



# **EM600 - Engineering Economics and Cost Analysis**

## ***Lecture 07: After Tax Analysis***

- References:
  - Park, Chan S. Contemporary Engineering Economics. New Jersey: Pearson Prentice Hall, 2006 (Chapter 9: 9.7 – 9.10; Chapter 10: 10.3 – 10.4)
  - Ganguly, A. Engineering Economics Using Excel. New Jersey: SSE, 2008

After completing this module you should understand the following:

- Corporate taxes
- Treatment of capital gains and losses
- Treatment of non-cash expenses
- After tax cash flow
  - Developing cash flow statements
  - Developing cash flow equations
  - Application of Excel to after tax analysis

- Corporate Taxes
  - Corporate tax rate is applied to the taxable income of a corporation.
  - Allowable deductions include:
    - Cost of goods sold
    - Salaries and wages
    - Rent
    - Interest
    - Advertising
    - Depreciation
    - Amortization (depreciation for an intangible asset, e.g. patents, good-will)
    - Depletion
    - Various tax payments other than federal income tax

- Corporate Tax Schedule 2006

<u>Taxable income</u>	<u>Tax rate</u>	<u>Tax computation</u>
0-\$50,000	15%	$\$0 + 0.15(\Delta)$
\$50,001-\$75,000	25%	$\$7,500 + 0.25 (\Delta)$
\$75,001-\$100,000	34%	$\$13,750 + 0.34(\Delta)$
\$100,001-\$335,000	39%	$\$22,250 + 0.39 (\Delta)$
\$335,001-\$10,000,000	34%	$\$113,900 + 0.34 (\Delta)$
\$10,000,001-\$15,000,000	35%	$\$3,400,000 + 0.35 (\Delta)$
\$15,000,001-\$18,333,333	38%	$\$5,150,000 + 0.38 (\Delta)$
\$18,333,334 and Up	35%	$\$6,416,666 + 0.35 (\Delta)$

( $\Delta$ ) denotes the taxable income in excess of the lower bound of each tax bracket

- Corporate Tax Schedule 2006: Example
  - Marginal and Effective (Average) Tax Rate for a Taxable Income of \$16,000,000

Taxable income	Marginal Tax Rate	Amount of Taxes	Cumulative Taxes
First \$50,000	15%	\$7,500	\$7,500
Next \$25,000	25%	6,250	13,750
Next \$25,000	34%	8,500	22,250
Next \$235,000	39%	91,650	113,900
Next \$9,665,000	34%	3,286,100	3,400,000
Next \$5,000,000	35%	1,750,000	5,150,000
Remaining \$1,000,000	38%	380,000	\$5,530,000

$$\text{Total Tax} = \$5,150,000 + 0.38(16,000,000 - 15,000,001)$$

$$\text{Total Tax} = \$5,530,000$$

Chan S. Park, Section 9.7.1

- Items to consider:
  - Disposal of a MACRS property
    - Has the property been disposed of *during* or *before* its specified recovery period?
    - Note: for a personal property, the half-year convention is applied to depreciation amount for the year of disposal.
  - Calculations of gains and losses on MACRS property
    - Has the depreciable asset been sold for an amount greater than (gain) or less than (loss) its book value?
      - Case 1: Salvage Value (S) < Cost Basis (I)
      - Case 2: Salvage Value (S) > Cost Basis (I)

- Case 1:  $S < I$ 
  - Gains (Losses) = Salvage Value - Book Value  
where,  
salvage value = proceeds from sale
  - Gains commonly known as depreciation recapture.
    - Taxed as ordinary income.
    - No capital gains to be considered.
    - All gains are ordinary gains.

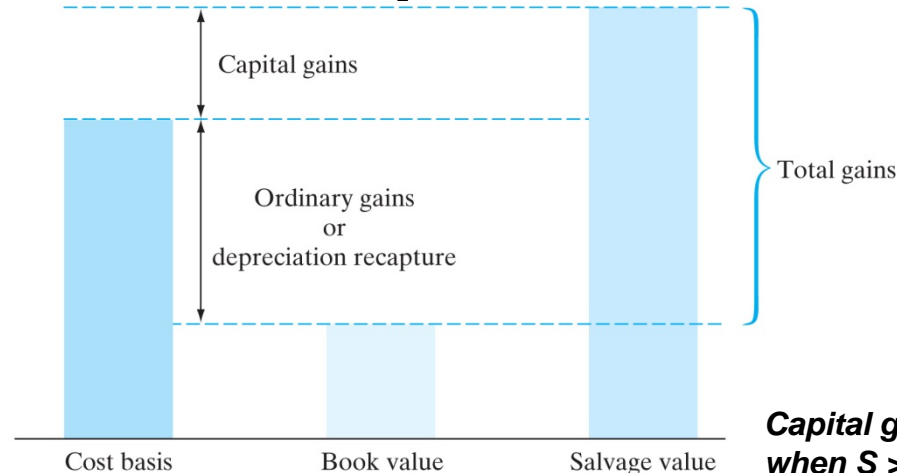


- Case 2:  $S > I$

— Gains = Salvage Value - Book Value

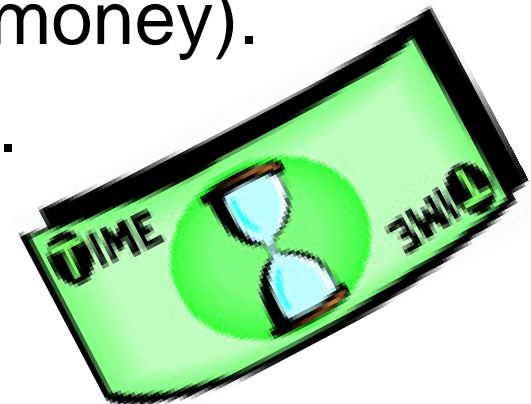
$$\text{Gains} = \underbrace{(\text{Salvage Value} - \text{Cost Basis})}_{\text{Capital Gains}} + \underbrace{(\text{Cost Basis} - \text{Book Value})}_{\text{Ordinary Gains}}$$

- Distinction only required when capital gains are taxed at a special rate and ordinary gains are taxed at the ordinary income tax rate.



**Capital gains and ordinary gains  
when  $S > I$  (Figure 9.9, Chan S. Park)**

- Net Income versus Net Cash Flow
  - Over a company's life, net incomes and net cash inflows will usually be the same.
  - The timing of incomes and cash inflows can differ substantially.
  - Cash can be invested to earn more cash, therefore it is better to receive cash NOW rather than later (time value of money).
  - Net income cannot be invested.



- Noncash Expenses

- Expenses that are deducted from revenue on a daily basis, however, NO cash is paid to anyone.

- Cash outflow not required.

- Examples:

- Depreciation

- Amortization



- Cash Flow Statements
  - Cash flows are important for project evaluation purposes
  - Net Income
    - Accounting profit.
    - Important for accounting purposes.
    - Provides a starting point to estimate the cash flow of a project.
  - Net Cash Flow = Net Income + Noncash Expenses



- Development of cash flow statements:
  - Two approach methods:
    - Income statement approach
      - Primary Focus for this class.
      - Multiple examples provided.
    - Generalized cash flow approach
      - Brief introduction provided.
      - Discussion: In class example.

