- The basic problem: How reliable is our NPV estimate?
  - Projected vs. Actual cash flows

    Estimated cash flows are based on a distribution of possible outcomes each period
  - Forecasting risk

    The possibility of a bad decision due to errors in cash flow projections
  - Sources of value

    What conditions must exist to create the estimated NPV?

    "What If" analysis

    A. Scenario analysis

    B. Sensitivity analysis

- Scenario and Other "What-If" Analyses
  - "Base case" estimation

    Estimated NPV based on initial cash flow projections
  - Scenario analysis

    Base, best, and worst-case scenarios and calculate NPVs

    Change var. values (sale, Var.cost, Fixed cost…etc)
  - Sensitivity analysis

    How does the estimated NPV change when one of the input variables changes? Freeze all other var.
  - Simulation analysis

    Vary several input variables simultaneously, then construct a distribution of possible NPV estimates

Example:

- Fairways Driving Range expects rentals to be 20,000 buckets at $3 per bucket. Equipment costs $20,000 and will be depreciated using SL over 5 years and have a $0 salvage value. Variable costs are 10% of rentals and fixed costs are $40,000 per year. Assume no increase in working capital nor any additional capital outlays. The required return is 15% and the tax rate is 15%.

Revenues	$60,000 (3x20,000)
Variable costs	6,000 (10% rev)
Fixed costs	40,000
Depreciation	4,000 (20,000/5)
EBIT	$10,000
Taxes (@15%)	1500
Net income	$ 8,500

Example (concluded)

- Estimated annual cash inflows:

  $10,000 + 4,000 - 1,500 = $12,500

  EBIT Dep. Tax

- At 15%, the 5-year annuity factor is 3.352. Thus, the *base-case NPV* is:

  NPV = $-20,000 + ($12,500 × 3.352) = $21,900.

Scenario Analysis: Change var.

INPUTS FOR SCENARIO ANALYSIS

- Base case: Rentals are 20,000 buckets, variable costs are 10% of revenues, fixed costs are $40,000, depreciation is $4,000 per year, and the tax rate is 15%.

- Best case: Rentals are 25,000 buckets, variable costs are 8% of revenues, fixed costs are $40,000, depreciation is $4,000 per year, and the tax rate is 15%.

- Worst case: Rentals are 18,000 buckets, variable costs are 12% of revenues, fixed costs are $40,000, depreciation is $4,000 per year, and the tax rate is 15%.

Scenario Analysis (concluded)

Scenario	Rentals	Revenues	Net Income	Project Cash Flow	NPV
Best Case	25,000	$75,000	$21,250	$25,250	$64,635
Base Case	20,000	60,000	8,500	12,500	21,900
Worst Case	18,000	54,000	2,992	6,992	3,437

