C-20: A Route choice model for Colombo City

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An urban highway network generally has a number of different routes between any origin and destination of a given vehicle trip. Each individual vehicle user will determine his trip to minimise the disutility of making the trip. Different methodological approaches are available to estimate the choice function based on highway attributes and socio-economic characteristics of the decision maker.

Colombo's highway network is presently saturated and daily average speeds are around 21 km/h. Improvements to the network are required by increasing speeds, capacities and with new links. However, identification of the links which need such improvement must be based on their impact on the entire network. This paper produces a model capable of estimating such impact when road characteristics are changed affecting any given route alternative for travel between any given origin and destination.

The Route Choice Model was calibrated using data from the Colombo Traffic Study. The private vehicular flow within the Colombo City area was observed at 31 different locations. These flows were then assigned to a trip matrix of 20 zones. Each trip has an origin and a destination zone. Each unique combination of origin and destination zones is a particular cell in a trip matrix. This cell contains the total number of trips between the 2 zones by all different routes available on the network.

The observed route choice for each cell was computed together with the highway characteristics of the alternative routes. Length of road, average width of road, travel time, surface condition and availability of centre median were obtained.

Multiple regression analysis was used to determine the significance of the different attributes in the aggregate route choice behaviour in the Colombo City highway network.

The Route Choice Model obtained is of the logit type formulation.

$$\mathbf{RC_{ijk}} = \frac{1}{\mathbf{1 + (n_{ij} - 1) \exp U_{ijk}}}$$

where
$\mathbf{RC_{ijk}}$ is the proportion of the total O-D flow between zones i and j oserved on the path k.
$\mathbf{n_{ij}}$ the total number of routes between zones i and j
$\mathbf{U_{ijk}}$ is the utility of path k given by:

$$U_{ijk} = 0.000437\ l_{ijk} - 0.000486\ l_{ijm} - (0.42\ S_{ijk} - 0.51\ S_{ij})$$

where
l_{ijk} is the distance between zones i and j by route k in decametres and
l_{ijm} is the mean distance of all routes other than route k between zones i and j in decametres,
S_{ijk} is the speed computed as the distance l_{ijk} divided by the time t_{ijk} in decametres per second for travel between zones i and j on route k and
S_{ijm} is the mean speed of all routes other than route k for travel between zones i and j.

The statistical fit of the variables in the model are acceptable at a t-test significance level of less than 1%. The overall model fit at less than 1% for a F-test is also acceptable, although the adjusted R2 statistic of 27% indicates that more variables may be incorporated into the model.

As anticipated the model reveals that the primary determinants of route choice are travel time and distance. Reduction in each of these in one particular route will increase the share of traffic on that route. Correspondingly the increase of travel time on another route will also lead to an increase in the share of traffic. Using the calibrated coefficients, the nett increases and decreases in traffic flows can be estimated for proposed changes on the highway network.