ANALYSIS OF CAR BEHAVIOR IN
MATSUYAMA CITY
(USING PROBE PERSON DATA)

TEAM “G”

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&
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GROUP INTRODUCTION

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According to the PT survey conducted in 2007, car usage is more than half showing the Expanding Car Usage in Matsuyama City.
DATA CHARACTERISTICS & PREPARATION

Data Preparation for reducing computational load on RL Model

Data (Given for Exercise)

Probe Person (PP Data)  Network Data

Location Data
(Sequential GPS Log i.e. Latitude & Longitude)

Trip Data
(OD, Duration, Mode, Purpose)

Combination

Path Choice Can be Assumed

Problem  Approach

How to assume the Actual Path?

Map Matching Algorithm

FOCUS
Central Area of Matsuyama City

Extraction of Data

Extracted the OD Data and Network Data for Central Area of Matsuyama City

Reason of Extraction

Data Preparation for reducing computational load on RL Model
INTRODUCED POLICIES

Focus on Central Area

Attempts to make some roads Pedestrian Friendly

Car Flow Restraint (In central Area)
PRELIMINARY ANALYSIS

Whole City

Central Area

Legend

- bike
- bus
- car
- motorbike
- ship
- taxi
- train
- walk

Purpose of Trip

Percentage shared by each Mode

Purpose of Trip

Percentage shared by each Mode

Legend
FORMULATION OF MODEL

➢ **β-SCALED RECURSIVE LOGIT MODEL; OYAMA AND HATO 2016**

➢ Consider a directed connected graph; \( G = (A, N) \), where \( A \) — set of links, \( N \) — set of nodes

➢ The instantaneous random utility of a link \( a_j \) condition on being in state \( a_{j-1} \) is given by, \( u_n(a_j|a_{j-1}) = v_n(a_j|a_{j-1}) + \mu \epsilon_n(a_j) \)

➢ The total utility of link \( a_j \) given the state \( a_{j-1} \) is formulated by sum of the instantaneous utility \( u_n(a_j|a_{j-1}) \) and maximum expected downstream utility up to the destination link \( d \), denoted as value function \( V_n^d(a_j) \) and defined by the Bellman equation (Bellman, 1957);

\[
V_n^d(a_j) = E \left[ \max_{a_{j+1} \in A(a_j)} \{ v_n(a_{j+1}|a_j) + \beta V_n^d(a_{j+1}) + \mu \epsilon_n(a_{j+1}) \} \right] \quad \forall a_j \in A
\]

\( \beta \) is time discount rate represents the spatial cognition of driver for downstream links

➢ **LINK CHOICE PROBABILITY (MULTINOMIAL LOGIT MODEL)**

\[
P_n^d(a_{j+1}|a_j) = \frac{\frac{1}{e^{\beta}} \left[ v_n(a_{j+1}|a_j) + \beta V_n^d(a_{j+1}) \right]}{\sum_{a'_{j+1} \in A(a_j)} \frac{1}{e^{\beta}} \left[ v_n(a'_{j+1}|a_j) + \beta V_n^d(a'_{j+1}) \right]}
\]
## Preliminary Estimation Results

<table>
<thead>
<tr>
<th>Variables</th>
<th>Parameters</th>
<th>t-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel Time</td>
<td>-0.1106528</td>
<td>-7.2201359**</td>
</tr>
<tr>
<td>Right-Turn Dummy</td>
<td>-0.6584271</td>
<td>-6.194608**</td>
</tr>
<tr>
<td>$\beta$</td>
<td>0.4506658</td>
<td>-2.60758**</td>
</tr>
</tbody>
</table>

| $L_0$                      | -1268.621    |
| $L_L$                      | -1203.331    |
| Rho-Square                 | 0.05146568   |
| Adjusted Rho-Square        | 0.04910091   |
INTRODUCED POLICIES

Focus on Central Area of Matsuyama City

Making “Transit Mall” (A Pedestrian Friendly area)

Car Flow Restraint (In central Area)

Hanazonomachi Avenue

Reduced the No. of Car Lanes from 4 to 2
TRAFFIC ASSIGNMENT

➢ β-SCALED RECURSIVE LOGIT MODEL; OYAMA AND HATO 2016

\[ u_n(a_j|a_{j-1}) = \theta_{tt}(a_j|a_{j-1}) \ast (TT) + \theta_{RT}(a_j|a_{j-1}) \ast (RT) + \mu \varepsilon_n(a_j) \]

\[ P_n^d(a_{j+1}|a_j) = \frac{\frac{1}{\mu} e^{v_n(a_{j+1}|d) + \beta v_n^d(a_{j+1})}}{\sum_{a'_{j+1} \in A(a_j)} \frac{1}{\mu} e^{v_n(a'_{j+1}|a_j) + \beta v_n^d(a'_{j+1})}} \]

\[ e^{v_n^d(a_j)} = \begin{cases} \frac{1}{\mu} \sum_{a_{j+2} \in A(a_{j+1})} e^{v_n^d(a_{j+2}|a_{j+1}) + \beta v_n^d(a_{j+2})} & a_{j+1} \neq d \\ 0 & a_{j+1} = d \end{cases} \]

\[ z = Mz + b \]
\[ z = (I - M)^{-1} \ast b \]

Link Flows Equation: \((I - P^T)F = G\)
POLICY SIMULATION — (CASE-0)

Central Area
(Without any change)
Prohibit Cars in two (2) links
(The road in front of Central Station)
POLICY SIMULATION – (CASE-1)
POLICY — (CASE-2)

Prohibit Cars in ten (10) links (Case-1 + Hanazonomachi Avenue)
POLICY SIMULATION – (CASE-2)
POLICY — (CASE-3)

Prohibit Cars in sixteen (16) links
(Case-1,2 + Making a Small Traffic Cell)
POLICY SIMULATION — (CASE-3)
Prohibit Cars in sixty (60) links (Making a Large Traffic Cell)
POLICY SIMULATION — (CASE-4)
VISUALIZATION OF FLOW CHANGE

CASE-4