Mobility forecasting- a framework

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Purpose of this lecture

- Review of mobility forecasting theory and adopting a framework to your projects

Lecture outcomes

- Theory and description of mobility forecasting framework steps

Lecture topics

- Modeling mobility
  - General 4. step framework
  - Gravity model for analyzing splited mobility between schools

Non motorized transport types

- More focusing on sustainable transport types
- Demand still stays on comfort and individuality
  - Conclusion is to put people on shift modality. the new modality should be convenient enough
- What modality we will cover in projects?

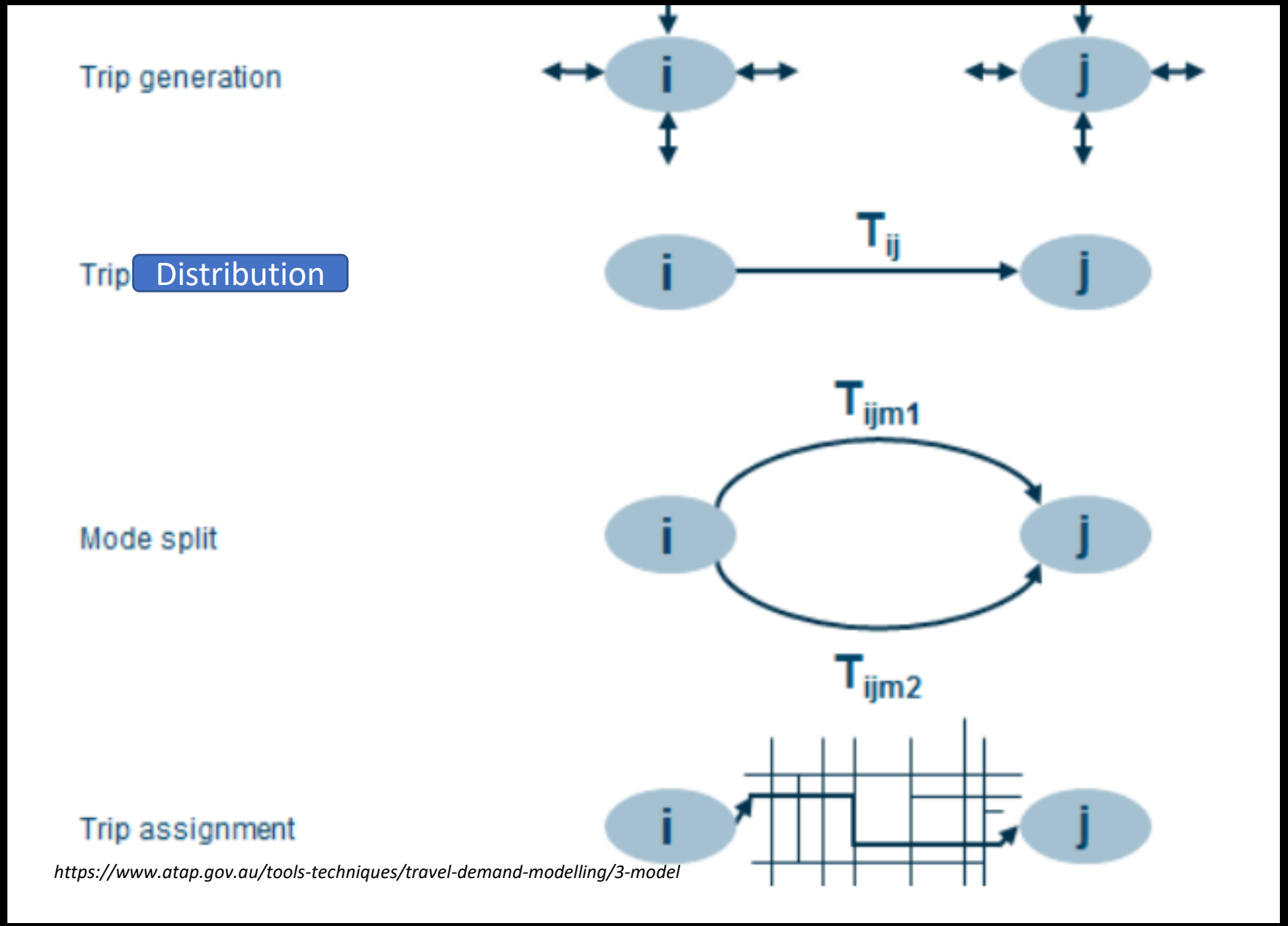
What is framework?

