

Explanation of the Multi-Time Windows Dataset for the Vehicle Routing Problem with Time Windows Dataset

Introduction

This document provides an overview of the newly created dataset that extends the classic Solomon benchmark instances for the Vehicle Routing Problem with Time Windows (VRPTW). The dataset introduces multiple time windows for each customer, enhancing the realism and applicability of routing algorithms in logistics and supply chain management.

Dataset Structure

The dataset consists of six CSV files, each corresponding to a specific problem type from the original Solomon datasets. Each file contains data for 100 customers, including the depot, and includes the following columns:

- **CUST_NO:** Customer ID (0 represents the depot)
- **XCOORD:** X-coordinate of the customer's location
- **YCOORD:** Y-coordinate of the customer's location
- **DEMAND:** The demand of the customer (in units)
- **READY_TIME_1:** Start time of the first time window
- **DUE_TIME_1:** End time of the first time window
- **READY_TIME_2:** Start time of the second time window
- **DUE_TIME_2:** End time of the second time window
- **READY_TIME_3:** Start time of the third time window
- **DUE_TIME_3:** End time of the third time window

Example of the New Dataset

The following table illustrates a sample of the new dataset, showing the first six customers, including the depot:

CUST_NO	XCO_ORD	YCO_ORD	DEM_AND	READY_TIME_1	DUE_TI_ME_1	READY_TIME_2	DUE_TI_ME_2	READY_TIME_3	DUE_TI_ME_3
0	40	50	0	0	960	0	960	0	960
1	45	68	10	690	750	570	630	900	960
2	45	70	30	750	810	480	540	570	630
3	42	66	10	780	840	540	600	720	780
4	42	68	10	480	540	810	870	750	810
5	42	65	10	690	750	810	870	480	540

Original Solomon Dataset Analysis

The following table summarizes the analysis of the original Solomon datasets, highlighting key metrics for each problem type:

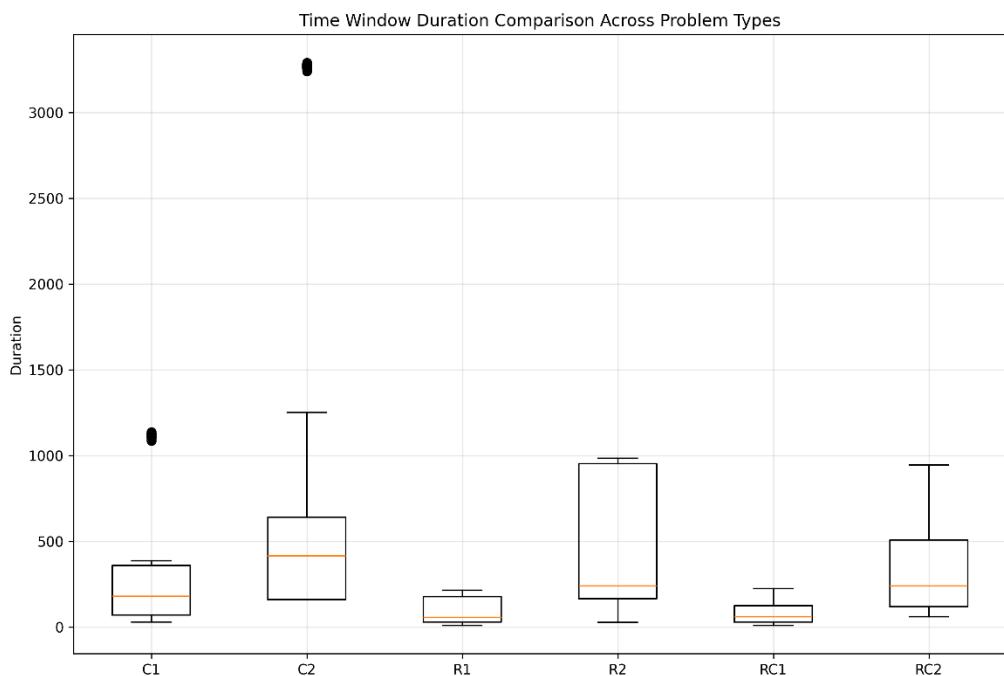
Problem Type	Count	Mean Ready Time	Mean Due Time	Mean Duration	Min Duration	Max Duration
C1	900	316.33	637.32	320.99	29	1136

C2	800	1114.85	2035.36	920.51	160	3291
R1	1200	59.46	146.42	86.95	10	215
R2	1100	241.34	695.08	453.73	27	985
RC1	800	64.26	149.69	85.42	10	225
RC2	800	258.90	628.66	369.75	60	945

