وزارت علوم، تحقیقات و فناوری

دانشگاه سوره

برنامه ریزی حمل و نقل

تکنیک شیوه حمل و نقل (مدی)

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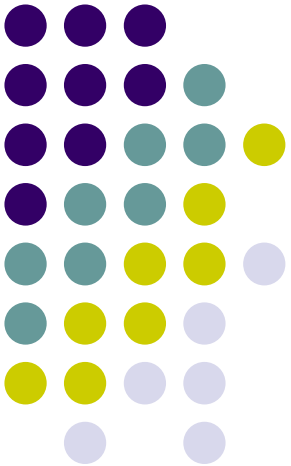

Modal Split

- **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^{-Cij}	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