Project Finances

- Time value of money
- Real options analysis
- Decision trees

Net Present Value Calculations

- Take into account the facts that:
  - Expenses are certain and early
  - Return is later and uncertain
    - Product may not succeed
    - Market may not be there

Risk-Free

- Inflation currently is around 3%
- Assume we're happy with a 7% return
  - 3% for inflation
  - 4% as a return on investment
  - No risk
- If we invested $1,000 today, we would expect $1,070 in a year
- What about the second year? Another $70?
- More:
  - For the second year, we have $1,070 invested, not $1,000
  - Expect a return of $1,070 x 0.07, i.e., $75 for the second year

Discount Rate Formula

So, the Future Value (FV) 2 years in the future is:

$$\underset{\text{Pres. Value}}{\$1{,}000} + \underset{\text{Interest year 1}}{\$1{,}000 \times 0.07} + \underset{\text{Interest year 2}}{(\$1{,}000 + \$1{,}000 \times 0.07) \times 0.07}$$

$$FV = PV + PV * k + (PV + PV \times k) \times k$$

$$\text{or } FV = PV * (1 + k)^2$$

So the Net Present Value (PV) of an amount FV two years in the future is

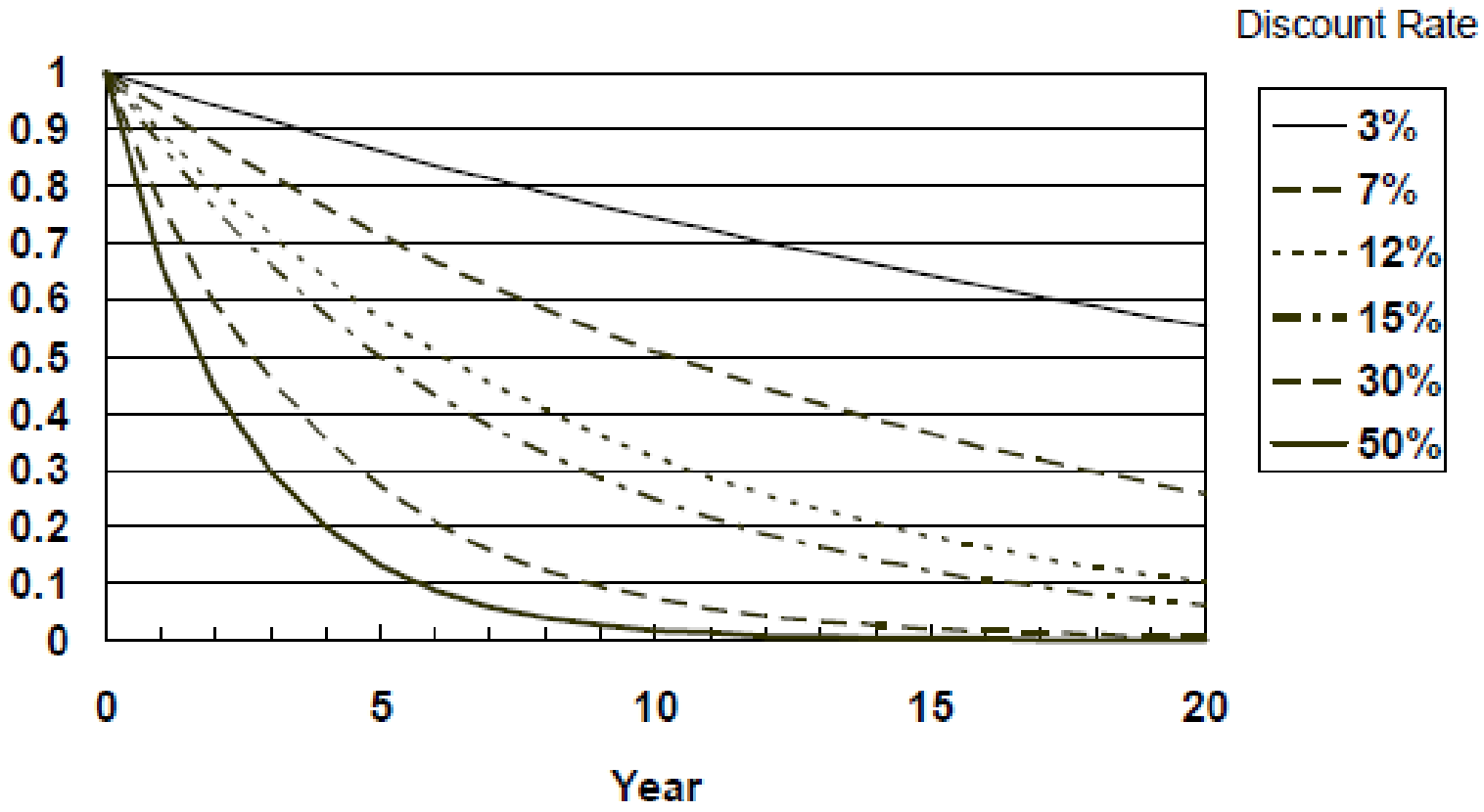
$$PV = FV / (1 + k)^2$$

- We would pay today $873.44 to get back $1,000 in two years
  - $873.44 is the Net Present Value of $1,000 in two years with a 7% discount rate

Discount Rates

Inflation Rate	3%
Long Term T Bill Rate	7%
Corporate Bond Rate	12% (Blue Chip) - 18% (Junk)
Average Corporate Cost of Capital	15%
Corporate Investment Hurdle Rate	30%
VC Investment Hurdle Rate	50%