- Development of Cash Flow Statements
  - Illustrated through examples and discussion of the following topics:
    - Income Statement Approach:
      - When projects require only operating and investing activities.
      - When projects require working-capital investments.
      - When projects are financed with borrowed funds.
      - When projects result in negative taxable income.
      - When projects require multiple assets.
    - Generalized cash flow approach
      - Setting up net cash flow equations
      - Lease-or-Buy decision
      - Pros and Cons of the generalized approach

# • Development of Cash Flow Statements

Income statement

Revenues	
Expenses	
Cost of goods sold	
Depreciation	
Debt interest	
Operating expenses	
<hr/>	
Taxable income	
Income taxes	
<hr/>	
Net income	

Cash flow statement

+ Net income	← Operating activities
+ Depreciation	
<hr/>	
– Capital investment	+
+ Proceeds from sales of depreciable assets	
– Gains tax	← Investing activities
– Investments in working capital	
+ Working capital recovery	+
<hr/>	
+ Borrowed funds	← Financing activities
– Repayment of principal	

Net cash flow

*A popular format used for presenting a cash flow statement (Figure 10.2, Chan S. Park)*

- Income Statement Approach:
  - **When projects require only operating and investing activities.**
  - Example 1: (Chan S. Park, example 10.1)
    - Project: Installation of a new computer system to monitor drug production.
    - Financial Data:
      - Investment: \$125,000
      - Project life: 5 years
      - Salvage value: \$50,000
      - Annual labor savings: \$100,000
      - Annual manufacturing costs:
        - » Labor: \$20,000
        - » Materials: \$12,000
        - » Overhead: \$8,000
      - Depreciation method: 7-year MACRS
      - Income tax rate: 40%
      - MARR: 15%



- Income Statement Approach:
  - **When projects require only operating and investing activities.**
  - Example 1: (Chan S. Park, example 10.1)
    - Deliverables:
      - Develop the project's cash flows over its project life.
      - Is this project justifiable at a MARR of 15%?
      - What is the internal rate of return of this project?



- Income Statement Approach:
  - **When projects require only operating and investing activities.**
  - Example 1: (Chan S. Park, example 10.1)
    - Develop the project's cash flows over its project life.
      - Step 1: Determine the allowed depreciation amounts
      - Step 2:
        - » a.) Calculate the Gains (Losses) associated with Asset Disposal
      - Step 3: Create the Income Statement
      - Step 4: Develop a Cash Flow Statement
      - Step 5: Create the Cash Flow Statement using Excel

- **Step 1: Determine the allowed depreciation amounts**

- $I = \$125,000$
- $S = \$50,000$
- $N = 5$  years
- **MACRS = 7-year**

% for 7-year MACRS  
Values shown for  $N = 1, \dots, 5$

$n$	$BV_0$	MACRS	$D_n$	$BV_n$
0	\$125,000	-	-	\$125,000
1	-	14.29%	\$17,863	\$107,138
2	-	24.49%	\$30,613	\$76,525
3	-	17.49%	\$21,863	\$54,663
4	-	12.49%	\$15,613	\$39,050
5	-	8.93%	<b>\$5,581</b>	\$33,469

$N = 5$  years, depreciation shown for years 1 to 5 using the MACRS 7-year % values.

$N = 5$ ;  
MACRS = 7-year  
 $D_5$  has the “half-year convention” applied

*Income Statement Approach; Example 1 (Chan S. Park, example 10.1);*

**Deliverable:** Develop the project's cash flows over its project life

- **Step 2:**
- **a.) Calculate the Gains (Losses) associated with Asset Disposal**
  - **Salvage Value, S**  
 $S = \$50,000$
  - **Book Value @  $n = 5$ ,  $BV_5$**   
Reference table shown in slide 19  
 $BV_5 = \$33,469$
  - **Taxable Gains or Losses**  
 $S > I$ , therefore,  
Taxable Gain (Loss) =  $S - BV_5$   
Taxable Gain (Loss) =  $\$50,000 - \$33,469 = \$16,531$
  - **Taxes for capital gains (rate = 40%)**  
 $Taxes = 0.4 \times \$16,531 = \$6,613$

- Step 3: Create the Income Statement**

<b>YEAR:</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Revenues</b>		\$100,000	\$100,000	\$100,000	\$100,000	\$100,000
<b>Expenses:</b>						
Labor		\$20,000	\$20,000	\$20,000	\$20,000	\$20,000
Material		\$12,000	\$12,000	\$12,000	\$12,000	\$12,000
Overhead		\$8,000	\$8,000	\$8,000	\$8,000	\$8,000
Depreciation		\$17,863	\$30,613	\$21,863	\$15,613	\$5,581
<b>Taxable Income</b>		\$42,137	\$29,387	\$38,137	\$44,387	\$54,419
<b>Income Taxes (40%)</b>		\$16,855	\$11,755	\$15,255	\$17,755	\$21,768
<b>Net Income</b>		\$25,282	\$17,632	\$22,882	\$26,632	\$32,651

- Step 4: Develop a Cash Flow Statement**

<b>YEAR:</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Operating Activities:</b>						
Net Income		\$25,282	\$17,632	\$22,882	\$26,632	\$32,651
Depreciation		\$17,863	\$30,613	\$21,863	\$15,613	\$5,581
<b>Investment Activities:</b>						
Investment	-\$125,000					
Salvage						\$50,000
Gains Tax						-\$6,613
<b>Net Cash Flow</b>	<b>-\$125,000</b>	<b>\$43,145</b>	<b>\$48,245</b>	<b>\$44,745</b>	<b>\$42,245</b>	<b>\$81,620</b>

