MATH 132M Business Math **Topic: Depreciation of an Asset**

For your study, please read the entire article titled *Depreciation: Definition and Types, With Calculation Examples*[1] https://www.investopedia.com/terms/d/depreciation.asp

What is a tangible or physical asset in a business? *A physical asset is something that has a use or function in a business (like machinery, equipment, tools, furniture, workspaces).*

What does it mean for something to depreciate? *Physical assets tend to decline in value over time. They have a limited useful life and eventually need to be repaired or replaced. Depreciation is a way to measure how much of an asset's value has been lost (or used) in a span of time.*

Name two reasons businesses use depreciation to record the cost of an asset. *One reason is that the IRS requires following a depreciation schedule for tax purposes. The other reason is that businesses can move the asset's cost from the balance sheet to the income statement (since the cost of the asset reduces income/profit).*

Some ***shorthand notation*** we will be using:

$\boldsymbol{OC}$ = original cost (what the asset cost as "new")
$\boldsymbol{SV}$ = salvage value (what the asset will be worth at the end of its useful lifespan)
$\boldsymbol{BV}$ = book value, or "carrying value" (original cost – accumulated depreciation) from the ***previous year***
$\boldsymbol{N}$ = life span in years
$\boldsymbol{X}$ = how much useful life (in years) ***remains*** (including the current year)
$\boldsymbol{\Sigma}$ = the sum (by adding) all useful years
(for example, if N = 10 then $\Sigma = 1 + 2 + 3 + \ldots + 10 = \frac{10 \times 11}{2}$)

Formulas Needed:

Straight-line Method – Depreciation Amount = $(\boldsymbol{OC} - \boldsymbol{SV}) \div \boldsymbol{N}$

Sum-of-Digits Method – Depreciation at $\boldsymbol{X}$ remaining years = $(\boldsymbol{OC} - \boldsymbol{SV}) \times \boldsymbol{X} \div \boldsymbol{\Sigma}$

Declining Method – Depreciation Amount = $\boldsymbol{BV} \div \boldsymbol{N}$

Double Declining Method – Depreciation Amount = $\mathbf{2} \times \boldsymbol{BV} \div \boldsymbol{N}$

Depreciable Base = $\boldsymbol{OC} - \boldsymbol{SV}$ $\quad\quad$ $\boldsymbol{\Sigma} = \boldsymbol{N} \times (\boldsymbol{N} + \mathbf{1}) \div \mathbf{2}$

[1] Tuovila, Alicia. "Depreciation: Definition and Types, With Calculation Examples." *Corporate Finance: Accounting*, Investopedia, 31 October 2023, https://www.investopedia.com/terms/d/depreciation.asp

Example of Book Value (and Straight-Line Method)

Assume CMYK Interior Painters buys a $23,000 truck to assist in the performing of residential interior painting work, and the business owner creates a new truck asset on the books with a value of $23,000. Due to factors such as the total mileage and service history, the truck is assigned a *useful life of five years*. Salvage value is the remaining value of the asset at the end of its useful life.
CMYK decides to depreciate the asset using the straight-line method with a $3,000 salvage value. The ***depreciable base*** is the $23,000 original cost minus the $3,000 salvage value, or $OC - SV = \$20{,}000$.

Using the formula: annual depreciation = $20,000 divided by 5, or $4,000 (per year).

The **end-of-year book value** of the truck changes each year because of the additional depreciation in value that is posted annually. The truck's ***book value (BV)*** is seen in this table:

Year	Depreciation Amount (Expense)	Accumulated Depreciation	End-of-Year Book Value
0	$(\boldsymbol{OC - SV}) \div \boldsymbol{N}$		Cost = $23,000
1	4,000	4,000	19,000
2	4,000	8,000	15,000
3	4,000	12,000	11,000
4	4,000	16,000	7,000
5 = N	4,000	20,000	3,000 = SV

Patterns in Depreciation

Example: You decide to start a 3D-printing business to make custom PVC fittings. The printer costs $29,000 brand new. The manufacturer claims that it has an 8-year life span if it is being used 11 hours/day every day, with regular recommended service.

Both the declining method and double declining method are used if the salvage value is unknown, and the remaining value of the printer is based on an ***exponential decay*** model.

Under these two depreciation models the BV will never get to zero. But the asset loses more of its value in the first year than in the second, and so on.

	Declining Method		Double Declining Method	
Year	Depreciation Amount	Book Value (BV)	Depreciation Amount	Book Value (BV)
0	$\boldsymbol{BV \div N}$	Cost = 29,000.00	$\boldsymbol{2 \times BV \div N}$	Cost = 29,000.00
1	3,625.00	25,375.00	7,250.00	21,750.00
2	3,171.88		5,437.50	
3				
4				
5				
6				
7				
8				

Complete the rest of the table. Now let's compare these depreciation amounts with straight-line and sum-of-digits methods. We will assume the salvage value of the asset is $2,900.

	Straight-line Method			Sum-of-Digits Method	
$\boldsymbol{OC - SV = 29,000 - 2,900 = 26,100}$				$\boldsymbol{\Sigma = 8 \times 9 \div 2 = 36}$	
Year	Depreciation Amount	Book Value (BV)	**X**	Depreciation Amount	Book Value (BV)
0	$\boldsymbol{(OC - SV) \div N}$	Cost = 29,000.00		$\boldsymbol{(OC - SV) \times X \div \Sigma}$	Cost = 29,000.00
1	3,262.50	25,737.50	8	5,800.00	23,200.00
2	3,262.50	22,475.00	7	5,075.00	18,125.00
3			6	4,350.00	
4			5	3,625.00	
5			4		
6			3		
7			2		
8			1		

Complete the rest of the table. Be ready to talk about the differences between these approaches. What assumptions do you think are made? If the printer becomes less productive as time goes on, resulting in 5% less operating time each year from one year to the next, and as a result income also decreases by 5% of the previous year's income which model makes the most sense from a cost-income perspective?

Questions for Understanding

1. A camera with a value of $20,000 has a life expectancy of 20 years. Its salvage value will be $4,000. What % of the depreciable base will be lost each year under the straight-line method? [Convert from fraction to %]

2. A photocopier has a value of $6,000 and a life of 10 years. What is the percentage depreciation of the book value each year using the double declining method?

3. A printer worth $30,000 has a life expectancy of 15 years. It depreciates using the sum-of-digits method. What is the book value at year 3?

Some key takeaways about the different depreciation methods:
1) Use the straight-line method for buildings and furniture as its use is fairly constant. (You don't use a chair less just because it may be slightly worn)
2) A method we did not discuss was "units of production" which should be used for mileage on a car – or situations where use is measured by output, not in time spent in operation.
3) Declining or double declining methods are used (typically) when productivity declines and maintenance becomes more frequent resulting in more down time.
4) Sum-of-digits method is basically a hybrid between the declining method and straight-line but is used when the salvage value is known.

Tony Bell has a series "Financial Accounting" of YouTube videos on this topic. Look for FA 35 through FA 38 on the Financial Accounting playlist. For anyone interested in learning or taking a Financial Accounting course, there is a workbook with exercises and related videos for anyone that joins the channel. See https://www.accountingworkbook.com/ Module 8 is on Capital Asset Depreciation. The worked-through example is problem number 8-2A and there are 3 parts. https://www.accountingworkbook.com/fa-mod-8-videos.html