- You have a common structure for making things.
  - Sequence of steps
- Inside every step you solve problems in different contexts.
  - Problem varies step by step.
- Frameworks tell what in steps order and generalize what we should do inside those steps.
  - You could think about it as a guideline.

4 step traffic forecasting model

- More like a framework
- Purpose is to forecast travel demand in the near future
- Example
  - How many bicycles could use the road
  - How many vehicles could use the bridge
  - How many people could use airport

Visualizing a 4 step traffic forecasting model



https://www.atap.gov.au/tools-techniques/travel-demand-modelling/3-model

What are those 4 steps- descriptions

- **Trip generation**
  - Aligning trip origin and destination regions with target groups
- **Trip distribution**
  - Mobility and mobility OD matrix
  - Often done by using gravity model
- **Modal split**
  - Between each origin and destination point
- **Traffic assignment**
  - Output is trips

1. step- trip generation

- Take following into account:
  - Home-based work trips (such as work trips that begin at home)
  - Home-based shopping trips
  - Home-based education trips (such as from home to primary, secondary and tertiary education)
  - Non home-based trips (trips that neither beginning nor end at home)
- It predicts the number of trips originating in or destined for a particular traffic analysis zone

1. step- trip generation. Example

- Household with **2 vehicles** and **4 people** may be assumed to produce **3.0 work trips per day**

- **Input**
  - Statistical findings, bounding areas of interest
- **Output**
  - Home based working trips number per area

2. step- trip distribution

- Matching every commuter origin and destination to develop a trip matrix table.
- Matrix reflects the number of trips going from each origin to each destination
- **It is called the OD matrix**

2. step- trip distribution. OD matrix

- Origin and destination trips have to be equal

Table 5: Origin-Destination (OD) matrix

O-D	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10	∑O
Zone 1											296505
Zone 2											1283072
Zone 3											1019880
Zone 4											1109603
Zone 5											1201413
Zone 6											688446
Zone 7											1222716
Zone 8											1386605
Zone 9											740705
Zone 10											395176
∑D	598526	1961928	1483197	1677424	1934899	1046528	1060918	1131867	1491721	492962	

2. step- trip distribution

STEP IN/OUTPUT

Input:

how many trips per area

Output:

matching origin and destination area and volume

- Mostly using Gravity Model to distribute trips
- Others models that are out of our interest:
  - Growth factor
  - Entropy maximising approach
  - Intervening opportunities

- Gravity model take one zone outgoing trips and distribute them to other zones based on their area or some other factors (employment rate, students)
- In our project we use the school maximum students number to distribute trips

3. step- modal split

- What type of transport will people choose
  - Bus
  - On foot
  - Car
  - Bicycle

STEP IN/OUTPUT

Input:

OD matrix, statistical raports

Output:

how many inhabitants will take named transportation type

4. step- traffic assignment

- Minimum cost path/ route is used
- Every OD pair is associated with a route that is already calculated.
- At the end of the process we have trip volume for every road network link/segment