- Step 5: Create the Cash Flow Statement using Excel**

### Income Statement Notes:

Taxable Income = Revenue – Expenses

Net Income = Taxable Income × Tax Rate

### Cash Flow Statement Notes:

Net Cash Flow = Operating Activities +  
Investment Activities

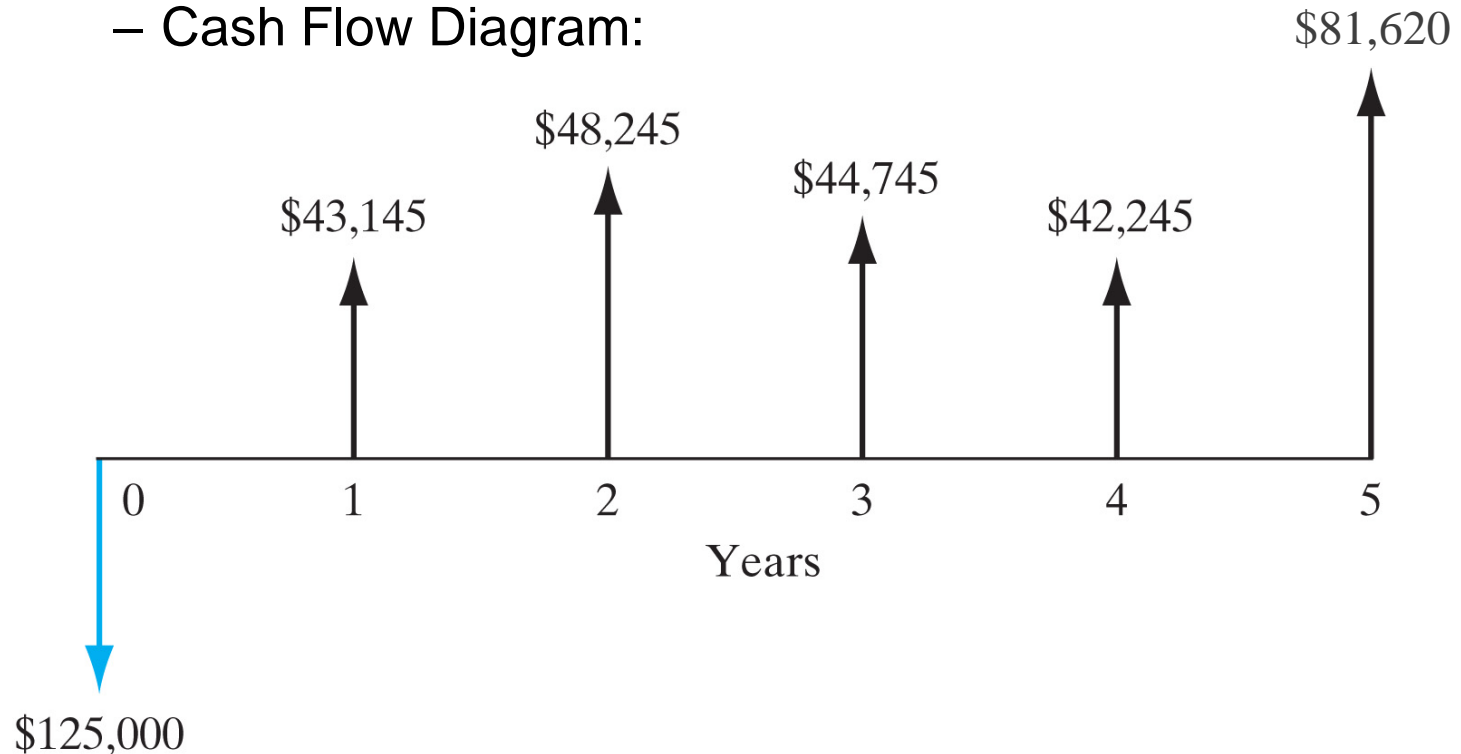
	A	B	C	D	E	F	G
1	<b>Step 1: Determine the allowed depreciation amounts</b>						
2							
3	I	\$125,000					
4	N	5					
5	S	\$50,000					
6	MACRS	7-year					
7							
8	As N = 5; the allowable amounts are as follows:						
9		n	BV <sub>n-1</sub>	MACRS	D <sub>n</sub>	BV <sub>n</sub>	
10		1	\$125,000	14.29%	\$17,863	\$107,138	
11		2	\$107,138	24.49%	\$30,613	\$76,525	
12		3	\$76,525	17.49%	\$21,863	\$54,663	
13		4	\$54,663	12.49%	\$15,613	\$39,050	
14		5	\$39,050	8.93%	\$5,581	\$33,469	
15				<i>(D<sub>5</sub>, half year convention applied)</i>			
16							
17	<b>Step 2: Calculate the Gains (Losses) associated with Asset Disposal</b>						
18							
19	Salvage Value						
20		5	\$50,000				
21	Book Value						
22		BV <sub>5</sub>	\$33,469				
23	Taxable Gains (Losses)						
24			\$16,531				
25	Taxes (Capital Gains, rate = 40%)						
26		Rate (S - BV <sub>5</sub> )	\$6,613				
27							
28	<b>Step 3: Create the Income Statement</b>						
29							
30	<b>Income Statement</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
31	Revenues		\$100,000	\$100,000	\$100,000	\$100,000	\$100,000
32	Expenses:						
33	Labor		\$20,000	\$20,000	\$20,000	\$20,000	\$20,000
34	Material		\$12,000	\$12,000	\$12,000	\$12,000	\$12,000
35	Overhead		\$8,000	\$8,000	\$8,000	\$8,000	\$8,000
36	Depreciation		\$17,863	\$30,613	\$21,863	\$15,613	\$5,581
37	Taxable Income		\$42,137	\$29,387	\$38,137	\$44,387	\$54,419
38	Income Taxes (40%)		\$16,855	\$11,755	\$15,255	\$17,755	\$21,768
39	Net Income		\$25,282	\$17,632	\$22,882	\$26,632	\$32,651
40							
41	<b>Step 4: Develop a Cash Flow Statement</b>						
42							
43	<b>Cash Flow Statement</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
44	Operating Activities:						
45	Net Income		\$25,282	\$17,632	\$22,882	\$26,632	\$32,651
46	Depreciation		\$17,863	\$30,613	\$21,863	\$15,613	\$5,581
47	Investment Activities:						
48	Investment	-\$125,000					
49	Salvage						\$50,000
50	Gains Tax						-\$6,613
51	Net Cash Flow	-\$125,000	\$43,145	\$48,245	\$44,745	\$42,245	\$81,620

**Income Statement Approach; Example 1 (Chan S. Park, example 10.1);**

**Deliverable:** Develop the project's cash flows over its project life



- Income Statement Approach:
  - Example 1: (Chan S. Park, example 10.1)
    - Is this project justifiable at a MARR of 15%?
      - Cash Flow Diagram:



*Cash Flow Diagram, example 10.1 (Figure 10.3, Chan S. Park)*



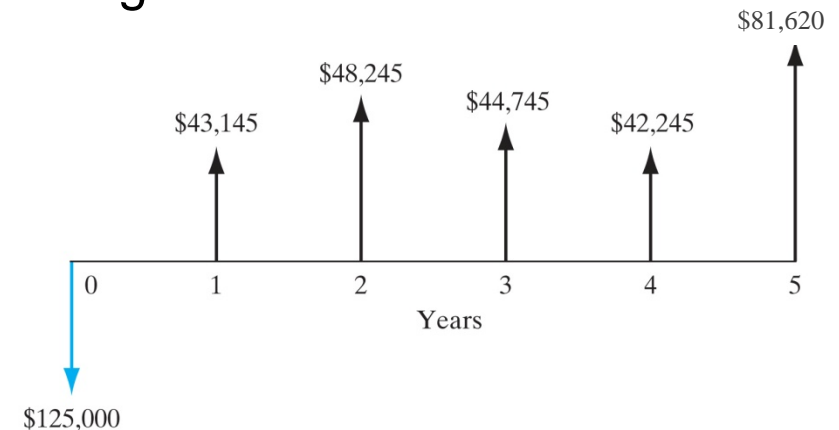
- **Calculate the Present Worth (PW) at  $i = 15\%$**

- Recall from lecture 3, for a non uniform cashflow,

$$PW = -P + \sum_{n=1}^N A_n (P/F, i, n) + F (P/F, i, N)$$

- For this example, the cash flow diagram shows:

- $P = \$125,000$
- $A_1 = \$43,145$
- $A_2 = \$48,245$
- $A_3 = \$44,745$
- $A_4 = \$42,245$
- $F = \$81,620$



- **Calculate the Present Worth (PW) at  $i = 15\%$**

- Therefore:

$$PW = -P + \sum_{n=1}^N A_n(P/F, i, n) + F(P/F, i, N)$$

$$PW = -\$125,000 + \$43,145(P/F, 15\%, 1) + \$48,245(P/F, 15\%, 2) + \\ \$44,745(P/F, 15\%, 3) + \$42,245(P/F, 15\%, 4) + \$81,619(P/F, 15\%, 5)$$

$$PW = -\$125,000 + \$43,145(0.8696) + \$48,245(0.7561) + \\ \$44,745(0.6575) + \$42,245(0.5718) + \$81,619(0.4972) \\ PW = \$43,153$$

- **PW > 0, therefore the project is justifiable and a good investment at a MARR of 15%**

- Income Statement Approach:
  - Example 1: (Chan S. Park, example 10.1)
    - What is the internal rate of return of this project?

n	Net Cash Flow
0	-\$125,000
1	\$43,145
2	\$48,245
3	\$44,745
4	\$42,245
5	\$81,620

	A
1	-\$125,000
2	\$43,145
3	\$48,245
4	\$44,745
5	\$42,245
6	\$81,620
7	=IRR(A1:
8	A6)
7	27.62%

**IRR = 27.62%**

**IRR > 15%**

**ACCEPT**

- Income Statement Approach:
  - **When projects require working-capital investments.**
    - What is Working Capital?
      - *Working capital means the amount carried in cash, accounts receivable, and inventory that is available to meet day-to-day operating needs.*
    - Treatment of Working Capital Investments
      - Treat working capital investments just like a capital expenditure **except that no** depreciation is allowed.

