

Analytical Toolbox for Smart City Applications: Garbage Collection Log Use Case

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Background

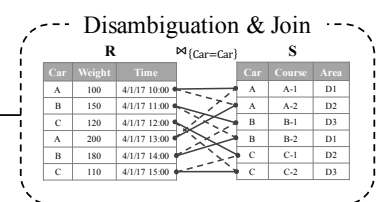
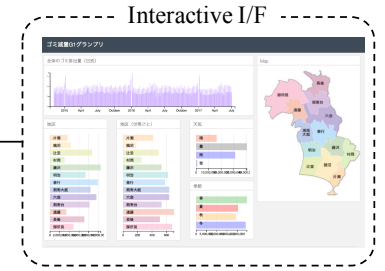
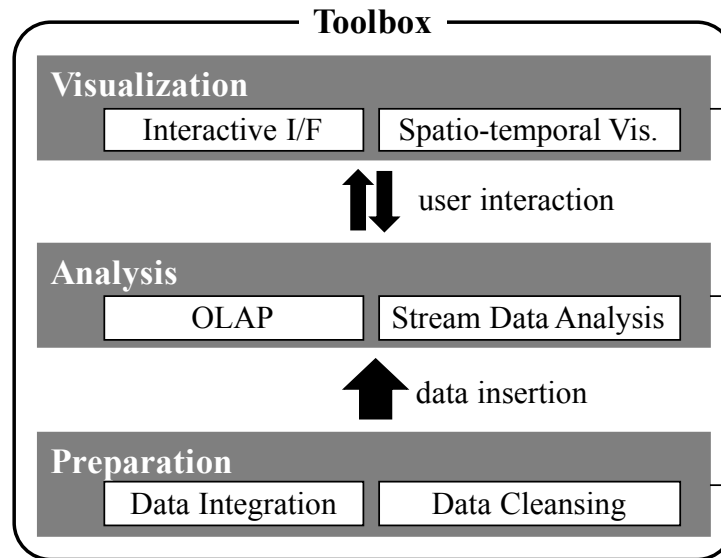
- Big Data + IoT + Smart City
 - Large amount of data from various resources
 - Data tends to be noisy or inconsistent.
 - Analytics is a feedback way to real-world activities.
- Analytics plays a critical role.
 - Data does not solely tell what to do next.

Objective and Approach

- Objective
- Approach

- Making analytics easier

- Handling noisy data
- Interactive analysis



Routing Info.

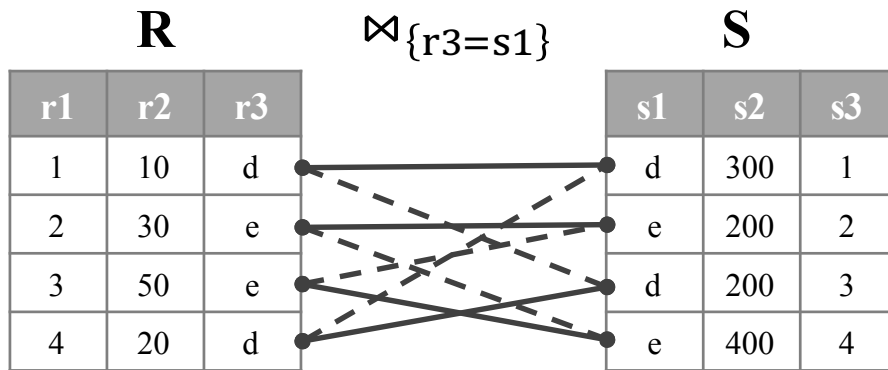


Our tools

- Preparation
 - Implicit order join: joining two data having insufficient information (i.e., attributes)
- Analysis
 - Stream OLAP*: OLAP analysis for both streaming data and static data
- Visualization
 - Geo-spatial visualization
 - Interactive interface