Figures

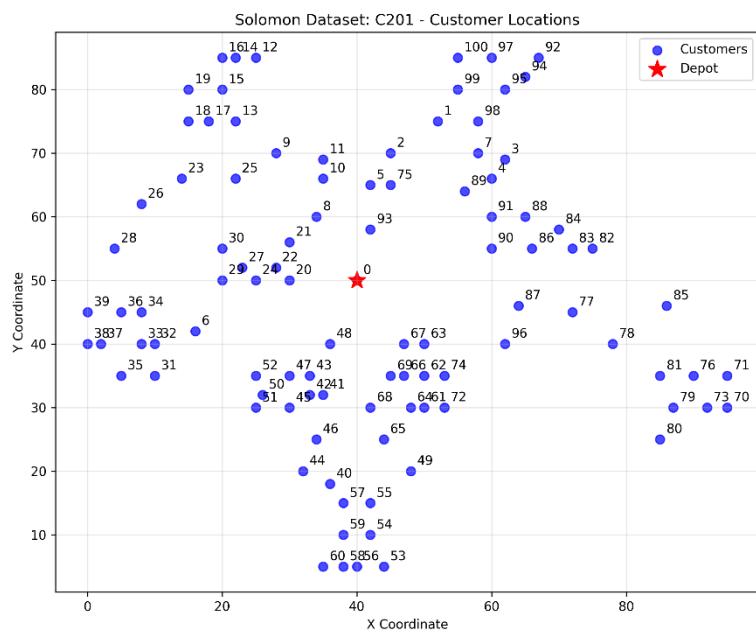
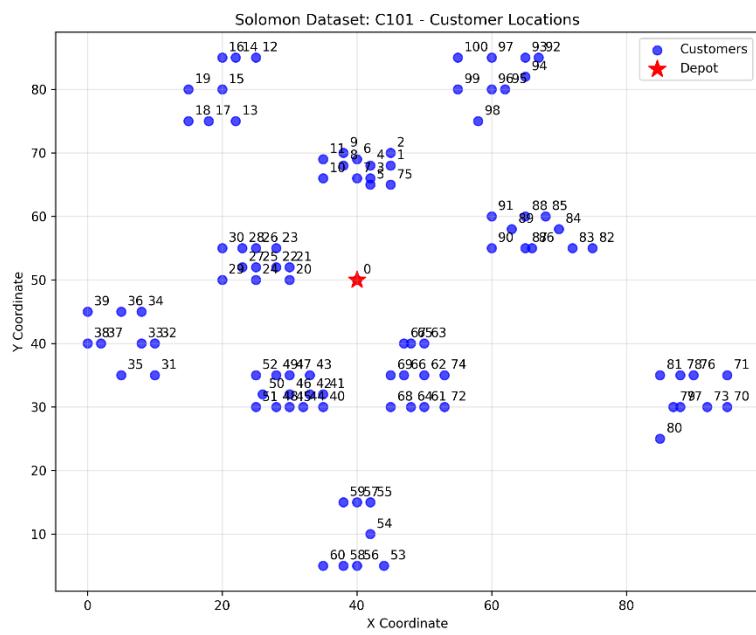
1. Time Window Duration Comparison Across Problem Types

