CHAPTER

6

Making Capital Investment Decisions

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Key Concepts and Skills

- Understand how to determine the relevant cash flows for various types of capital investments
- Be able to compute depreciation expense for tax purposes
- Incorporate inflation into capital budgeting
- Understand the various methods for computing operating cash flow
- Apply the Equivalent Annual Cost (EAC) approach to choose among unequal lives project alternatives

Chapter Outline

6.1 Incremental Cash Flows

6.2 The Baldwin Company: An Example

6.3 Inflation and Capital Budgeting

6.4 Alternative Definitions of Cash Flow

6.5 Investments of Unequal Lives: The Equivalent Annual Cost (EAC) Method

6.1 Incremental Cash Flows

- Cash flows matter—not accounting earnings.
- *Incremental* cash flows matter.
- Opportunity costs matter.
- Side effects like cannibalism and erosion, as well as synergy, matter.
- Taxes matter: we want incremental after-tax cash flows.
- Inflation matters.
- Sunk costs do not matter.

INCREMENTAL Cash Flows -- Not Accounting Earnings

- Include changes in the firm's future cash flows that are resulted from the acceptance of the project,

  i.e., INCREMENTAL CFs!
  - Consider tax effect of depreciation expense
    - You never write a check made out to "depreciation", but it helps to lower tax payment.
- Much of the work in evaluating a project lies in taking accounting numbers and generating cash flows.

Incremental Cash Flows

- Opportunity costs *do* matter.
  - Just because a project has a positive NPV, that does not mean that it should also have automatic acceptance. Specifically, if another project with a higher NPV would have to be passed up, then we should not proceed.
- Include foregone cash flows due to the acceptance of the project!
  - If possible, determine it using the market value of the most valuable foregone alternative.

Incremental Cash Flows

- Side (or Spillover) effects matter.
  - Erosion is a “bad” thing. If our new product causes existing customers to demand less of current products, we need to recognize that.
  - If, however, synergies result that create increased demand of existing products, we also need to recognize that.

Remember: The goal is to add value to the company, not just to your division!

Incremental Cash Flows

- Net Working Capital (NWC) matters
  - Include cash flows that are associated with changes in NWC investment as a result of accepting the project!

Recall that NWC investment is for supporting the production and sales activities of the project.

-- It should be <u>recaptured at the termination</u> of the project! Recall that when the project winds down, we enjoy a return of NWC.

Incremental Cash Flows

- Tax effect matters
  - Do the analysis on the after-tax basis!
  - Include the tax effect in the transaction of assets, i.e., after-tax salvage value of assets
    - **(market value – book value) * marginal tax rate**
- Inflation effect matters
  - Consistent treatment is the key!
  - **Discount nominal (or real) cash flows with the appropriate nominal (or real) discount rate!**
    - If not, systematic biases in NPV estimation!

Estimating Cash Flows, CF(A)
(Recall from Chapter 2)

- Cash Flow from Operations, OCF
  - OCF = EBIT – Taxes + Depreciation
- Net Capital Spending, CE
  - CE = Change in net fixed assets + Change in accumulated depreciation; OR
  - CE = Change in (gross) fixed assets
  - Do not forget salvage value (after tax, of course)!
- Changes in Net Working Capital
  - Recall that an increase (or a decrease) in NWC represents a cash outflow (or inflow).

Sunk Cost and Interest Expense

- Sunk (or Historical) costs are NOT relevant
  – Should ***NOT*** be included because these cash flows have already been incurred and cannot be removed, regardless of the decision!
  – Just because "we have come this far" does not mean that we should continue to throw good money after bad.
- Interest Expenses
  – For now, we assume that the firm's level of debt is independent of the project, and hence interest expense is ***NOT*** relevant!

6.2 The Baldwin Company

- Costs of test marketing (already spent): $250,000
- Current market value of proposed factory site (which we own): $150,000
- Cost of bowling ball machine: $100,000 (depreciated according to MACRS 5-year)
- Increase in net working capital: $10,000
- Production (in units) by year during 5-year life of the machine: 5,000, 8,000, 12,000, 10,000, 6,000

The Baldwin Company

- Price during first year is $20; price increases 2% per year thereafter.
- Production costs during first year are $10 per unit and increase 10% per year thereafter.
- Annual inflation rate: 5%
- Working Capital: initial $10,000; changes with annual sales, 10% of annual sales, thereafter.
- Discount rate: 10%
- Corporate tax rate: 34%

The Baldwin Company

($ thousands) (All cash flows occur at the *end* of the year.)