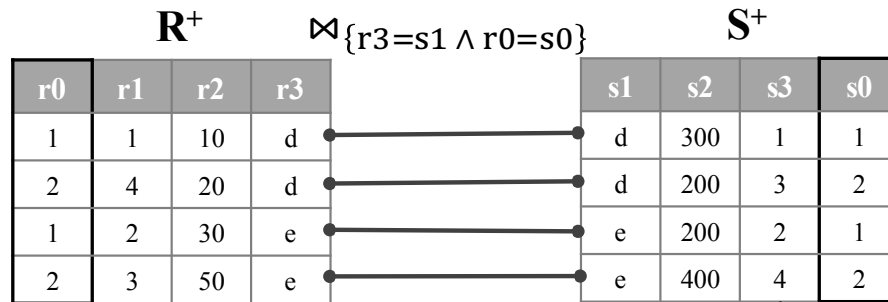
*OLAP = Online Analytical Processing

Preparation: Implicit Order Join



- — ● Expected join results
- - - ● Unexpected join results

- Give unnecessary join results cuz. Lack of info. to join.
- Causes errors on further analysis.

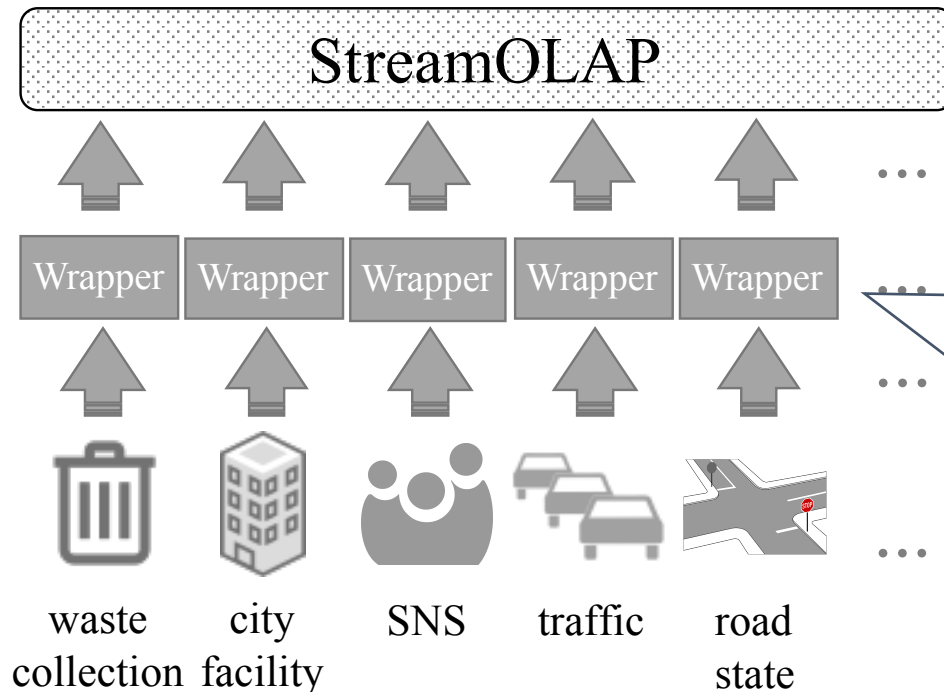


rank of r1
within r3 values

rank of s3
within s1 values

- Find implicit join key from feedbacks.
- Order-oriented correlation assumption.

