Detecting Sudden Rises in Traffic Demand Based on Route Search Request Log

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NAVITIME JAPAN Co., Ltd.
About NAVITIME

A Multi-modal Navigation Service Provider on Mobile Phone

Route Search Service

Automotive Navigation

Founded: March 1, 2000
Scale of Our Services

4 million Dues-paying Members
26 million Monthly Unique Users

As of September 30, 2014.
Our Business Domain

Consumer Services

Domestic Apps.

Inbound App.

International Apps.

Business Solutions

Web Media

Telematics

Transport Consulting

Business NAVITIME

ASP
Our Data for Traffic Analysis

Big Data

Today’s Topic
Traffic Demand
Route Search
Request Logs
Travel Record
Probe Data
at 1 sec. interval

Route Choice
Logs

Road Traffic
Network Data

Master Data

Road
Public Transport
Timetable,
Station
Data

GPS
# Route Search Request Logs

## Origin & Destination
- **From:** Shinjuku
- **To:** Asakusa (Tokyo)

## Time Setting
- **Request Time:** Present
- **Specified Time:** Future
- **Sort by:**
  - Quicker
  - Cheaper Fare
  - Fewer Changes
  - Priority on Elevator
- **Means of Transportation**
  - Airplane
  - Shinkansen (Bullet train)
  - Express
  - Other Added-Fare Trains
  - Airport Bus

## Journey Details
- **Departure:** Fri 13 Mar 09
- **Arrival:** Sat 14 Mar 10
- **First:** Sun 15 Mar 11
- **Last:** Today 12:00
- **Next:** Tue 17 Mar 13:01

**Reflect Future Traffic Demand**
Data Volume (FY 2013)

Public Transport

<table>
<thead>
<tr>
<th>#</th>
<th>Pref.</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tokyo</td>
<td>510.4 mil.</td>
</tr>
<tr>
<td>2</td>
<td>Kanagawa</td>
<td>152.4 mil.</td>
</tr>
<tr>
<td>3</td>
<td>Osaka</td>
<td>126.7 mil.</td>
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<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>45</td>
<td>Tokushima</td>
<td>0.7 mil.</td>
</tr>
<tr>
<td>46</td>
<td>Kochi</td>
<td>0.7 mil.</td>
</tr>
<tr>
<td>47</td>
<td>Okinawa</td>
<td>0.3 mil.</td>
</tr>
</tbody>
</table>

Annual Sample Number
- less than 3 mil.
- 3 mil. and more
- 10 mil. and more
- 30 mil. and more
- 100 mil. and more

Road Traffic

<table>
<thead>
<tr>
<th>#</th>
<th>Pref.</th>
<th>Samples</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Tokyo</td>
<td>14.3 mil.</td>
</tr>
<tr>
<td>2</td>
<td>Kanagawa</td>
<td>9.0 mil.</td>
</tr>
<tr>
<td>3</td>
<td>Saitama</td>
<td>8.0 mil.</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>45</td>
<td>Saga</td>
<td>0.6 mil.</td>
</tr>
<tr>
<td>46</td>
<td>Kochi</td>
<td>0.5 mil.</td>
</tr>
<tr>
<td>47</td>
<td>Tokushima</td>
<td>0.5 mil.</td>
</tr>
</tbody>
</table>

Annual Sample Number
- less than 1 mil.
- 1 mil. and more
- 2 mil. and more
- 5 mil. and more
- 10 mil. and more

1.3 bn. Samples a Year

130 mil. Samples a Year

Large Amount of Samples Available
Research Outline

Route Search Request Logs

- Large Amount of Samples Available
  - esp. for rail service
- Reflect Future Traffic Demand

Purpose of our Study

To Detect Sudden Rises in Traffic Demand by Using Route Search Request Logs
Heat Map

Visualizing the Concentration of Traffic Demand

April 13, 2013

Seibu-Kyūjō-mae station

描画条件：
1時間に600回以上
発着地に指定されている駅を描画。
多いほど赤い。

データ元：
NAVITIME, 乗換NAVITIME,
PC-NAVITIME
Before the curtain time of *Momoiro Clover Z*’s concert at Seibu Dome, April 13, 2013

Seibu-Kyūjō-mae was the 7th most requested station.