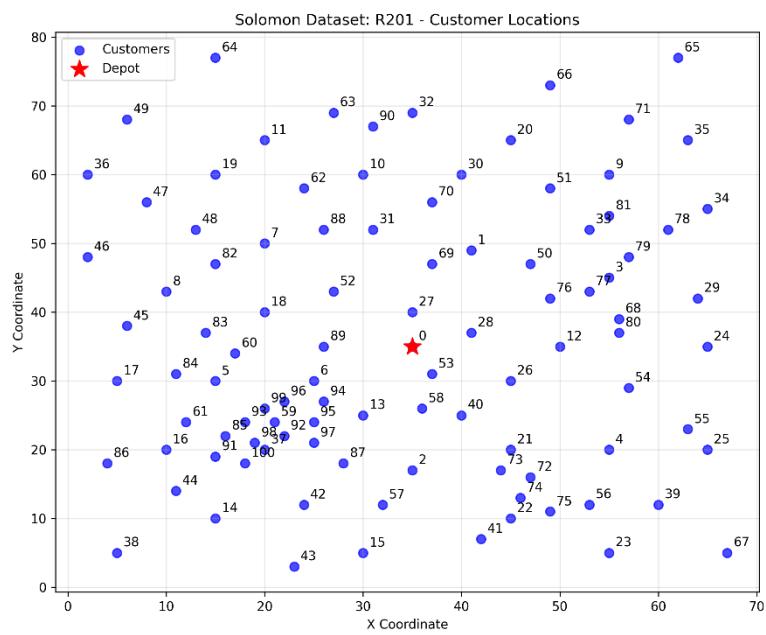
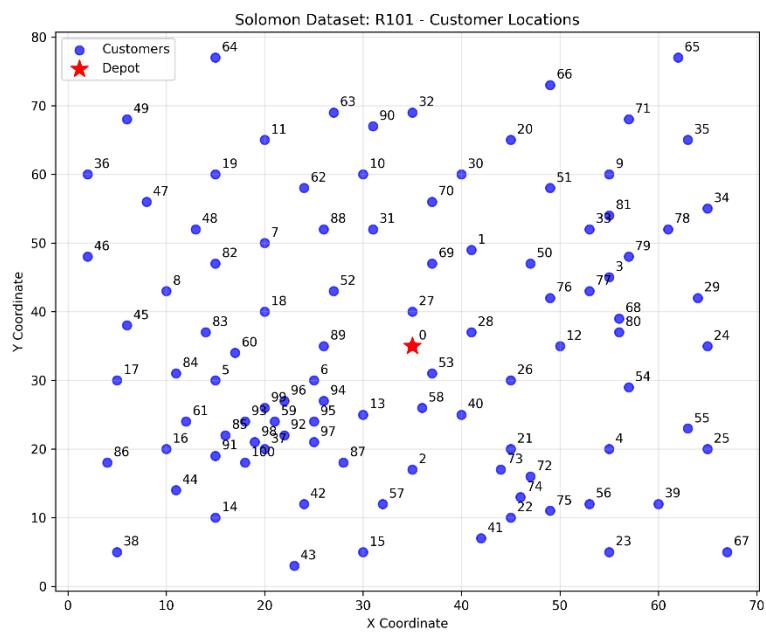
The boxplot below illustrates the duration of time windows across the six different problem types. Each box represents the distribution of time window durations, highlighting the variability and central tendency.

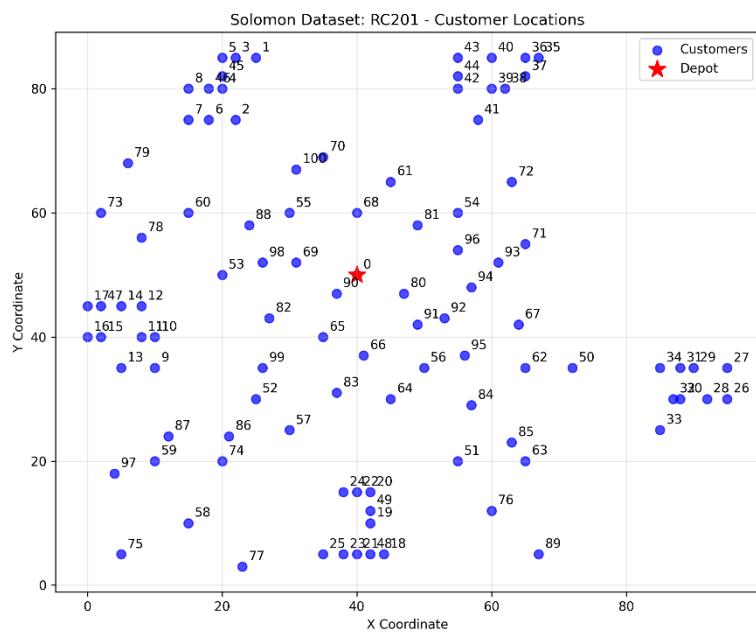
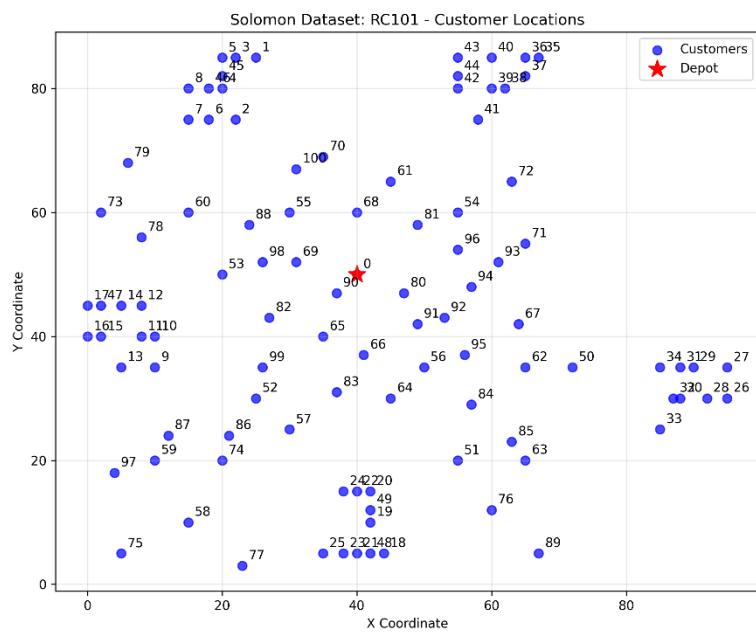