Sensitivity Analysis: Freeze var. except for one

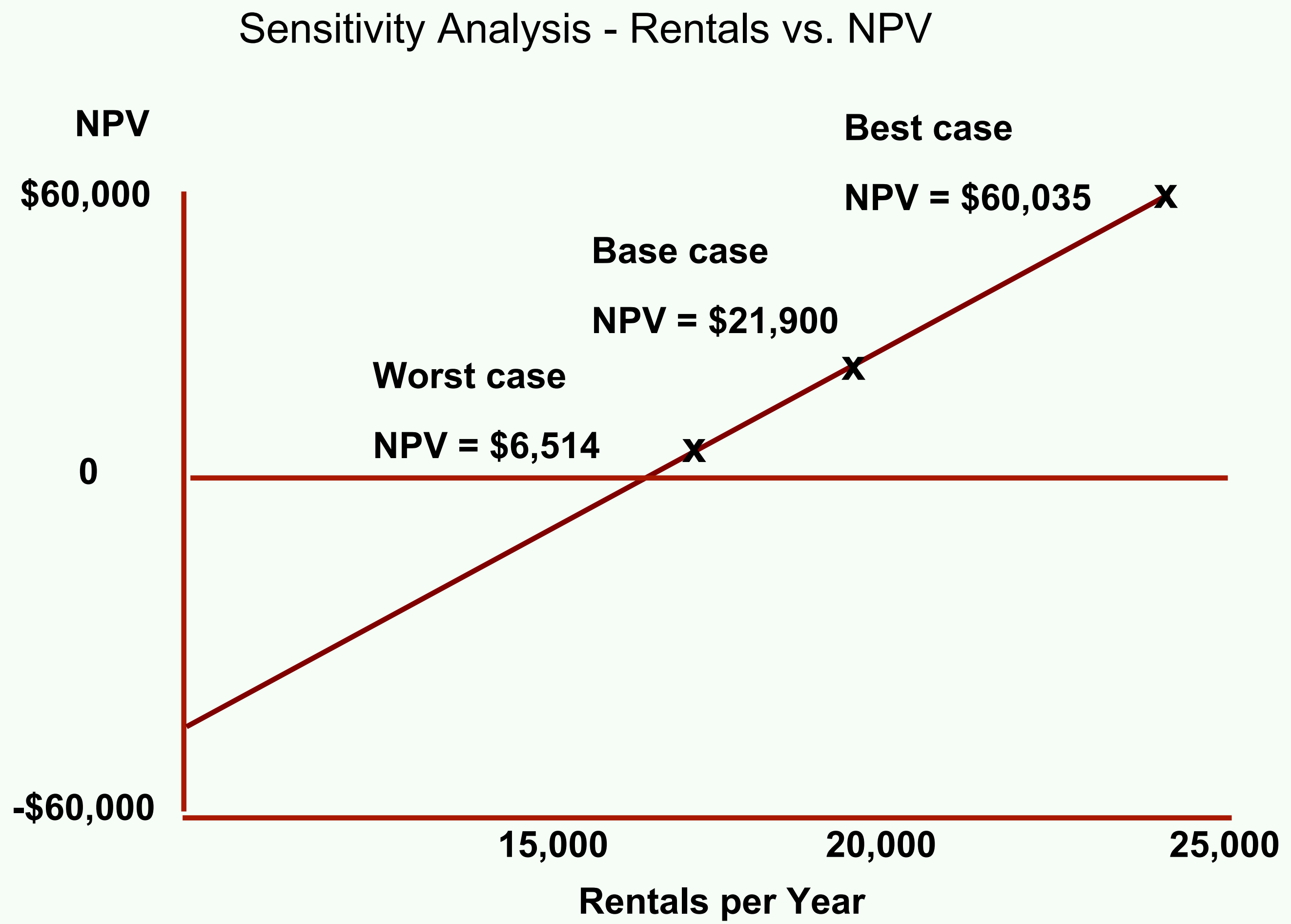
INPUTS FOR SENSITIVITY ANALYSIS

- Base case: Rentals are 20,000 buckets, variable costs are 10% of revenues, fixed costs are $40,000, depreciation is $4,000 per year, and the tax rate is 15%.
- Best case: Rentals are 25,000 buckets and revenues are $75,000. All other variables are unchanged.
- Worst case: Rentals are 18,000 buckets and revenues are $54,000. All other variables are unchanged.

Sensitivity Analysis (concluded)

Scenario	Rentals	Revenues	Net income	Project cash flow	NPV
Best case	25,000	$75,000	$19,975	$23,975	$60,364
Base case	20,000	60,000	8,500	12,500	21,900
Worst case	18,000	54,000	3,910	7,910	6,514

