Engineering Economics

Lecture 8

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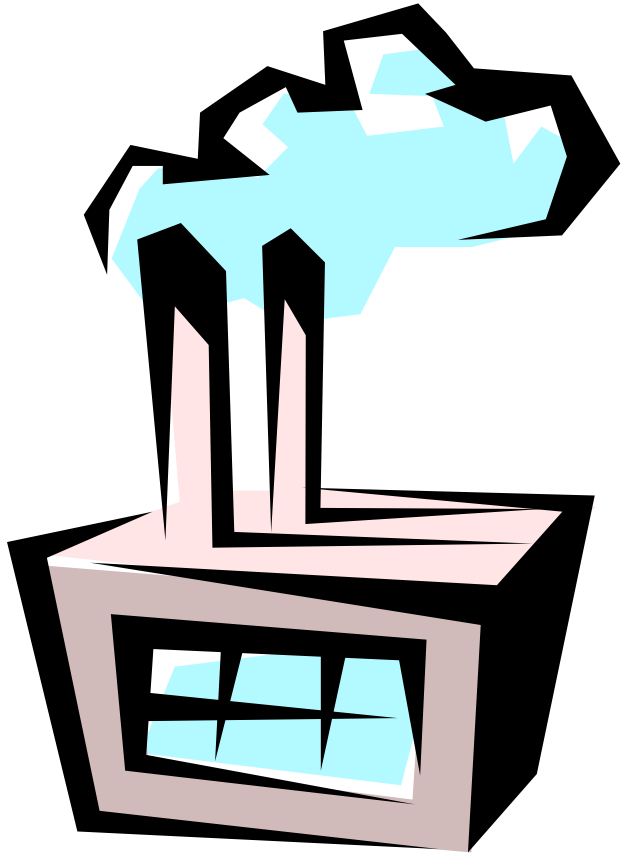
Chapter 10
Depreciation

- Asset Depreciation
- Factors Inherent to Asset Depreciation
- Book Depreciation
- Tax Depreciation
- Depletion
- Repairs or Improvements to Depreciable Assets



Depreciation

• Definition: Loss of value for a fixed asset

• Example: You purchased a car worth $15,000 at the beginning of year 2000.

End of Year	Market Value	Loss of Value
0	**$15,000**	
1	**10,000**	**$5,000**
2	**8,000**	**2,000**
3	**6,000**	**2,000**
4	**5,000**	**1,000**
5	**4,000**	**1,000**

Depreciation

Why Do We Need to Consider Depreciation?

Business Expense:
Depreciation is viewed as part of business expenses that reduce taxable income.

Gross Income -Expenses:
(Cost of goods sold)
(Depreciation)
(operating expenses)

Taxable Income

- Income taxes

Net income (profit)

