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Summary:

Regional transport model for the greater Oslo area (RETRO)
Version 1.0

The combination of a travel demand model and a representation of the real transport network are often used to model passenger transport in urban areas. The real transport network representation describes the most important roads and intersections for automobiles in a city and the transit lines for public transport. The roads, intersections and transit lines are characterised by volume-delay functions and other characteristics. The travel demand and the network representations are used as input to an assignment algorithm for calculation of the transport quality data. Demand for trips and the transportation quality data are inevitably dependent in congested areas. Hence, there is an interaction between the travel demand model and the assignment algorithms. Solution methods for transport models of this type are often based on an iterative loop where the travel demand model and the assignment algorithm are run alternately while exchanging data until equilibrium between travel demand and generalised travel costs is achieved.

This report describes some general theory of transport models and in particular a model system for passenger transport in the greater Oslo area (RETRO). The model system consists of a car ownership model, a travel demand model for the region, and an EMME/2-databank representation of the real transport network in the region and assignment algorithms of EMME/2 for calculation of transport quality data (see EMME/2 manual).

The car ownership model is a national model that is due to Ramjerdi and Rand (1992) and Rand and Rekdal (1996). It is used to calculate car availability in the region. Input includes factors for overall changes in income and fixed and variable costs of travel. The car ownership model is independent of the other parts of the model system. Car ownership is fixed if the car ownership model is inactivated.

A prototypical sample (socio-economic representation of individuals in the population) is part of the input to the travel demand model. The travel demand model uses the prototypical sample to make predictions at the disaggregated level. The construction of a prototypical sample is based on pre-specified aggregates, “target variables”, for the number of people in defined population subgroups and data of individuals in the population. The target variables can be obtained from regional statistics, and the data of individuals can be obtained from travel surveys. This report describes the data and the method that were used to construct the prototypical samples that have been used with the model, and characteristics of the prototypical samples are discussed. One of the prototypical samples is based on regional statistics of the number of people grouped by age, employment status and

gender and a dataset from a travel survey described by Vibe (1991). Another prototypical sample is based on regional statistics of the number of people of different income groups and data from the same travel survey.

The prototypical sample for the individuals in the population, the calculated car availability and transport quality data are used as input to the travel demand model. The travel demand model divides the region in 49 zones. Oslo is divided in 27 zones, where each zone corresponds to zones used by the city authorities for local administration (townships). The remaining 22 zones represent the surrounding municipalities in Akershus. The travel demand model consists of a nested logit model for mode and destination choice (Ben-Akiva, 1995) and a trip frequency model that is based on a geometric distribution (Bhattacharyya and Johnson, 1977). The systematic components of the model are described in this report.

Total travel demand is represented as OD-matrices for total trip frequency and for trip frequencies of car, public transport and slow mode (walking/bicycle).

The OD matrices are used with assignment algorithms of EMME/2 and an EMME/2-databank, where the most important road links and transit lines in the region are represented. The databank represents 438 zones, whereas the travel demand model has only 49. A conversion algorithm is used to split trips between the 49 zones in the travel demand model to the 438 EMME/2-zones and vice-versa for transport quality data. Sets of volume-delay functions for User-equilibrium (UE) and System optimum (SO) are described.

The auto assignment algorithms calculate route choice and the corresponding transport quality data. The difficulty of calculating the solution depends on the network representation and on the connected travel demand model. As the complexity increases, solution algorithms can be very computer demanding.

From established theory of assignment algorithms, two methods of assignment can be used as part of the solution algorithm for the transport model of the greater Oslo area. Both algorithms are based on the Double Stage Algorithm. In both methods there is an iterative loop where the travel demand model and an assignment algorithm is run alternately while exchanging data until equilibrium is achieved. One of the methods uses the OD-matrix for car trips in fixed auto-assignment. The other method uses the total OD matrix from the travel demand model in variable demand auto-assignment. The latter assignment method was used in the EU project AFFORD. It is experienced that the convergence characteristics of the combination of the travel demand model and the variable demand algorithm is superior to the convergence characteristics of the travel demand in combination with the fixed demand algorithm only. The solution after only three iterations is usually close to convergence.

The transit assignment algorithm in EMME/2 is part of the iterative loop. It is used with the transportation level of service (equation 4.17) to decide on which route the traveller will choose. Hence, the transit assignment depends on the overall frequency of public transport vehicles, which is calculated endogenously as part of every iteration as a function of the total number of travellers by public transport.

The RETRO model has a wide range of application areas. It is suitable as a general tool for investigation of the effects of changed prices, taxes, and infrastructure on total travel demand and travel times. Moreover, the disaggregated structure of the travel demand model makes it possible to study the change in travel demand and travel times for subgroups in the population. In the EU project AFFORD the RETRO model was used in strategic analyses to calculate marginal cost road pricing (Fridstrøm, 1999).