Rentals vs. NPV



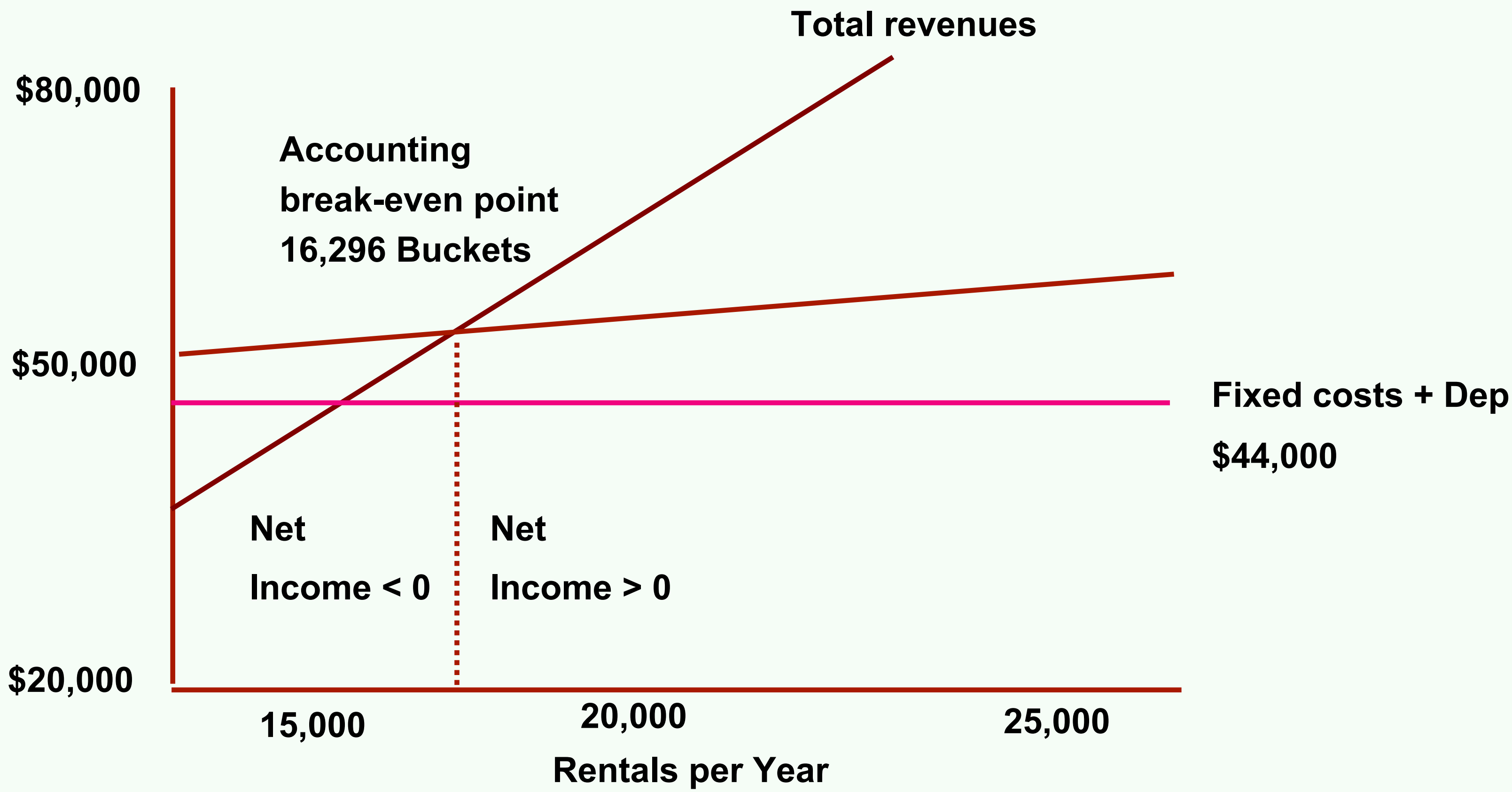
Total Cost Calculations

- Total Cost = Variable cost + Fixed cost

Rentals	Revenue	Variable cost	Fixed cost	Total cost	Depr.	Total acct. cost
0	$0	$0	$40,000	$40,000	$4,000	$44,000
15,000	45,000	4,500	40,000	44,500	4,000	48,500
20,000	60,000	6,000	40,000	46,000	4,000	50,000
25,000	75,000	7,500	40,000	47,500	4,000	51,500

Break-Even Analysis

Fairways Break-Even Analysis - Sales vs. Costs and Rentals



Accounting Break-Even Quantity

- Accounting Break-Even Quantity (Q)

Q = (Fixed costs + Depreciation)/(Price per unit - Variable cost per unit)

= (FC + D)/(P - V)

= ($40,000 + 4,000)/($3.00 - .30)

= 16,296 buckets

If sales do not reach 16,296 buckets, the firm will incur losses in both the accounting sense and the financial sense .