Depreciation Concept

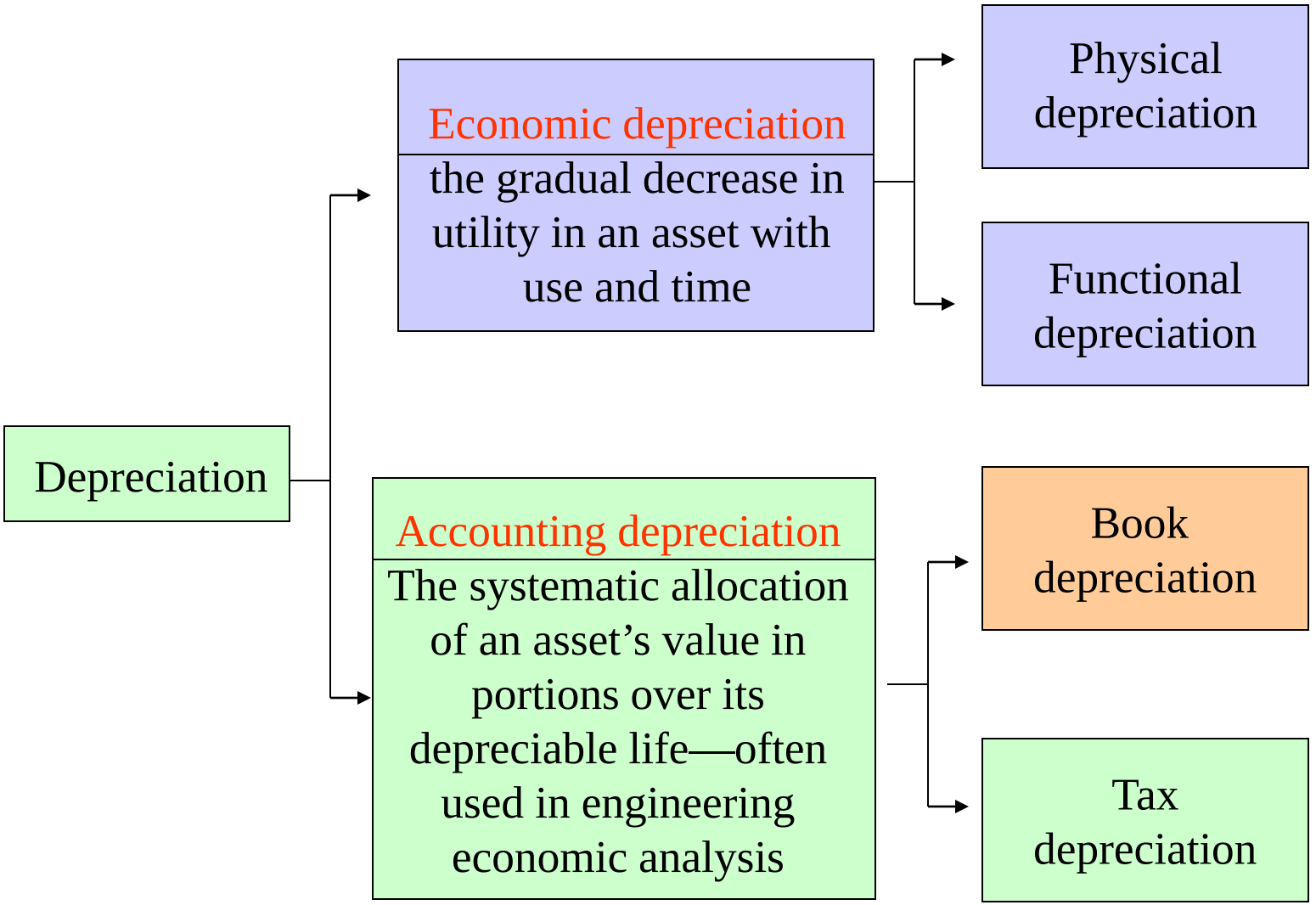
- Economic Depreciation

  Purchase Price – Market Value
  (Economic loss due to both physical deterioration and technological obsolescence)

- Accounting Depreciation

  A systematic allocation of cost basis over a period of time.

Asset Depreciation



Factors to Consider in Asset Depreciation

- Depreciable life (how long?)
- Salvage value (disposal value)
- Cost basis (depreciation basis)
- Method of depreciation (how?)

What Can Be Depreciated?

- Assets used in business or held for production of income
- Assets having a definite useful life and a life longer than one year
- Assets that must wear out, become obsolete or lose value

A qualifying asset for depreciation must satisfy all of the three conditions above. Can you depreciate land?

Cost Basis

Cost of new hole-punching machine (Invoice price)	$62,500
+ Freight	725
+ Installation labor	2,150
+ Site preparation	3,500
Cost basis to use in depreciation calculation	$68,875

Cost Basis with Trade-In Allowance

Old hole-punching machine (book value)	$4,000
Less: Trade-in allowance	5,000
Unrecognized gains	$1,000
Cost of new hole-punching machine	$62,500
Less: Unrecognized gains	(1,000)
Freight	725
Installation labor	2,150
Site preparation	3,500
Cost of machine (cost basis)	$67,875

	Asset Depreciation Range **ADRs** (years)		
Assets Used	Lower Limit	Midpoint Life	Upper Limit
Office furniture, fixtures, and equipment	8	10	12
Information systems (computers)	5	6	7
Airplanes	5	6	7
Automobiles, taxis	2.5	3	3.5
Buses	7	9	11
Light trucks	3	4	5
Heavy trucks (concrete ready-mixer)	5	6	7
Railroad cars and locomotives	12	15	18
Tractor units	5	6	7
Vessels, barges, tugs, and water transportation system	14.5	18	21.5
Industrial steam and electrical generation and or distribution systems	17.5	22	26.5
Manufacturer of electrical and nonelectrical machinery	8	10	12
Manufacturer of electronic components, products, and systems	5	6	7
Manufacturer of motor vehicles	9.5	12	14.5
Telephone distribution plant	28	35	42

Types of Depreciation

- Book Depreciation
  - In reporting net income to investors/stockholders
  - In pricing decision
- Tax Depreciation
  - In calculating income taxes for the IRD
  - In engineering economics, we use depreciation in the context of tax depreciation

Book Depreciation Methods

- Purpose: Used to report net income to stockholders/investors
- Types of Depreciation Methods:
  - Straight-Line Method
  - Declining Balance Method
  - Sum of the Years' Digits Method
  - Unit Production Method