STEP IN/OUTPUT

Input:

trips per given transportation type, streetnetwork

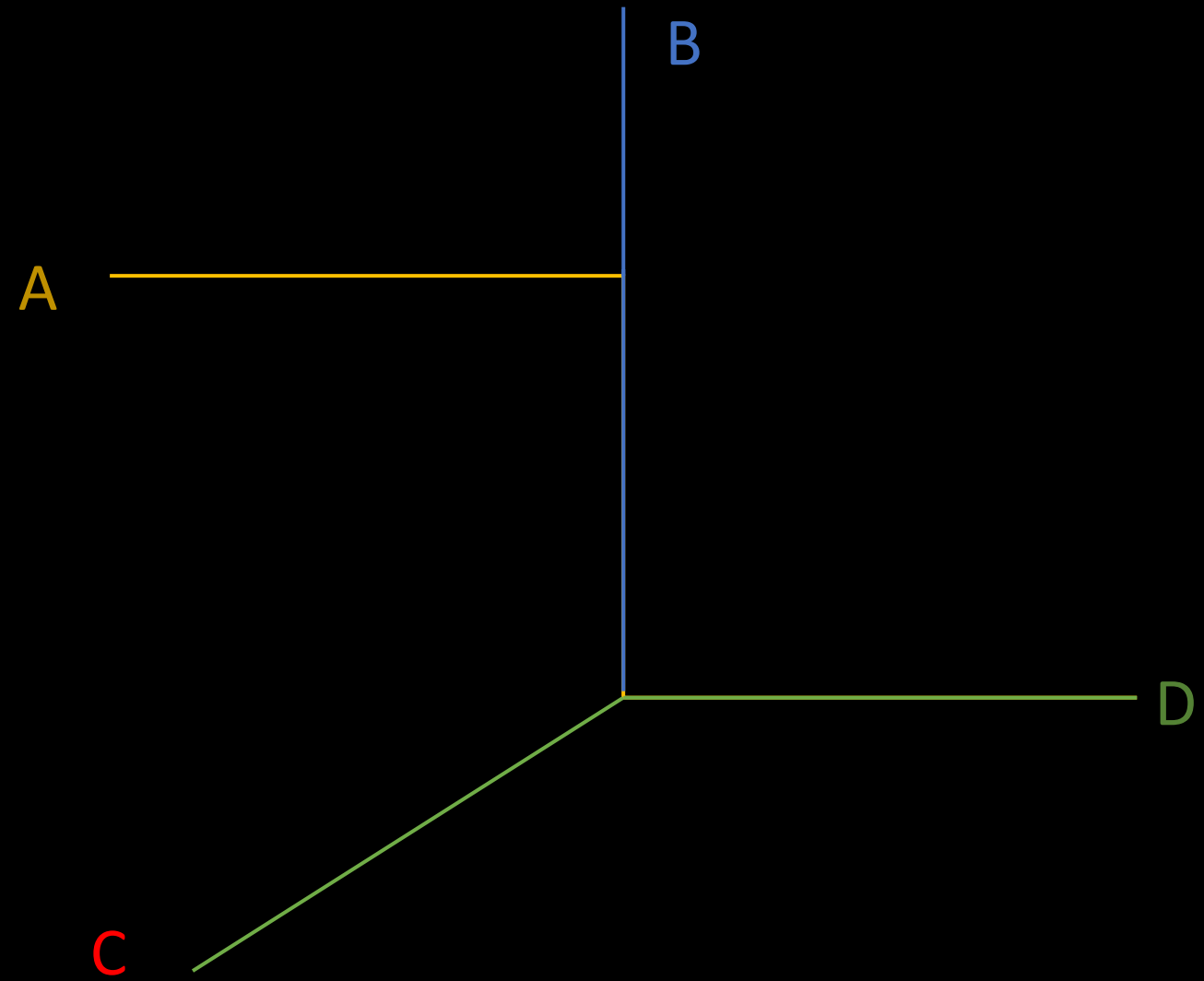
Output:

trip path on streets network

Segment definition

- **Segment-** road exploded to small junks. Mostly where roads will curve or intersect with other roads
- So you have a path, now how to make it into the segments
- So you could have every part with a label of how much people will use that road part

Visualiziation of segments and trip paths



4 step traffic assignment model critiques

- Development end at 1990
  - After that there is no development made
- Focus is more on process (did the public have opportunity to commend?), than transport outcomes (travel time reducing, greenhouse gases)
  - Todays focuse has been changed

Huff Gravity model- trip distribution step

- **Gravity in physics**
  - Pulling force
- **Gravity model**
  - Pulling force model of inhabitants