2. Customer Locations (X, Y) for Each Dataset

The following figures display the customer locations for each of the six datasets. Each point represents a customer, with the depot marked distinctly.

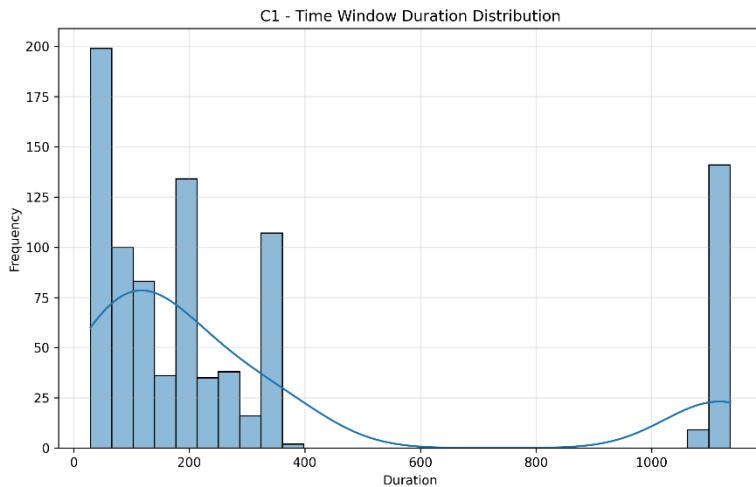






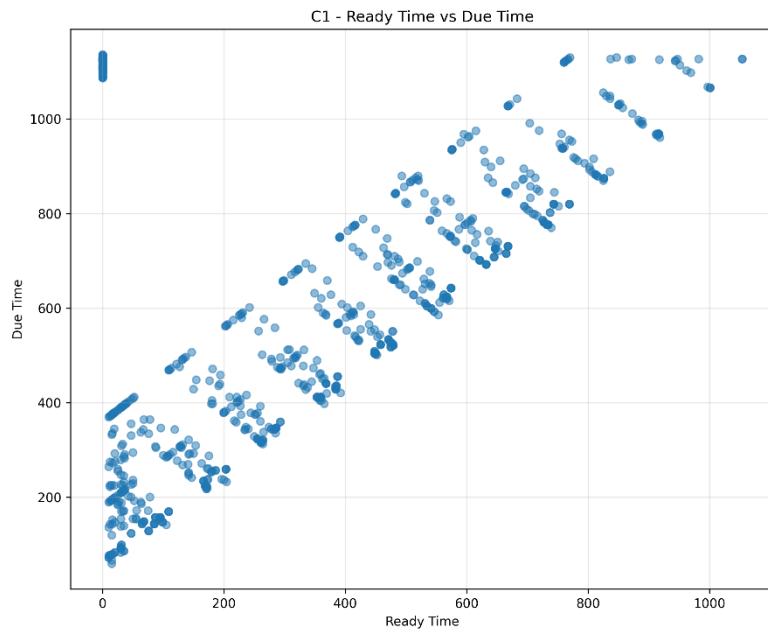
3. Time Window Duration Distribution

The distribution of time window durations for each problem type is shown in the histogram below. The x-axis represents the duration, while the y-axis indicates the frequency of occurrences.



4. Ready Time vs. Due Time

The scatter plots below depict the relationship between ready time and due time for each dataset. The x-axis represents the due time, while the y-axis represents the ready time.



Standardization of Time Windows

In the new dataset, each customer is assigned three standardized time windows, each with a duration of 60 minutes. This standardization allows for a more flexible and realistic representation of customer availability, facilitating the development and testing of advanced routing algorithms.

Conclusion

This explanation file provides a comprehensive overview of the new dataset, including its structure, analysis of the original Solomon datasets, and visual representations of key metrics.

The dataset is designed to support research in preference-based routing, dynamic scheduling, and multi-objective optimization in logistics and supply chain management.