Straight – Line (SL) Method

- Principle

  A fixed asset as providing its service in a uniform fashion over its life

- Formula
  - Annual Depreciation

    $D_n = (I - S) / N$, and constant for all n.
  - Book Value

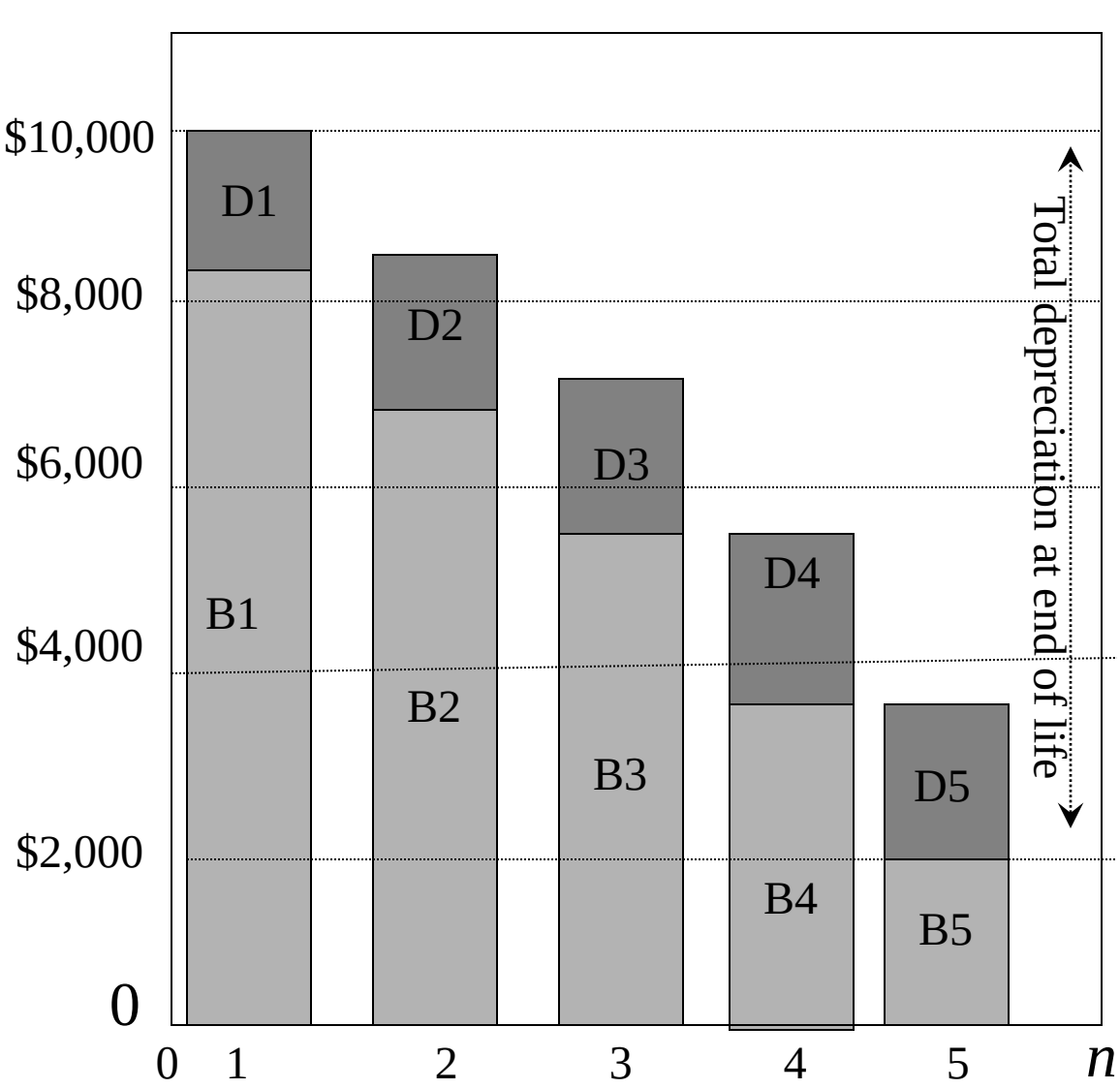
    $B_n = I - n\,(\sum D)$

  where I = cost basis

  S = Salvage value

  N = depreciable life

Example 10.3 – Straight-Line Method



Annual Depreciation

Book Value

I = \$10,000

N = 5 Years

S = \$2,000

$D = (I - S)/N$

n	D_n	B_n
1	1,600	8,400
2	1,600	6,800
3	1,600	5,200
4	1,600	3,600
5	1,600	2,000

Declining Balance Method

- Principle:

  A fixed asset as providing its service in a decreasing fashion

- Formula
  - Annual Depreciation

$$D_n = \alpha I (1-\alpha)^{n-1}$$

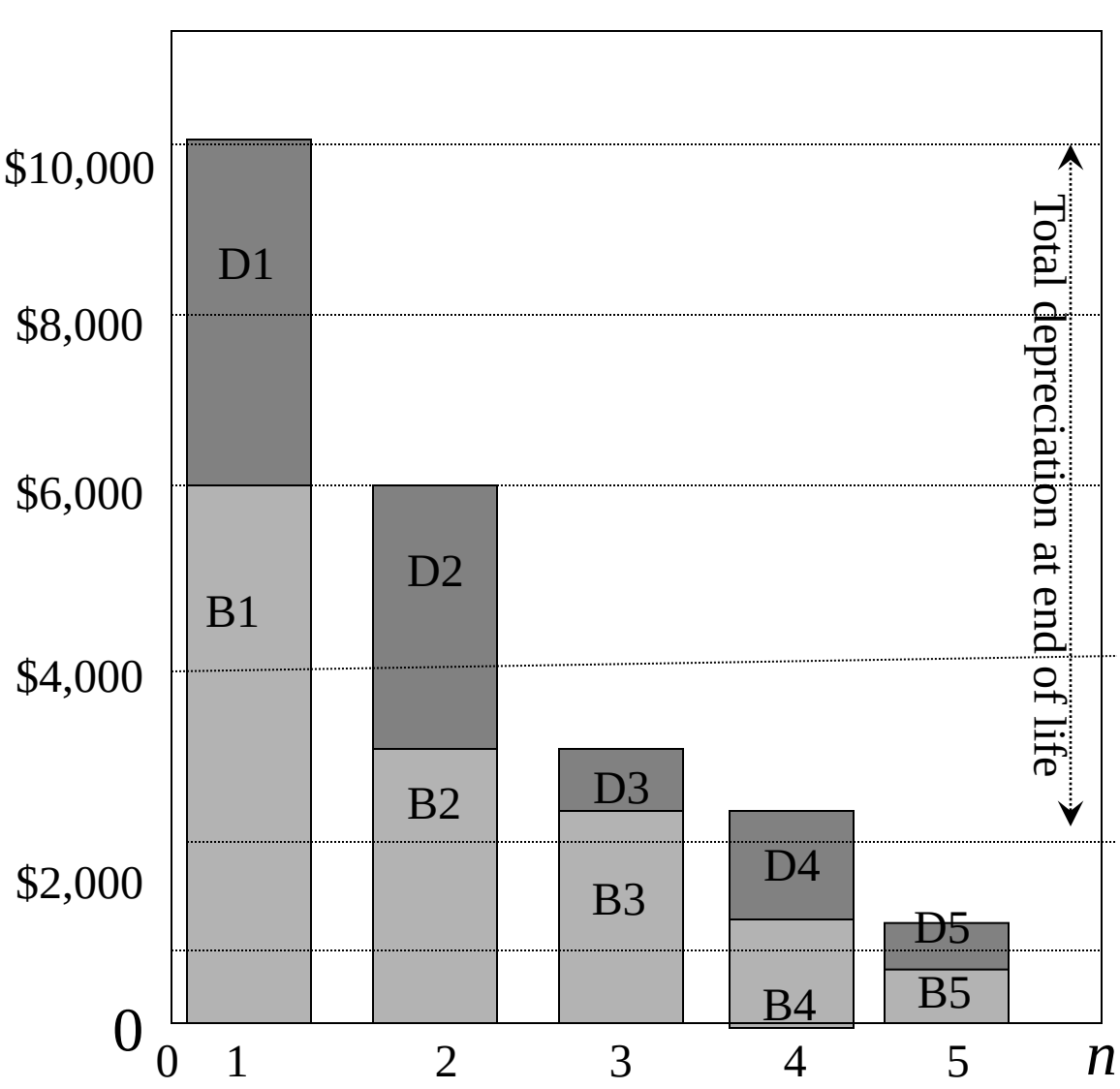
$$D_n = \alpha B_{n-1}$$

  - Book Value

$$B = I(1-\alpha)^n \quad \text{where } 0 < \alpha \leq 2(1/N)$$

Note: if α is chosen to be the upper bound, $\alpha = 2(1/N)$, we call it a 200% DB or double declining balance method.

Example 10.4 – Declining Balance Method



Annual Depreciation

Book Value

$$I = \$10{,}000$$
$$N = 5 \text{ years}$$
$$S = \$778$$
$$D_n = \alpha B_{n-1}$$
$$= \alpha I (1 - \alpha)^{n-1}$$
$$B_n = I(1-\alpha)^n$$

n	D_n	B_n
0		$10,000
1	$4,000	6,000
2	2,400	3,600
3	1,440	2,160
4	864	1,296
5	518	778

Example 10.5
DB Switching to SL

Asset:	**Invoice Price**	**$9,000**
	Freight	**500**
	Installation	**500**
Depreciation Base		**$10,000**
Salvage Value		**0**
Depreciation		**200% DB**
Depreciable life		**5 years**

- SL Dep. Rate = 1/5
- α (DDB rate) = (200%) (SL rate)
  = 0.40

Case 1: S = 0

(a) Without switching

n	Depreciation	Book Value
1	10,000(0.4) = 4,000	$6,000
2	6,000(0.4) = 2,400	3,600
3	3,600(0.4) = 1,440	2,160
4	2,160(0.4) = 864	1,296
5	1,296(0.4) = 518	778

(b) With switching to SL

n	Depreciation	Book Value
1	4,000	$6,000
2	6,000/4 = 1,500 < 2,400	3,600
3	3,600/3 = 1,200 < 1,440	2,160
4	2,160/2 = 1,080 > 864	1,080
5	1,080/1 = 1,080 > 518	0

Note: Without switching, we have not depreciated the entire cost of the asset and thus have not taken full advantage of depreciation's tax deferring benefits.

