a simple bond of $3,000 that makes annual payments of $250 for 5 years if the discount rate is 7%
- What is it worth?
  - Step 1: What are the cash flows
  - Step 2: What are they worth today
  - Step 3: Add up the present values

DCF: Simple Bond

DCF: Simple Bond

- In our example the bond is worth $3,164
- That is how much money the bond would raise if sold today
- There is no reason anyone would pay more or less

DCF: Stock Valuation

- How much should a share of Bangkok Bank worth?
- Cash to Shareholders? When?
- Model both of these and DCF
- This is partly what stock analysts do

DCF: Other Assets

- Apply the principle to any asset:
  - Real Estate
  - Mergers and Acquisitions
  - Derivatives
- Cash and timing drive all valuation

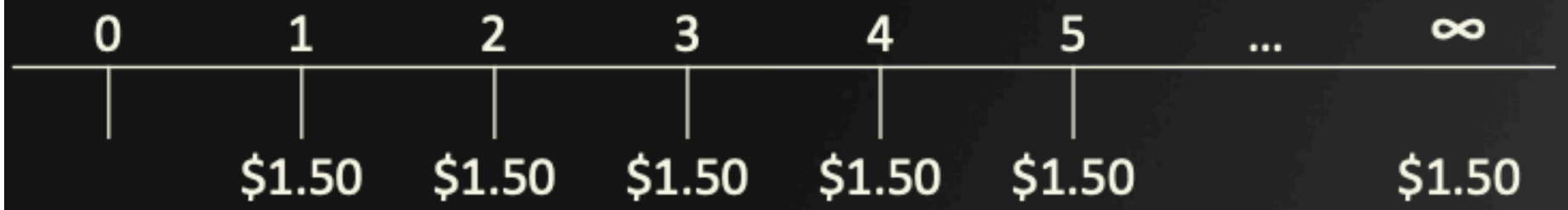
DCF: Practical Example

- A water well in the desert
- If the well is dry, it does not worth anything
- If it is connected to an active source of water, it is worth something
  - How much is it worth to sell or acquire?

DCF: Practical Example

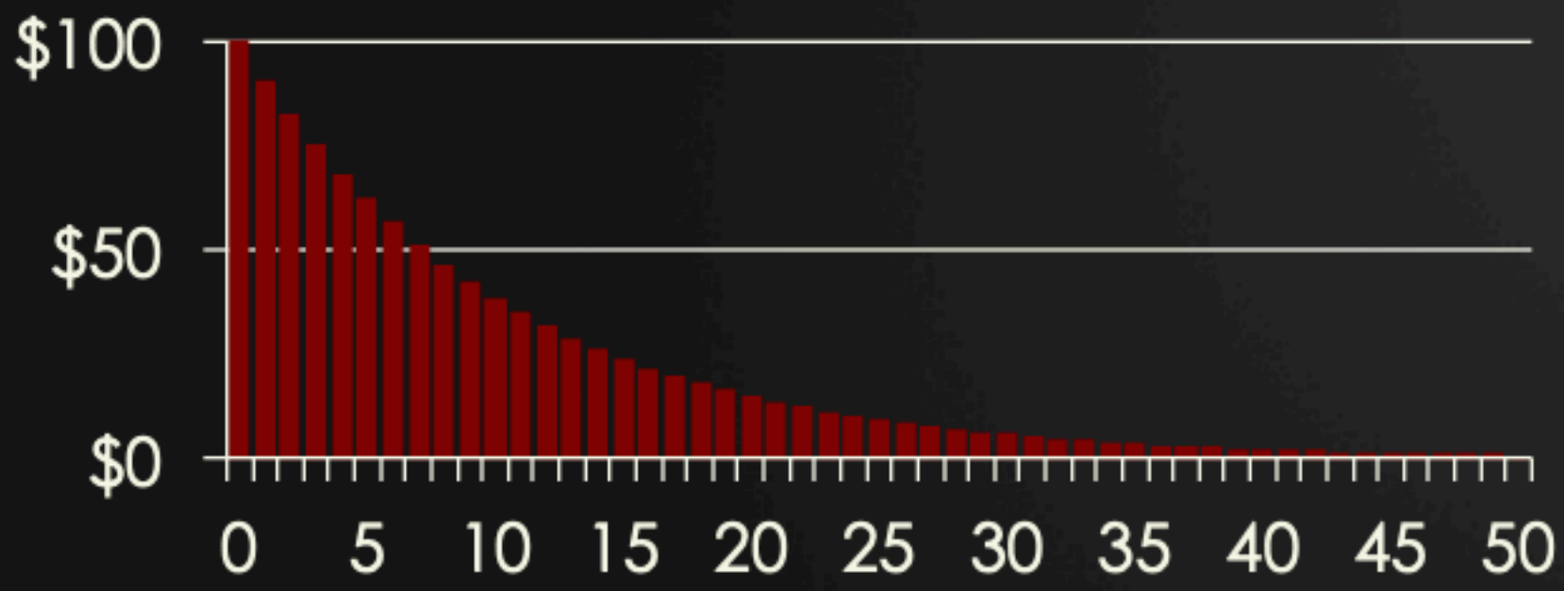
- How much water is there?
  - Let’s say infinite
- How much does it produce?
  - 1 gallon/day
- How much cash flow?
  - Net $1.50/day
- Can we put a realistic price on this asset?