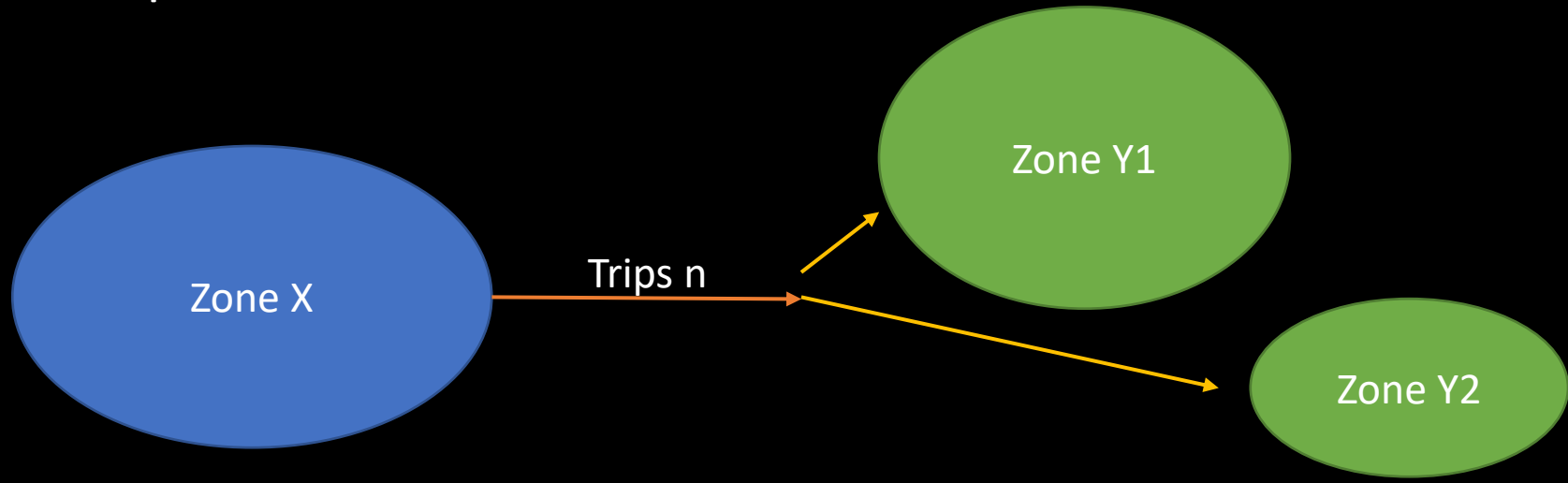
- Pulling force decreas
  - With distance
  - With smaller object

- Whatever object is bigger and near to other objects, the more it is going to pull something
  - In our case it is people

Producing trips and finding attraction

- When we know that **zone X** produces **trips n**
- How many trips will end at destination **zone Y1** and how many of them in **zone Y2**

- It will depend on attractiveness of **zone Y** comparing to other zones that pulls people
  - Attractiveness could be workplaces or school maximum number or area of mall