Case 2: S = $2,000

End of Year	Depreciation	Book Value
1	0.4($10,000) = $4,000	$10,000 - $4,000 = $6,000
2	0.4(6,000) = 2,400	6,000 – 2,400 = 3,600
3	0.4(3,600) = 1,440	3,600 –1,440 = 2,160
4	0.4(2,160) = 864 > 160	2,160 – 160 = 2,000
5	0	2,000 – 0 = 2,000

Note: Tax law does not permit us to depreciate assets below their salvage values.

Summary

- The entire cost of replacing a machine cannot be properly charged to any one year's production; rather, the cost should be spread (or capitalized) over the years in which the machine is in service.
- The cost charged to operations during a particular year is called depreciation.
- From an engineering economics point of view, our primary concern is with accounting depreciation; The systematic allocation of an asset's value over its depreciable life.

- Accounting depreciation can be broken into two categories:

  1. Book depreciation—the method of depreciation used for financial reports and pricing products;

  2. Tax depreciation—the method of depreciation used for calculating taxable income and income taxes; it is governed by tax legislation.

- The four components of information required to calculate depreciation are:

  1. The cost basis of the asset,
  2. The salvage value of the asset,
  3. The depreciable life of the asset, and
  4. The method of its depreciation.

•Many firms select straight-line depreciation for book depreciation because of its relative ease of calculation.

Depletion is a cost allocation method used particularly for natural resources. Cost depletion is based on the units-of-production method of depreciation. Percentage depletion is based on a prescribed percentage of the gross income of a property during a tax year.

Given the frequently changing nature of depreciation and tax law, we must use whatever percentages, depreciable lives, and salvage values mandated at the time an asset is acquired

Component of Depreciation	Book Depreciation	Tax depreciation (MACRS)
Cost basis	Based on the actual cost of the asset, plus all incidental costs such as freight, site preparation, installation, etc.	Same as for book depreciation
Salvage value	Estimated at the outset of depreciation analysis. If the final book value does not equal the estimated salvage value, we may need to make adjustments in our depreciation calculations.	Salvage value is zero for all depreciable assets

Component of Depreciation	Book Depreciation	Tax depreciation (MACRS)
Depreciable life	Firms may select their own estimated useful lives or follow government guidelines for asset depreciation ranges (ADRs)	Eight recovery periods– 3,5,7,10,15,20,27.5,or 39 years– have been established; all depreciable assets fall into one of these eight categories.
Method of depreciation	Firms may select from the following: •Straight-line •Accelerated methods (declining balance, double declining balance, and sum-of- years' digits) •Units-of-proportion	Exact depreciation percentages are mandated by tax legislation but are based largely on DDB and straight-line methods.

Chapter 11
Corporate Income Taxes

- Income tax rates
- Average vs. Marginal tax rates
- Gains taxes
- Income tax rate for economic analysis

Corporate Income Taxes (Year 2000)

(dollars in millions)

Company	Gross Income	Taxable Income	Income Taxes	Net Income	Average Tax Rate
Intel	$33,726	$15,141	$4,606	$10,535	30.42%
Cisco	18,920	4,343	1,675	2,668	38.57%
Amazon	2,762	(1,707)	0	(1,411)	0%
Broadcom	1,132	339	68	271	20.00%
Oracle	17,173	101,232	3,827	6,297	37.80%