	Year 0	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*
Investments:						
(1) Bowling ball machine	–100.00					21.76*
(2) Accumulated depreciation		20.00	52.00	71.20	82.72	94.24
(3) Adjusted basis of machine after depreciation (end of year)		80.00	48.00	28.80	17.28	5.76
(4) Opportunity cost (warehouse)	–150.00					150.00
(5) Net working capital (end of year)	10.00	10.00	16.32	24.97	21.22	0
(6) Change in net working capital	–10.00		–6.32	–8.65	3.75	21.22
(7) Total cash flow of investment [(1) + (4) + (6)]	–260.00		–6.32	–8.65	3.75	192.98

The Baldwin Company

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Investments:						
(1) Bowling ball machine	–100.00					21.76*
(2) Accumulated depreciation		20.00	52.00	71.20	82.72	94.24
(3) Adjusted basis of machine after depreciation (end of year)		80.00	48.00	28.80	17.28	5.76
(4) Opportunity cost (warehouse)	–150.00					150.00
(5) Net working capital (end of year)	10.00	10.00	16.32	24.97	21.22	0
(6) Change in net working capital	–10.00		–6.32	–8.65	3.75	21.22
(7) Total cash flow of investment [(1) + (4) + (6)]	–260.00		–6.32	–8.65	3.75	192.98

At the end of the project, the warehouse is unencumbered, so we can sell it if we want to.

The Baldwin Company

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Income:						
(8) Sales Revenues		100.00	163.20	249.72	212.20	129.90

Recall that production (in units) by year during the 5-year life of the machine is given by:

(5,000, 8,000, 12,000, 10,000, 6,000).

Price during the first year is $20 and increases 2% per year thereafter.

Sales revenue in year 3 = $12{,}000 \times [\$20 \times (1.02)^2] = 12{,}000 \times \$20.81 = \$249{,}720$.

The Baldwin Company

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Income:						
(8) Sales Revenues		100.00	163.20	249.72	212.20	129.90
(9) Operating costs		50.00	88.00	145.20	133.10	87.84

Again, production (in units) by year during 5-year life of the machine is given by:

(5,000, 8,000, 12,000, 10,000, 6,000).

Production costs during the first year (per unit) are \$10, and they increase 10% per year thereafter.

Production costs in year 2 = $8{,}000 \times [\$10 \times (1.10)^1] = \$88{,}000$

The Baldwin Company

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Income:						
(8) Sales Revenues		100.00	163.20	249.72	212.20	129.90
(9) Operating costs		50.00	88.00	145.20	133.10	87.84
(10) Depreciation			20.00	32.00	19.20	11.52
11.52						

Depreciation is calculated using the Accelerated Cost Recovery System (shown at right).

Our cost basis is $100,000.

Depreciation charge in year 4

= $100,000 × (.1152) = $11,520.

Year	ACRS %
1	20.00%
2	32.00%
3	19.20%
4	11.52%
5	11.52%
6	5.76%
Total	100.00%

The Baldwin Company

	Year 0	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*
Income:						
(8) Sales Revenues		100.00	163.20	249.72	212.20	129.90
(9) Operating costs		50.00	88.00	145.20	133.10	87.84
(10) Depreciation		20.00	32.00	19.20	11.52	11.52
(11) Income before taxes [(8) – (9) - (10)]		30.00	43.20	85.32	67.58	30.54
(12) Tax at 34 percent		10.20	14.69	29.01	22.98	10.38
(13) Net Income		19.80	28.51	56.31	44.60	20.16

Incremental After Tax Cash Flows

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
(1) Sales Revenues		$100.00	$163.20	$249.72	$212.20	$129.90
(2) Operating costs		-50.00	-88.00	-145.20	133.10	-87.84
(3) Taxes		-10.20	-14.69	-29.01	-22.98	-10.38
(4) OCF (1) – (2) – (3)		39.80	60.51	75.51	56.12	31.68
(5) Total CF of Investment	–260.		–6.32	–8.65	3.75	192.98
(6) IATCF [(4) + (5)]	–260.	39.80	54.19	66.86	59.87	224.66

$$NPV = -\$260 + \frac{\$39.80}{(1.10)} + \frac{\$54.19}{(1.10)^2} + \frac{\$66.86}{(1.10)^3} + \frac{\$59.87}{(1.10)^4} + \frac{\$224.66}{(1.10)^5}$$

$$NPV = \$51.588$$

NPV of Baldwin Company

CF0	–260
CF1	39.80
F1	1
CF2	54.19
F2	1
CF3	66.86
F3	1
CF4	59.87
F4	1
CF5	224.66
F5	1
I	10
NPV	51.588

6.3 Inflation and Capital Budgeting

- Inflation is an important fact of economic life and must be considered in capital budgeting.