- Income Statement Approach:
  - **When projects require working-capital investments.**
    - Investments in Working Capital
      - Have no tax effects
      - The flows always sum to zero over the life of the project
      - The inflows and outflows are shifted in time, therefore, the present worth is effected
    - Working Capital Requirements
      - Differ according to the nature of the investment

- Income Statement Approach:
  - **When projects require working-capital investments.**
    - Working Capital (WC) equations:
      - $WC = \text{Current Asset} - \text{Current Liabilities}$
      - $\Delta WC = \Delta CA - \Delta CL$ 
        - where,  $\Delta WC$  = changes in working capital
        - $\Delta CA$  = changes in current assets
        - $\Delta CL$  = changes in current liabilities
    - **If  $\Delta WC > 0$ , working capital requirement.**

With the net change being positive, the firm has a net requirement of working capital that has to be financed during the year. Therefore, the WC requirement appears as uses of cash in the cash flow statement.
    - **If  $\Delta WC < 0$ , working capital release.**

If this amount were negative, there would have been a cash inflow from working capital release, which could add to the sources of cash.

- Income Statement Approach:
  - **When projects require working-capital investments.**
  - Example 2: (Chan S. Park, example 10.2&3)
    - Consider the same project from example 1
    - Assume the projected \$100,000 is based on sales of 10,000 units per year
    - Assume the following accounting information:

Price (revenue) per unit	\$10
Unit variable manufacturing costs:	<b>(sum = \$4)</b>
Labor	\$2
Material	\$1.20
Overhead	\$0.80
Monthly volume	833 units
Finished goods inventory to maintain	2 – month supply
Raw materials inventory to maintain	1 – month supply
Accounts payable	30 days
Accounts receivable	60 days

- Income Statement Approach:
  - **When projects require working-capital investments.**
  - Example 2: (Chan S. Park, example 10.2&3)
    - Deliverables:
      - Develop the project's cash flows over its project life.
      - Is this project justifiable at a MARR of 15%?
      - What is the internal rate of return of this project?





- Income Statement Approach:
  - **When projects require working-capital investments.**
  - Example 2: (Chan S. Park, example 10.2&3)
    - Develop the project's cash flows over its project life.
      - Step 1: Determine the allowed depreciation amounts
      - Step 2:
        - » a.) Calculate the Gains (Losses) associated with Asset Disposal
        - » b.) Calculate the working capital requirements (yr 1)
      - Step 3: Create the Income Statement
      - Step 4: Develop a Cash Flow Statement
      - Step 5: Create the Cash Flow Statement using Excel

- **Step 1: Determine the allowed depreciation amounts**

- As per example 1

- **Step 2:**

- **a.) Calculate the Gains (Losses) associated with Asset Disposal**

- As per example 1

- **b.) Calculate the working capital requirements (yr 1)**

**Accounts Receivable:**

Cash not received as a result of holding 2 months inventory

$$-\$16,667 = -(10000/12 \times 2 \times \$10)$$

**Cost of finished goods Inventory:**

Cost associated with manufacturing 2 months worth of inventory

$$-\$6,667 = -(10000/12 \times 2 \times \$4)$$

**Value of Raw materials inventory:**

Value associated with maintaining 1 month worth of inventory of raw materials

$$\$1,000 = (10000/12 \times 1 \times \$1.20)$$

**Cost of Raw materials inventory:**

Cost associated with purchasing 1 month worth of inventory of raw materials

$$-\$1,000 = -(10000/12 \times 1 \times \$1.20)$$

**Working Capital Requirements:                      -\\$23,333**

*Income Statement Approach;                      Example 2 (Chan S. Park, example 10.2&3);*

**Deliverable:** *Develop the project's cash flows over its project life*

- **Step 3: Create the Income Statement**
  - As per example 1

<b>YEAR:</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Revenues</b>		\$100,000	\$100,000	\$100,000	\$100,000	\$100,000
<b>Expenses:</b>						
Labor		\$20,000	\$20,000	\$20,000	\$20,000	\$20,000
Material		\$12,000	\$12,000	\$12,000	\$12,000	\$12,000
Overhead		\$8,000	\$8,000	\$8,000	\$8,000	\$8,000
Depreciation		\$17,863	\$30,613	\$21,863	\$15,613	\$5,581
<b>Taxable Income</b>		\$42,137	\$29,387	\$38,137	\$44,387	\$54,419
<b>Income Taxes (40%)</b>		\$16,855	\$11,755	\$15,255	\$17,755	\$21,768
<b>Net Income</b>		\$25,282	\$17,632	\$22,882	\$26,632	\$32,651

- Step 4: Develop a Cash Flow Statement**

<b>YEAR:</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Operating Activities:</b>						
Net Income		\$25,282	\$17,632	\$22,882	\$26,632	\$32,651
Depreciation		\$17,863	\$30,613	\$21,863	\$15,613	\$5,581
<b>Investment Activities:</b>						
Investment	-\$125,000					
Salvage						\$50,000
Gains Tax						-\$6,613
<b>Working Capital</b>	<b>-\$23,333</b>					<b>\$23,333</b>
<b>Net Cash Flow</b>	<b>-\$148,333</b>	<b>\$43,145</b>	<b>\$48,245</b>	<b>\$44,745</b>	<b>\$42,245</b>	<b>\$104,953</b>

- Step 5: Create the Cash Flow Statement using Excel

	A	B	C	D	E	F	G
1	<b>Step 1: Determine the allowed depreciation amounts</b>						
2							
3	I	\$125,000					
4	N	5					
5	S	\$50,000					
6	MACRS	7-year					
7							
8	As N = 5; the allowable amounts are as follows:						
9		n	BV <sub>n-1</sub>	MACRS	D <sub>n</sub>	BV <sub>n</sub>	
10		1	\$125,000	14.29%	\$17,863	\$107,138	
11		2	\$107,138	24.49%	\$30,613	\$76,525	
12		3	\$76,525	17.49%	\$21,863	\$54,663	
13		4	\$54,663	12.49%	\$15,613	\$39,050	
14		5	\$39,050	8.93%	\$5,581	\$33,469	
15					<i>(D<sub>5</sub>, half year convention applied)</i>		
16							
17	<b>Step 2:</b>						
18							
19	<b>a. Calculate the Gains (Losses) associated with Asset Disposal</b>						
20							
21	Salvage Value						
22	S	\$50,000					
23	Book Value						
24	BV <sub>5</sub>	\$33,469					
25	Taxable Gains (Losses)						
26		\$16,531					
27	Taxes (Capital Gains, rate = 40%)						
28	Rate (S - BV <sub>5</sub> )	\$6,613					
29							
30	<b>b. Calculate the working capital requirements (year 1)</b>						
31							
32	Projected Units			10000		<b>EXPENSES:</b>	
33	Revenue per unit			\$10		Labour	\$2.00
34	Units per month			833		Material	\$1.20
35	2 month inventory allowance (finished goods)			1667		Overhead	\$0.80
36							
37	Accounts Receivable:						
38	Cash not received as a result of holding 2 months inventory						
39				-\$16,667			
40							
41	Cost of finished goods Inventory:						
42	Cost associated with manufacturing 2 months worth of inventory						
43				-\$6,667			
44							
45	Value of Raw materials inventory:						
46	Value associated with maintaining 1 month worth of inventory of raw materials						
47				\$1,000			
48							
49	Cost of Raw materials inventory:						
50	Cost associated with purchasing 1 month worth of inventory of raw materials						
51				-\$1,000			
52							
53	Working Capital Requirements:			-\$23,333			