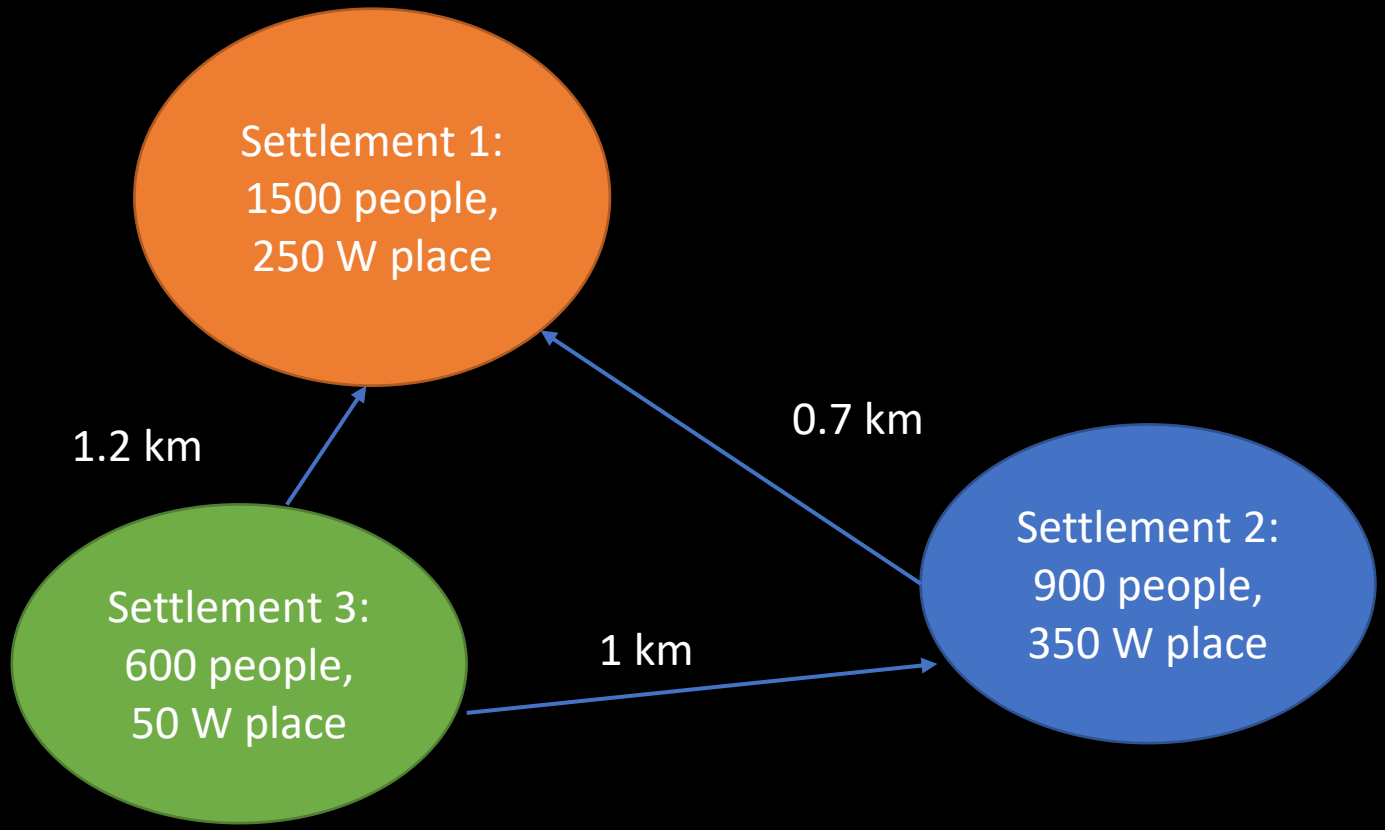
Huff gravity model

- J t, xy- Estimated trips from zone X to Y
- J k,x- potensial users of travel mode from zone X
- T x,y- destination atractivity in zone X
- Lx,y- distance between zones

$$J_{t,xy} = J_{k,x} * \frac{\left(\frac{t_{xy}}{l_{xy}^2}\right)}{\left(\frac{t_1}{l_{x1}^2}\right) + \left(\frac{t_2}{l_{x2}^2}\right) + \left(\frac{t_3}{l_{x3}^2}\right) + \ldots + \left(\frac{t_n}{l_{xn}^2}\right)}$$

Huff gravity model

$$pot\ people\ *\ \frac{\frac{Work\ places}{distance^2}}{\frac{work\ places 1}{distance^2 1} + \frac{work\ places\ n}{distance^2 n}}$$



Modality split

Modality between types	Work	School
Car	70%	35%
Public transport	23%	10%
Pedestrians	5%	50%
Bicycles	2%	5%

Task in Moodle

- What to do
  - 4 step traffic forecasting framework
- How to do it
  - Teams describe what every step is all about and how to implement it on your project in QGIS

Thank you for your attention!

Interreg Central Baltic Project: INTELTRANS – Intelligent Transport and Traffic Management study module.