Effect of Discount Rate Over Long Periods

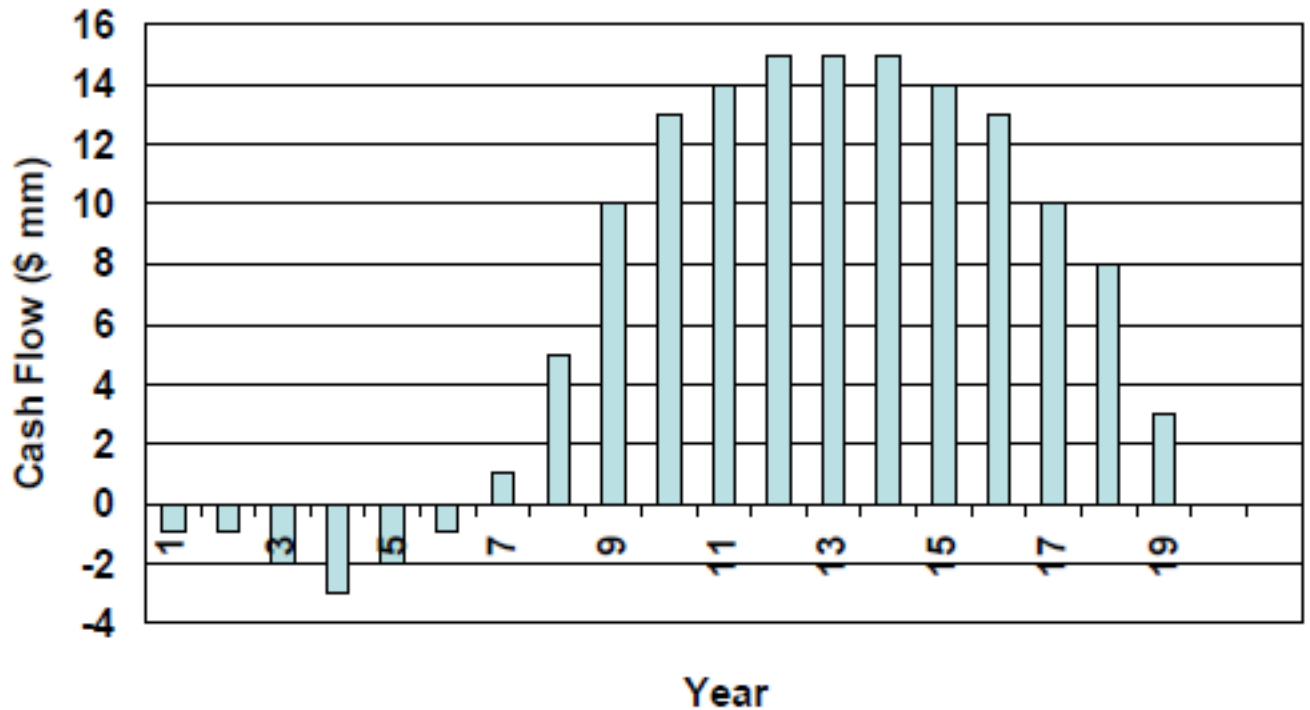


A typical project

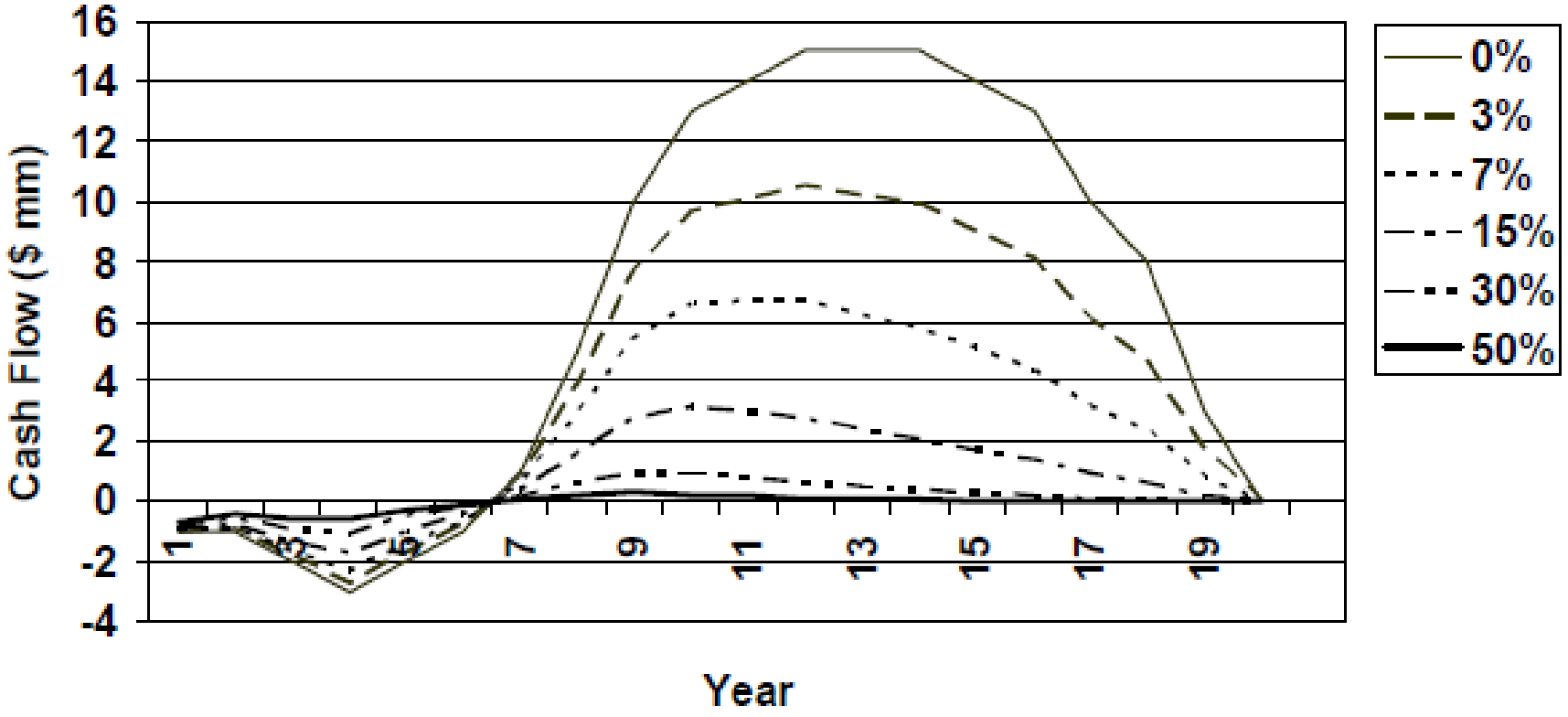
- $10 mm invested over 6 years
- Sales start in year 7
- Peak profits of $15 mm in years 12-14
- Over by year 19
- Total Net Income of $136 mm
- Net Profits exceed expenses by $126 mm

Looks like a great investment

A Typical R&D Project



How it looks at various discount rates



Is it still a good deal?

- The answer depends on the discount rate

k	Net Present Value	Payback
0%	$126.0 mm	12.6x
3%	$83.4mm	8.3x
7%	$49.0 mm	4.9x
15%	$17.3 mm	1.7x
30%	$1.6 mm	0.2x
50%	$(1.4 mm)	nm

Financial options: Black-Scholes

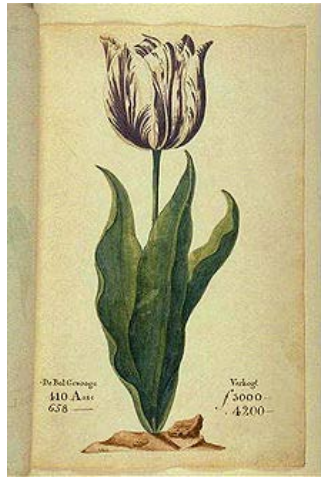
- Based on the model for financial options (rights to buy or sell stocks, bonds, etc. at a specified price) developed by Black and Scholes (1973)
- Can be applied to real options such as can occur with new products following a successful innovation and development process.
- Formulaic and complex. Amenable to tables and computer predictions. Black box.
- Assumptions: uncertain future described by log normal distribution (ok for stocks but unlikely for binary nature of risks with start-ups)

