

A NOVEL, MULTI-COMPONENT OBJECTIVE FUNCTION FOR MODELING REAL-WORLD VEHICLE ROUTING PROBLEM CONSTRAINTS

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Abstract. *Standard Vehicle Routing Problem (VRP) models, often focused on minimizing total distance, fail to capture the complex, competing constraints of real-world logistics. In sectors like daily goods distribution, operational success depends on balancing route efficiency with critical business rules, such as client time-windows, variable service times, and differing client priorities.*

This work introduces a novel, multi-component objective function designed specifically to bridge this gap. Our function integrates base travel time with a flexible system of weighted penalties for service timeliness (early or late arrivals) and a scaling factor for client priority.

To demonstrate its efficacy in modeling real-world scenarios, we apply the function to guide an optimization algorithm on a test instance. We show how the resulting routes systematically balance travel time against critical business constraints in a way that simple min-distance models cannot. By adjusting the function's component weights, we demonstrate its capability to produce operationally-aware routes that verifiably prioritize key clients and respect time-windows, better reflecting the complex decision-making required in practical logistics. This research validates the function's utility as a superior model for real-world operations

Key words: Vehicle Routing Problem, VRP, Objective Function, Real-World Constraints, Logistics Modeling, Time Windows, Client Priority, Multi-Component Model.

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