**Income Statement Approach; Example 2 (Chan S. Park, example 10.2&3);**

**Deliverable:** Develop the project's cash flows over its project life

- Step 5: Create the Cash Flow Statement using Excel**

**Income Statement Notes:**

Taxable Income = Revenue – Expenses

Net Income = Taxable Income × Tax Rate

**Cash Flow Statement Notes:**

Net Cash Flow = Operating Activities +  
Investment Activities

**Working Capital**

	A	B	C	D	E	F	G
54							
55							
56	<b>Step 3: Create the Income Statement</b>						
57							
58	<b>Income Statement</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
59	Revenues		\$100,000	\$100,000	\$100,000	\$100,000	\$100,000
60	Expenses:						
61	Labor		\$20,000	\$20,000	\$20,000	\$20,000	\$20,000
62	Material		\$12,000	\$12,000	\$12,000	\$12,000	\$12,000
63	Overhead		\$8,000	\$8,000	\$8,000	\$8,000	\$8,000
64	Depreciation		\$17,863	\$30,613	\$21,863	\$15,613	\$5,581
65	Taxable Income		\$42,137	\$29,387	\$38,137	\$44,387	\$54,419
66	Income Taxes (40%)		\$16,855	\$11,755	\$15,255	\$17,755	\$21,768
67	Net Income		\$25,282	\$17,632	\$22,882	\$26,632	\$32,651
68							
69	<b>Step 4: Develop a Cash Flow Statement</b>						
70							
71	<b>Cash Flow Statement</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
72	Operating Activities:						
73	Net Income		\$25,282	\$17,632	\$22,882	\$26,632	\$32,651
74	Depreciation		\$17,863	\$30,613	\$21,863	\$15,613	\$5,581
75	Investment Activities:						
76	Investment	-\$125,000					
77	Salvage						\$50,000
78	Gains Tax						-\$6,613
79	Working Capital	-\$23,333					\$23,333
80	Net Cash Flow	-\$148,333	\$43,145	\$48,245	\$44,745	\$42,245	\$104,953

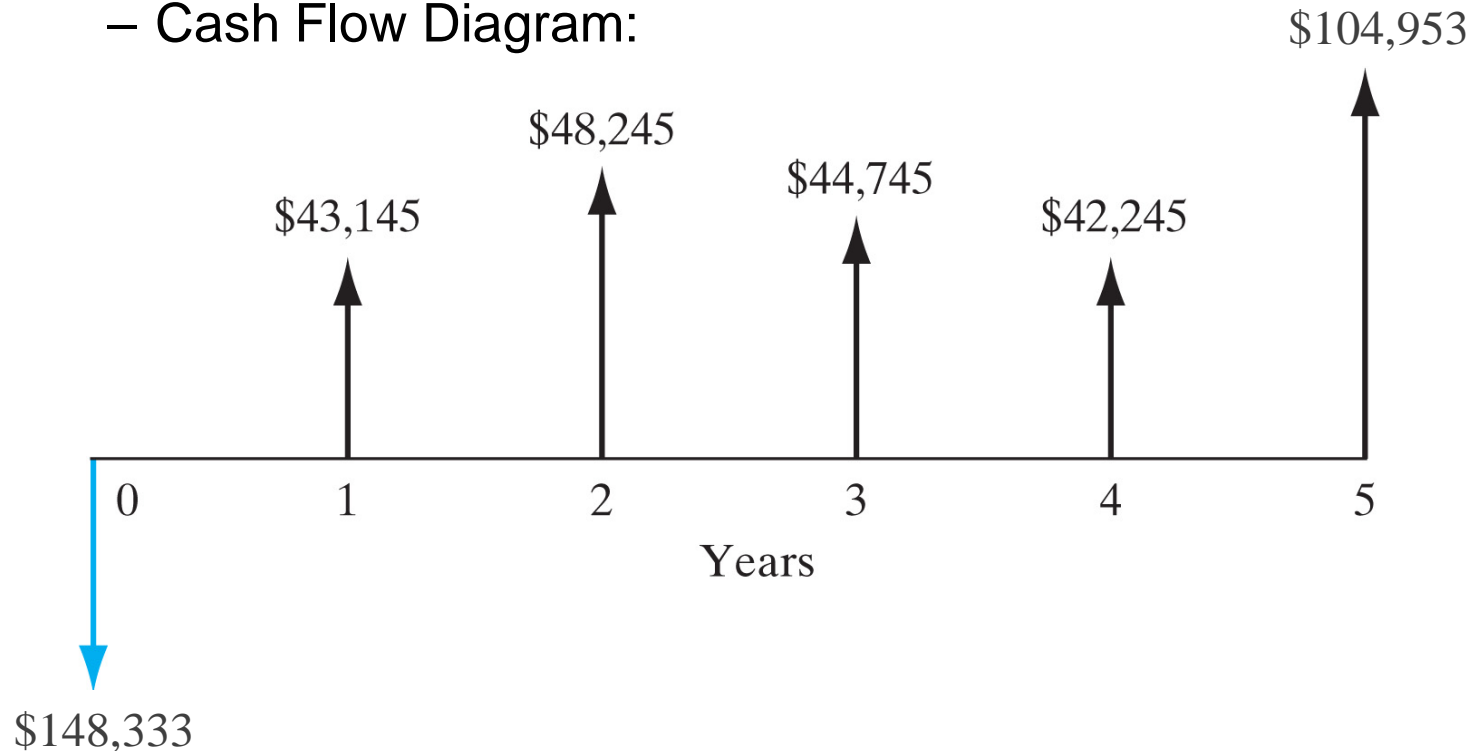
**Income Statement Approach;**      **Example 2 (Chan S. Park, example 10.2&3);**

**Deliverable:** Develop the project's cash flows over its project life



- Income Statement Approach:
  - Example 2: (Chan S. Park, example 10.2&3)
    - Is this project justifiable at a MARR of 15%?

– Cash Flow Diagram:



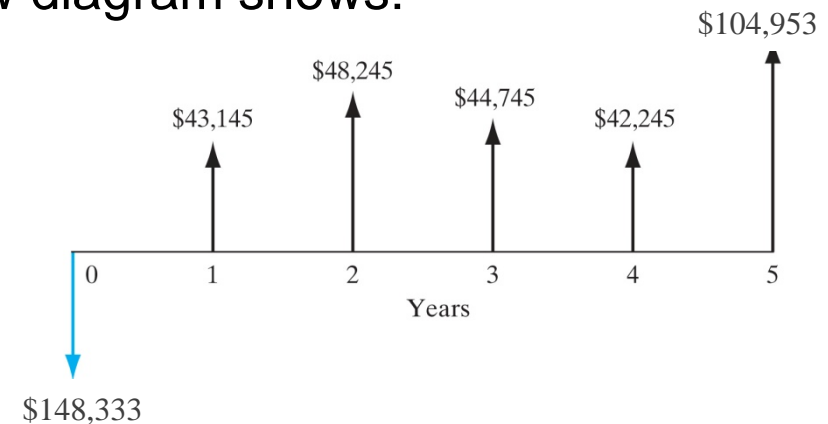
- **Calculate the Present Worth (PW) at  $i = 15\%$**

- Recall from lecture 3, for a non uniform cashflow,

$$PW = -P + \sum_{n=1}^N A_n (P/F, i, n) + F (P/F, i, N)$$

- For this example, the cash flow diagram shows:

- $P = \$148,333$
- $A_1 = \$43,145$
- $A_2 = \$48,245$
- $A_3 = \$44,745$
- $A_4 = \$42,245$
- $F = \$104,953$





- **Calculate the Present Worth (PW) at  $i = 15\%$**

- Therefore:

$$PW = -P + \sum_{n=1}^N A_n(P/F, i, n) + F(P/F, i, N)$$

$$PW = -\$148,333 + \$43,145(P/F, 15\%, 1) + \$48,245(P/F, 15\%, 2) + \\ \$44,745(P/F, 15\%, 3) + \$42,245(P/F, 15\%, 4) + \$104,953(P/F, 15\%, 5)$$

$$PW = -\$148,333 + \$43,145(0.8696) + \$48,245(0.7561) + \\ \$44,745(0.6575) + \$42,245(0.5718) + \$104,953(0.4972)$$

$$PW = \$31,421$$

- **PW > 0, therefore the project is justifiable and a good investment at a MARR of 15%**

- **Comparison of Present Worth (PW) at  $i = 15\%$** 
  - Without Working Capital requirement (example 1)
    - $PW = \$43,153$
  - With Working Capital (\$23,333) requirement
    - $PW = \$31,421$
  - Difference
    - $\Delta PW = \$11,732$
  - Conclusion
    - The \$11,732 reduction in present worth is from the investment tied up in working capital that results in lost earnings.