Financial Options

- Financial options involves speculative and hedging transactions on currencies, securities and commodities.
- Black-Scholes formula requires five inputs:
  - Value of underlying security
  - Strike price
  - Time period for option
  - Volatility. The annual standard deviation of the price of the security under option. (e.g. www.cboe.com)
  - Risk free rate

Real options: the application of options theory to everyday business situations

- Produce a new microcomputer model, Mark 1, requiring first-year investment of $450M.
- Run for six years and harvested in 5th and 6th years
- The NPV of cash flow is -$46M at DCF of 20%. CEO says no go!
- CFO argues there is an option of Mark 2 in 3rd year. Mark 2 is forecast to be no more profitable, but because of the high growth rate of the industry, it will be double the scale of Mark 1. That is, Mark 2 will require $900M investment in year 4 and produce double the cash flows in year 5 through 9.
- Mark 2 cash flows are worth $808M in year 4 or $468 when discounted to year 1.
- Mark 2 is a 3 year call option on an asset valued at $468M with a strike price of $900M. Black-Scholes formula values this option at $55M, assuming volatility = 0.35.
- The real value of Mark 1 is the sum of the NPV = -$46Mand the option value of Mark 2 = $55M. The positive outcome depends on high market volatility and X2 future growth rate.
- If growth rate were at internet speed, then the option value would be X5 = $275M.
- If volatility was to be 1.0, the option value would be $1,263M. Bubble!



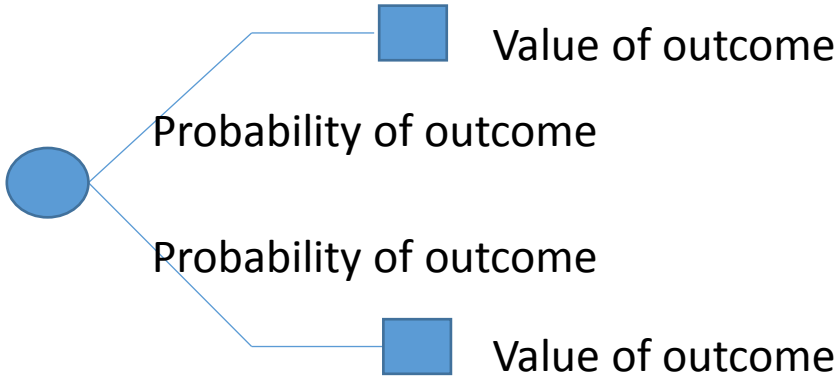
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
After-tax operating cash flow	-$200	$110	$159	$295	$185	$0
Capital investment	$250	$0	$0	$0	$0	$0
Increase in working capital	$0	$50	$100	$100	-$125	-$125
Net cash flow	-$450	$60	$59	$195	$310	$125

