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Fleet Composition under Uncertainty: A Multi-Objective Optimization Approach

This study tackles the fleet composition problem for a transport operator facing uncertainties in energy prices, vehicle costs, and operational expenses over a defined planning horizon. With a limited budget, the decision-maker must choose among vehicle types—such as diesel with lower upfront costs but higher running expenses, and electric with the opposite profile.

To manage long-term cost and risk, the research proposes a multi-objective mixed-integer quadratic programming (MO-MIQP) model. This model minimizes total cost of ownership (including purchase, energy, maintenance, depreciation, and emissions) while also reducing financial risk linked to uncertain parameters.

A Pareto front guides trade-off decisions between cost and risk. The model incorporates ARIMA-based forecasts for energy and vehicle prices, integrating them into both cost and risk functions. This approach offers practical insights into balancing economic and environmental considerations in fleet planning, supporting resilient, data-driven decision-making.

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