Closing the Business Case

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The top 5 investor questions

- How much will I need to invest?
- How much will I get back?
- When will I get my money back?
- How much is this going to cost me?
- How are you handling risk & uncertainty?

Investment criteria

- Net present value
- Payback
- Discounted payback
- Average return on book value
- Internal rate of return

Net present value (NPV)

- Measure of present value of various cash flows in different periods in the future
- Cash flow in any given period discounted by the value of a dollar today at that point in the future
  - “Time is money”
  - A dollar tomorrow is worth less today since if properly invested, a dollar today would be worth more tomorrow
- Rate at which future cash flows are discounted is determined by the “discount rate” or “hurdle rate”
  - Discount rate is equal to the amount of interest the investor could earn in a single time period (usually a year) if he/she were to invest in a “safer” investment

Calculating NPV

- Forecast the cash flows of the project over Its economic life
  - Treat investments as negative cash flow
- Determine the appropriate opportunity cost of capital
- Use opportunity cost of capital to discount the future cash flow of the project
- Sum the discounted cash flows to get the net present value (NPV)

$$NPV = C_0 + \frac{C_1}{1+r} + \frac{C_2}{(1+r)^2} + \ldots + \frac{C_T}{(1+r)^T}$$

NPV example

Period	Discount Factor	Cash Flow	Present Value
0	1	-150,000	-150,000
1	0.935	-100,000	-93,500
2	0.873	+300000	+261,000
Discount rate = 7%		NPV =	$18,400

Points to keep in mind about NPV

- Assumes only one course of action:
  - Reasonable assumption if conditions are stable
  - No room for managerial flexibility
- Choice of the discount rate is difficult:
  - Typically, use a combination of equilibrium models (like CAPM) and “expert judgment”
  - Should always perform sensitivity analysis on discount rate!

Payback

- Investment decision based on “time it takes to recover investment”
- No discounting of cash flows
- Gives equal weight to cash flows before cut-off date & no weight to cash flows after cut-off date
- Cannot distinguish between projects with different NPV
- Difficult to decide on appropriate cut-off date

Payback example

Project	C_0	C_1	C_2	C_3	NPV @ 10%	Payback
A	-2,000	+1,000	+1,000	+5,000	3,492	2
B	-2,000	0	+2000	+5,000	3,409	2
C	-2,000	+1,000	+1,000	+100,000	74,867	2

Discounted payback

- Payback criterion modified to account for the time value of money
  - Cash flows before cut-off date are discounted
- Surmounts objection that equal weight is given to all flows before cut-off date
- Cash flows after cut-off date still not given any weight

Average return on book value

- Investment decision based on book rate of return of project relative to book rate of return of entire firm (or some external yardstick)
- Book rate of return given by dividing the average forecasted profits (after depreciation & taxes) by the average book value of the investment
- Average return on book value depends on accounting income (different from cash flow)
- Decision of yardstick is arbitrary

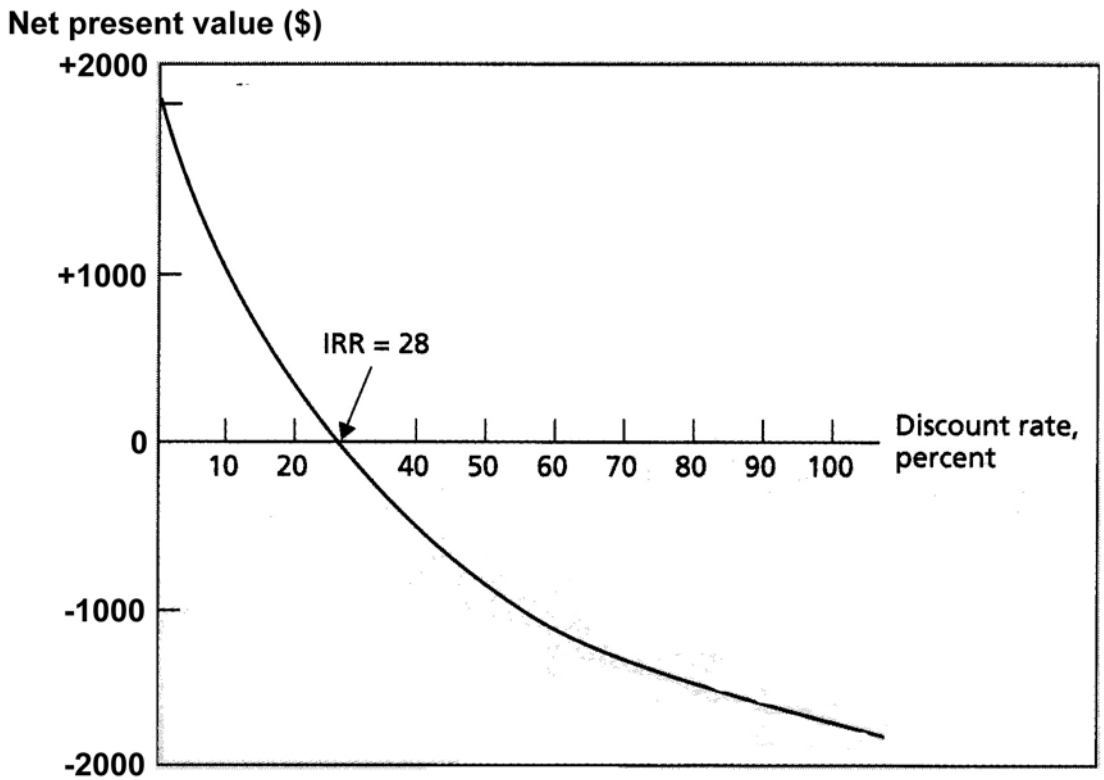
Internal rate of return (IRR)

