Chapter 7

Uncertainty and Project Evaluation

Chapter Outline

7.1 Sensitivity Analysis, Scenario Analysis, and Break-Even Analysis

7.2 Monte Carlo Simulation

7.1 Sensitivity, Scenario, and Break-Even

- Each allows us to look behind the NPV number to see how stable our estimates are.
- When working with spreadsheets, try to build your model so that you can adjust variables in a single cell and have the NPV calculations update accordingly.

NPV Following Successful Test

Investment	Year 1	Years 2-5
Revenues		$7,000
Variable Costs		(3,000)
Fixed Costs		(1,800)
Depreciation		(400)
Pretax profit		$1,800
Tax (34%)		(612)
Net Profit		$1,188
Cash Flow	-$1,600	$1,588

$$NPV_1 = -\$1{,}600 + \sum_{t=1}^{4} \frac{\$1{,}588}{(1.10)^t}$$

$$NPV_1 = \$3{,}433.75$$

NPV Following Unsuccessful Test

Investment	Year 1	Years 2-5
Revenues		$6,000
Variable Costs		(3,000)
Fixed Costs		(1,800)
Depreciation		(400)
Pretax profit		$800
Tax (34%)		(272)
Net Profit		$528
Cash Flow	-$1,600	$928

NPV = 1,342

Sensitivity Analysis: Stewart

- We can see that NPV is very sensitive to changes in revenues. In the Stewart Pharmaceuticals example, a 14% drop in revenue leads to a 61% drop in NPV.

$$\%\Delta\text{Rev} = \frac{\$6{,}000 - \$7{,}000}{\$7{,}000} = -14.29\%$$

(1342-3434)/3434 = 61%

For every 1% drop in revenue, we can expect roughly a 4.26% drop in NPV:

61/14.29 = 4.26%

Scenario Analysis: Stewart

- A variation on sensitivity analysis is scenario analysis.
- For example, the following three scenarios could apply to Stewart Pharmaceuticals:
  1. The next few years each have heavy cold seasons, and sales exceed expectations, but labor costs skyrocket.
  2. The next few years are normal, and sales meet expectations.
  3. The next few years each have lighter than normal cold seasons, so sales fail to meet expectations.
- Other scenarios could apply to FDA approval.
- For each scenario, calculate the NPV.

Break-Even Analysis

- Common tool for analyzing the relationship between sales volume and profitability
- There are three common break-even measures
  - Accounting break-even: sales volume at which net income = 0
  - Cash break-even: sales volume at which operating cash flow = 0
  - Financial break-even: sales volume at which net present value = 0

7.2 Monte Carlo Simulation

- Monte Carlo simulation is a further attempt to model real-world uncertainty.
- This approach takes its name from the famous European casino, because it analyzes projects the way one might evaluate gambling strategies.

Monte Carlo Simulation

- Imagine a serious blackjack player who wants to know if she should take the third card whenever her first two cards total sixteen.
  - She could play thousands of hands for real money to find out.
  - This could be hazardous to her wealth.
  - Or, she could play thousands of practice hands.
- Monte Carlo simulation of capital budgeting projects is in this spirit.

Monte Carlo Simulation

- Step 1: Specify the Basic Model
- Step 2: Specify a Distribution for Each Variable in the Model
- Step 3: The Computer Draws One Outcome
- Step 4: Repeat the Procedure
- Step 5: Calculate NPV