

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.

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

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

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

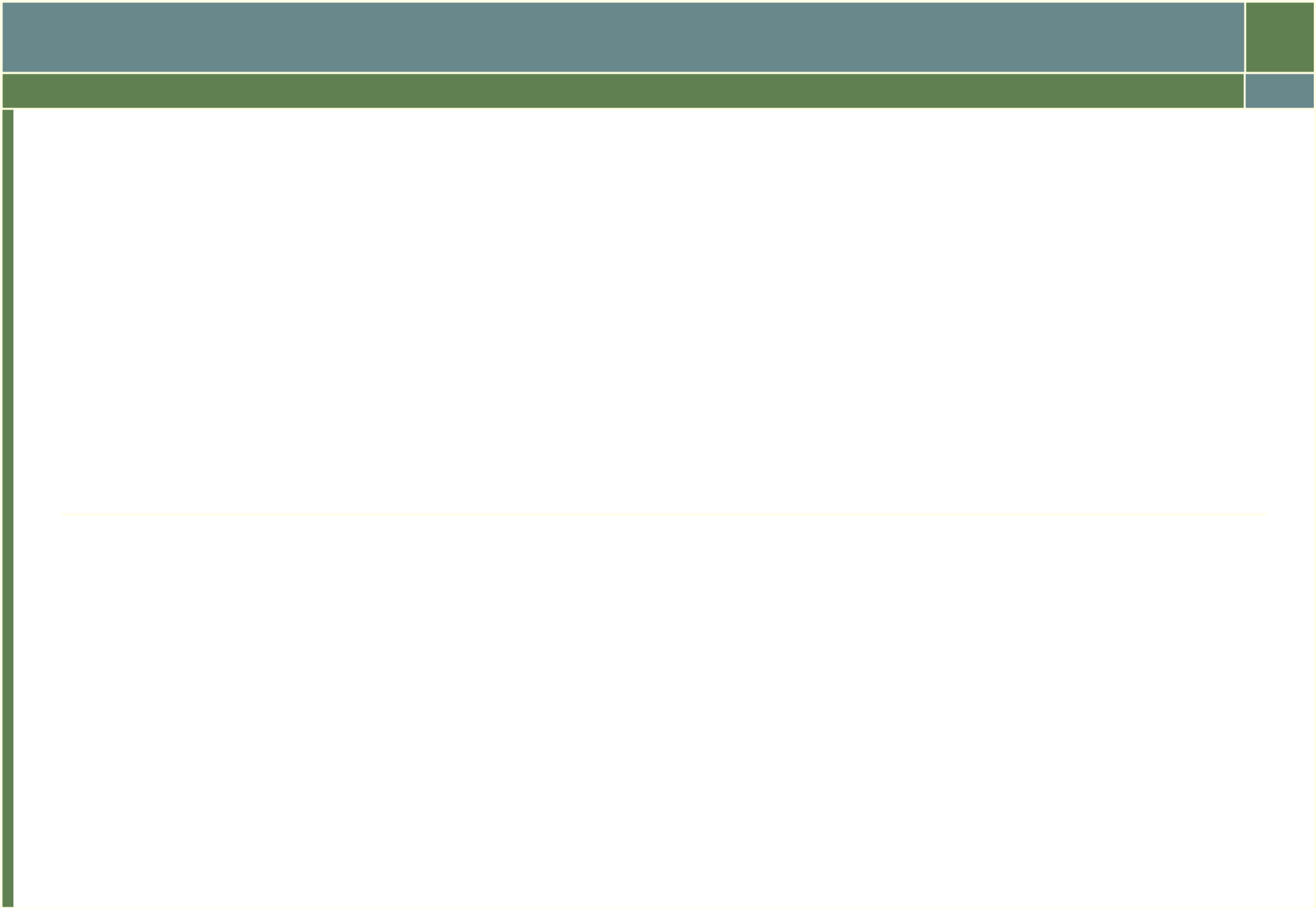
NPV Following Unsuccessful Test

	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

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