Analysis: Stream OLAP

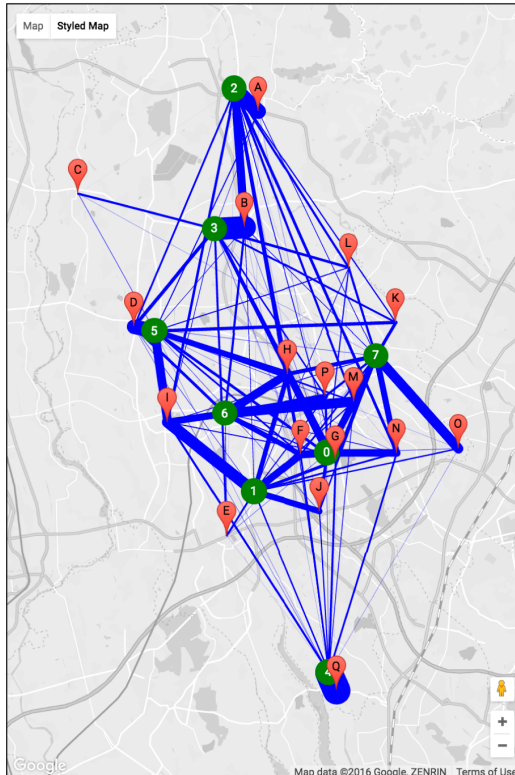


Stream Processing
Engine (SPE)
+
OLAP Engine

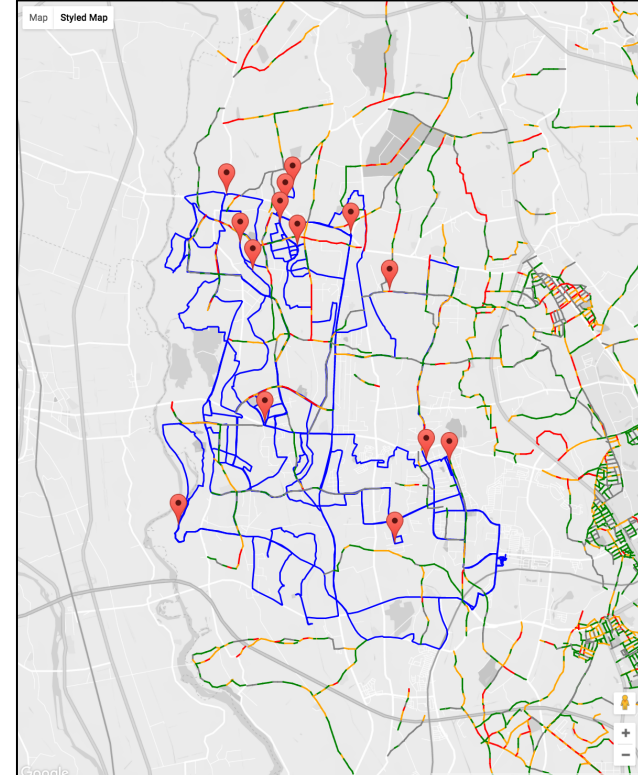
Wrapper converts
hetero data into a
common format
(e.g., relational).

