



An Adaptation of Bayesian Theorem for Passenger Destination Estimation

승객 목적지 추정을 위한 베이지안 이론 적용

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Outline

- Introduction
- Related Works
- Preliminary
- Proposed Method
- Further Research

Introduction

- Intelligent Transportation Systems (ITS) is an innovative idea in the field of transportation.
- Transit Origin-Destination matrix (OD matrix) is an important input for various ITS application, and usually destination of each passenger in smart card data is estimated construct the OD matrix.
- Therefore, Passenger Destination Estimation (PDE) algorithm can be improved for an important contribution to the field of ITS.

Related Works

- For AFC data including only boarding information,
 - From the past, until some time ago, there were mainly algorithmic proposals without good validation.
- For AFC data including both boarding and alighting information,
 - some researchers tried to perform algorithm verification or infer passenger destinations using deep learning.

Card ID	Card style	Route	Stop	Veh. ID	Time	Date	Fare
-1760518818	Monthly card	115	156	2798	06:27:16	2009-07-07	-
-1760518818	Monthly card	115	3	2346	18:47:21	2009-07-07	-
-1760517522	Common card	115	19	2810	08:34:53	2009-07-07	0.9
-1760517522	Common card	115	151	2808	17:47:31	2009-07-07	0.9
-1760515746	Monthly card	115	133	2794	11:56:22	2009-07-07	-
-1760515746	Monthly card	115	133	2814	18:52:29	2009-07-07	-
-1760515714	Monthly card	115	23	2794	17:32:51	2009-07-07	-

AFC data NOT including alighting information

Transaction Number	Boarding Time (yyyy/mm/dd/hh/mm/ss)	ID of Boarding Location	Alighting Time (yyyy/mm/dd/hh/mm/ss)	ID of Alighting Location
1	20150318092455	4196066	20150318092714	4196117
2	20150318214734	4196061	20150318215035	4196065
3	20150318225205	12174	20150318225855	8001017
4	20150318075726	70647	20150318082805	10585
5	20150318070948	216	20150318084718	4101317
...	...	...	...	...

AFC data including alighting information

Preliminary: a simple PDE example

- Use 2 simple assumptions:
 - 1) The destination of most trips is the origin of the next trip.
 - 2) The last destination is the first origin.

Terms	Meaning
D	The set of AFC transaction from all the passengers
S	The set of all the transit station in one city
T	The set of all the trips composed of origin and estimated destination
H	The first boarding station of a passenger
o_i	The origin of the i -th trip
d_i	The estimated destination of the i -th trip
id_i	The card ID of i -th transaction in D
bs_i	The boarding station of i -th transaction in D

Preliminary: a simple PDE example

Algorithm 1 A simple PDE algorithm	
Input: D, S ;	
Output: T ;	
1:	Ascend D according to card ID and boarding time;
2:	$H \leftarrow o_1$;
3:	for ($i = 1$; $i \leq n$; $i++$) do
4:	$o_i \leftarrow bs_i$;
5:	if ($id_i == id_{i+1}$) then
6:	$d_i \leftarrow bs_{i+1}$;
7:	else
8:	$d_i \leftarrow H$;
9:	$H \leftarrow o_{i+1}$;
10:	end for

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Proposed Method

- An Adaptation of Bayesian Theorem for Passenger Destination Estimation
- Motivation: Several deep learning approaches are often called “black box” because they provide little explanatory insight.

$$P(C_i|X) = \frac{P(X|C_i)P(C_i)}{P(X)} \quad (1)$$

Proposed Method

- Some conditions are

$$x_j = -\log(bt_{i+1} - bt_i) \quad (2)$$

- where bt_i is the boarding time of the i -th transaction, and

$$x_k = -\log dt_i \quad (3)$$

- where dt_i is the distance between the transit route of the i -th transaction and candidate station.

Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8	Station 9
a %	b %	c %	d %	e %	f %	g %	h %	i %

- Checking the variation in the probability distribution of destination for each transaction

Further Research

- Implement the comparison algorithm
- Ideas for some conditions
- AFC data process