High Speed Rail Passenger Demand Forecasting: 
A New Approach Based on Network Scale with Real-world Applications in China

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Introduction

The HSR network in China is rapidly expanding…
Introduction

The HSR travel demand forecasting is a vital issue.

From the view of macroscopic planning perspective:
- Evaluate the feasibility of construction project
- Foresee the overall trend of the rail network.

From the view of microscopic operation perspective:
- Determining the technical index
- Rail track length
- Rail network operational scheme
- HSR revenue management and so on.
Objectives

- Develop an improved four-step demand model for HSR operators and planning authorities.
- Demonstrate the methods through case studies in China
- Explore the transferability of the model to the other countries.
Methodology

The Improved Four-Step Demand Model

- Comprehensively consider the characteristics of HSR passenger flows: Temporal dynamics and spatial network effects.
- Build economic-population model to predict induced travel demand.
- Use RP/SP joint survey of modal split.
- Assign travel demand to multiple paths based on utility function.
Traffic zone division and determination of OD

Traffic generation and distribution in different Developing stages

Traffic modes division

Traffic assignment based on utility function

Determine travel demand of each OD in the base year

Trend passenger flow model

Economy – population induced passenger flow models

Total travel demand of each OD in different developing stages

HSR travel demand split rates of each OD in different developing stages

multiple paths traffic assignment model based on utility function

passenger travel demand along each path in different developing stages
Application: A case study

Traffic Analysis Zones and Base Year ODs by Travel Modes
Application: Data

- The highway data was computed according to passenger departure schedules. The airline data was obtained from China's Traffic Yearbook. The HSR data was deprived from the Ticketing and Reservation System.
- Regional economic data was employed to acquire the trend and the induced passenger demand.
- Mode preference survey at different mode stations in Beijing, Tianjin, Shanghai, Guangzhou.
Results: **Trip generation and distribution**
Results: High speed rail mode split rates
Results: **Comparison**

- **Predicted Rail Trips**
- **The Observed or the official predicted Rail Trips**

![Bar chart showing predicted and observed rail trips from 2009 to 2020.](chart)

- **2009**: Predicted rail trips: 150,000, Observed: 120,000
- **2011**: Predicted rail trips: 300,000, Observed: 300,000
- **2015**: Predicted rail trips: 450,000, Observed: 450,000
- **2020**: Predicted rail trips: 600,000, Observed: 600,000
Conclusions

- The HSR travel demand will continue increasing with reduced growth rate.
- With the growth of the HSR network, the induced passenger demand becomes more important.
- The trips are concentrated in the developed regions with large population and high employment. In different HSR developing stages, passenger demand increases with different growth rates.
Future steps

- Further modify the calibration method of the parameters in order to improve prediction accuracy.
- Establish utility functions specific to traffic zones.
- Consider complementary effects and substitute effects among multiple modes.
Thank you

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Introduction

- **Traditional model**
  - Historical Average model
  - Exponential smoothing model
  - Grey forecasting
  - Autoregressive integrated moving average (ARIMA)
  - Elastic coefficient method
  - Box - Jenkins approach and so on.

- **The modal demand method**

- **The logit model**

- **Four step model**