描画条件：
1時間に600回以上
発着地に指定されている駅を描画。
多いほど赤い。

データ元：
NAVITIME, 乗換NAVITIME,
PC-NAVITIME
Seibu-Kyūjō-mae Sta. on April 13, 2013

The Number of Request Logs

Cumulated Number of Route Search Requests

Before the Opening Time of the Merchandise Booth

Before the Curtain Time

Specified Arrival Time of Route Search Requests

- Real Time
- 10 min before
- 2 hours before
- 15 hours before
- 4 days before
- Cumulated Number in an Ordinary Day

8 times more requested than an ordinary day at 4 days before

Possible Use for the Capacity Adjustment & Retail Marketing
Increasing Trend in Advance Searches

The Growth of Advance Search Gives the Key to the Prediction

People run searches for morning trips much earlier than for evening trips.

People run searches by arrival time much earlier than by departure time.

Differences between Request Time and Specified Time

Advance Search Rate

- [DPT] 6 a.m.
- [ARR] 6 a.m.
- [DPT] 8 a.m.
- [ARR] 8 p.m.

People run searches in advance for morning trips by arrival time.
Detection Method

Learning Period: From February 1 To March 17, 2013 (6 Weeks)
Target Period for Prediction: From March 18 to April 14, 2013 (4 Weeks)
Target Units for Prediction: $1,762,880 = 1,574 \text{ Stations} \times 28 \text{ Days} \times 20 \text{ Time Zones} \times 2(\text{Departure or Arrival})$

A sudden rise is defined as a case which retrieval frequencies become at twice an ordinary day.

Forecasting the growth of the number of the future route search.

The basic retrieval frequencies in an ordinary day.

References

Ishimura R, Ota K & Tomii N (2013)
Detecting Sudden Rise in Demand of Transportation Needs in the Near Future Based on Immediate and Historic Data of Route Search Service (in Japanese).
The 47th Research Meeting on Civil Engineering Planning, 2013
**Detection Result**

**Target Period:** From March 18 To April 14, 2013 (4 weeks)

**The Number of Sudden Rise in Traffic Demand:**
Total 12,268 (2.2% were detected 4 days before)

<table>
<thead>
<tr>
<th>Cause Event</th>
<th>Number Detected</th>
<th>Stations for Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concert</td>
<td>62</td>
<td>Seibu-Kyūjō-mae, Suidōbashi, Korakuen, Saitama-Shintoshin, Shin-Yokohama</td>
</tr>
<tr>
<td>Sporting Event</td>
<td>17</td>
<td>Ukimafunado, Hasune and Keisei-Sakura (for marathon), Urawa-misono</td>
</tr>
<tr>
<td>Other Event</td>
<td>12</td>
<td>Kokusai-tenjijō-seimon, Yokosuka-chūō (for U.S. Fleet Activities)</td>
</tr>
<tr>
<td>Holiday Resort</td>
<td>28</td>
<td>Kudanshita (for cherry-blossom viewing), Takaosanguchi, Tokyo DisneySea Station</td>
</tr>
<tr>
<td>Government &amp; Business District</td>
<td>36</td>
<td>Nihon-ōdōri, Tochōmae, Kasumigaseki, Nishi-shinjuku</td>
</tr>
<tr>
<td>School Event</td>
<td>47</td>
<td>Kudanshita, Hiyoshi, Chuo-Daigaku・Meisei-Daigaku</td>
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<tr>
<td>Time Schedule Revision</td>
<td>15</td>
<td>Wakōshi, Shinjuku-sanchome, Kita-sando, Motomachi-Chūkagai</td>
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<tr>
<td>Airport</td>
<td>2</td>
<td>Haneda Airport, Haneda Airport Terminal 1</td>
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<tr>
<td>Unknown</td>
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<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>267</strong></td>
<td></td>
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The World’s Fastest? Demand Detection of NEW SHINKANSEN
新幹線は北陸へ。2015年3月14日、新幹線が富山/金沢まで開通します。近日開業予定の北陸新幹線をご紹介。