Quick Quiz -- Part 1 of 2

Assume you have the following information about RJInc:

- Price = $5 per unit; variable costs = $3 per unit
- Fixed operating costs = $10,000
- Initial cost is $20,000
- 5 year life; straight-line depreciation to 0, no salvage value
- Assume no taxes
- Required return = 20%

Part 1 of 2 (concluded)

- Break-Even Computations

A. Accounting Break-Even

Q = (FC + D)/(P - V) = ($_____ + $4,000)/($5 - 3) = _______ units

IRR = _______ ; NPV   _______ (= -$_______)

B. Cash Break-Even

Q = FC/(P - V) = $10,000/($5 - 3) = _______ units

IRR = _______ ; NPV = _______

B. Financial Break-Even

Q = (FC + $6,688)/(P - V)

= ($10,000 + 6,688)/($5 - 3) = 8,344 units

IRR = _______ ; NPV = _______

Quick Quiz -- Part 1 of 2 (concluded)

- Break-Even Computations

A. Accounting Break-Even (non-cash –Dep)

Q = (FC + D)/(P - V) = ($10,000 + $4,000)/($5 - 3) = 7,000 units

IRR = 0 ; NPV = -$8,038

B. Cash Break-Even

Q = FC/(P - V) = $10,000/($5 - 3) = 5,000 units

IRR = -100% ; NPV = -$20,000

B. Financial Break-Even

Q = (FC + $6,688)/(P - V)

= ($10,000 + 6,688)/($5 - 3) = 8,344 units

IRR = 20% ; NPV = 0

Summary of Break-Even Measures

I. The General Expression

$$Q = (FC + OCF)/(P - V)$$

where: FC = total fixed costs

P = Price per unit

v = variable cost per unit

II. The Accounting Break-Even Point

$$Q = (FC + D)/(P - V)$$

At the Accounting BEP, net income = 0, NPV is negative, and IRR of 0.

III. The Cash Break-Even Point

$$Q = FC/(P - V)$$

At the Cash BEP, operating cash flow = 0, NPV is negative, and IRR = -100%.

IV. The Financial Break-Even Point

$$Q = (FC + OCF^{*})/(P - V)$$

At the Financial BEP, NPV = 0 and IRR = required return.

DOL (Degree of operating leverage):

- Since %Δ in OCF = DOL $\times$ % Δ in Q, DOL is a "multiplier" which measures the effect of a change in quantity sold on OCF.
- For Fairways, let Q = 20,000 buckets. Ignoring taxes,

  OCF = $14,000 and fixed costs = $40,000, and

  Fairway's DOL = 1 + FC/OCF = 1 + $40,000/$14,000 = 3.857.

  In other words, a 10% increase (decrease) in quantity sold will result in a 38.57% increase (decrease) in OCF.
- Two points should be kept in mind:

  Higher DOL suggests greater volatility (i.e., risk) in OCF;

  Leverage is a two-edged sword - sales decreases will be magnified as much as increases.

Quick Quiz -- Part 2 of 2

1. What is forecasting risk?

   It is the possibility that errors in projected cash flows will lead to incorrect decisions.

2. What is scenario analysis? Why might this exercise be useful for decision-makers to perform, even if their estimates ultimately turn out to be incorrect?

   It uses estimates of "Best- and Worst-case" outcomes to see what happens to NPV estimates if things turn out differently than expected. It forces decision-makers to think about the possibility of alternative outcomes.

Problem 1

- BetaBlockers, Inc. (BBI) manufactures biotech sunglasses. The variable materials cost is $0.68 per unit and the variable labor cost is $2.08 per unit.
- What is the variable cost per unit?

  VC = variable material cost + variable labor cost

  = $0.68 + $2.08 = $2.76

- Suppose BBI incurs fixed costs of $520,000 during a year when production is 250,000 units. What are total costs for the year?