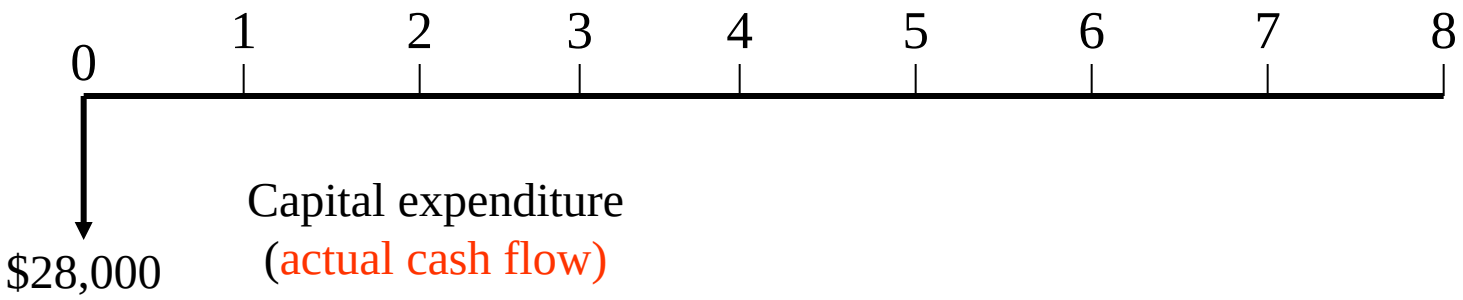
Taxable Income and Income Taxes

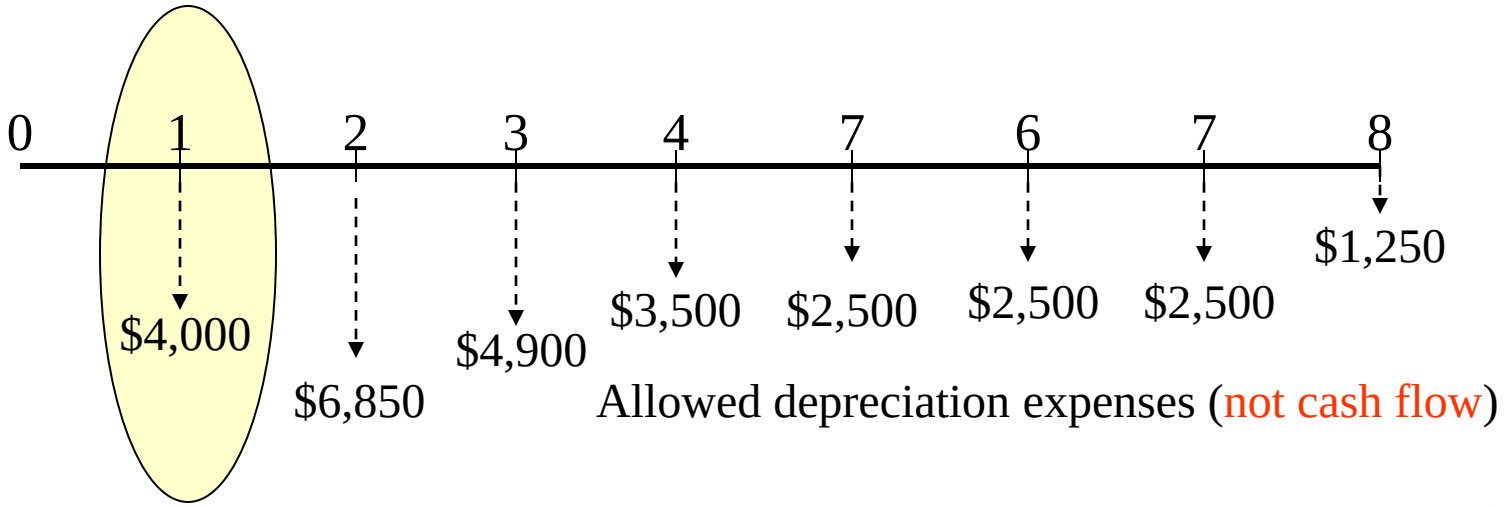
Item
Gross Income
Expenses
Cost of goods sold (revenues)
Depreciation
Operating expenses
Taxable income
Income taxes
Net income

Example 11.1- Net Income Calculation

Item	Amount
Gross income (revenue)	$50,000
Expenses	
Cost of goods sold	20,000
Depreciation	4,000
Operating expenses	6,000
Taxable income	20,000
Taxes (40%)	8,000
Net income	$12,000

Capital Expenditure versus Depreciation Expenses





Cash Flow vs. Net Income

Net income: Net income is an accounting means of measuring a firm's profitability based on the matching concept. Costs become expenses as they are matched against revenue. The actual timing of cash inflows and outflows are ignored.

Cash flow: Given the time value of money, it is better to receive cash now than later, because cash can be invested to earn more money. So, it is desirable why cash flows are relevant data to use in project evaluation.

Why Do We Use Cash Flow in Project Evaluation?

Example: Both companies (A & B) have the same amount of net income and cash sum over 2 years, but Company A returns $1 million cash yearly, while Company B returns $2 million at the end of 2nd year. Company A can invest $1 million in year 1, while Company B has nothing to invest during the same period.

