Capital Budgeting

Cash Flow Analysis

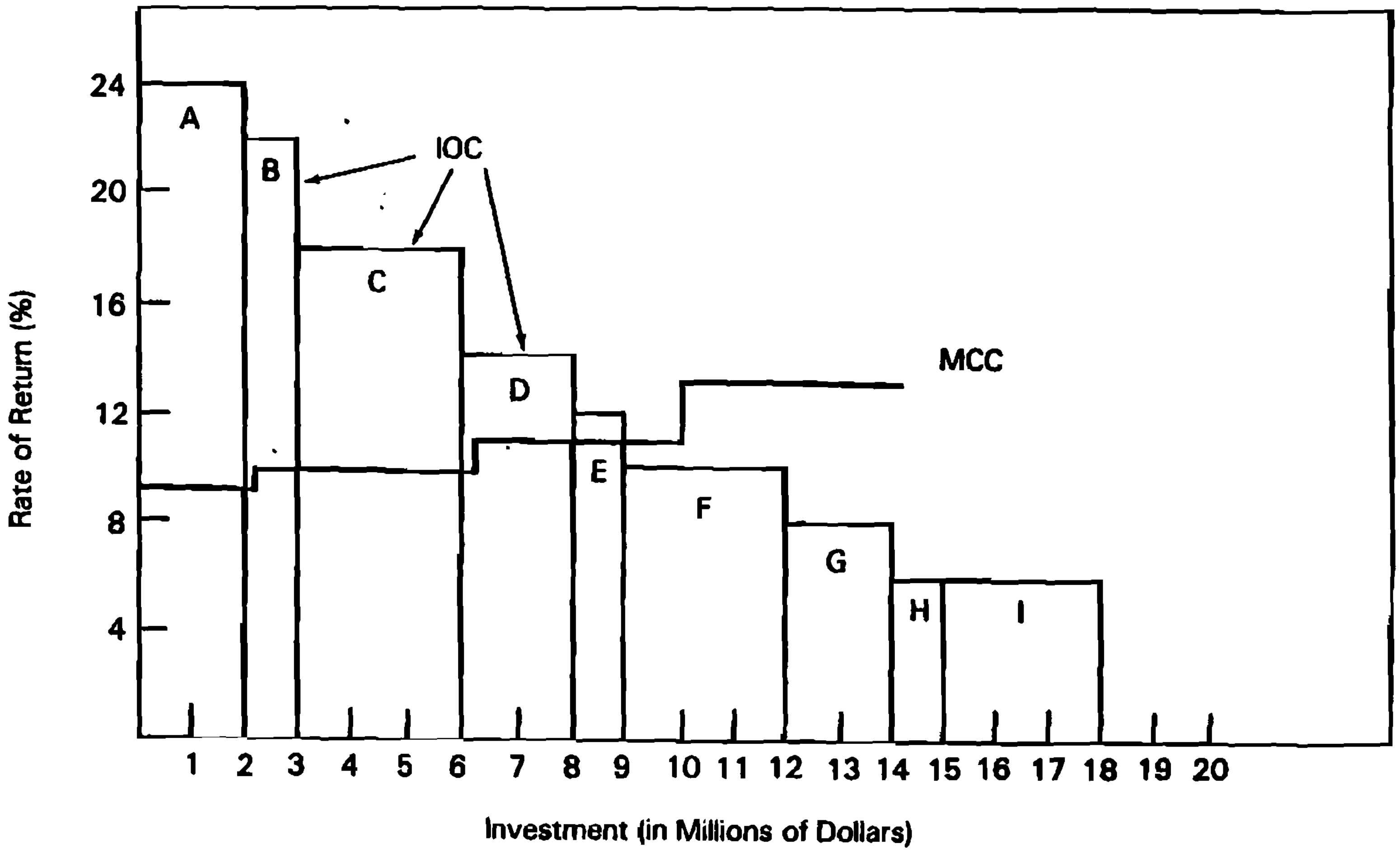
Capital Budgeting: Process of planning for acquisition of fixed assets.