Visualization: Geo-spatial Visualization

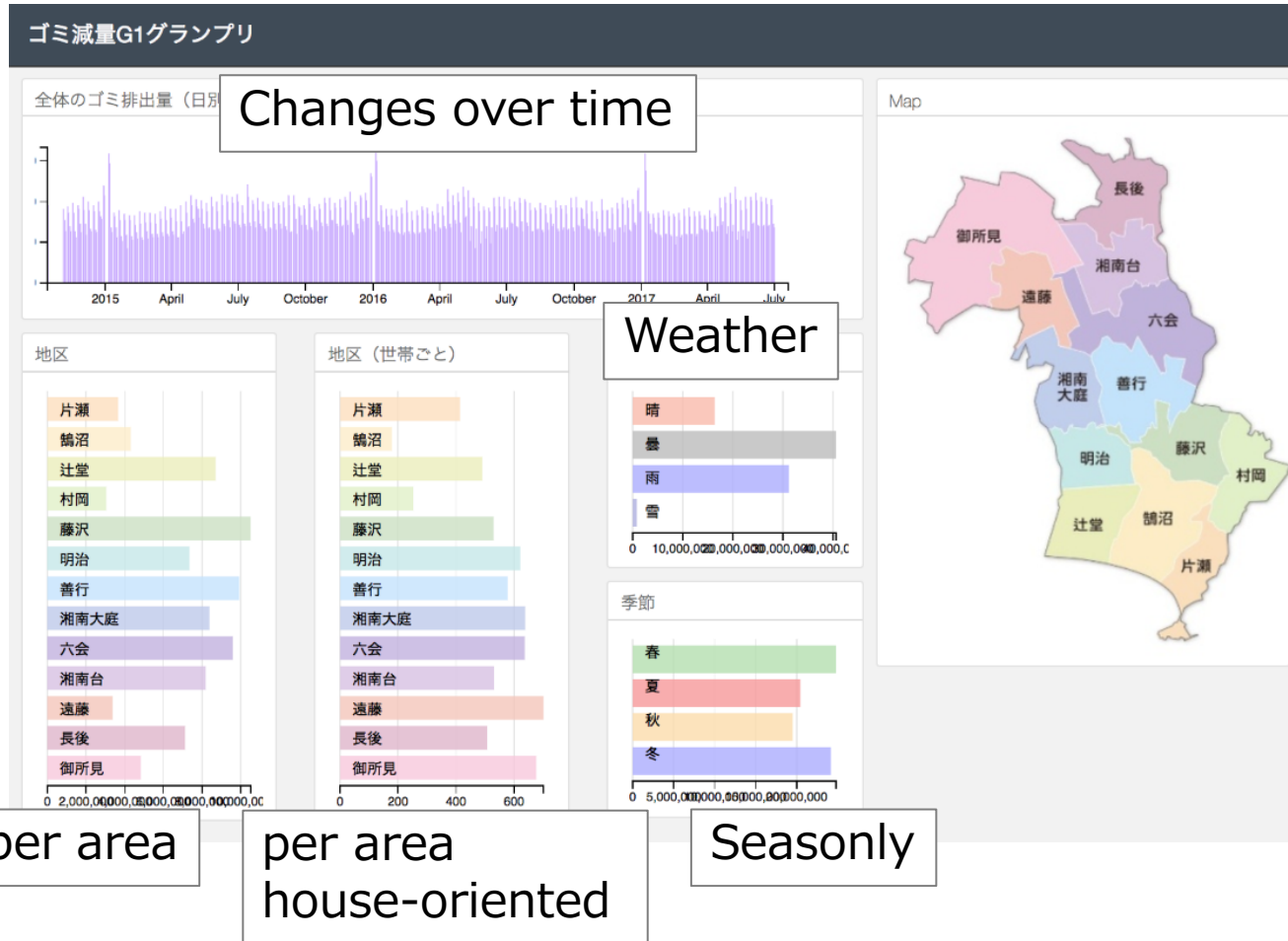
Point-by-Point relationship



Trajectory and point visualization



Visualization: Interactive Interface



Use Case: Garbage Collection in Fujisawa city

- Logs of amount of garbage per collection
 - Car drives a route at a time.
 - Car drives several routes per day.

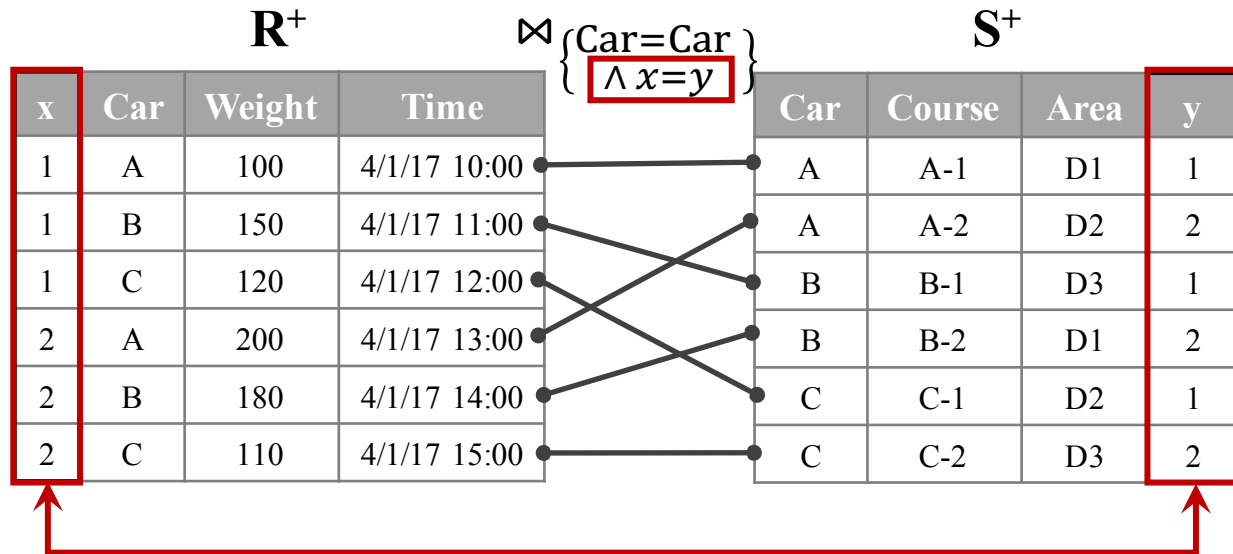
Garbage Collection Logs

Field	Explanation
slip_number	the number of a record
timestamp	date and time of arrival of the collecting car
company_type	classification of company of the car
garbage_type	type of garbage (e.g., burnable)
car_id	identifier of the car
total_weight	overall weight of the car including garbage
car_weight	weight of the car
garbage_weight	total_weight – car_weight
unit_price	price for garbage per kilogram
price	total price for the garbage
plant_id	identifier of the garbage treatment plant

