Week 7 Lecture Notes

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

7.2 Monte Carlo Simulation

8.1 Bond Valuation

8.2 Government and Corporate Bonds

8.3 Bond Markets

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.

Example: Stewart Pharmaceuticals

- Stewart Pharmaceuticals Corporation is considering investing in the development of a drug that cures the common cold.
- A corporate planning group, including representatives from production, marketing, and engineering, has recommended that the firm go ahead with the test and development phase.
- This preliminary phase will last one year and cost $1 billion. Furthermore, the group believes that there is a 60% chance that tests will prove successful.
- If the initial tests are *successful*, Stewart Pharmaceuticals can go ahead with full-scale production. This investment phase will cost $1.6 billion. Production will occur over the following 4 years.

NPV Following Successful Test

Note that the *NPV* is calculated as of date 1, the date at which the investment of $1,600 million is made. Later we bring this number back to date 0. Assume a cost of capital of 10%.

	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

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

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

Sensitivity to Revenue Changes

Note that the *NPV* is calculated as of date 1, the date at which the investment of $1,600 million is made. Later we bring this number back to date 0. Assume a cost of capital of 10%.

	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

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

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

Sensitivity Analysis

- 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.

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

$$\%\Delta NPV = \frac{\$1{,}341.64 - \$3{,}433.75}{\$3{,}433.75} = -60.93\%$$

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

$$-4.26 = \frac{-60.93\%}{14.29\%}$$

Scenario Analysis

NPV Following Unsuccessful Test

	Year 1	Years 2-5
Revenues		$4,050
Variable Costs		(1,735)
Fixed Costs		(1,800)
Depreciation		(400)
Pretax profit		$115
Tax (34%)		(39.10)
Net Profit		$75.90
Cash Flow	-$1,600	$475.90

$$NPV_1 = -\$1{,}600 + \sum_{t=1}^{4} \frac{\$475.90}{(1.10)^t}$$

$$NPV_1 = -\$91.461$$

60% successful, 40% unsuccessful

Expected NVP = -1,000 + [60% 3,433.75 + 40% (-91.46)] /1.1

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

- Monte Carlo simulation of capital budgeting projects is often viewed as a step beyond either sensitivity analysis or scenario analysis.
- Interactions between the variables are explicitly specified in Monte Carlo simulation; so, at least theoretically, this methodology provides a more complete analysis.
- While the pharmaceutical industry has pioneered applications of this methodology, its use in other industries is far from widespread.

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

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

Break-Even Analysis:

Break-Even Analysis:

Break-Even Analysis:

Onlinepoll

111S20Q23
pw: EAC

Break-Even Analysis:

Break-Even Analysis:

Break-Even Analysis:

Break-Even Analysis:

Break-Even Analysis:

BOND VALUATION

BOND VALUATION

BOND VALUATION

BOND VALUATION

BOND VALUATION

BOND VALUATION

BOND VALUATION