CLASS 17

Table: Symbols, Meanings, and Definitions for Replacement Problems

Symbol	Meaning	Definition / Explanation
C	Purchase cost	The initial cost of buying the asset or machine.
M	Maintenance cost	The repair and upkeep cost of the asset in a particular year.
ΣM	Total maintenance cost	The sum of maintenance costs for all years the asset is used.
S	Scrap value	The estimated resale or salvage value of the asset at the end of its life.
n	Number of years	The total number of years the asset is in operation before replacement.
TC	Total cost	The overall cost of owning and maintaining the asset for n years: $TC = C + \Sigma M - S$
AC	Average cost per year	The cost per year of owning the asset: $AC = \frac{TC}{n}$
AC_n	Average cost for n years	The specific average cost if the asset is used for exactly n years.
MC_{n+1}		The maintenance cost expected in the year after n

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	Next year's maintenance cost	years, used to decide replacement.

Basic Formulae Used:

- **Total Cost:** $TC = C + \Sigma M - S$
- **Average Cost per Year:** $AC = \dfrac{TC}{n} = \dfrac{C + \Sigma M - S}{n}$
- **Replacement Rule:** Replace the asset when next year's maintenance cost exceeds current average cost

CLASS 18

Replacement of items whose maintenance cost increases with time and the value of money remain same during the time period:

Replacement of items whose maintenance cost increases with time and the value of money remains the same during the time period refers to the process of deciding the optimal time to replace an asset, like machinery or equipment, whose repair and upkeep costs rise as it ages, while assuming that the value of money does not change over time (no inflation or discounting). The objective is to minimize the average total cost per year, which includes purchase cost, increasing maintenance costs, and scrap value, so that the asset is neither replaced too early-wasting its useful life-nor too late-incurring excessive maintenance expenses.

Benefits of Timely Replacement of Equipment with Rising Maintenance Costs:

• Lower Total Operating Cost: When maintenance costs continuously increase over time, replacing the item at the right stage reduces the overall expenditure.

• Elimination of Escalating Repair Expenses: Frequent repairs and part replacements are avoided, preventing unnecessary spending on aging equipment.

• Improved Reliability: New equipment performs more consistently and reduces the risk of unexpected failures.

• Better Resource Utilization: Time, labor, and effort spent on maintaining old equipment can be redirected toward more productive activities.

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