Cost of Capital: cost of funds supplied to the firm, or the minimum required rate of return on invested funds.

Classification of Projects:

1. Independent: acceptance not directly related to other projects
2. Mutually Exclusive: acceptance rules out another project.
3. Contingent: acceptance is dependent on another project's adoption.

MCC: Cost of the next increment of capital acquired by the firm.



Simplified Capital Budgeting Model

Guidelines for estimating Cash Flows (CF's):

1. CF's should be measured on an <u>incremental</u> basis, i.e., CF if the project is adopted minus CF if project is not adopted.
2. CF's should be measured on an after-tax basis.
3. CF's must include all indirect effects, as changes in working capital or decreased revenues from other products.
4. Sunk costs should <u>not</u> be considered.
5. Resource values should be based on their opportunity costs, i.e., the value of their next best use.
6. Interest should <u>not</u> be considered as a cash flow.
   → and cash dividends

Types of Cash Flows:

1. NINV Time 0
2. NCF Time 1, 2,......

NINV

1. Cost + installation + shipping
2. Increase (+) or decrease (-) in working capital
3. Proceeds from sale of existing asset
4. Taxes on new or old asset

Taxes

SP = Selling price (market value)
BV = Book value
OC = Original cost
t_n = Normal marginal tax rate
t_c = Capital gains marginal tax rate

1. SP = BV $\Rightarrow$ no tax consequences
2. SP < BV $\Rightarrow$ tax decrease
   $= t_n (BV - SP)$
3. OC > SP > BV $\Rightarrow$ tax increase
   $= t_n (SP - BV)$
4. SP > OC $\Rightarrow$ tax increase
   $= t_n (OC - BV) + t_c (SP - OC)$

<u>NCF</u> (incremental after tax) net cash flows

ΔR = Revenues if the firm adopts the project minus revenues if it does not adopt.

ΔO = Cash Operating Costs if the firm adopts minus those if it does not adopt.

ΔD = Non Cash Depreciation charges with the project minus those without the project.

t = firm's marginal tax rate

$$NCF = (\Delta R - \Delta O - \Delta D)(1-t) + \Delta D$$

Metro Imaging Labs, Inc. Capital Budgeting Example

CAPITAL BUDGETING REPLACEMENT DECISION: CASH FLOWS

Net Investment: MetroLabsCapBudg.xls

Metro Imaging Labs, Inc. provides imaging and lab testing services for the medical community. They are considering replacing some automated test equipment which was purchased several years ago. The test equipment which was purchased for $600,000 currently has a book value of $250,000. The new, more efficient test equipment will cost $1,000,000 and will require an additional $50,000 for delivery and installation. The new test equipment will also require the firm to increase its investment in working capital by $10,000. The new test equipment will be depreciated in accordance with the 5-year MACRS schedule.The company expects to sell the old test equipment for $300,000 and is in the 40% marginal tax rate (federal + state + local). Determine the firm's net investment in the new test equipment.

SOLUTION:

Step 1:	1,000,000	asset cost
	50,000	delivery and installation
Step 2:	10,000	increase in working capital
Step 3:	-300,000	proceeds from the sale of old asset
Step 4:	20,000	tax on gain from old asset sale[1]
	780,000	**Net Investment**

1.

300,000	sale price		50,000	gain on sale
250,000	book value		40%	ordinary tax rate
50,000	gain on sale		**20,000**	tax on gain

Net Cash Flows:

If Metro purchases the new test equipment, revenues are expected to increase by $200,000 (due to increased capacity) and cash operating expenses are expected to decrease by $20,000. After five years the test equipment is expected to be sold for $70,000. Assume that the original test equipment was depreciated $50,000 per year. Compute the project's net cash flows.

SOLUTION:

Depreciable base = installed cost = 1,050,000

Depreciation Schedule:

Year	Depreciation Rate	Depreciation Amount	Year End Book Value
1	20.00%	210,000	840,000
2	32.00%	336,000	504,000
3	19.20%	201,600	302,400
4	11.52%	120,960	181,440
5	11.52%	120,960	60,480
6	5.76%	60,480	0
	100.00%	1,050,000	

Aftertax Salvage Value of New Equipment (ATSV):

At the end of its economic life the new equipment will be sold for more than its book value resulting in the recapture of depreciation.

