DCF ANALYSIS -- Part 1
INTRO AND DCF MECHANICS

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OUTLINE

Our Discussion has 3 elements

Part 1 reviews the basic concepts and mechanics. While most of it may be a review for you, it is essential to discuss the topic and resolve questions you may have.

It covers (a) basic concepts and (b) mechanics.

Part 2 discusses the critical analytic issue of "Choice of Discount Rate"

WHAT IS DCF ?

DCF Stands for “Discounted Cash Flow”

It’s an essential tool for all future planning, for System Design and Management particularly.

Its central element is a spreadsheet showing the possible evolution of a System over time in terms of the inputs and performance.

Excel is the industry standard (free from MIT) but there are alternatives (e.g. Google Docs)

SPREADSHEET ELEMENTS

The “headline” elements in a spreadsheet are Systems Inputs and Performance.

Inputs are what it takes to achieve results

- ➔ Capacity built, number of employees, etc.
- ➔ The Inputs inevitably cost money

Performance is as you define it. It may be

- ➔ Directly monetary: sales made, revenues
- ➔ Or not: people cured, pilots trained.

SOME SPREADSHEET DETAILS

Spreadsheet normally includes details about derivation of inputs and performance.

For example, for “capacity” it might include

- ➔ Cost per unit
- ➔ Amount built in each period
- ➔ Total cost
- ➔ See “Garage Template” posted on course website as a model

Spreadsheets can be very detailed. Best practice focuses on top-line results.

SPREADSHEETS INEVITABLY REFER TO MONEY, IF ONLY FOR INPUT COSTS

Essence of DCF is to place all money received or spent (the "cash flow") on a common basis.

This is necessary because money has a time value (a $ now is worth more than a $ later.

This means that future income and expenses need to be appropriately "discounted" to make them comparable to a base case.

DCF is essential for proper System Evaluation

DCF Mechanics

Topics

- ➔ Concepts
- ➔ Discount Formulas
- ➔ Present Value Analysis
- ➔ Effects of Rate and Time

Issue - Value over time

Money now has a different value than the same amount at a different date

Rate of Change is comparable to –

but not equal to – interest rate

Difference discussed in DCF Part 2 presentation -- “choice of discount rate”

This rate of change is the “Discount Rate”, r

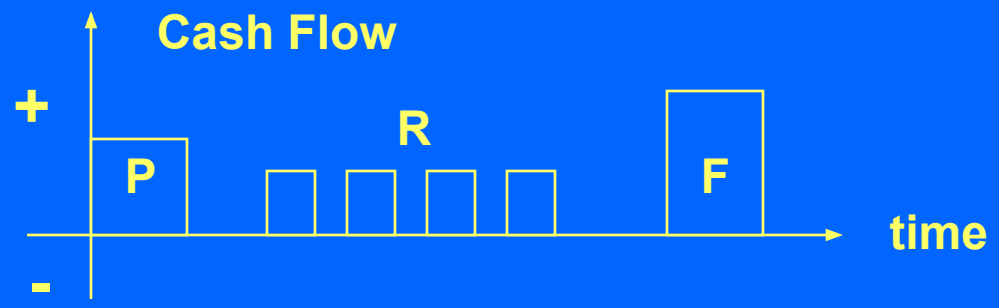
because future benefits/costs are reduced… (that is, “discounted”) compared to present

DCF Basic Elements

Objective: To compare correctly economic benefits and costs that occur over time

3 general categories

- ➔ **Present -- associated with Baseline time 0**
- ➔ **Recurring -- equal in each period (e.g. ren)t**
- ➔ **Future Amounts -- at a specific later period**



Formulas for N Periods

- **Single amounts**

  $$\text{Future Amount} = P (1 + r)^N = P (caf)$$

  caf = Compound Amount Factor

  $$\text{Present Amount} = F/caf$$

  1/caf = Present Worth Factor

- **Finite Series of R amounts each period**

  $$F = \Sigma_i R (1 + r)^i = R [(1 + r)^N - 1] / r$$

  $$R = P (crf) = [P*r (1+r)^N] / [(1 + r)^N - 1]$$

  crf = Capital Recovery Factor

Formulas for N Periods (continued)

- Infinite Series for recurrence

  Then: $1 << (1 + r)^N$

  So that: $(1+ r)^N / [(1 + r)^N - 1] = 1$ (in limit)

  And Then: the crf = r

- If Periods are very small (days or weeks)

  $(1 + r)^N$ becomes equal to e^{rN}

Rule of Thumb Formula

To appreciate effect of discounting we can use:

"Rule of 72" or "Rule of 70"

$e^{rN} = 2.0$ when $rN \sim 0.72$ (actually = 0.693)

Thus: present amount doubles (or future amount halves), when

$rN = 72$ with r expressed in percent

Examples

➔ When would $1000 invested at 10% double?

➔ At 9%, what is the value of $1000 in 8 years?

Discussion of DCF Formulas

Formulas presented to illustrate concepts

In practice, we use computer-based spreadsheet to calculate discounting of cash flows over time.

We treat DCF Analysis as a “black box”

But you should understand the elements!

Ask if you have questions or doubts!

