

وزارت علوم، تحقیقات و فناوری

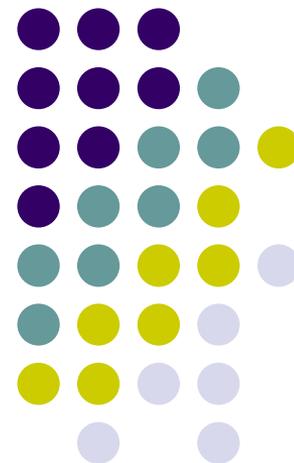


دانشگاه سوره

# برنامه ریزی حمل و نقل

مبانی مدل های تعاضا- جمع آوری داده ها

<http://mnooriamiri.professora.ir/>



# Travel demand modeling

## ► Overview

What is modeling?

Concept of transport demand and supply?

Concept of equilibrium?

Traditional four step demand modeling?



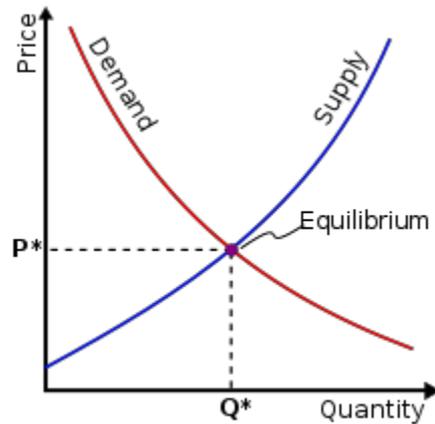
# Travel demand modeling

- ▶ **Transport modeling**
  - Factors that affect the performance of the system
- ▶ **Models:** physical (physical representation of the Reality)
  - symbolic (representation of the complex relations with symbols)
  - mathematical (representation highly complex relations with Equations)
- ▶ Transport modeling is the study of the behavior of individuals in making decisions regarding the provision and use of transport



# Travel demand modeling

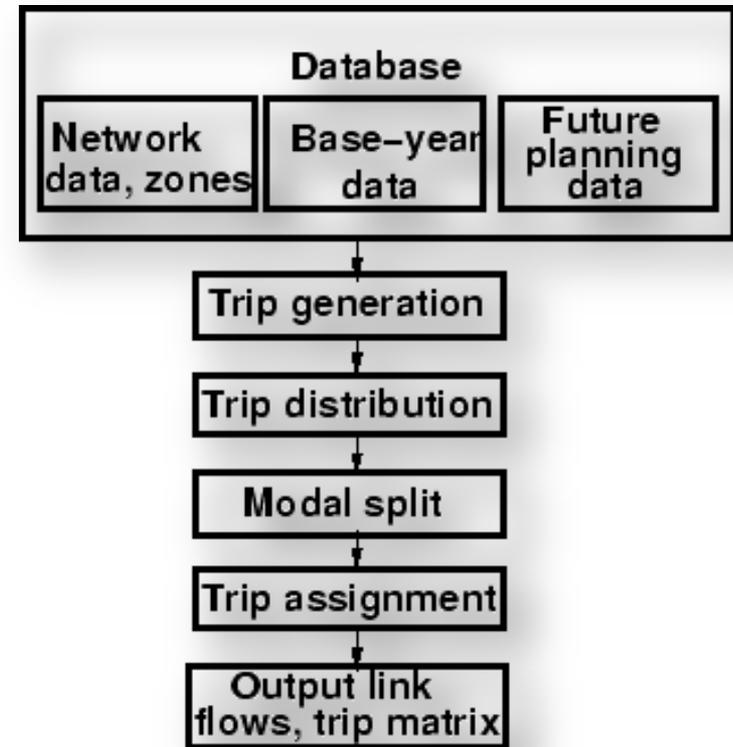
- ▶ **Transport demand and supply**
  - Transport demand is a derived demand
  - Demand supply equilibrium



# Travel demand modeling

## ▶ Travel demand modeling

- spatial distribution of travel
- base decisions:
  - the choice of destination
  - the choice of the mode
  - the choice of the route
- four-stage model (FSM)