Book value in year 5	60,480	
Salvage value (SV)	70,000	
Overdepreciation	9,520	
Tax rate (T)	40%	
Tax increase (Tax)	3,808	
ATSV	**66,192**	<-- SV - Tax

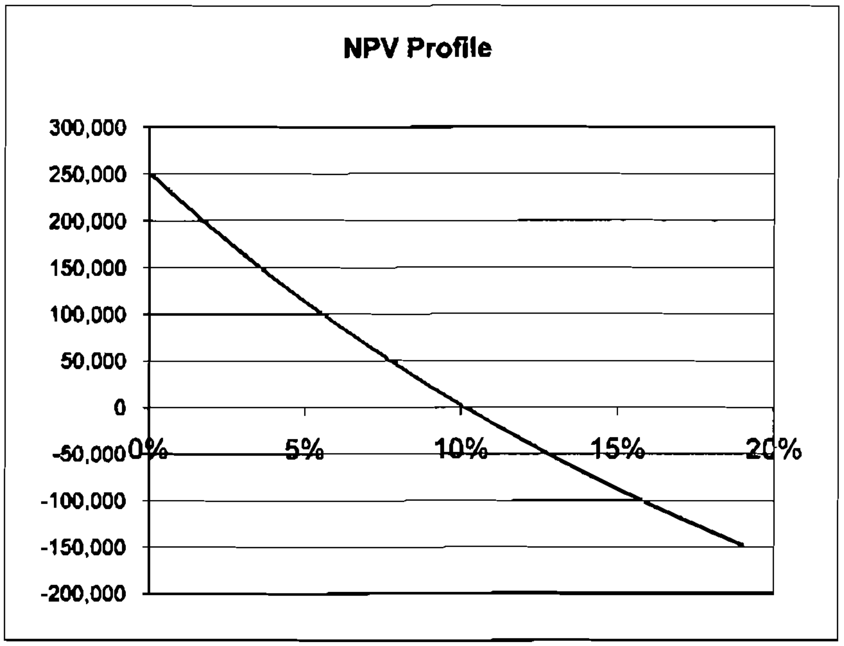
Incremental Operating Cash Flows (OCF's):

Year	Incremental Revenues (R)	Incremental Operating Costs (O)	New Depreciation	Old Depreciation	Incremental Depreciation (D)	OCF = (R-O-D) (1-T) + D
1	200,000	-20,000	210,000	50,000	160,000	**196,000**
2	200,000	-20,000	336,000	50,000	286,000	**246,400**
3	200,000	-20,000	201,600	50,000	151,600	**192,640**
4	200,000	-20,000	120,960	50,000	70,960	**160,384**
5	200,000	-20,000	120,960	50,000	70,960	**160,384**

Net Cash Flows (NCF's): Opportunity Cost of Capital = **10%**

Year	ATSV	WC Return	OCF	NCF	Discount factor	PV (NCF)
0	negative of initial investment -->			**-780,000**	1.0000	-780,000
1			196,000	**196,000**	0.9091	178,182
2			246,400	**246,400**	0.8264	203,636
3			192,640	**192,640**	0.7513	144,733
4			160,384	**160,384**	0.6830	109,544
5	66,192	10,000	160,384	**236,576**	0.6209	146,895
					NPV	**2,991**
					IRR	**10.15%**

Discount Rate	2,991
0%	252,000
1%	221,799
2%	192,962
3%	165,411
4%	139,074
5%	113,880
6%	89,768
7%	66,676
8%	44,550
9%	23,338
10%	2,991
11%	-16,537
12%	-35,288
13%	-53,302
14%	-70,616
15%	-87,267
16%	-103,287
17%	-118,707
18%	-133,557
19%	-147,864



Net Cash Flows are incremental (Δ) :
CF WITH project minus CF WITHOUT project

$$NPV = \sum_{t=0,n} \frac{NCF(t)}{(1 + k)^t}$$

Cost of capital for avg risk project:
accounts for interest/related taxes & dividends