- Investment criterion is “rate of return must be greater than the opportunity cost of capital”
- Internal rate of return is equal to the discount rate for which the NPV is equal to zero

$$NPV = C_0 + \frac{C_1}{1+IRR} + \frac{C_2}{(1+IRR)^2} + \ldots + \frac{C_T}{(1+IRR)^T} = 0$$

- IRR solution is not unique
  - Multiple rates of return for same project
- IRR doesn’t always correlate with NPV
  - NPV does not always decrease as discount rate increases

IRR example


Net present value ($)
+2000
+1000
0
-1000
-2000
IRR = 28
10
20
40
50
60
70
80
90
100
Discount rate, percent

Dealing with risk & uncertainty

- Artificially high hurdle rate
- Bracketing (upper & lower bounds)
- Probabilistic analysis
- Decision tree analysis

Artificially high hurdle rate

- Simplistic
- Doesn’t fully capture range of possibilities
- Not well suited for products with relatively small margins such as aircraft
- Better suited for products with relatively large margins or projects that require small capital outlays

Bracketing

- Better that using a high hurdle rate
- Gives indication of variability in financial performance
- Highly unlikely that all the factors or issues will be all good or all bad at the same time
- Can over estimate “best” and “worst” case outcomes
- Best used for analysis with few factors

Probabilistic analysis

- Essentially a Monte-Carlo simulation of NPV
- Repetitive NPV analyses using input values selected from probability distributions
- Can become very complex for products with many components & factors
- Requires many assumptions & good understanding of development & manufacturing/production processes

Decision tree analysis

- NPV calculation that incorporates different future scenarios based on the likely hood of that scenario occurring
- Cash flow for any given year is the weighted sum of the cash flows for each scenario that could occur in that year
- Weightings are equal to the probability that a specific scenario will occur

