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SENSITIVITY ANALYSIS

Sensitivity analysis is a technique used in capital budgeting to understand how different values of an independent variable affect a particular dependent variable under a given set of assumptions. Sensitivity analysis helps managers identify critical variables and assess the potential impact of changes in these variables on their investment projects. It involves varying the values of key factors such as sales volume, sales price, cost per unit, inflation rate, and project life, and observing the resulting effect on the project's Net Present Value (NPV). This method helps to determine which variables have the most significant impact on the project's outcome.

Advantages of Sensitivity Analysis	Disadvantages of Sensitivity Analysis
• Demonstrates the effect of varying values of project elements (e.g., sales, costs) on the project outcome. • Identify critical assumptions or compare alternative model structures. • Helps identify the most sensitive variables in a project.	• Variables are often correlated, making it unrealistic to examine each individually. Changes in one factor affect others. • Assumptions are often based on past data, which may not be valid in the future. • Assigning maximum and minimum values can be subjective, affecting accuracy and objectivity.

Common sensitivity analysis techniques:

i. *One-way sensitivity analysis:* Vary one variable at a time
ii. *Two-way sensitivity analysis:* Vary two variables simultaneously
iii. *Scenario analysis:* Test multiple variables under different scenarios
iv. *Tornado diagram:* Visualize the impact of each variable on the NPV
v. *Spider plot:* Show the impact of multiple variables on the NPV

Uncertainty analysis, which has a greater focus on uncertainty quantification and propagation of uncertainty, is often used alongside sensitivity analysis. While uncertainty analysis examines the total uncertainty affecting a study's conclusions, sensitivity analysis pinpoints which uncertainties have the most significant impact on those conclusions.

☑ EXAMPLE 15.1

Exquisite Oil is considering a project with the following estimates:

- Initial cash outlay: $25,000 (Year 0)
- Sales price per unit: $30
- Unit cost: $20
- Discount rate: 10% per annum
- Project life: 3 years
- Sales volume: 1000 units (Year 1), 1500 units (Year 2), 750 units (Year 3)

Perform sensitivity analysis on sales price, unit cost, sales volume, and initial outlay.

SOLUTION **tips**

Step 1: Compute cash flows and NPV
Cash flow = sales volume × (sales price – unit cost)

Year	Cash flow	Present value
0	-25,000	-25,000
1	10,000	9,090
2	15,000	12,390
3	7,500	5,633
	NPV	2,113

Sales	PV of sales	Costs	PV of costs
-	-	-	-
30,000	27,270	20,000	18,180
45,000	37,170	30,000	24,780
22,500	16,898	15,000	11,265
	81,338		54,225

Step 2: Sensitivity Analysis

i. Sensitivity to Sales Price

$$\frac{\text{NPV}}{\text{PV of sales}} \times 100 = \frac{2113}{81338} \times 100 = 0.02597 = 2.6\%$$

Comment: The NPV is 2.6% sensitive to changes in the sales price. A 1% decrease in the sales price would reduce the NPV by 2.6%.

ii. Sensitivity to Unit Cost

$$\frac{\text{NPV}}{\text{PV of Costs}} \times 100 = \frac{2113}{54225} \times 100 = 0.0389 = 3.9\%$$

Comment: The NPV is 3.9% sensitive to changes in unit cost. A 1% increase in unit cost would reduce the NPV by 3.9%.

iii. Sensitivity to Sales Volume

$$\frac{\text{NPV}}{\text{PV of Contribution}} \times 100 = \frac{2113}{81338 - 54225} \times 100 = 0.0779 = 7.8\%$$

Comment: The NPV is 7.8% sensitive to changes in sales volume. A 1% reduction in sales volume would reduce the NPV by 7.8%.

iv. Sensitivity to Initial Outlay

$$\frac{\text{NPV}}{\text{Initial Outlay}} \times 100 = \frac{2113}{25000} \times 100 = 0.0845 = 8.5\%$$

Comment: The NPV is 8.5% sensitive to changes in the initial outlay. A 1% increase in the initial outlay would reduce the NPV by 8.5%.

v. Sensitivity to Project Life

Assume the project duration is shortened to 2 years:

Year	Cash Flow	Present Value (PV)
0	-25,000	-25,000
1	10,000	9,090
2	15,000	12,390
Total		-3,520

- *Using interpolation:*

Adjusted project life

$$= 2 + \frac{3520}{2113 - (-3520)}(3 - 2) = 2.63\text{years}$$

Sensitivity to project life

$$= \frac{3 - 2.63}{3} \times 100 = 12.3\%$$

Thus, the project can tolerate a maximum reduction in project life of 12.3% while remaining viable. If the project's lifespan is reduced to less than approximately 2.63 years, the NPV becomes negative (-$3,520), leading to project rejection.

- *Using Alternative Method*

This method assumes net cash inflows occur at year-end, making it crucial to consider cash flow timing.

Percentage Change

$$= \frac{3 - 2}{3} \times 100 = 33.33\%$$

The maximum allowable change is 33.33%.

Comment: The project is sensitive to variations in all tested factors, especially selling price and unit cost. These factors should be closely monitored. Other variables are also sensitive but less critical.