Cash flows NOT in NPV: Proceeds from purchase or sale of securities

$$NCF(t) = OCF(t) + NOCF(t) - WC + OC\&E(t)$$

- OCF(t): $(\Delta R - \Delta O)(1 - T) + \Delta D\, T$
- NOCF(t): Asset purchases & sales + related taxes
- WC: $\Delta CA - \Delta CL$
- OC&E(t): Opportunity Costs & Externalities

Adjusting for Risk in Capital Budgeting

The more risky or uncertain the cash flows of an investment opportunity the less desirable is that project. There are several techniques to explicitly account for differential project risk in capital budgeting:

1. Subjective or Informal Approach

- Use judgment and common sense.
- Penalize for high risk; reward for low risk.
- In practice the most critical part of the capital budgeting analysis is usually the estimation of the elements that determine the project's net cash flows. Of these, cash flow related to sales is often the most critical estimate for an expansion project.

2. NPV/Payback (PB)

- Project must satisfy <u>both</u>:

  $NPV \geq 0$

  $PB \leq$ Standard

3. Risk-adjusted Discount Rate (RADR)
When projects are not of "average" risk (relative to other projects undertaken by that particular firm) the required rate of return on the project, called the RADR, will not equal the firm's MCC or WACC (Weighted Average Cost of Capital).

- RADR represents the correct and appropriate cost of capital for the particular project and explicitly considers that its risk may differ from other investments.

- **The project's RADR is the appropriate discount rate for calculating (risk adjusted) NPV and for comparing to the project's IRR.**

- In general, higher than average risk cash inflows should be discounted at a RADR above the MCC and lower than average risk cash inflows should be discounted at a RADR below the MCC. Thus, in calculating present value, the more risky or uncertain the cash inflow the smaller the present value and the bigger the risk "penalty". Note that cash ***outflows*** that are more risky than average must be penalized by discounting at a RADR ***less*** than the MCC.

- Methods of estimating RADR
  a. Subjective
  b. Risk-class

Category	Project Description	RADR	Example
No Risk	Riskless securities	R_f	5%
Low Risk	Leases, replacements, secured investments, etc.	$(R_f + MCC)/2$	10%
Average Risk	"Typical" projects	MCC	15%
High Risk	New ventures for firm	MCC +	24%
Very Risky	New ventures for market	MCC + +	36%

  c. SML: determine RADR the same way a "fair" rate of return for common stock is determined:

$$RADR = R_f + \beta\,(R_m - R_f)$$

Where β measures the project's systematic risk.

4. Hurdle Rate

- Accept project if IRR > Hurdle Rate

- In practice many firms set a "hurdle rate" well above the project's true RADR to compensate for optimistic biases in project cash flow estimates and to challenge managers to achieve better results.

- These biases occur because of managerial optimism and/or personal preferences for the project and result in an upward bias in the estimate of the project's expected (true) IRR.

5. Certainty Equivalent NPV

α_t = Certainty Equivalent Factor for period $_t$

$$= \frac{Value\ of\ a\ "Certain"\ return\ in\ t}{Value\ of\ a\ "Risky"\ return\ in\ t}$$

Where: $1 \geq \alpha_o \geq \alpha_1 \geq \alpha_2 .... \geq \alpha_t \geq 0$

$$\text{Certainty Equivalent NPV} = \text{-NINV}\ (\alpha_o) + \sum_{t=1}^{n} \frac{NCF_t(\alpha_t)}{(1+R_f)^t}$$

- Certainty Equivalent NPV and Risk Adjusted NPV are both valid and "correct" methods and conceptually should yield the same results.