- Consider the relationship between interest rates and inflation, often referred to as the **Fisher Equation**:

  (1 + Nominal Rate) = (1 + Real Rate) × (1 + Inflation Rate)

➔ Nominal Rate = (1+Real Rate) X (1+Inflation Rate) - 1

Inflation and Capital Budgeting

- For low rates of inflation, this is often approximated:

  Real Rate ≅ Nominal Rate – Inflation Rate

- While the nominal rate in the U.S. has fluctuated with inflation, the real rate has generally exhibited far less variance than the nominal rate.

- **In capital budgeting, one must compare real cash flows discounted at real rates or nominal cash flows discounted at nominal rates in order to avoid bias in NPV!**

6.4 Other Methods for Computing OCF

- Bottom-Up Approach
  - Works only when there is no interest expense
  - OCF = NI + depreciation
- Top-Down Approach
  - OCF = Sales – Costs – Taxes
  - Do not subtract non-cash deductions
- Tax Shield Approach
  - OCF = (Sales – Costs)(1 – T) + Depreciation*T

Example of Capital Budgeting under Inflation

- Sony International has an investment opportunity to produce a new stereo color TV.
- The required investment on January 1 of this year is $32 million. The firm will depreciate the investment to zero using the straight-line method. The firm is in the 34% tax bracket.
- The price of the product on January 1 will be $400 per unit. The price will stay constant in real terms.
- Labor costs will be $15 per hour on January 1. The will increase at 2% per year in real terms.
- Energy costs will be $5 per TV; they will increase 3% per year in real terms.
- The inflation rate is 5% Revenues are received and costs are paid at year-end.

Example of Capital Budgeting under Inflation

	Year 1	Year 2	Year 3	Year 4
Physical Production (units)	100,000	200,000	200,000	150,000
Labor Input (hours)	2,000,000	2,000,000	2,000,000	2,000,000
Energy input, physical units	200,000	200,000	200,000	200,000

The real discount rate for costs and revenues is 8% ➔ The nominal discount rate for risky cash flows is 13.4% (Ref: Fisher Equation).

Calculate the NPV.

Example of Capital Budgeting under Inflation

The depreciation tax shield is a nominal cash flow, and is therefore discounted at the nominal discount rate.

Cost of investment today = $32,000,000

Project life = 4 years

Annual depreciation expense: $\$8{,}000{,}000 = \dfrac{\$32\text{M}}{4 \text{ years}}$

Depreciation tax shield = $8,000,000 × .34 = $2,720,000

CF0	0		
CF1	2,720,000	I	13.4
F1	4	NPV	8,023,779

Year 1 After-tax Real Cash Flows

- Risky Real Cash Flows
  - Price: $400 per unit with zero real price increase
  - Labor: $15 per hour with 2% real wage increase
  - Energy: $5 per unit with 3% real energy cost increase
- Year 1 After-tax Real Risky Cash Flows:

After-tax revenues =

$$\$400 \times 100{,}000 \times (1 - .34) = \$26{,}400{,}000$$

After-tax labor costs =

$$\$15 \times 2{,}000{,}000 \times 1.02 \times (1 - .34) = \$20{,}196{,}000$$

After-tax energy costs =

$$\$5 \times 200{,}000 \times 1.03 \times (1 - .34) = \$679{,}800$$

After-tax net operating CF =

$$\$26{,}400{,}000 - \$20{,}196{,}000 - \$679{,}800 = \$5{,}524{,}200$$

Year 2 After-tax Real Cash Flows

- Risky Real Cash Flows
  - Price: $400 per unit with zero real price increase
  - Labor: $15 per hour with 2% real wage increase
  - Energy: $5 per unit with 3% real energy cost increase
- Year 2 After-tax Real Risky Cash Flows:

After-tax revenues =

$$\$400 \times 200{,}000 \times (1 - .34) = \$52{,}800{,}000$$

After-tax labor costs =

$$\$15 \times 2{,}000{,}000 \times (1.02)^2 \times (1 - .34) = \$20{,}599{,}920$$