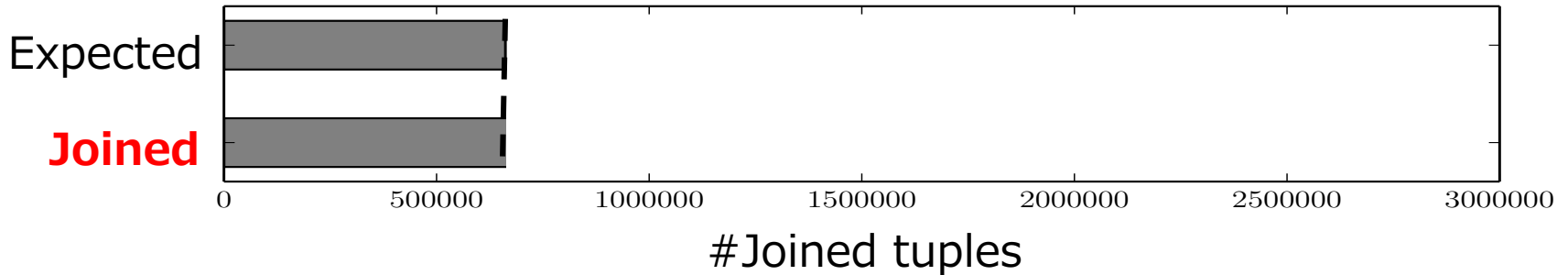
Collection Routing

Field	Explanation
car_id	identifier of the car
course_id	identifier of the course
dow	day of the week when the car goes
block	block where the course belongs
number_of_houses	the number of houses on the course
young_or_elder	rough estimate classes (young or elder) of average ages of the course

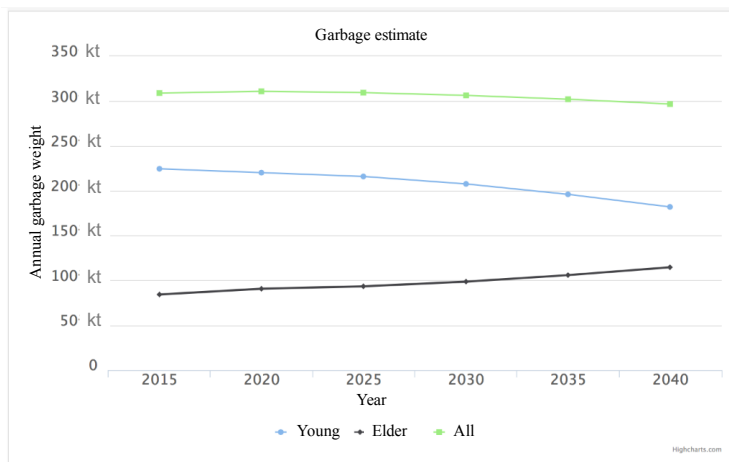
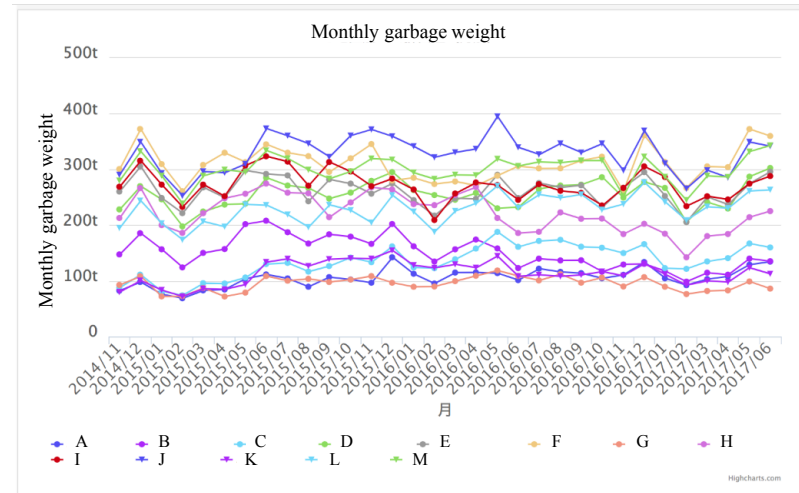
Preparation: Successfully Joins



