Chapter 11

**Project Analysis and Evaluation**

- Understand forecasting risk and sources of value
- Understand and be able to do scenario and sensitivity analysis
- Understand the various forms of break-even analysis

Evaluating NPV Estimates

- An investment has a positive NPV if its MV exceeds its cost. Such an investment is desirable because it creates value for its owner.
- What is it about this investment that leads to a positive NPV? What are some potential sources of value in a new product?
  - Is it better than our competitor? Can we manufacture at lower cost? Can we distribute more effectively? Can we gain control of the market?
- Forecasting risk - the risk that a poor decision is made because of errors in projected cash flows.
  - How sensitive is our NPV to changes in the CF estimates? The more sensitive, the greater the forecasting risk

Scenario and Sensitivity Analyses

- Scenario Analysis
  - The determination of what happens to NPV estimates under different CF scenarios. (we let all different variables change only a small number of values)
- Sensitivity Analysis
  - Investigation of what happens to NPV when only one variable is changed.

**AIM:**

**Scenario Analysis**

- What happens to the NPV under different cash flows scenarios?
- At the very least look at:
  - Base case – initial set of projections
  - Best case – high revenues, low costs
  - Worst case – low revenues, high costs
  - Measure of the range of possible outcomes
- Best case and worst case are not necessarily probable, but they can still be possible

**BEST CASE**
- Sales and prices increase, while costs decrease.

**WORST CASE**
- Sales and prices decrease, and costs increase.
Example 11.1: Scenario Analysis

Consider a project. The initial cost is $200,000 and the project has a 5-year life. There is no salvage. Depreciation is straight-line, the required return is 12% and the tax rate is 34%. What is the base case NPV? What are the best and worst case scenario NPVs?

<table>
<thead>
<tr>
<th></th>
<th>Base Case</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Sales (thousands)</td>
<td>6,000</td>
<td>5,500</td>
<td>6,500</td>
</tr>
<tr>
<td>Price/unit</td>
<td>$85</td>
<td>$75</td>
<td>$85</td>
</tr>
<tr>
<td>Variable cost/unit</td>
<td>$60</td>
<td>$58</td>
<td>$62</td>
</tr>
<tr>
<td>Fixed cost/year</td>
<td>$50,000</td>
<td>$45,000</td>
<td>$55,000</td>
</tr>
</tbody>
</table>

Summary of Scenario Analysis for New Project

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Net Income</th>
<th>Cash Flow</th>
<th>NPV</th>
<th>IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base case</td>
<td>19,800</td>
<td>59,800</td>
<td>15,567</td>
<td>15.1%</td>
</tr>
<tr>
<td>Worst case</td>
<td>-23,500</td>
<td>18,500</td>
<td>-180,521</td>
<td>-14.4%</td>
</tr>
<tr>
<td>Best case</td>
<td>59,730</td>
<td>99,730</td>
<td>159,507</td>
<td>40.9%</td>
</tr>
</tbody>
</table>

Sensitivity Analysis

What happens to NPV when we vary one variable at a time? i.e. we are looking at the effect of specific variables on NPV.

- The greater the volatility in NPV in relation to a specific variable, the larger the forecasting risk associated with that variable and the more attention we want to pay to its estimation.

Example 11.2: Sensitivity Analysis

Consider the previous project (Example 1). How sensitive is OCF to changes in the quantity sold?

Summary of Sensitivity Analysis for New Project (Unit Sales)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Unit Sales</th>
<th>Cash Flow</th>
<th>NPV</th>
<th>IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base case</td>
<td>6,000</td>
<td>59,800</td>
<td>15,567</td>
<td>15.1%</td>
</tr>
<tr>
<td>Worst case</td>
<td>5,500</td>
<td>53,200</td>
<td>-8,226</td>
<td>10.3%</td>
</tr>
<tr>
<td>Best case</td>
<td>6,500</td>
<td>66,400</td>
<td>39,557</td>
<td>19.7%</td>
</tr>
</tbody>
</table>

Sensitivity Analysis
Making a Decision

• At some point you have to make a decision
• If the majority of your scenarios have positive NPVs, then you can feel reasonably comfortable about accepting the project.
• If you have a crucial variable that leads to a negative NPV with a small change in the estimates, then you may want to give up the project.

Fix Costs and Variable Costs

• There are two types of costs that are important in breakeven analysis: variable and fixed costs.
  • **Variable Costs**: Change as the quantity of output changes
    - Total VC: Quantity * Cost per unit
  • **Fixed costs**: are constant, regardless of output, over some time period
    - (Eg. administrative salaries, insurance, rent, property tax)
    - TOTAL COSTS: FC + VC
    - FC + VC(Q)

Output Level and Total Cost

Average vs. Marginal Cost

• **Average Cost**: TC / # of units
  • Will decrease as # of units increases
• **Marginal Cost**
  • The cost to produce one more unit
  • Same as variable cost per unit

Example 11.3

• Your firm pays $3000 per month in fixed costs. You also pay $15 per unit to produce your product. First assume that you produce 1000 units and than assume that you produce 5000 units?
  • A) What is your total cost?
  • B) What is your average cost?
  • C) That is your marginal cost

Answer 11.3
Break-Even Analysis

- B-E Analysis is a tool for analyzing the relationship between sales volume and profitability.
- "How bad do sales have to get before we actually begin to lose money?"

Three Types of Break-Even Analysis

- Accounting Break-Even (B-E) - The sales level that results in a net income of zero:
  - Accounting B-E gives managers an indication of how a project will impact accounting profit
  - If a project cannot B-E on an accounting basis, then it is not going to be a worthwhile project

- Cash Break-even
  The sales level that results in a zero OCF.

- Financial Break-even
  The sales level that results in a zero NPV.
  How many does the company has to sell to B-E once we account for the 20% per year opportunity cost?

OCF and Sales Volume

- Consider the following project
  - A new product requires an initial investment of $5 million and will be depreciated to an expected salvage of zero over 5 years
  - The price of the new product is expected to be $25,000 and the variable cost per unit is $16,000
  - The fixed cost is $1 million
  - What is the accounting break-even point each year?
Example 11.4

Example 11.5: Break-Even Analysis

• Consider the previous example. Assume a required return of 18%. What is the financial B-E point? i.e. What OCF (or payment) makes NPV = 0?

Answer 11.5

Example 11.6

• A project under consideration costs $750,000, has a five-year life, and has no salvage value. Depreciation is straight line to zero. The required return is 17%, and the tax rate is 34%. Sales are projected at 500 units per year. Price per unit is $2,500, variable cost per unit is $1,500, and fixed costs are $200,000 per year.

• A) Suppose you think that the unit sales, price, variable cost, and fixed costs projections given here are accurate to within 5%. What are the upper and lower bounds for these projections? What is the base case NPV? What are the best and worst case scenario NPVs?

• B) Given the base case projections in the previous problem, what are the cash, accounting and financial break even sales level for this project? Ignore taxes in answering.
Suggested Problems

• 1-3, 7, 9, 10, 19.