# Report for Assignment 2: Question 2

## 1. Requirements

* Simulate two fan replacement policies via Monte Carlo.
* Perform exactly 45 replacement events per simulation run.
* Randomly generate both fan lifetimes and technician arrival delays.
* Calculate downtime cost and labor cost for each event.
* Sum these costs to produce a total cost per policy per run.

## 2. Simulation Overview

The simulation compares two strategies:

1. **Current Policy**: Replace only the failed fan each time.
2. **Proposed Policy**: Replace all three fans whenever any one fails.

Each failure event incurs three cost components, calculated as follows.

**Replacement Cost**

where

**Downtime Cost**

where

**Labor Cost**

where

The total cost for one failure event is

A full simulation run of $N = 45$ failures yields

## 3. Random Sampling of Inputs

We sample from the discrete distributions given in the assignment PDF:

* **Fan Lifetimes (hours)**:

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* **Technician Delays (minutes)**:

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## 4. Core Simulation Function

We encapsulate each policy’s event loop in a function:

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This is invoked twice per run:

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## 5. Monte Carlo Loop and Data Capture

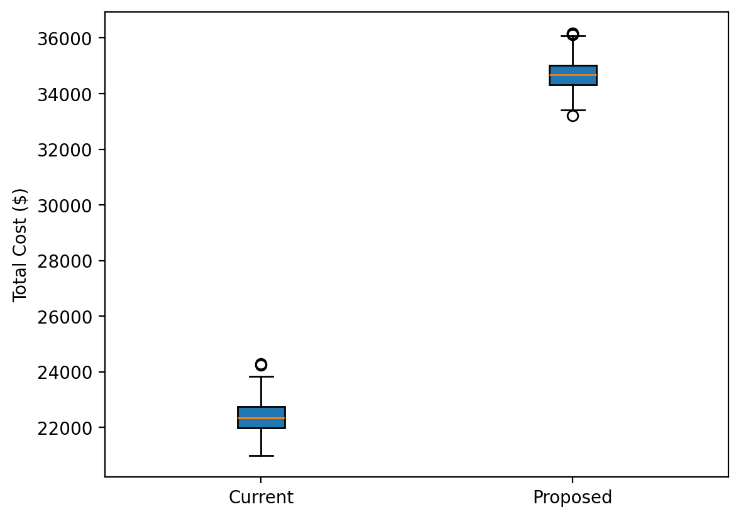
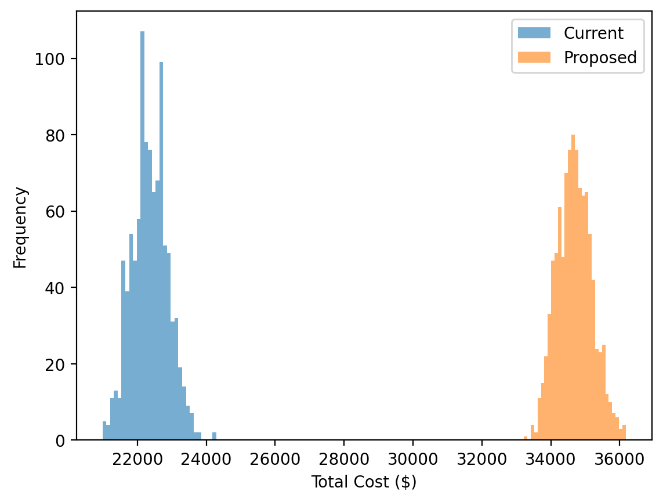
A fixed seed ensures reproducibility. We execute 1 000 runs, collecting totals:

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## 6. Visualization of Outcomes

We visualize df\_results via histogram and boxplot to compare distributions of total costs across policies.



## 7. Manual Verification Example

Fixing delay $D = 20$ min yields per-event costs:

Aggregating 45 failures:

Comparing these hand‐computed totals to Monte Carlo means confirms correctness.

## 8. Conclusion and Recommendation

We compute average total cost per policy over 1 000 runs; the policy with the lower mean is recommended.

## 9. Anexo:

Link: <https://unfcsimulation.streamlit.app/>

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