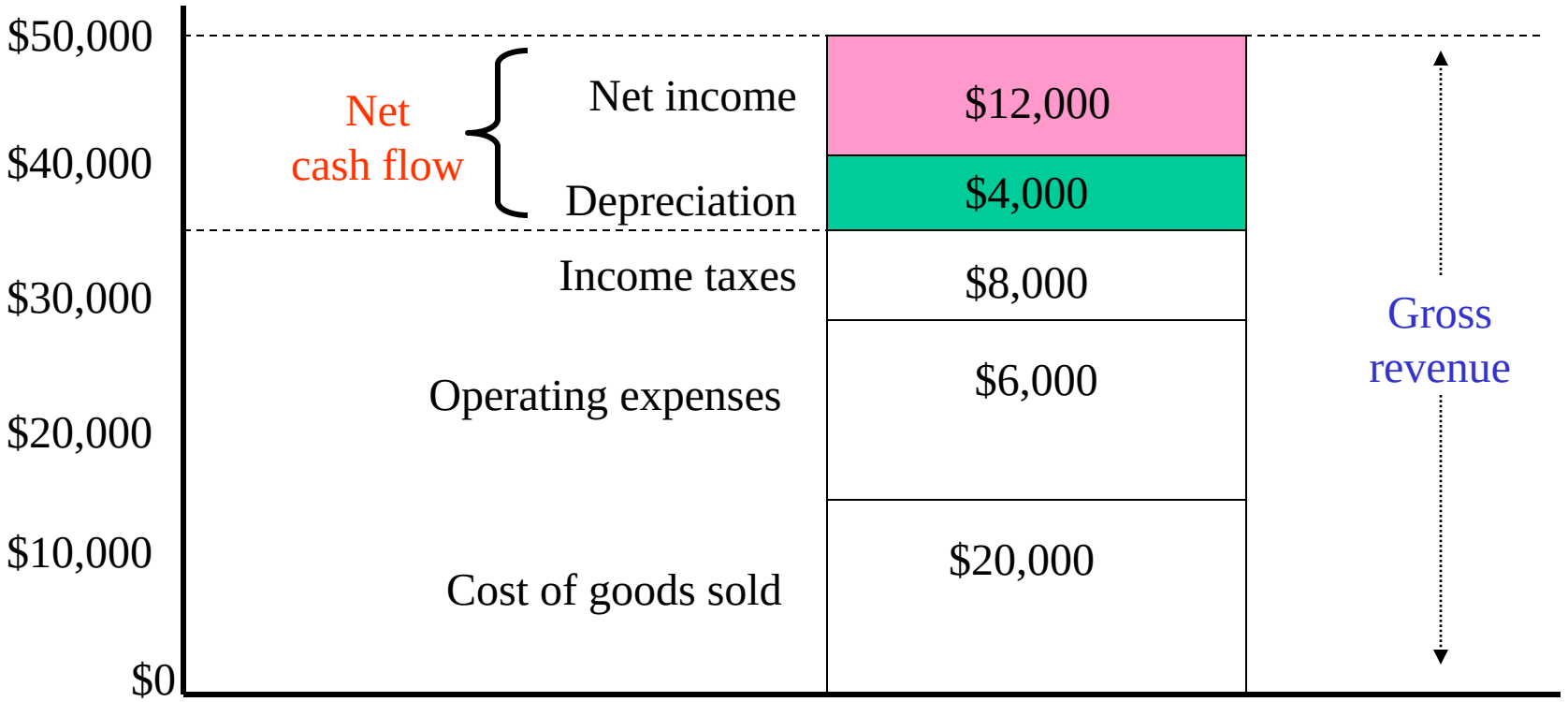
		Company A	Company B
Year 1	Net income	$1,000,000	$1,000,000
	Cash flow	1,000,000	0
Year 2	Net income	1,000,000	1,000,000
	Cash flow	1,000,000	2,000,000

Example 11.2 – Cash Flow versus Net Income

Item	Income	Cash Flow
Gross income (revenue)	$50,000	$50,000
Expenses		
Cost of goods sold	20,000	-20,000
Depreciation	4,000	
Operating expenses	6,000	-6,000
Taxable income	20,000	
Taxes (40%)	8,000	-8,000
Net income	$12,000	
Net cash flow		$16,000

Net income versus net cash flow

Net cash flows = Net income + non-cash expense (depreciation)



Corporate Tax Rate Nepal

- For Normal Business Tax Rate is 25%
- Tax Rate is 20% for the following
  - Entity operated in special economic zones under section (11)
  - Other entities involved in business of construction of roads, bridges, tunnels, rope-ways, suspension bridges
  - Entity operating trolley bus or trams
  - On transactions of cooperatives (other than tax exempted transactions) of registered under Cooperative Act, 2048
  - Entity those involved in construction or operation of public infrastructure and to be transferred to Nepal Government or involved in construction of hydropower house and its generation

Corporate Tax Rate Nepal

- Tax Rate is 30% for the following
  - Banks and financial institutions (Commercial Banks, Development Banks and Finance Companies)
  - Entity carrying General insurance business (Non life Insurance)
  - Entity engaged in petroleum business under Nepal Petroleum Act, 2040
  - Entity engaged in business of cigarette, tobacco, cigar, chewing tobacco, alcohol and beer

Example 11.3 - Corporate Income Taxes

Facts:

Capital expenditure	$100,000
(allowed depreciation)	$58,000
Gross Sales revenue	$1,250,000
Expenses:	
Cost of goods sold	$840,000
Depreciation	$58,000
Leasing warehouse	$20,000

Question: Taxable income?