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

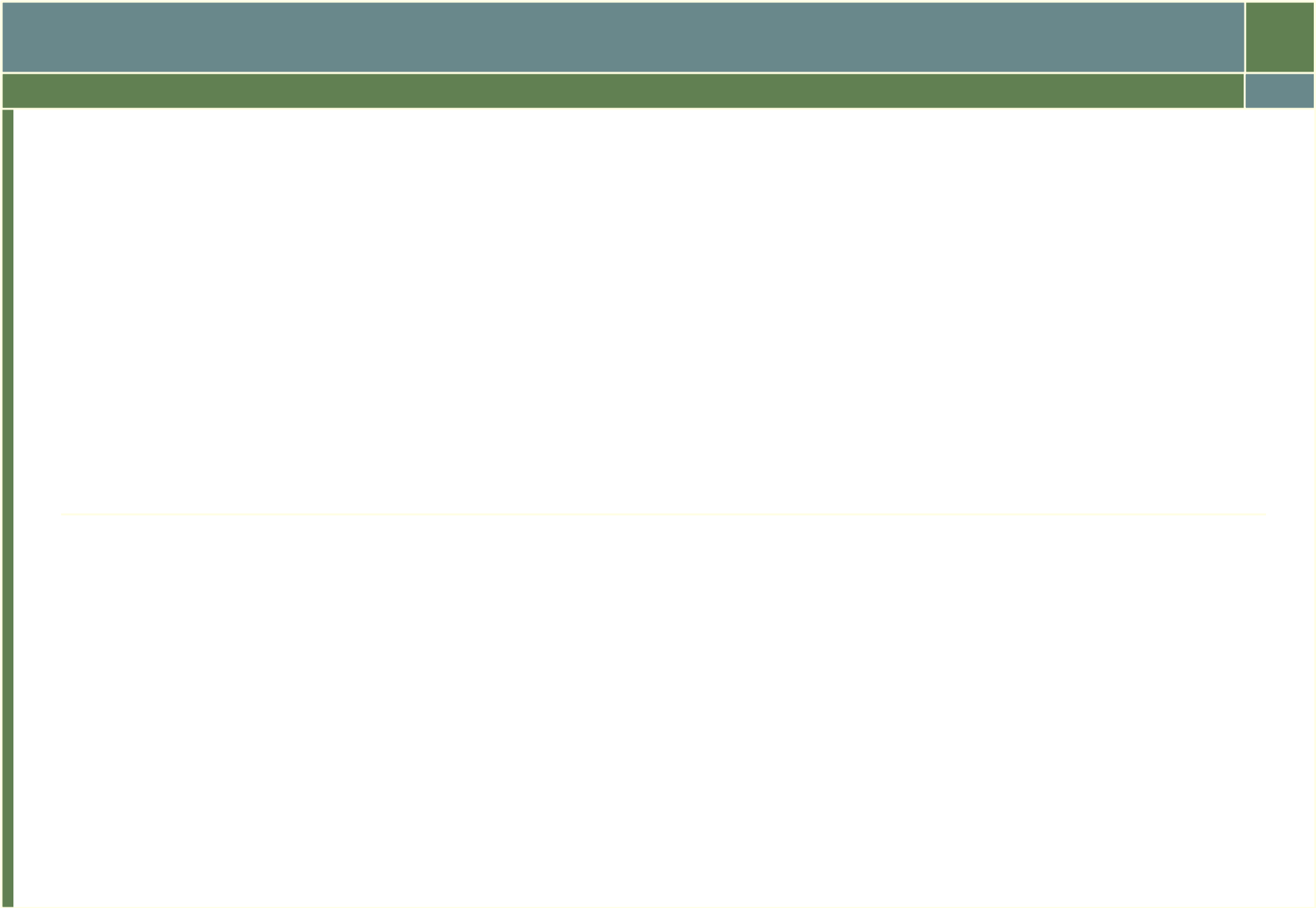
- Imagine a serious blackjack player who wants to know if she should take the third card whenever her first two cards total sixteen.
 - She could play thousands of hands for real money to find out.
 - This could be hazardous to her wealth.
 - Or, she could play thousands of practice hands.
- Monte Carlo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

