

# Travel Modelling Group

## MEMORANDUM

**Date:** 2018-03-08  
**Number:** 2018-01  
**To:** TMG Technical Advisory Committee  
**From:** Bilal Yusuf  
**Subject:** **Fare Modelling in Emme Updates**

### 1. Introduction

The purpose of this memorandum is to provide an update to the fare modelling workshop that was held on February 7, 2018 with the Technical Advisory Committee. A number of issues were raised with the current situation of fare modelling in Emme, and TMG has tried to investigate various solutions to these problems. Each section of this memo will seek to address a different issue that was raised.

### 2. Location Based Transfers

Toronto and York region raised a concern that when transferring between TTC routes in York Region and the YRT, the fare hypernetwork still imposes the full initial cost of the YRT when it should in fact be free. The hypernetwork did not support location-based transfers like it supported location-based boarding. This was rectified by updating the hypernetwork generation code to now include the ability to specify transfers' cost based on a location. This is done in the schema using something like the following

```
<fare cost="-2.13" type="transfer">  
  <from_group>TTC Regular</from_group>  
  <to_group>YRT</to_group>  
  <bidirectional>True</bidirectional>  
  <in_zone> York 1 </in_zone>  
</fare>
```

Similar to that shown above, a negative location-based transfer charge was added in the Base Fare Schema so that when transferring between TTC and YRT in York Region, a negative transfer cost is applied as to cancel out the initial cost applied to transfer between TTC and YRT in general.

### 3. Fares with Certain Base Component Free

Metrolinx raised the issue that they are exploring different fare options for GO transit such as paying an initial fare that includes a certain portion of travel for free. This was investigated using two methods, as shown below.

#### Method 1: Affects Mode Choice Only

No changes to Emme fares. Still charge a base fare and then use a distance-based fare on every segment.

However add an extra attribute (@dist) to the lines that will have this form of fare structure (eg. GO Lines)

Run a transit assignment, and aggregate the @dist attribute in form of an OD matrix

Do the following calculations for every given OD

$$Tfare_{OD} - [\max(@dist_{OD} - Discount, Discount)] \left( \frac{\$}{km} \right) = Tfare'_{OD}$$

Where:

Discount is the distance that is included in the Base Fare component

\$/km is the distance based cost for the line (eg. \$0.1/km)

This modified  $Tfare'$  matrix is then given to mode choice which would reflect a change in transit demand. However, this change in transit demand might not be visible in the transit assignment as route choice remains the same. For example, if the GO fare structure changes to this model and this increases transit demand as a whole from mode choice, Emme might show that TTC ridership has grown at the expense of GO due to Emme not knowing how the fare structure truly operates.

#### Method 2: Imperfect Route Choice

This will change Emme fares to the following

$$Initial\ Boarding\ Cost = Base\ Cost - Free\ Distance \left( \frac{\$}{km} \right)$$

Then each segment will still have a cost such that when the individual travels the Free Distance, their cost will be equal to the Base Cost.

However, this is imperfect due to the fact that when an individual travels less than the Free Distance, they will be paying an amount less than the base cost, which is impossible in reality.

#### 4. TTC-GO-TTC Paradigm

This issue was raised by a number of regions, most notably by Toronto due to their Smart Track analysis, and refers to the problem that when transferring from TTC to GO back to the TTC, there should be no fare charged on the last leg. The fare needs to only be paid on the first TTC journey and in the hypernetwork approach, it is being charged on both TTC journeys. It was attempted to use journey levels to solve this problem as there is no “agent memory” in the hypernetwork, while each agent has a journey state.

However, when trying to set up journey levels with 3 base levels (TTC, GO, 905), 3 intermediate levels (TTC+GO, GO+905, TTC+905), and 1 final level (TTC+GO+905), there was a limitation with the journey levels algorithm. Each journey level can only have 1 level it can progress to which presents difficulty in this case as the “TTC” level can move on to the “TTC+905” level as well as the “TTC+GO” level. The only way this would work would be have separate modes for all lines in the three levels (TTC, GO, 905) and then to have duplicates for each line with the various combination of modes that the individual could have taken. This would end up making the concept of capacity useless as each line would have its effective capacity multiplied by 3. Therefore, this approach is not a viable one.

TMG will continue to investigate the issue, but this appears to be a limitation of the static transit assignment used in Emme.