北陸新幹線は、長野新幹線の長野駅から先に延伸する形になります。長野県から新潟県、富山県を経て石川県に達する、長野駅〜金沢駅間の228.1kmが今回の開通区間です。東京〜金沢間を最短で2時間28分、東京〜富山間を最短で2時間8分で結びます。

飯山駅、上越妙高駅、糸魚川駅、黒部宇奈月温泉駅、富山駅、新高岡駅にも新幹線の駅が開設されます。このうち、黒部宇奈月温泉と新高岡は今回新しくできる駅で、上越妙高は信越本線の諏訪野田駅を移設して名称を変更しています。その他の駅は既存の駅に新幹線ホームが増設されます。今回の開通と同時に、東京駅〜長野駅間の路線名称も長野新幹線から北陸新幹線に変更となります。
Station Congestion Prediction Calendar as of March 7
http://www.navitime.co.jp/pcn/forecast/station  (Japanese)

<table>
<thead>
<tr>
<th>土</th>
<th>日</th>
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<tbody>
<tr>
<td>3/7</td>
<td>3/8</td>
</tr>
<tr>
<td>平塚</td>
<td>ナゴヤドーム前矢田</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>3/14</th>
<th>3/15</th>
</tr>
</thead>
<tbody>
<tr>
<td>新富士(北海道)前橋</td>
<td>前橋みなとみらい</td>
</tr>
<tr>
<td>富山金沢</td>
<td>大正(大阪府)ドーム前</td>
</tr>
<tr>
<td>近鉄長島ドーム前千里崎鳥栖</td>
<td>ドーム前千里崎ユニバーサルシティ</td>
</tr>
</tbody>
</table>

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Toyama Station

- 2015年3月14日 8時, 9時, 11時, 13時, 14時
- 2015年3月15日 1時, 2時
- 2015年3月16日 7時

Kanazawa Station

- 2015年3月14日 5時, 6時, 7時, 8時, 9時, 10時
- 2015年3月15日 6時, 7時, 8時
- 2015年3月16日 7時
- 2015年3月23日 7時

新幹線は北陸へ。
Kanazawa or Toyama?
Kanazawa or Toyama?

Kanazawa  Toyama
Specified Date (as Arrival): From March 14 to 31, 2015
Request Date: From February 1 to March 7, 2015
Destination Station: Kanazawa, Toyama

Kanazawa Total 23,258
Toyama Total 9,886

2.4 Times as Many as Toyama
Origin Distribution to Kanazawa

Specified Date (as Arrival):
From March 14 to 31, 2015

Request Date:
From February 1 to March 7, 2015

Destination Station:
Kanazawa

JR East Widely Draws Customers from their Shinkansen Areas

- Tohoku Shinkansen Area
- Hokuriku (Nagano) Shinkansen Area
- Tokyo
Development Potential

The impact to be inscribed on the UNESCO World Heritage List

The Tomioka Silk Mill

The Daily Number of Searches

Sudden Rise after UNESCO’s Announcement

Origin Distribution (Public Transport)

Target Period: From April 26 To June 30, 2014

Route Search Request Logs Reflect a Trend Quickly

Spin-off Effect on the Safari Park

Visiting a Little Further from Neighboring Area
Conclusion

Sudden Rises in Traffic Demand

- Have been Difficult to be Detected
- Can be Detected by
  - Route Search Request Logs

Detecting Sudden Rises in Traffic Demand

- Will Improve
  - Public Transportation Services
  - Retail Marketing Approaches
- Would Contribute to success
  - 2020 Tokyo Olympics & Paralympics