

برنامه ریزی حمل و نقل

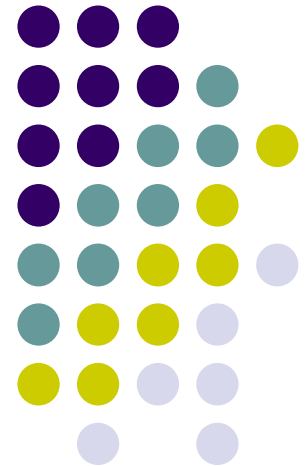
وزارت علوم، تحقیقات و فناوری



دانشگاه سوره

تعلیم شوه حمل و نقل (مدی)

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Modal Split

● Overview

- The third stage in travel demand modeling
- The trip matrix or O-D matrix is sliced into number of matrices representing each mode
- Two types of mode choice models: binary mode choice and multinomial mode choice



Modal Split

● Mode choice

- **Public transport modes:**
 - **Road space more efficiency**
 - **More social benefits**
 - **Less congestion**
 - **Less accidents**
 - **Low cost**
 - **Fuel use more efficiently**
- **private transport:**
 - **Highly flexible**
 - **more comfortable and convenient**
 - **better accessibility**



Modal Split

● The choice factors of mode

- **Characteristics of the trip maker :**
 - (a) **Car availability and/or ownership;**
 - (b) **Possession of a driving license;**
 - (c) **Household structure** (young couple, couple with children, retired people etc.);
 - (d) **Income;**
 - (e) **Decisions made elsewhere**, for example the need to use a car at work, take children to school, etc;
 - (f) **Residential density.**



Modal Split

● The choice factors of mode

➤ Characteristics of the journey:

- (a) **The trip purpose;** for example, the journey to work is normally easier to undertake by public transport than other journeys because of its regularity and the adjustment possible in the long run;
- (b) **Time of the day** when the journey is undertaken.
- (c) **Late trips** are more difficult to accommodate by public transport.



Modal Split

● The choice factors of mode

➤ Characteristics of the transport facility:

Quantitative factors:

- (a) **relative travel time:** in-vehicle, waiting and walking times by each mode;
- (b) **relative monetary costs** (fares, fuel and direct costs);
- (c) **availability and cost of parking**

Qualitative factors:

- (a) **comfort and convenience**
- (b) **reliability and regularity**
- (c) **protection, security**



Modal Split

● Types of modal split models

- **Trip-end modal split models:**
 - **Modal-split models immediately after trip generation**
 - **Different characteristics of the person for estimating modal split**
 - **Person characteristics like income, residential density and car ownership**
 - **The advantage:** very accurate in the short run, if public transport is available and there is little congestion.
 - **Limitation:** insensitive to policy decisions example: Improving public transport, restricting parking etc.



Modal Split

● Types of modal split models

- Trip-interchange modal split models:
 - The post-distribution model
 - Advantage:
 - ✓ possible to include the characteristics of the journey and alternative modes available
 - ✓ possible to include policy decisions

- Aggregate and disaggregate models:
 - **Aggregate:** if based on zonal and inter-zonal information
 - **Disaggregate:** if based on household or individual data.



Modal Split

● Binary logit model

- travel choice between two modes
- value for the utility of each mode

➤ **Disutility:** $C_{ij} = \alpha \cdot t_{ij}^{\lambda} + \beta \cdot F_{ij}^{\gamma} + \delta$

- If the travel cost is low, then that mode has more probability of being chosen

$$P_m^1 = \frac{T_{ij}^1}{T_{ij}} = \frac{e^{-\beta C_{ij}^1}}{e^{-\beta C_{ij}^1} + e^{-\beta C_{ij}^2}} \Rightarrow P_m^1 = \frac{1}{1 + e^{C_{ij}^2 - C_{ij}^1}}$$



Modal Split

- **Multinomial logit model**

➤ **travel choice between several modes**

$$P_m = \frac{e^{-\beta C_{ij}^m}}{\sum_{m'} e^{-\beta C_{ij}^{m'}}$$

Modal Split

● Multinomial logit model

➤ Example:

	t_v	t_w	t_t	F	Q
coff	۰/۰۳	۰/۰۴	۰/۰۶	۰/۱	۰/۱
car	۲۰	۰	۰	۱۸	۴
bus	۳۰	۵	۳	۶	۰
train	۱۲	۱۰	۲	۴	۰

P	$e^{-C_{ij}}$	C_{ij}	
%۱۲/۴	۰/۰۶	۲/۸	car
%۳۱/۰	۰/۱۵	۱/۸۸	bus
%۵۶/۶	۰/۲۸	۱/۲۸	train
%۱۰۰/۰	۰/۴۹		total

$$C^c = 0.03 * 20 + 0.1 * 18 + 0.1 * 4 = 2.8$$

$$P_c = e^{-2.8} / (e^{-2.8} + e^{-1.88} + e^{-1.28}) = 0.124$$

12.4% travel with Car