**Transport Model for Commuter Trips at Ward-level for Bangalore**

**INTRODUCTION**

A Transport Model is a representation of the movement of people (trips) around a transport network within a defined area of study having certain socio-economic and land-use characteristics. Typically, it is intended to provide an indication of how trips will respond, given changes in transport supply and/or demand. For this purpose of this task relating to the mock-up of a transport model, the focus will be on transportation forecasting of trips and modal choice at the ward-level in Bangalore.

The four-step travel model has evolved over the years to provide a rough estimate of commuter movements and choices at an aggregated, but detailed level. Improvements in computational powers and availability of libraries has meant that fast running of models for various scenarios and situations can be done quickly. At its core, given the availability of existing supply and demand data, the four-step travel model focuses on a cost functions to help distribute trips and utility functions to help modal choice. This approach will be used for this task.

**DESCRIPTION OF MODEL**

This model consists of four steps:

1. Trip Generation

Within the area of study (Bangalore, in this case), this step begins with identifying the primary unit of study, i.e. the “zone”. The data needed for the supply side refers to highways/road network layers, public transport schedules, additional relevant network infrastructure, etc. For the demand side, an aggregation of the trips originating and ending within the area of study at the level of the zones are generated. These are typically gathered from census data, labour statistics, industry statistics, etc. In the case of this particular, wards of Bangalore have been selected as the zone unit.

1. Trip Distribution

Following on from the previous step, where the production and attraction trips for all the zones have been generated, this step involves distributing the trips between the wards. There are many approaches for this distribution, but given that the production data refers to homes of commuters, while the attraction data refers to working locations of commuters, the Gravity model is well-prescribed approach. As mentioned earlier, this involves a cost function that can be customised for future enhancements.

*cost* = e(β \* Dij)

(where β is a decay factor applied to the distance between two zones)

1. Mode Choice

Once the distribution of trips is completed in the previous step, the model now has to assign modes for these trips. Given the presence of multiple transpost modes in the study area, a nested logit model will be used to build utility functions for each mode. These will dictate the modal choice process. Additionally, different utility functions can be created to test out various scenarios. The modes selected for this mock-up are: walking, public transport and car.

Scenario 1:

Uwalk = exp(-0.05 \* distance)

Ubus = exp(-0.03 \* distance)

Ucar = exp(-0.01 \* distance)

Scenario 2:

Uwalk = exp(-0.05 \* distance)

Ubus = exp((-0.03 \* distance) + 0.75)

Ucar = exp(-0.01 \* distance)

Scenario 3:

Uwalk = exp(-0.05 \* distance)

Ubus = exp(-0.03 \* distance)

Ucar = exp((-0.01 \* distance) - 0.75)

1. Route Assignment

Finally, once the trips have been distributed and the mode for each trip selected, this step assigns the route for the trips along the network. Ideally, these routes would be assigned based on the roads along the network. For the purpose of this mock-up, the centroids of the wards will be used as the starting/ending point for each zone. The routes would be segments from one centroid to another.

**DATA LINKS, ASSUMPTIONS**

SUPPLY

1. BBMP Wards - [link](https://github.com/datameet/Municipal_Spatial_Data/blob/master/Bangalore/BBMP.GeoJSON)

DEMAND

1. Commuter Home Locations [*Total Worker Population Person* from Census data] - [link](https://knoema.com/zhziwrg/bangalore-census-data-ward-wise?variable=Total%20Worker%20Population%20Person&action=export&gadget=first&action=export&gadget=first)
2. Employee Work Locations: This data-set wasn’t easily available freely, hence a normal distribution of employee locations was assumed using other countries’ base data.

**SCENARIOS FOR MODELLING**

1. Base Scenario: This scenario models an approximation of existing travel patterns with weightage of distance factored by “cost” of each mode. [NOTE: this doesn’t take into account vehicle ownership data]
2. Flat Fare for Public Transport: This scenario models an improvement on existing public transport routes by capping the fare of buses, hence providing a favourable cost factor for long distance trips.
3. Congestion Pricing: This is a “mock scenario” (similar to schemes in London, Stockholm), where cars are charged for entering certain zones. For the purpose of this mock-up, it is represented as an extra cost for the car mode.

**ROADMAP**

* Agent-based modelling to identify possible emergent phenomena
* Route-assignment based on actual road network
* Cost function based on distance, time, vehicle ownership
* Utility function based on distance, time and external costs (fares, etc.)