- Income Statement Approach:
  - Example 2: (Chan S. Park, example 10.2&3)
    - What is the internal rate of return of this project?

n	Net Cash Flow
0	-\$148,333
1	\$43,145
2	\$48,245
3	\$44,745
4	\$42,245
5	\$104,953

	A
1	-\$148,333
2	\$43,145
3	\$48,245
4	\$44,745
5	\$42,245
6	\$104,953
7	=IRR(A1:A6)
8	
7	22.55%

**IRR = 22.55%**

**IRR > 15%**

**ACCEPT**

- Income Statement Approach:
  - **When projects are financed with borrowed funds.**
    - Debt Ratio:
      - *Represents the percentage of the total initial investment provided by borrowed funds.*
      - If debt ratio is 0.4 for example,
        - » 40% of the initial investment is borrowed
        - » 60% of the initial investment is financed from the companies earnings (equity)
      - Remember, the interest repayments on borrowed funds are tax-deductible.

- Income Statement Approach:
  - **When projects are financed with borrowed funds.**
  - Example 3: (Chan S. Park, example 10.4)
    - Rework example 2 with the following changes:
      - Debt ratio = 0.5
        - » \$62,500 of borrowed funds
          - » Equal annual repayment schedule
          - » Interest,  $i = 10\%$
          - » Loan period,  $N = 5$  years
        - » \$62,500 of equity

- Income Statement Approach:
  - **When projects are financed with borrowed funds.**
  - Example 3: (Chan S. Park, example 10.4)
    - Deliverables:
      - Develop the project's cash flows over its project life.
      - Is this project justifiable at a MARR of 15%?
      - What is the internal rate of return of this project?



- Income Statement Approach:
  - **When projects are financed with borrowed funds.**
  - Example 3: (Chan S. Park, example 10.4)
    - Develop the project's cash flows over its project life.
      - Step 1: Determine the allowed depreciation amounts
      - Step 2:
        - » a.) Calculate the Gains (Losses) associated with Asset Disposal
        - » b.) Calculate the working capital requirements (yr 1)
        - » c.) Calculate the repayment schedule of the loan
      - Step 3: Create the Income Statement
      - Step 4: Develop a Cash Flow Statement
      - Step 5: Create the Cash Flow Statement using Excel

- **Step 1: Determine the allowed depreciation amounts**
  - As per example 1
- **Step 2:**
  - **a.) Calculate the Gains (Losses) associated with Asset Disposal**
    - As per example 1
  - **b.) Calculate the working capital requirements (yr 1)**
    - As per example 1
  - **c.) Calculate the repayment schedule of the loan**

Year	Beginning Balance	Interest Payment	Principal Payment	Ending Balance
1	\$62,500	\$6,250	\$10,237	\$52,263
2	\$52,263	\$5,226	\$11,261	\$41,002
3	\$41,002	\$4,100	\$12,387	\$28,614
4	\$28,614	\$2,861	\$13,626	\$14,988
5	\$14,988	\$1,499	\$14,988	\$0

(Refer to next slide for details)



- **Step 2: c.) Calculate the repayment schedule of the loan**
  - Calculate the annual repayments,  $AE = \$16,487$

56	P, amount borrowed	\$62,500	56	P, amount borrowed	\$62,500
57	i	10%	57	i	10%
58	N	5	58	N	5
59	AE	\$16,487	59	$=PMT(B57, B58, -B56, ,)$	

- **Set up the table for the loan schedule**

Beginning Balance = the ending balance for the previous year

Interest Payment = Beginning Balance  $\times$  Interest rate (i)

Principal Payment = AE - Interest Payment

Ending Balance = Beginning Balance - Principal Payment

Year	Beginning Balance	Interest Payment	Principal Payment	Ending Balance
1	\$62,500	\$6,250	\$10,237	\$52,263
2	\$52,263	\$5,226	\$11,261	\$41,002
3	\$41,002	\$4,100	\$12,387	\$28,614
4	\$28,614	\$2,861	\$13,626	\$14,988
5	\$14,988	\$1,499	\$14,988	\$0

**Income Statement Approach; Example 3 (Chan S. Park, example 10.4);**

**Deliverable:** Develop the project's cash flows over its project life

- Step 3: Create the Income Statement**

<b>YEAR:</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Revenues</b>		\$100,000	\$100,000	\$100,000	\$100,000	\$100,000
<b>Expenses:</b>						
Labor		\$20,000	\$20,000	\$20,000	\$20,000	\$20,000
Material		\$12,000	\$12,000	\$12,000	\$12,000	\$12,000
Overhead		\$8,000	\$8,000	\$8,000	\$8,000	\$8,000
Depreciation		\$17,863	\$30,613	\$21,863	\$15,613	\$5,581
<b>Debt Interest</b>		<b>\$6,250</b>	<b>\$5,226</b>	<b>\$4,100</b>	<b>\$2,861</b>	<b>\$1,499</b>
<b>Taxable Income</b>		\$35,887	\$24,161	\$34,037	\$41,526	\$52,920
<b>Income Taxes (40%)</b>		\$14,355	\$9,664	\$13,615	\$16,610	\$21,168
<b>Net Income</b>		\$21,532	\$14,496	\$20,422	\$24,915	\$31,752

*Income Statement Approach; Example 3 (Chan S. Park, example 10.4);*

**Deliverable:** Develop the project's cash flows over its project life

- Step 4: Develop a Cash Flow Statement**

<b>YEAR:</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Operating Activities:</b>						
Net Income		\$21,532	\$14,496	\$20,422	\$24,915	\$31,752
Depreciation		\$17,863	\$30,613	\$21,863	\$15,613	\$5,581
<b>Investment Activities:</b>						
Investment	-\$125,000					
Salvage						\$50,000
Gains Tax						-\$6,613
Working Capital	-\$23,333					\$23,333
<b>Financing Activities:</b>						
Borrowed Funds	\$62,500					
Principal Repayment		-\$10,237	-\$11,261	-\$12,387	-\$13,626	-\$14,988
<b>Net Cash Flow</b>	-\$85,833	\$29,157	\$33,848	\$29,897	\$26,902	\$89,066