Implicit keys

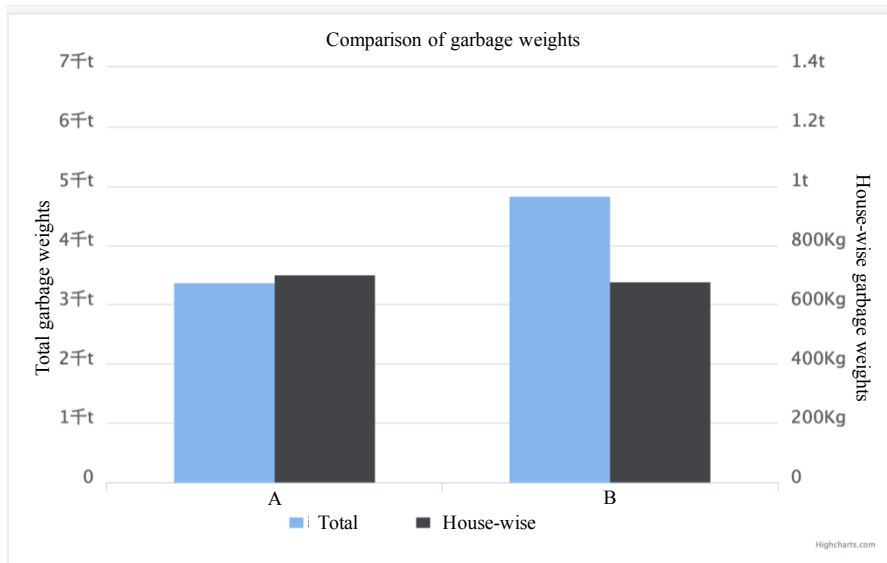


Analytic Scenarios: Comprehensive Analysis

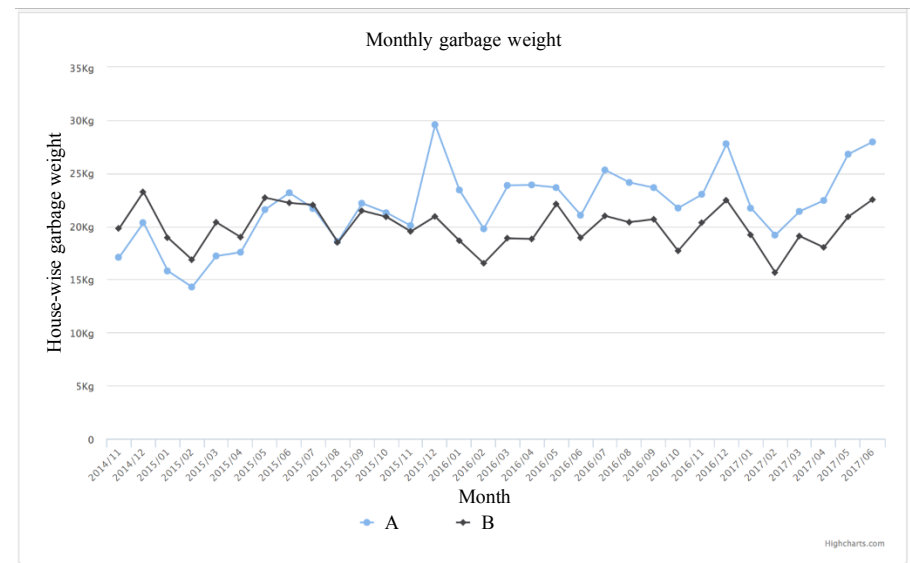


↑ Monthly change per area.
 ↖ Rainy day in 2016.
 ← Future estimates.
 etc.

Analytic Scenarios: Comparative Analysis



↑ Garbage amount comparison in total and in house-wise perspectives.



↑ Monthly changes of garbage amounts on different areas.

Conclusion