Present Value Analysis

Present Value Analysis puts all cash flows on a common basis, typically "the present"

➔ This may be any convenient period, such as year of proposed investment, 'Time Zero'

"Net" Present Value is the total of the present values of all future amounts

➔ Net Present Value (NPV) =
Present Revenues – Present Costs

Example Present Value Analysis

Example Spreadsheet Analysis (units/year)

Year	0	1	2	3	4	5	6	7	8	9
Investment	15			3			5			
Net Income		2	3	4	5	5	3	4	5	6
Cash Flow	-15	2	3	1	5	5	-2	4	5	6
NPV at 12%	**0.79**									

Formula: =NPV(12%, B9:K9)

***Note: formula assumes that Initial Cost paid at year end**

Effect of Different Time Horizons

Longer Periods of Benefits

➔ Increase Present Values

➔ Increment depends on discount rate

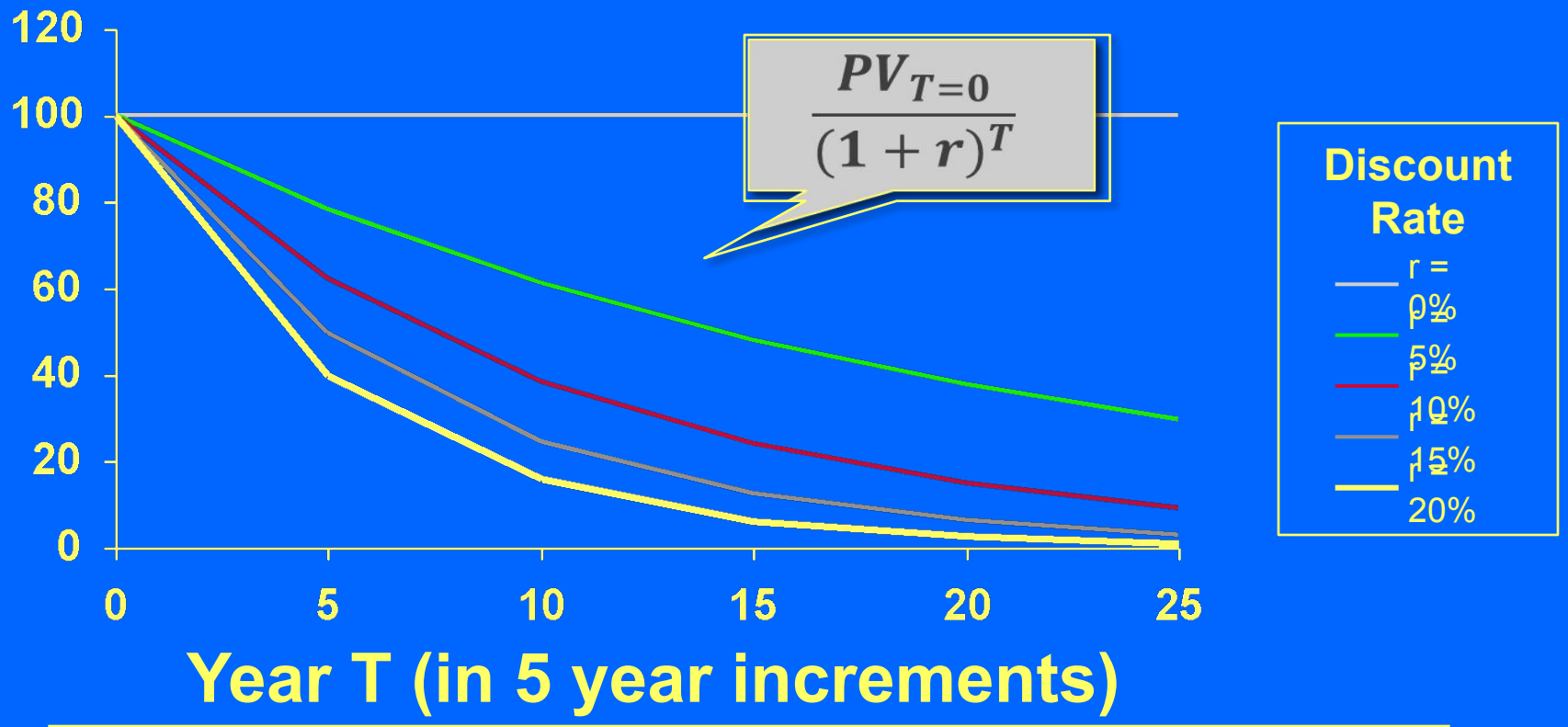
What length of time matters?

➔ For Discount Rates used in business (such as 10 to 20%), anything after 20 years has little present value

➔ EXCEPTION: If future benefits grow exponentially, they may compensate for discounting of future net benefits

Graph of Effect of Different Discount Rates and Lengths of Time

Relative Present Value (PV)



Effect of Different Discount Rates

Higher Discount rates imply

- ➔ smaller value of future benefits
- ➔ discourage projects with long pay-back times
- ➔ project advocates minimize discount rate
- ➔ Examples: long-life infrastructure projects

Discount rates in Business Practice

- ➔ Often 10% -- up to 25% for high risk projects
- ➔ What is your experience?
- ➔ Generally higher than politicians want – Why?

Takeaways on Calculations

- Formulas Simple
- Embedded in Spreadsheet commands
- These can handle any pattern of cash flow

- Discount rate is key issue
- High rates appropriate commercially
- Longer term benefits not large (unless market grows faster than discount rate)

IDS.333 Risk and Decision Analysis

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