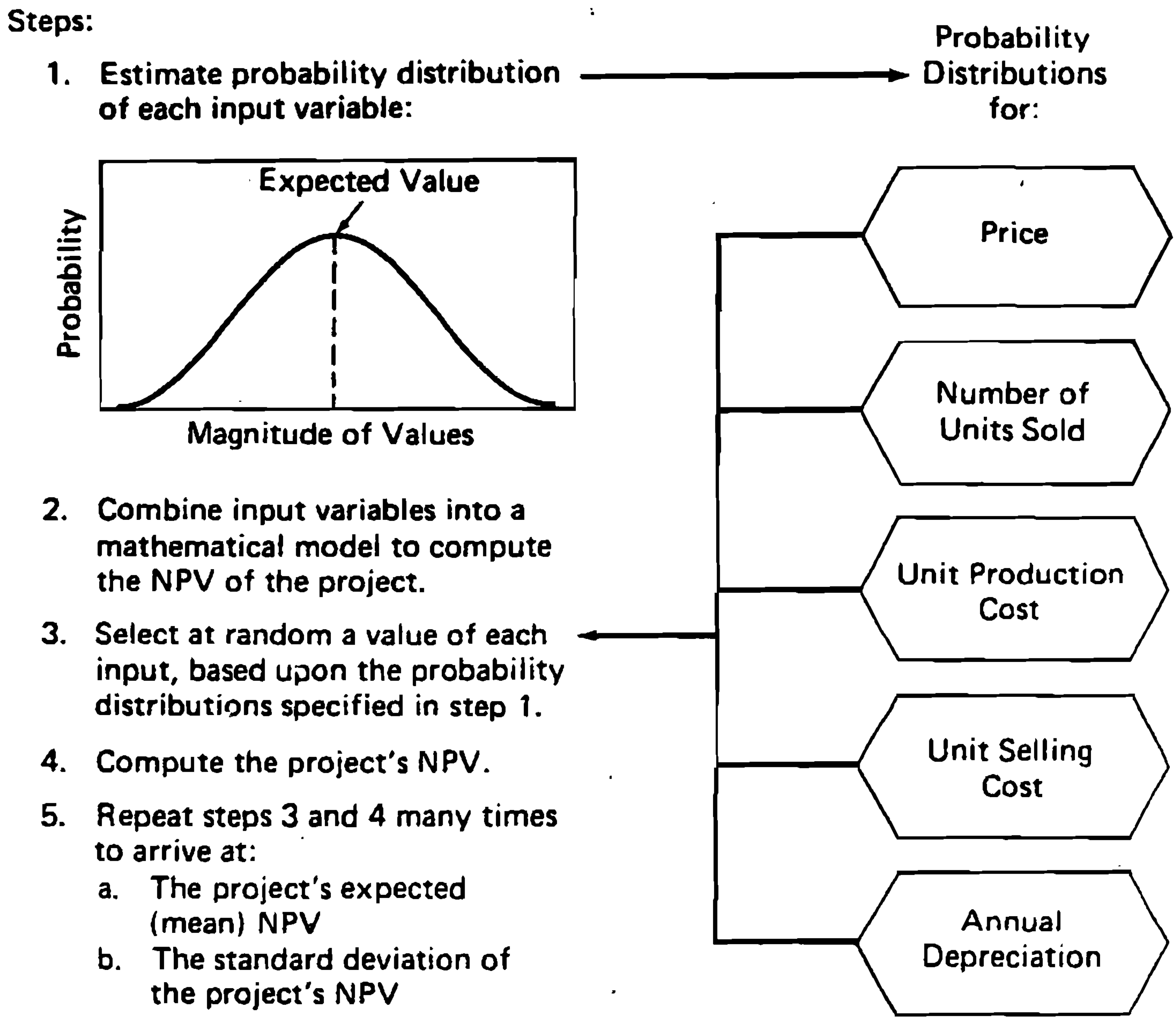
6. Sensitivity Analysis

- Change one input variable at a time and observe the impact on NPV

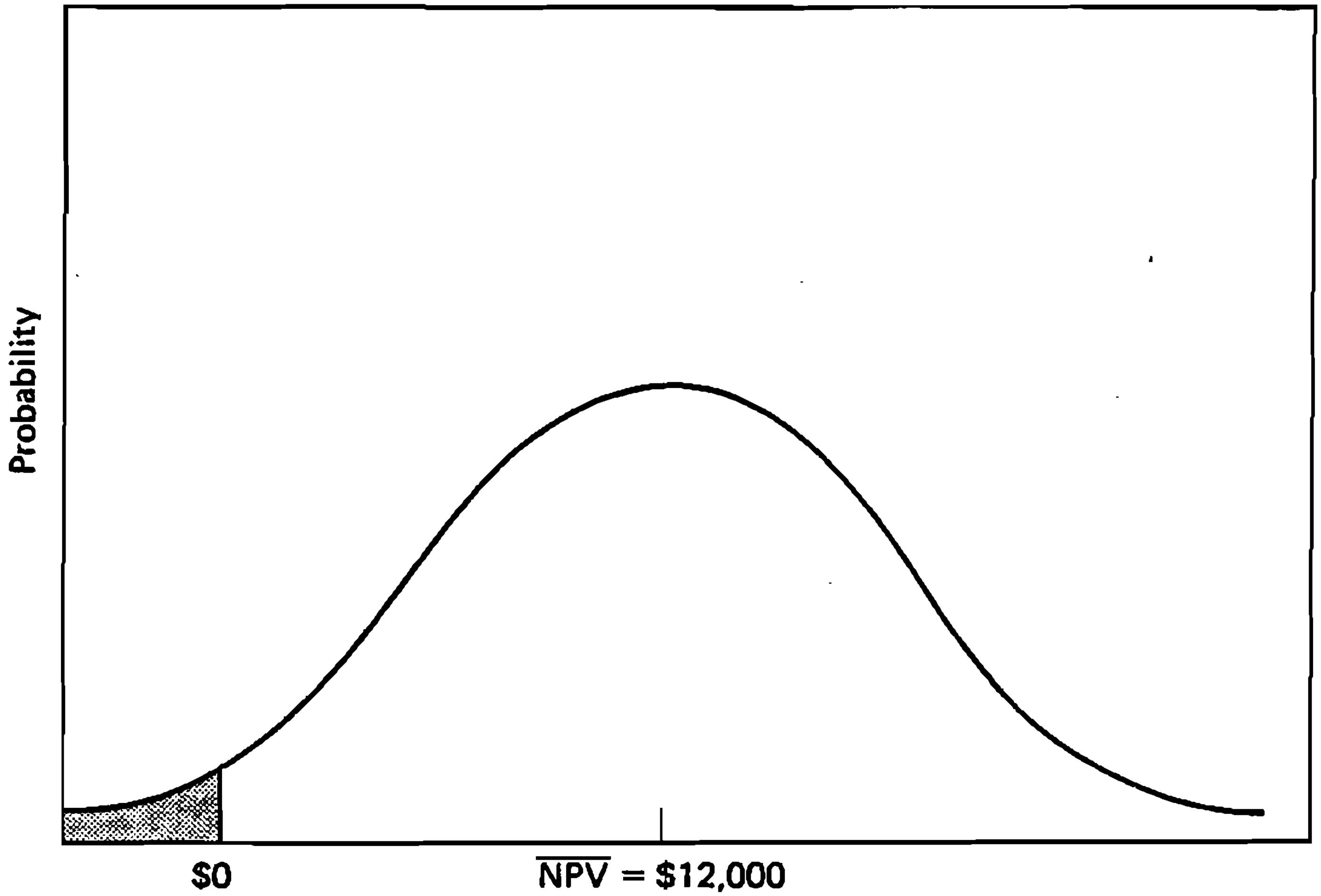
- For each input variable select a "high" and a "low" value to represent a reasonable range for the outcome

- For input variables which have a significant impact on NPV consider investing more resources to get a better estimate of that variable. For example, if forecasted sales has a big impact on NPV you may wish to spend some money test marketing a product to get a more realistic forecast.

7. Simulation Approach



An Illustration of the Simulation Approach



σ = $6,000

$$z = \frac{\$0 - \$12{,}000}{\$6{,}000} = -2.0 \text{ below the mean}$$

A Sample Illustration of the Probability that a Project's Returns will be Less than $0