1. Introduction
Replacement and maintenance models help determine optimal policies for replacing assets or components to minimize total costs over time.

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2. Individual Replacement Policy

- Each item is replaced as soon as it fails.
- Costs:
    - **Cf** = cost of failure replacement
    - **Tp** = time to failure (random, often exponential distribution)
- Used when failures are infrequent or non-critical.

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3. Group Replacement Policy

- **Replace all items at fixed intervals, regardless of condition.**
- **Can still replace failed units between group replacements.**
- **Reduces downtime but increases replacement cost if many items are still functional at group replacement time.**

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4. Preventive Maintenance (PM)

- **Maintenance performed at scheduled intervals to reduce likelihood of failure.**
- **Trade-off:**
    - **Too frequent PM → high maintenance cost**
    - **Too infrequent PM → high failure cost**

5. Decision Factors

- Cost of downtime vs. cost of maintenance/replacement
- Failure probability distribution
- Impact of failure on operations

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6. Applications

- Manufacturing machinery
- Fleet vehicle scheduling

- IT hardware replacement
- Infrastructure maintenance (bridges, pipelines, aircraft parts)