  TC = total variable costs + fixed costs

  = ($2.76)(_______) + $ _______ = $ _______

Solution to Problem 1

- BetaBlockers, Inc. (BBI) manufactures biotech sunglasses. The variable materials cost is \$0.68 per unit and the variable labor cost is \$2.08 per unit.
- What is the variable cost per unit?

  VC = variable material cost + variable labor cost

  = \$0.68 + \$2.08 = \$2.76
- Suppose BBI incurs fixed costs of \$520,000 during a year when production is 250,000 units. What are total costs for the year?

  TC = total variable costs + fixed costs

  = (\$2.76)(250,000) + \$520,000 = \$1,210,000

Solution to Problem 1 (concluded)

- If the selling price is $6.00 per unit, does BBI break even on a cash basis? If depreciation is $150,000 per year, what is the accounting break-even point?

Q_{cash} = $520,000/($ ______ – $ ______)

= ______ units

Q_{acct} = ($ ______ + $ ______)/($6.00 – $2.76)

= ______ units

Solution to Problem 1 (concluded)

- If the selling price is \$6.00 per unit, what is the BBI break even on a cash basis? If depreciation is \$150,000 per year, what is the accounting break-even point?

Q_{cash} = \$520,000/(\$ 6.00 – \$ 2.76)

= 160,494 units

Q_{acct} = (\$520,000 + \$150,000)/(\$6.00 - \$2.76)

= 206,790 units

Problem 2

- In each of the following cases, calculate the accounting break-even and the cash break-even points. Ignore any tax effects in calculating the cash break-even.

Unit price	Unit VC	Fixed costs	Depreciation
$1,900	$1,750	$16 million	$7 million
30	26	60,000	150,000
7	2	300	365

Solution to Problem 2 (concluded)

Solutions

(1) Q_{acct} = ($16M + $___)/($1,900 - $1,750) = _______ units

Q_{cash} = $16M/($______ - $ ______) = 106,667 units

(2) Q_{acct} = ($60K + $150K)/($__ - $26) = 52,500 units

Q_{cash} = $_______ /($30 - $26) = _______ units

(3) Q_{acct} = ($300 + $365)/($7 - $2) = ___ units

Q_{cash} = $300/($7 - $2) = 60 units

Solution to Problem 2 (concluded)

Solutions

(1) Q_{acct} = (\$16M + \$ 7m)/(\$1,900 - \$1,750) = 153,334 units

Q_{cash} = \$16M/(\$1,900 - \$ 1,750) = 106,667 units

(2) Q_{acct} = (\$60K + \$150K)/(\$30 - \$26) = 52,500 units

Q_{cash} = \$60,000/(\$30 - \$26) = 15,000 units

(3) Q_{acct} = (\$300 + \$365)/(\$7 - \$2) = 133 units

Q_{cash} = \$300/(\$7 - \$2) = 60 units

Problem 3

- A proposed project has fixed costs of $20,000 per year. OCF at 7,000 units is $55,000. Ignoring taxes, what is the degree of operating leverage (DOL)?
- If units sold rises from 7,000 to 7,300, what will be the increase in OCF? What is the new DOL?

DOL = 1 + ($20,000/$55,000) = 1.3637

% Δ Q = (7,300 - 7,000)/7,000 = 4.29%

and

% Δ OCF = DOL(% Δ Q) = ______ (4.29) = ____ %

New OCF = ($55,000)(_______) = $_______

DOL at 7,300 units = 1 + ($20,000/$ _______) = _______

Solution to Problem 3

- A proposed project has fixed costs of \$20,000 per year. OCF at 7,000 units is \$55,000. Ignoring taxes, what is the degree of operating leverage (DOL)?
- If units sold rises from 7,000 to 7,300, what will be the increase in OCF? What is the new DOL?

DOL = 1 + (\$20,000/\$55,000) = 1.3637

% Δ Q = (7,300 - 7,000)/7,000 = 4.29%

and

% Δ OCF = DOL(% Δ Q) = 1.3637 (4.29) = 5.85%

New OCF = (\$55,000)(1.0585) = \$58,218

DOL at 7,300 units = 1 + (\$20,000/\$58,218) = 1.3435