- Step 5: Create the Cash Flow Statement using Excel

	A	B	C	D	E	F	G
1	<b>Step 1: Determine the allowed depreciation amounts</b>						
2							
3	I	\$125,000					
4	N	5					
5	S	\$50,000					
6	MACRS	7-year					
7							
8	As N = 5; the allowable amounts are as follows:						
9		n	BV <sub>n-1</sub>	MACRS	D <sub>n</sub>	BV <sub>n</sub>	
10		1	\$125,000	14.29%	\$17,863	\$107,138	
11		2	\$107,138	24.49%	\$30,613	\$76,525	
12		3	\$76,525	17.49%	\$21,863	\$54,663	
13		4	\$54,663	12.49%	\$15,613	\$39,050	
14		5	\$39,050	8.93%	\$5,581	\$33,469	
15					<i>(D<sub>5</sub>, half year convention applied)</i>		
16							
17	<b>Step 2:</b>						
18							
19	<b>a. Calculate the Gains (Losses) associated with Asset Disposal</b>						
20							
21	Salvage Value						
22	S	\$50,000					
23	Book Value						
24	BV <sub>5</sub>	\$33,469					
25	Taxable Gains (Losses)						
26		\$16,531					
27	Taxes (Capital Gains, rate = 40%)						
28	Rate (S - BV <sub>5</sub> )	\$6,613					
29							
30	<b>b. Calculate the working capital requirements (year 1)</b>						
31							
32	Projected Units			10000		<b>EXPENSES:</b>	
33	Revenue per unit			\$10		Labour	\$2.00
34	Units per month			833		Material	\$1.20
35	2 month inventory allowance (finished goods)			1667		Overhead	\$0.80
36							
37	Accounts Receivable:						
38	Cash not received as a result of holding 2 months inventory						
39				-\$16,667			
40							
41	Cost of finished goods Inventory:						
42	Cost associated with manufacturing 2 months worth of inventory						
43				-\$6,667			
44							
45	Value of Raw materials inventory:						
46	Value associated with maintaining 1 month worth of inventory of raw materials						
47				\$1,000			
48							
49	Cost of Raw materials inventory:						
50	Cost associated with purchasing 1 month worth of inventory of raw materials						
51				-\$1,000			
52							
53	Working Capital Requirements:			-\$23,333			

**Income Statement Approach; Example 3 (Chan S. Park, example 10.4);**

**Deliverable:** Develop the project's cash flows over its project life

- Step 5: Create the Cash Flow Statement using Excel

### Income Statement Notes:

Taxable Income = Revenue – Expenses

Net Income = Taxable Income × Tax Rate

### Cash Flow Statement Notes:

Net Cash Flow = Operating Activities +

Investment Activities + Financing Activities

**Financing Activities**

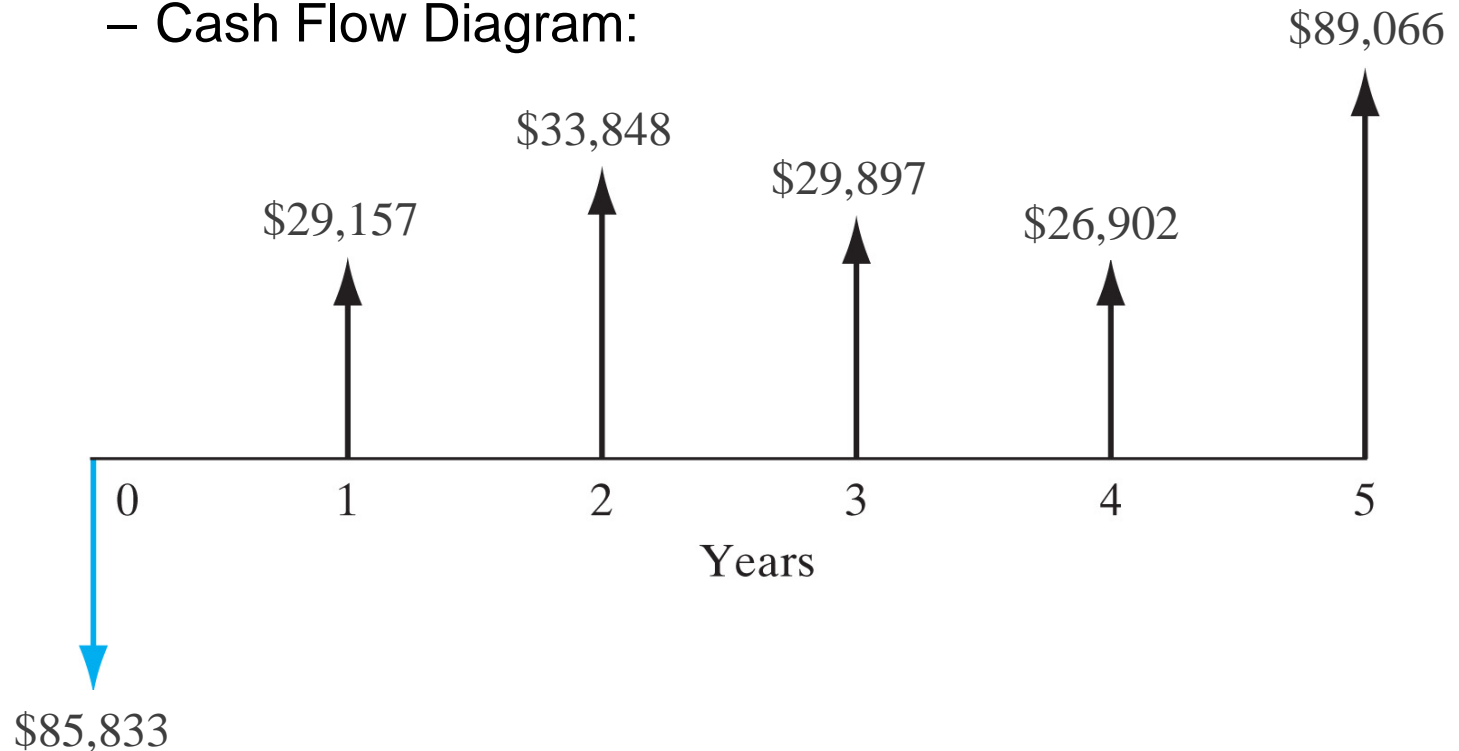
	A	B	C	D	E	F	G
54							
55	<b>c. Calculate the repayment schedule of the loan</b>						
56	P, amount borrowed	\$62,500					
57	i	10%					
58	N	\$5					
59	AE	\$16,487					
60							
61		Beginning	Interest	Principal	Ending		
62	Year	Balance	Payment	Payment	Balance		
63	1	\$62,500	\$6,250	\$10,237	\$52,263		
64	2	\$52,263	\$5,226	\$11,261	\$41,002		
65	3	\$41,002	\$4,100	\$12,387	\$28,614		
66	4	\$28,614	\$2,861	\$13,626	\$14,988		
67	5	\$14,988	\$1,499	\$14,988	\$0		
68							
69							
70	<b>Step 3: Create the Income Statement</b>						
71							
72	<b>Income Statement</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
73	Revenues		\$100,000	\$100,000	\$100,000	\$100,000	\$100,000
74	Expenses:						
75	Labor		\$20,000	\$20,000	\$20,000	\$20,000	\$20,000
76	Material		\$12,000	\$12,000	\$12,000	\$12,000	\$12,000
77	Overhead		\$8,000	\$8,000	\$8,000	\$8,000	\$8,000
78	Depreciation		\$17,863	\$30,613	\$21,863	\$15,613	\$5,581
79	Debt Interest		\$6,250	\$5,226	\$4,100	\$2,861	\$1,499
80	Taxable Income		\$35,887	\$24,161	\$34,037	\$41,526	\$52,920
81	Income Taxes (40%)		\$14,355	\$9,664	\$13,615	\$16,610	\$21,168
82	Net Income		\$21,532	\$14,496	\$20,422	\$24,915	\$31,752
83							
84	<b>Step 4: Develop a Cash Flow Statement</b>						
85							
86	<b>Cash Flow Statement</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
87	Operating Activities:						
88	Net Income		\$21,532	\$14,496	\$20,422	\$24,915	\$31,752
89	Depreciation		\$17,863	\$30,613	\$21,863	\$15,613	\$5,581
90	Investment Activities:						
91	Investment	-\$125,000					
92	Salvage						\$50,000
93	Gains Tax						-\$6,613
94	Working Capital	-\$23,333					\$23,333
95	Financing Activities:						
96	Borrowed Funds	\$62,500					
97	Principal Repayment		-\$10,237	-\$11,261	-\$12,387	-\$13,626	-\$14,988
98	Net Cash Flow	-\$85,833	\$29,157	\$33,848	\$29,897	\$26,902	\$89,066