After-tax energy costs =

$$\$5 \times 200{,}000 \times (1.03)^2 \times (1 - .34) = \$700{,}194$$

After-tax net operating CF =

$$\$52{,}800{,}000 - \$\ 20{,}599{,}920 - \$\ 700{,}194 = \$\ 31{,}499{,}886$$

Year 3 After-tax Real Cash Flows

- Risky Real Cash Flows
  - Price: \$400 per unit with zero real price increase
  - Labor: \$15 per hour with 2% real wage increase
  - Energy: \$5 per unit with 3% real energy cost increase
- Year 3 After-tax Real Risky Cash Flows:

After-tax revenues =

$$\$400 \times 200{,}000 \times (1 - .34) = \$52{,}800{,}000$$

After-tax labor costs =

$$\$15 \times 2{,}000{,}000 \times (1.02)^3 \times (1 - .34) = \$21{,}011{,}918.40$$

After-tax energy costs =

$$\$5 \times 200{,}000 \times (1.03)^3 \times (1 - .34) = \$721{,}199.82$$

After-tax net operating CF =

$$\$52{,}800{,}000 - \$\ 21{,}011{,}918.40 - \$\ 721{,}199.82 = \$31{,}066{,}882$$

Year 4 After-tax Real Cash Flows

- Risky Real Cash Flows
  - Price: \$400 per unit with zero real price increase
  - Labor: \$15 per hour with 2% real wage increase
  - Energy: \$5 per unit with 3% real energy cost increase
- Year 4 After-tax Real Risky Cash Flows:

After-tax revenues =

$$\$400 \times 150{,}000 \times (1 - .34) = \$39{,}600{,}000$$

After-tax labor costs =

$$\$15 \times 2{,}000{,}000 \times (1.02)^4 \times (1 - .34) = \$21{,}432.156.77$$

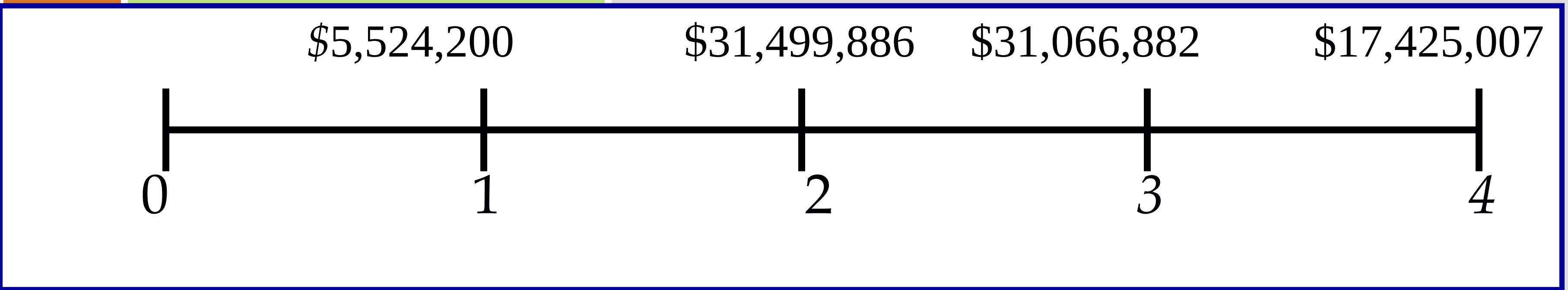
After-tax energy costs =

$$\$5 \times 2{,}00{,}000 \times (1.03)^4 \times (1 - .34) = \$742{,}835.82$$

After-tax net operating CF =

$$\$29{,}600{,}000 - \$21{,}432{,}156.77 - \$742{,}835.82 = \$17{,}425{,}007$$

Example of Capital Budgeting under Inflation



CF0	
CF1	5,524,000
F1	1
CF2	31,499,886
F2	1
CF3	31,066,882
F3	1
CF4	17,425,007
F4	1
I	8
NPV	69,590,868

Example of Capital Budgeting under Inflation

The project *NPV* can now be computed as the sum of the *PV* of the cost, the *PV* of the real cash flows discounted at the real discount rate and the *PV* of the nominal cash flows discounted at the nominal discount rate.