# Travel demand modeling

## ▶ Travel demand modeling

- Database
  - Population, Economic activity (employment, shopping space, educational, leisure facilities), Land use
- Trip generation model ( $T_i$ )
  - total number of trips generated and attracted by each zone
- Trip distribution models ( $T_{ij}$ )
  - allocation of trips from each zone to various other destination zones
- Modal split models ( $T_{ijm}$ )
  - allocation trips to different modes
- Trip assignment models ( $T_{ijmr}$ )
  - assign trips to the route network

# Data Collection

## ► Overview

- information about ... of the area influenced by the system
- data collection
  - survey design
  - household data collection
  - data analysis
  - other important surveys

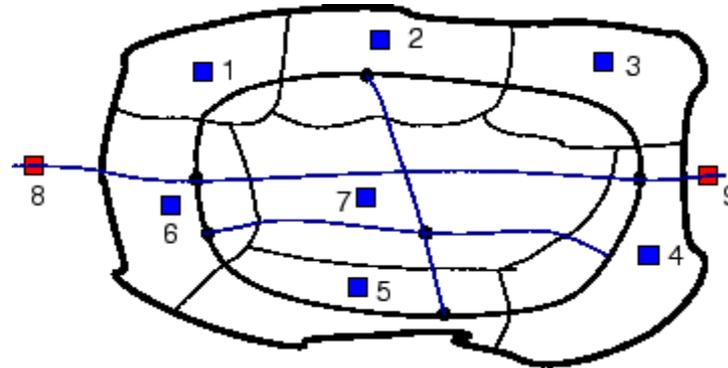


# Data Collection

## ▶ Survey design

- Information needed

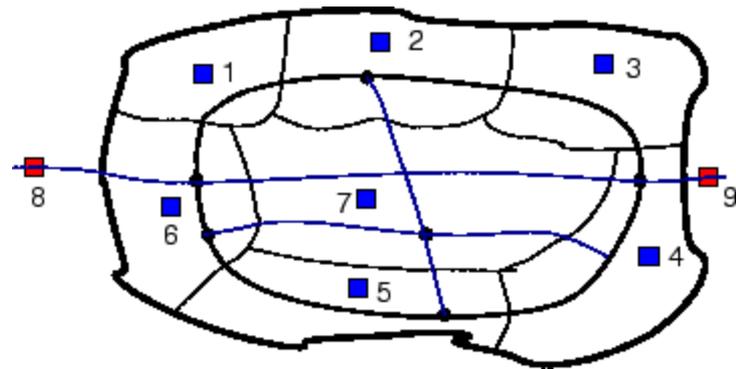
- **Socio-economic data:** *income, vehicle ownership, family size*
- **Travel surveys:** Origin-destination travel survey at households and traffic data from cordon lines and screen lines; Former data include the number of trips made by each member of the household, the direction of travel, destination, the cost of the travel, etc; traffic flow, speed, and travel time
- **Land use inventory:** housing density at residential zones, establishments at commercial and industrial zones
- **Network data:** Transport network data (road network, traffic signals, junctions etc), service inventories (public and private transport networks)



# Data Collection

## ▶ Study area

- the area of expected policy impact
- Not political boundaries, but bounded by the area influenced by the transportation systems
- The boundary of the study area is called as external cordon (or cordon line)
- trips, into, out of, and through the study area



# Data Collection



## ▶ Zoning

- Study area divided into a number of small units called traffic analysis zones (TAZ) (or zones)
- Zones in the study area are called internal zones
- If all attributes and properties of a zone were concentrated in a single point called the Zone centroid
- The centroids are connected to the nearest road junction or rail station by centroid connectors
- Both centroid and centroid connectors are notional
- it is assumed that all people have same travel cost from the centroid to the nearest transport facility which is the average for a zone
- The external zones are defined by the catchment area of the major transport links feeding to the study area
- few guidelines for selecting zones:
  - zones should match other administrative divisions, particularly census zones.
  - zones should have homogeneous characteristics, especially in land use, population etc.
  - zone boundaries should match cordon and screen lines, but should not match major roads.
  - zones should be as smaller in size as possible so that the error in aggregation caused by the assumption that all activities are concentrated at the zone centroids is minimum.