DCF PRACTICAL EXAMPLE: WATER WELL



Problem: Is it worth infinity?

Remember:



DCF: Practical Example

- Discount rate: 15%
- Build a spreadsheet model
  - Step 1: What are the cash flows
  - Step 2: What are they worth today
  - Step 3: Add up the present values

Valuation by Comparables

- Practitioners often refer to “comps”
- Comparable transactions or prices
- Quick, easy, and dangerous!

Assumptions for Comps

- 1. You can identify close comparables
- 2. You have a value–relevant ratio
- 3. The market values comps similarly

Comparables in Use

- (Price/ Attribute) * Your Attribute = Price of your asset
- Examples of attributes:
    - P/E ratios
    - Earnings Yield
    - Dividend Yield
    - Return on Assets
    - EBITDA multiples

P/E Ratios

- Price–to–earnings ratio is popular
- How much a dollar of current earnings costs?
  - “Trades at X times earnings”

P/E RATIOS: EXAMPLE

Value Lowes Corporation by comps

	Home Depot	Lowes
E (earnings)	$6.80	$2.46
P/E	25	--
Comp value	--	$61.60

Comp value of Lowes = $P/E_{\text{Home Depot}} * E_{\text{Lowes}}$

= 25 * $2.46 = $61.60

Lowes actual price in the market = $74 (about 20% different)

Other Comps

- Return on Assets or Equity (ROA/ROE)
- Return on invested capital (ROI)
- Dividend yield
- PEG ratio (P/E ratio over Growth in E)

Measuring Comps

- Comps rely on historical averages
- Trailing 12m, most recent Q, past 3 years…?
- Negative earnings, negative prices?

Comps VS DCF

- Both can provide useful information
- Executed correctly, both are valid
- Comps often used (and abused) in practice
- Both require forecasts
- DCF is more appealing in theory and more accurate, but requires much more work
- Comps can be a good quick-and-dirty valuation, but be careful!

Examples and Applications: Bonds

- Simple debt instruments
- Promise coupons (interest) and face value
- U.S. treasury bonds, corporate bonds, municipals, sovereign debt
    - Different risks associated with each type of bonds
- Valuation: what cash and when

Treasury Bond Example

- Treasury issues 3 year bonds with a 2.5% coupon rate. If the six month interest rate is 1.2%, what is the price of the bond per $100 of face value?

Examples and Applications: Mortgages

- Simple debt instrument
- Borrow money today to purchase real estate
- Each payment includes principal and interest
- Amortization schedule

Mortgage Example

- Assume a bank charges 7% interest per year. You borrow $10,000 to be repaid in equal yearly installments of $3,810.52 over 3 years. Let’s amortize the loan schedule and compute interest and principle repayments.

Examples and Applications: Annuities

- Series of equal payments at regular intervals
    - Regular deposits to savings account
    - Monthly mortgage payments
    - Insurance premiums
    - Pension payments

Retirement Annuity Example

- You want to retire and maintain a monthly income of $2,500 for the next 20 years. How much would it cost to purchase this annuity if discount rates are currently 4%?

USING COMPOUNDING AND DISCOUNTING TO MAKE DECISIONS

You have a choice between three options:

1. Take $1,000 in cash now
2. Receive $2,000 at the end of three years
3. Wait 10 years to receive $3,000

Which is best choice if discount rate is 10%?

How does the answer change if r = 5%?

What We Have Learned

- Time value of money
    - Opportunity cost, inflation, and risk
- Interest rates
- Compounding and discounting
- Valuation by Discounted Cash Flow (DCF)
- Valuation by Comparables
- Applications in bonds, mortgages, etc.