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Shotengai Digital Twin: promoting stakeholder collaboration through decision support systems.

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Background

Shotengai associations are continuously working to revitalize their local communities and increase the number of customers through a variety of strategies. However, the lack of information sharing between individual shops and Shotengai associations limits their ability to measure the level of success after the implementation of different strategies. This research aims to both create simulation tools to test different strategies before their implementation and promote information sharing between stakeholders to measure their success.





Objectives

- Advancing retail modeling by using novel data sources and modern Machine Learning methods.
- Simulate changes in visitor patterns for different lacksquarerevitalization strategies.
- Share results with stakeholders and ask for data collaboration to promote a feedback loop.

Data sources

- App-based GPS data for ~2 million users in Tokyo (Jul-Aug 2023)
- Point of Interest data for all of Tokyo
- Event data (~100 events) for all of Tokyo

Methodology

1. Preprocessing: label and isolate consumption related visits from other human flows, then identify event-related flows

1 Classify ac data.	tivities from GPS
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(2) Separate e	vent-related
label individu	al event data
3 Train a Mac	hine Learning
model to pred	lict change in
Origin locatio	ns and flows

2. Train a model Machine

① Machine learning model to estimate OD pair flow volume

(2) Generate synthetic OD

3Predict flows using the

simulation.

synthetic matrix.

matrices using Monte Carlo

Results

Our model accurately predicts visitors on conventional days. However, its accuracy is lower for event days due to the extreme deviation from conventional behaviour on areas hosting events.

Example: Sangenjaya Summer Festival 2023年8月19日

Figure 3: simulation example and comparison with the actual event ground truth

(地図) 来訪者数と出発地

イベントのシミュレーション結果

0.47

601.34

Learning model to predict Origin-Destination flows on a synthetic Origin-Destination matrix

3. Web UI: simulate an event at a desired location and date \rightarrow present simulation results (source and volume of visitors),

4. Ask individual shops for data collaboration to provide with more ground truth data to improve the current model

Figure 1: Simulation Web UI





Table 1: Hourly prediction performance metrics for the current model.

Hourly predictions	R ²	RMSE (visitors)
Real matrix	0.99	43.67
Synthetic OD matrix: conventional flows	0.92	315.03