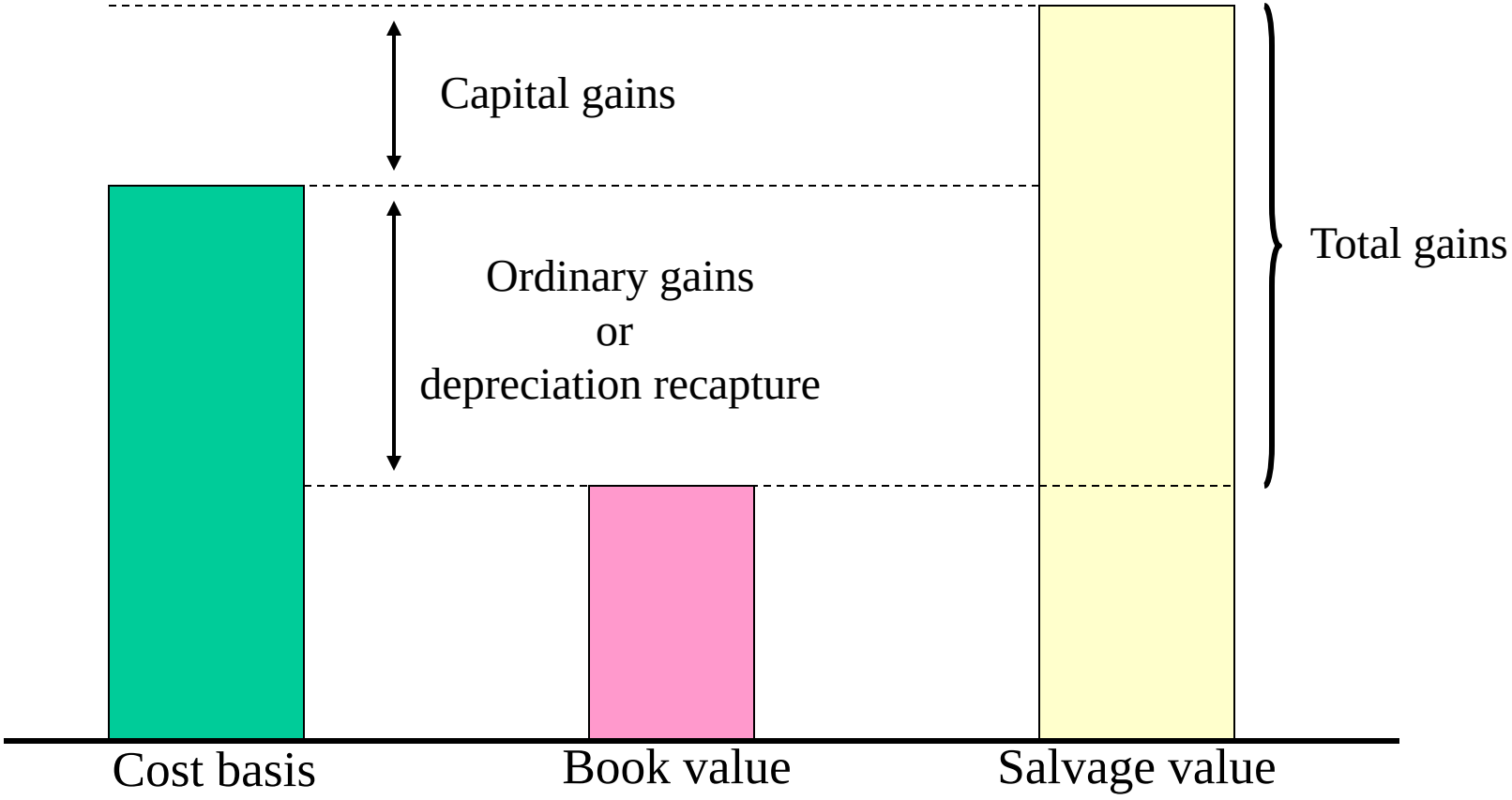
Taxable income:

Gross income	$1,250,000
- Expenses:	
(cost of goods sold)	$840,000
(depreciation)	$58,000
(leasing expense)	$20,000
Taxable income	**$332,000**

- **Income tax:**

???

Capital Gains and Ordinary Gains



Capital Gains Tax in Nepal

Individual

- Tax withholding on capital gain for natural person on transaction exceeding Rs 3 million (to be made by Land revenue office at the time of registration):
  - disposal of land or land & building owned for more than 5 years 2.5%
  - disposal of land or land & building owned for less than 5 years 5%

Corporate

- Income from disposal of non-business chargeable assets (Included in Income)

Summary

- Explicit consideration of taxes is a necessary aspect of any complete economic study of an investment project.
- Once we understand that depreciation has a significant influence on the income and cash position of a firm, we will be able to appreciate fully the importance of utilizing depreciation as a means to maximize the value both of engineering projects and of the organization as a whole.

• For corporations, the U.S. tax system has the following characteristics:

1. Tax rates are progressive: The more you earn, the more you pay.
2. Tax rates increase in stair-step fashion: four brackets for corporations and two additional surtax brackets, giving a total of six brackets.
3. Allowable exemptions and deductions may reduce the overall tax assessment.

- Marginal tax rate is the rate applied to the last dollar of income earned;
- Average (effective) tax rate is the ratio of income tax paid to net income; and
- Incremental tax rate is the average rate applied to the incremental income generated by a new investment project.
- Capital gains are currently taxed as ordinary income, and the maximum rate is capped at 35%.
- Capital losses are deducted from capital gains; net remaining losses may be carried backward and forward for consideration in years other than the current tax year.

• An investment tax credit is a direct reduction of income taxes payable, arising from the acquisition of depreciable assets. Government uses the investment tax credit to stimulate investments in specific assets or in specific industries.

End of Lecture 8