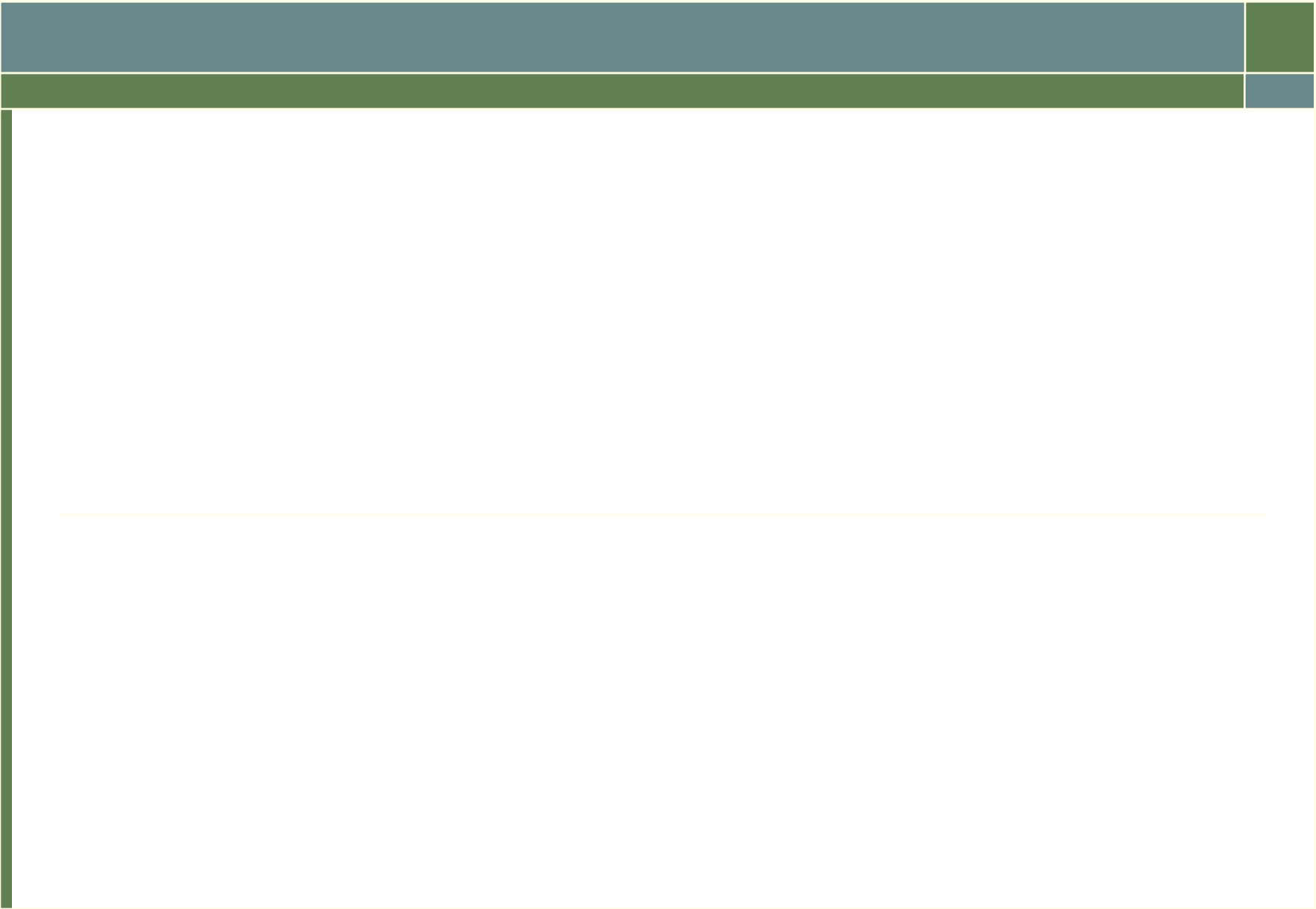
Monte Carlo Simulation

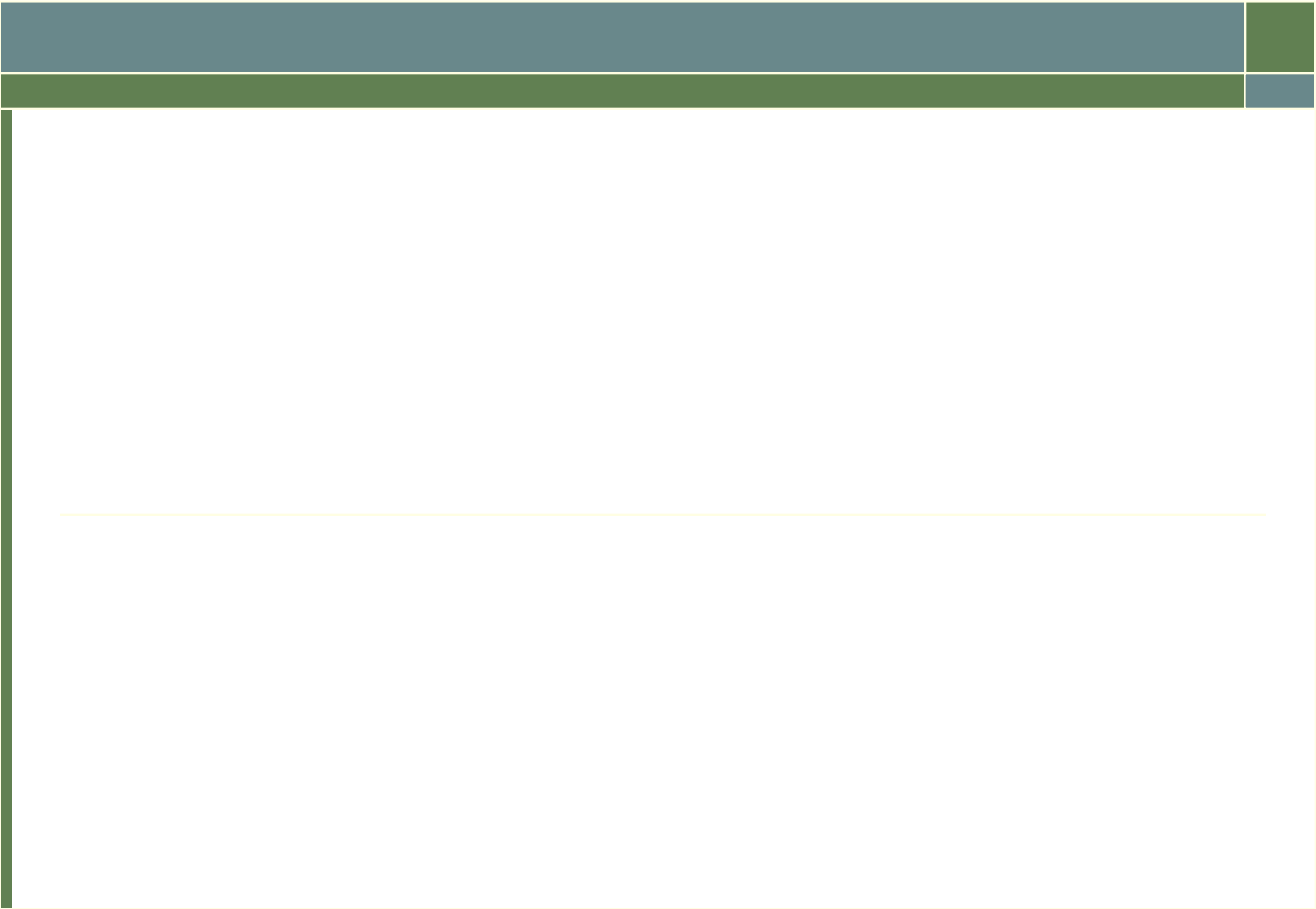
- Monte Carlo simulation of capital budgeting projects is often viewed as a step beyond either sensitivity analysis or scenario analysis.
- Interactions between the variables are explicitly specified in Monte Carlo simulation; so, at least theoretically, this methodology provides a more complete analysis.
- 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:

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BOND VALUATION

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