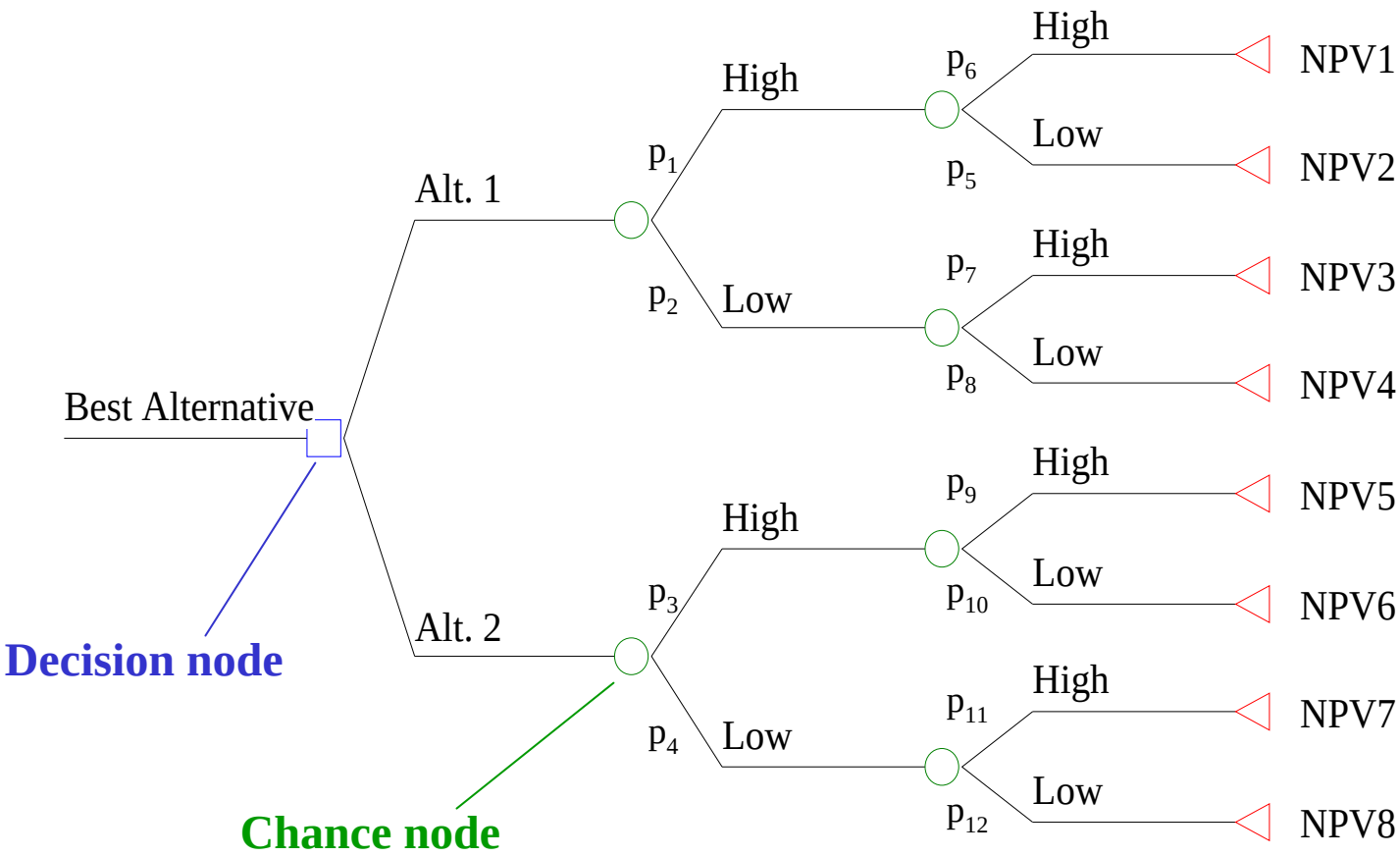
Decision tree example

Period	Option	Prob.	Cash Flow	PV	Prob. * PV
0	Both	100%	-150,000	-150,000	-150,000
1	A	50%	+50,000	+46,750	+23,375
	B	50%	+100000	+93,500	+46,750
2	A	50%	+50,000	+43,650	+22,825
	B	50%	+200,000	+174,600	+87,300
Discount rate = 7%			NPV =		$30,250

Decision tree analysis

- Widely used technique to determine value of investments under uncertainty
- Main steps:
  - Determine possible states of nature
  - Determine probability of reaching each state (use conditional probabilities)
  - Determine NPV for each end state (use constant discount rate)

Decision tree



Solving the tree

- Move along the tree from end to the front
- NPV for any state (except for end states) is the weighted sum of the NPV of following state
- Weightings are the probabilities of reaching such states

Points about decision analysis

- Difficult to apply when multiple sources of uncertainty are present
- Does not resolve problem of choice of discount rate

Possible analysis approaches

- Bottom-up analysis
- Top-down analysis

Bottom-up analysis

- Determine costs and timing (profile of expenditure versus time) for each phase of cargo system development and production based on heuristics or first principles analysis
- Determine market penetration (profile of cargo system revenue versus time) based on heuristics or first principles analysis
- Determine uncertainty in all values
- Determine NPV and variability in NPV

Top-down analysis

- Determine market penetration (profile of cargo system revenue versus time) based on heuristics or first principles analysis
- Scale existing profile of expenditure versus time for development and production of a closely related system
- Determine costs for which NPV equals zero
- Determine uncertainty in market penetration
- Determine uncertainty in costs

Managing risk

- Hedge investment
  - Buy portfolio that is not correlated with the market for the product you are developing
- Limit impact of factors outside your control
  - Insure against detrimental actions or inaction of partners, or catastrophic events
- Change the playing field
  - Influence market to either make it more stable overall or more favorable to your product

Managing risk

- Build in flexibility
  - Create ability to respond to changes in product requirements space and market
- Plan staged development and introduction
  - Develop strategy to evaluate product utility and market situation before full investment is made

Summary

- Investment criteria
  - NPV
- Risk & uncertainty
  - Bracketing (if there are only a few key factors)
  - Probabilistic analysis (if details of processes available)
  - Decision tree analysis (is there are clear investment options)
- Analysis approaches
  - Bottom-up analysis (if details of processes available)
  - Top-down analysis (if details of processes not available)
- Manage your risks