NPV = –\$32,000,000 + \$69,590,868 + \$8,023,779 = \$45,614,647

6.5 Some Special Cases of Discounted Cash Flow Analysis

- Cost-Cutting Proposals
- Setting the Bid Price
- Investments of Unequal Lives

Cost-Cutting Proposals

- Cost savings will increase pretax income
  - But, we have to pay taxes on this amount
- Depreciation will reduce our tax liability
- Does the present value of the cash flow associated with the cost savings exceed the cost?
  - If yes, then proceed.

Setting the Bid Price

- Find the sales price that makes NPV = 0
  - Step 1: Use known changes in NWC and capital to estimate “preliminary” NPV
  - Step 2: Determine what yearly OCF is needed to make NPV = 0
  - Step 3: Determine what NI is required to generate the OCF
    - OCF = NI + Depreciation
  - Step 4: Identify what sales (and price) are necessary to create the required NI
    - NI = (Sales – Costs – Depreciation)*(1 – T)

Investments of Unequal Lives

- There are times when application of the NPV rule can lead to the wrong decision. Consider a factory that must have an air cleaner that is mandated by law. There are two choices:
  - The “Cadillac cleaner” costs $4,000 today, has annual operating costs of $100, and lasts 10 years.
  - The “Cheapskate cleaner” costs $1,000 today, has annual operating costs of $500, and lasts 5 years.
- Assuming a 10% discount rate, which one should we choose?

Investments of Unequal Lives

Cadillac Air Cleaner

CF0	–4,000
CF1	–100
F1	10
I	10
NPV	–4,614.46

Cheapskate Air Cleaner

CF0	–1,000
CF1	–500
F1	5
I	10
NPV	–2,895.39

At first glance, the Cheapskate cleaner has a higher NPV.

Investments of Unequal Lives

- This overlooks the fact that the Cadillac cleaner lasts twice as long.
- When we incorporate the difference in lives, the Cadillac cleaner is actually cheaper (i.e., has a higher NPV).

Investments of Unequal Lives

- Replacement Chain
  - Repeat projects until they begin and end at the same time.
  - Compute *NPV* for the “repeated projects.”
- The Equivalent Annual Cost (EAC) Method

Replacement Chain Approach

The Cadillac cleaner time line of cash flows:

-$4,000	–100	-100	-100	-100	-100	-100	-100	-100	-100	-100
0	1	2	3	4	5	6	7	8	9	10

The Cheapskate cleaner time line of cash flows *over ten years:*

-$1,000	–500	-500	-500	-500	-1,500	-500	-500	-500	-500	-500
0	1	2	3	4	5	6	7	8	9	10

Replacement Chain Approach

Cadillac Air Cleaner		Cheapskate Air Cleaner	
CF0	–4,000	CF0	–1,000
CF1	–100	CF1	–500
F1	10	F1	4
I	10	CF2	–1,500
NPV	–4,614	F2	1
		CF3	–500
		F3	5
		I	10
		NPV	–4,693

Equivalent Annual Cost (EAC)

- Applicable to a much more robust set of circumstances than the replacement chain
- The EAC is the value of the level payment annuity that has the same *PV* as our original set of cash flows.
  - For example, the EAC for the Cadillac air cleaner is $750.98.
  - The EAC for the Cheapskate air cleaner is $763.80, which confirms our earlier decision to reject it.

Cadillac EAC with a Calculator

CF0	–4,000	N	10
CF1	–100	I/Y	10
F1	10	PV	–4,614.46
I	10	PMT	750.98
NPV	–4,614.46	FV	

Cheapskate EAC with a Calculator

CF0	–1,000	N	5
CF1	–500	I/Y	10
F1	5	PV	-2,895.39
I	10	PMT	763.80
NPV	–2,895.39	FV	

Example of Replacement Projects

Consider a Belgian Dentist's office; he needs an autoclave to sterilize his instruments. He has an old one that is in use, but the maintenance costs are rising and so is considering replacing this indispensable piece of equipment.