# Data Collection

## ► Network

- Roads, junctions, bus stops, rails, railway station etc
- Normally road network and rail network are represented separately
- Road network: nodes and links
- Link: starting node, ending node, road length, free flow speed, capacity, number of lanes or road width, type of road like divided or undivided etc.
- Road junctions or nodes: node number, starting nodes of all links joining the current node, type of intersection (uncontrolled, round about, signalized, etc).
- Similarly public transport network: frequency of service, fare of travel, line capacity, station capacity etc.



# Data Collection

## ▶ Household data

- The most basic and authentic information about the travel pattern of a city
- More complete travel details
- For population less than 50,000: minimum 10%
- For population more than 1,000,000: only 1%

## ▶ Questionnaire design

## ▶ Survey administration



# Data Collection



## ▶ Questionnaire design

- Design of questionnaire is more of an art than a science
- **should be simple, direct, should take minimum time, and should cause minimum burden to the respondent**
- Traditional household survey :
  - **Household characteristics:** socioeconomic information about the household (number of members, number of employed, number of unemployed, age and sex of the members in the house etc.), number of vehicles in the house (number of cycles, number of cars etc.), house ownership and family income
  - **Personal characteristics:** to classify the household members older than 5 relation to the head of the household e.g. wife, son, sex, age, possession of a driving license, educational level, and activity
  - **Trip data:** A trip is normally as any movement greater than 300 meters from an origin to a destination with a given purpose. Origin and destination, trip purpose, trip start and ending times, mode used, walking distance, public-transport line and transfer station or bus stop (if applicable)

# Data Collection



## ▣ Survey administration

- Train enumerators (details and how to conduct )
- **Random household**
- Have a permission to be surveyed from the household
- **Each member of the household should answer about their own travel details, except for children below 12 years**
- Trip details of children below 5 years are normally ignored
- **Question about the travel details of the previous day**
- Methods of the administration of the survey:
  - **Telephonic:** very popular in western countries where phone penetration is very high
  - **Mail back:** drops the questionnaire to the respondent and asks them to fill the details and mail them back with required information. Care should be self explanatory
  - Face-to-face:** visits the home and asks the questions and fills up the questionnaire by himself (not a very socially acceptable method in the developed countries, as intrusion to privacy)

# Data Collection



## ▶ Data preparation

- **Data correction:**
- **Household size correction:** while choosing the random samples, one may choose either larger or smaller than the average size of the population as observed in the census data
- **Socio-demographic corrections:** differences between the distribution of the variables sex, age, etc. between the survey and the census data
- **Non-response correction:** not be a response from respondents
- **Non-reported trip correction:** underestimate the non-mandatory trips and the actual trips
- **Sample expansion**
  - amplify the data to the total population of the zone with “expansion factor” :  $F_i = \frac{a}{b-d}$ 
    - a is the total number of household in the original population list
    - b is the total number of addresses selected as the original sample
    - d is the number of samples where no response was obtained.
- **Validation of results**
  - 3 validation tests:
    - consistency of the data by a field visit
    - choosing a computational check of the variables (age of a person like 150 years)
    - logical check for the internal consistency of the data (a person with age less than 18 years, cannot have a driving license)

# Data Collection

## ▶ Other surveys

### • O-D survey

- for small studies, or to get a feel of the O-D pattern without doing elaborate survey, work space interviews are conducted to find the origin-destination of employers in a location. Although they are biased in terms of the destination, they are random in terms of the mode of travel.

### • Road side interviews

- external-internal trips
- Sample of drivers and passengers crossing a particular location.
- ask with few questions like origin, destination, and trip purpose.

### • Cordon and screen-line survey

- For large study area
- trips from and to external zones.
- Objective: origin and destination zones, recording the license plate number at all the external cordon points or by post-card method.
- Screen lines: divide the study area into large natural zones, like either sides of a river, with few crossing points between them