Decision Trees

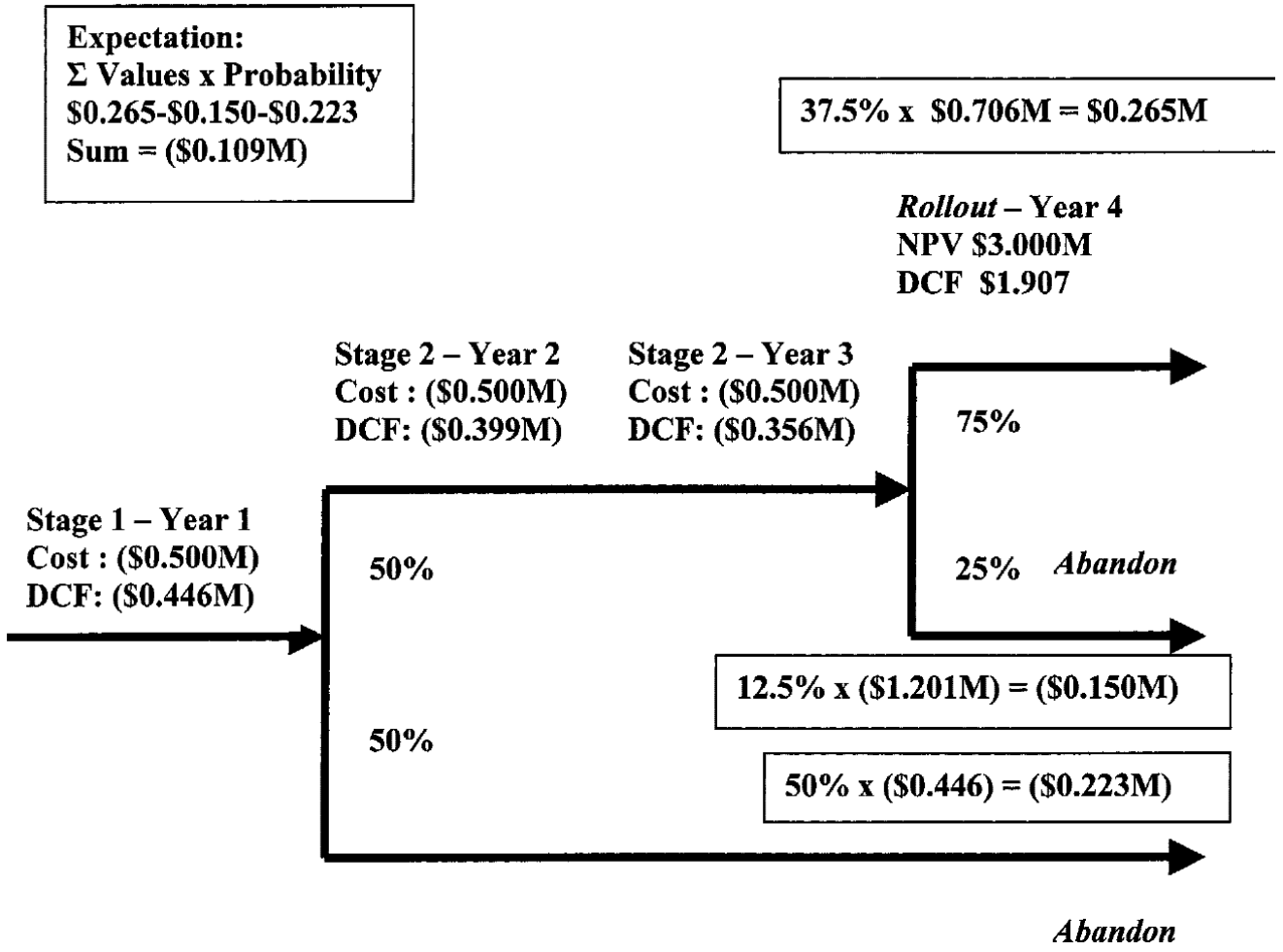
- Payment for the right to obtain more information in order to make a more informed decision in the future
- Requires defining the various specific uncertainties, developing alternatives and having flexibility to execute the appropriate alternative
- Suitable for stage-gate processes where additional investments are made as the project progresses

Decision trees

- Generally binomial
- Acknowledges scenario planning/flexibilty
- Visible and understandable



Project outcomes by DCF/Decision Tree



DCF/Decision Tree

- R&D: 2 stages:
  - Laboratory feasibility study of 1 yr, $0.5M (NPV at 12%= -$0.446), 50% chance
  - Feasibility study of 2 yrs, $1M (NPV at 12%= -$0.701M), 75% chance
  - Total NPV of costs at 12%= -$1.201M
- Commercialisation: Cost $5M, estimated value $8M. Payback= $3M (NPV at 12%= $1.907). NPV of payback after costs = $0.706M
- Three possible outcomes:
  - 50% chance of failure after feasibility, 50% x -$0.446M= -$0.223M
  - 12.5% chance of failure after field test, 12%x -$1.201M= -$0.150M
  - 37.5% chance of success, 37.5%x $0.706M= $0.265M
- Expectation is sum of possibilities: $0.265M-$0.223M-$0.150M= -$0.109M
- Therefore because of high development costs, high unique risks and time cost of capital, the project has negative value.
- Without the cost of capital, the value would have been positive at $0.125M
- Without the option to abandon, the project would have been worse. For example, signing a fixed contract for R&D would have returned 37.5% of $1.907M= $0.715M versus a cost of $1.201M and an expected loss of $0.486M

Combining Decision Tree with Real Options

- Market risk means the planners don't know the prices and costs that will affect the business in the future, but assume they will be subject to factors that have affected the industry in the past.
- Real Options add a perspective of market uncertainty which increases the potential value.
- Two additional parameters are required for options analysis:
  - Risk free rate
  - Volatility
- Real Options have the most impact for marginal projects, particularly if they have slightly negative values after just decision tree analysis.
- How close to the bone do you want to run your programme?