**Income Statement Approach;**

**Example 3 (Chan S. Park, example 10.4);**

**Deliverable:** Develop the project's cash flows over its project life

- Income Statement Approach:
  - Example 3: (Chan S. Park, example 10.4)
    - Is this project justifiable at a MARR of 15%?
      - Cash Flow Diagram:





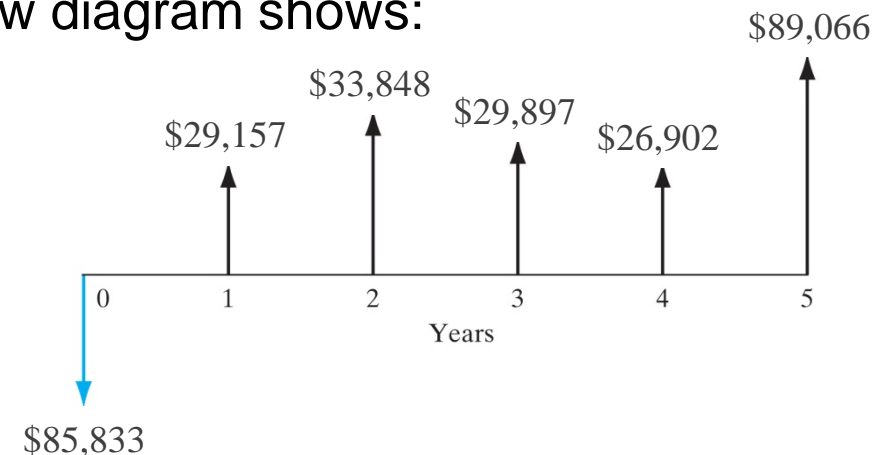
- **Calculate the Present Worth (PW) at  $i = 15\%$**

- Recall from lecture 3, for a non uniform cashflow,

$$PW = -P + \sum_{n=1}^N A_n (P/F, i, n) + F (P/F, i, N)$$

- For this example, the cash flow diagram shows:

- $P = \$85,833$
- $A_1 = \$29,157$
- $A_2 = \$33,848$
- $A_3 = \$29,897$
- $A_4 = \$26,902$
- $F = \$89,066$



- **Calculate the Present Worth (PW) at  $i = 15\%$**

- Therefore:

$$PW = -P + \sum_{n=1}^N A_n (P/F, i, n) + F(P/F, i, N)$$

$$PW = -\$85,833 + \$29,157(P/F, 15\%, 1) + \$33,848(P/F, 15\%, 2) + \\ \$29,897(P/F, 15\%, 3) + \$29,902(P/F, 15\%, 4) + \$89,066(P/F, 15\%, 5)$$

$$PW = -\$85,833 + \$29,157(0.8696) + \$33,848(0.7561) + \\ \$29,897(0.6575) + \$26,902(0.5718) + \$89,066(0.4972)$$

$$PW = \$44,438$$

- **PW > 0, therefore the project is justifiable and a good investment at a MARR of 15%**



- **Comparison of Present Worth (PW) at  $i = 15\%$** 
  - Without debt financing (example 2)
    - $PW = \$31,421$
  - With debt financing (debt ratio = 0.5)
    - $PW = \$44,438$
  - Difference
    - $\Delta PW = \$13,019$
  - Conclusion
    - The debt financing increases the present worth by \$13,019. This result is largely caused by the firm's being able to borrow the funds at a cheaper rate (10%) than its MARR of 15%.

- Income Statement Approach:
  - Example 3: (Chan S. Park, example 10.4)
    - What is the internal rate of return of this project?

n	Net Cash Flow
0	-\$85,833
1	\$29,157
2	\$33,848
3	\$29,897
4	\$26,902
5	\$89,066

	A
1	-\$85,833
2	\$29,157
3	\$33,848
4	\$29,897
5	\$26,902
6	\$89,066
7	=IRR(A1:A6)
8	
7	31.88%

**IRR = 31.88%**

**IRR > 15%**

**ACCEPT**

- Income Statement Approach:
  - **When projects result in negative taxable income.**
    - What does a negative taxable income mean?
      - If Revenues < Expenses, the result is a **negative taxable income**.
        - » The project will not generate enough revenue to offset the incurred expenses.
        - » When comparing **cost-only** mutually exclusive projects (service projects), zero revenue is typically assumed
      - A negative taxable income results in tax savings.
      - A negative taxable income can be used to reduce other taxable incomes generated by other business operations in the firm.

Year	0	1	2	3	4	5	6	7	8	9–15	16
<b>Income Statement</b>											
Revenues											
Expenses											
Depreciation		\$ 76,594	\$131,266	\$ 93,746	\$ 66,946	\$ 47,865	\$ 47,811	\$ 47,865	\$ 23,906		
Electricity cost		<u>86,000</u>	<u>86,000</u>	<u>86,000</u>	<u>86,000</u>	<u>86,000</u>	<u>86,000</u>	<u>86,000</u>	<u>86,000</u>	<u>86,000</u>	<u>86,000</u>
Taxable income		(162,594)	(217,266)	(179,746)	(152,946)	(133,865)	(133,811)	(133,865)	(109,906)	(86,000)	(86,000)
Income taxes		<u>(65,038)</u>	<u>(86,906)</u>	<u>(71,898)</u>	<u>(61,178)</u>	<u>(53,546)</u>	<u>(53,524)</u>	<u>(53,546)</u>	<u>(43,962)</u>	<u>(34,400)</u>	<u>(34,400)</u>
Net income		\$ (97,556)	\$ (130,360)	\$ (107,848)	\$ (91,768)	\$ (80,319)	\$ (80,287)	\$ (80,319)	\$ (65,944)	\$ (51,600)	\$ (51,600)
<b>Cash Flow Statement</b>											
Operating activities											
Net income		(97,556)	(130,360)	(107,848)	(91,768)	(80,319)	(80,287)	(80,319)	(65,944)	(51,600)	(51,600)
Depreciation		76,594	131,266	93,746	66,946	47,865	47,811	47,865	23,906	0	0
Investment activities											
Cooling fans	(536,000)										
Salvage value											
Gains tax											
Working capital		<u>2,121,000</u>									<u>(2,121,000)</u>
Net cash flow	\$ (536,000)	\$2,100,038	\$ 906	\$ (14,102)	\$ (24,822)	\$ (32,454)	\$ (32,476)	\$ (32,454)	\$ (42,038)	\$ (51,600)	\$ (2,172,600)
<i>Note: The working-capital release attributable to a reduction in work-in-process inventories will be realized at the end of year 1.</i>											

- Income Statement Approach:
  - **When projects require multiple assets.**
    - For example, ABC Pharmaceuticals need to expand their existing facility in order to manufacture a new patented tablet. The following are some of the assets that will be required:
      - Building (to be built on existing land)
      - Equipment (Granulators, Tablet Presses, Coating machines, Packaging Lines, . . . etc)
      - Support Systems (raw material tracking, intermediate product tracking, finished product tracking, warehouse retrieval system, . . . etc)
    - Each asset will vary in terms of its initial cost basis, MACRS classification, useful life, salvage value, . . . etc.
    - The expenses incurred for each asset must appear on the income statement.
    - The associated operating, investment and financial activities for each asset must appear on the cash flow statement.
  - Refer to example 10.6, Chan S. Park.

- Generalized cash flow approach:
  - Used when a project does not change a company's marginal tax rate
  - Pros
    - Cash flows can be generated faster
    - Formatting of results is less elaborate than with the income statement approach
  - Cons
    - Less intuitive than the income statement approach
    - Not commonly understood by business people

- Generalized cash flow approach:
  - **Lease-or-Buy decision**
    - Example 5: (Chan S. Park, example 10.8)
    - In class review of problem.
    - Is it better to own or lease the forklift truck?