New Autoclave

- Cost = $3,000 today,
- Maintenance cost = $20 per year
- Resale value after 6 years = $1,200
- *NPV* of new autoclave (at *r* = 10%) is $2,409.74

$$-\$2{,}409.74 = -\$3{,}000 - \sum_{t=1}^{6} \frac{\$20}{(1.10)^t} + \frac{\$1{,}200}{(1.10)^6}$$

EAC of new autoclave = -$553.29

$$-\$2{,}409.74 = \sum_{t=1}^{6} \frac{-\$553.29}{(1.10)^t}$$

Example of Replacement Projects

- Existing Autoclave

Year	0	1	2	3	4	5
Maintenance	0	200	275	325	450	500
Resale	900	850	775	700	600	500
Total Annual Cost		*340*	*435*	*478*	*620*	*660*

Total Cost for year 1 = $(900 \times 1.10 - 850) + 200 = \$340$

Total Cost for year 2 = $(850 \times 1.10 - 775) + 275 = \$435$

Total Cost for year 3 = $(775 \times 1.10 - 700) + 325 = \$478$

Total Cost for year 4 = $(700 \times 1.10 - 600) + 450 = \$620$

Total Cost for year 5 = $(600 \times 1.10 - 500) + 500 = \$660$

Note that the total cost of keeping an autoclave for the first year includes the \$200 maintenance cost as well as the opportunity cost of the foregone future value of the \$900 we didn't get from selling it in year 0 less the \$850 we have if we still own it at year 1.

Example of Replacement Projects

- New Autoclave
  - *EAC* of new autoclave = -$553.29
- Existing Autoclave

Year	**0**	**1**	**2**	**3**	**4**	**5**
Maintenance	0	200	275	325	450	500
Resale	900	850	775	700	600	500
Total Annual Cost		*340*	*435*	*478*	*620*	*660*

•We should keep the old autoclave until it's cheaper to buy a new one.

•Replace the autoclave after year 3: at that point the new one will cost $553.29 for the next year's autoclaving and the old one will cost $620 for one more year.

Quick Quiz

- How do we determine if cash flows are relevant to the capital budgeting decision?
- What are the different methods for computing operating cash flow, and when are they important?
- How should cash flows and discount rates be matched when inflation is present?
- What is equivalent annual cost, and when should it be used?

Dorm Beds Example

Consider a project to supply the University of Missouri with 10,000 dormitory beds annually for each of the next 3 years.

Your firm has half of the woodworking equipment to get the project started; it was bought years ago for $200,000: is fully depreciated and has a market value of $60,000 today. The remaining $100,000 worth of equipment will have to be purchased.

The engineering department estimates you will need an initial net working capital investment of $10,000.

Dorm Beds Example

The project will last for 3 years. Annual fixed costs will be $25,000 and variable costs should be $90 per bed.

The initial fixed investment will be depreciated straight line to zero over 3 years. It also estimates a (pre-tax) salvage value of $10,000 (for all of the equipment).

The marketing department estimates that the selling price will be $200 per bed.

You require an 8% return and face a marginal tax rate of 34%.

Dorm Beds Example CF_0

What is the CF in year zero for this project?

Cost of New Equipment $100,000

Net Working Capital Investment $10,000

Opportunity Cost of Old Equipment $\underline{\$39{,}600}$ = $60,000 × (1-.34)

$149,600

Dorm Beds Example $OCF_{1,2}$

What is the *OCF* in years 1 and 2 for this project?

Revenue	$10{,}000 \times \$200 =$	\$2,000,000
Variable cost	$10{,}000 \times \$90 =$	\$900,000
Fixed cost		\$25,000
Depreciation	$\$100{,}000 \div 3 =$	\$33,333
EBIT		\$1,041,667
Tax (34%)		\$354,167
Net Income		\$687,500

$$OCF_{1,2} = \$687{,}500 + \$33{,}333 = \$720{,}833$$

$$\text{OR } (\$2{,}000{,}000 - 925{,}000) \times (1 - .34) + 33{,}333 \times .34 = \$720{,}833$$

Dorm Beds Example CF_3

Revenue	$10{,}000 \times \$200 =$	$2,000,000
Variable cost	$10{,}000 \times \$90 =$	$900,000
Fixed cost		$25,000
Depreciation	$\$100{,}000 \div 3 =$	$33,333
EBIT		$1,041,667
Tax		$354,167
	NI	$687,500
	$OCF_3 = NI + D$	$720,833

We get our $10,000 NWC back and sell the equipment.

The after-tax salvage value is $\$6{,}600 = \$10{,}000 \times (1-.34)$

Thus, $CF_3 = \$720{,}833 + \$10{,}000 + \$6{,}600 = \$737{,}433$

Dorm Beds Example *NPV*

First, set your calculator to 1 payment per year.

Then, use the cash flow menu:

CF0	–$149,600
CF1	$720,833
F1	2
CF2	$737,433
F2	1

I	8
NPV	$1,721,235