

Dataset Description – Electric Vehicle Routing Problem with Time Windows given the Altitude Information

1. Network size, type, and File Variants

This is the dataset used in the experimental study of the paper entitled “Uphill Struggles, Downhill Gains: How Road Gradients and Load Dynamics Influence Electric Vehicle Routing Decisions?” by Rastani et al. (2025). This paper deals with the Electric Vehicle Routing Problem with Time Windows by taking into account the effect of road gradient and regenerative braking on energy consumption, which is referred to as the EVRPTW-GR. The instances are generated using the EVRPTW instances of Schneider et al. (2014), modified by Rastani et al. (2025).

EVRPTW-GR dataset consists of three subsets with different network sizes. Small networks include three further categories with 5-, 10-, and 15-customer datasets, whereas medium and large networks include 25- and 50-customer datasets, respectively. Each subset consists of three versions of the same instance, differentiated by the terrain altitudes assigned to each customer location, namely level, nearly level, and very gentle. Each small and medium-size dataset includes 12 instances, and the large-size data set contains 4 instances.

It is worth noting that the level terrain, where the altitude data is neglected, is similar to Shneider et al. (2014) data, with the only difference being the demand data, as we scaled the demand to make it meaningful for large vehicles and load-dependent cases.

Files are given names following the convention used in Schneider et al. (2014). For example, in “c101C25_L”, c101 is the identifier of the instance, where the first letter shows the category for the geographic distribution of customers: clustered (c-type), random (r-type), and a combination of clustered and random (rc-type). Additionally, type-1 problems (subsets r1, c1, rc1) feature a short planning horizon with narrow customer time windows, whereas type-2 problems (subsets r2, c2, rc2) have a long planning horizon with wider time windows. The next identifier shows the number of customers in the instance. Finally, the letter at the end represents the terrain conditions, which are explained in Table 1:

Table 1. File Variants

File Variant	Name	Description
_L	Level	Represents flat terrain where all altitude values are set to 0.0.
_NL	Nearly Level	Contains nearly level altitude values.
_VG	Very Gentle	Represents steeper terrain. Altitude values are 1.5 times higher than those in the _NL file.

These three variants allow comparative analysis of how different terrain conditions affect routing, distance, and energy consumption.

2. File Structure

Each file follows the same structure and contains the following columns:

Table 2. File Structure

Column	Description
StringID	Unique identifier for each node (e.g., depot or customer).
Type	Node type indicator (e.g., C for customer, D for depot).
x	X coordinate of the node location.
y	Y coordinate of the node location.
demand	Customer demand at the node.
ReadyTime	Earliest allowable service start time.
DueDate	Latest allowable service start time.
ServiceTime	Duration of service required at the node.
altitude	Elevation of the node, varying according to the file variant (_NL, _VG, or _L).

References

- Schneider, M., Stenger, A. and Goeke, D., 2014. The Electric Vehicle-Routing Problem with Time Windows and Recharging Stations. *Transportation Science*, 48(4), pp.500-520.
- Rastani, S., Keskin, M., Yüksel, T., Çatay, B., 2025. Uphill Struggles, Downhill Gains: How Road Gradients and Load Dynamics Influence Electric Vehicle Routing Decisions? *European Journal of Operational Research*, to appear.