## Summary

# A new model for shifting the time of travel in regional transport models

*TØI Report 11356/2019*
*Author(s): Stefan Flügel & Tom N. Hamre*
*Oslo 2019 27 pages Norwegian language*

*The regional transport models (RTM) do not model the choice of travel time and thus cannot predict the extent to which measures - such as time-differentiated road tolls - lead to changes in the choice of travel time. In this report, we document a model that can distribute and shift demand data from RTM between individual hours.*

The regional transport model, RTM, is a static model within predetermined time periods. While the demand model in the RTM system, Tramod_By, predicts travel frequency, travel mode choice and destination choice, it cannot predict departure time choice. The model is run either with 1, 2 or 4 time periods. For some analyzes, especially in urban areas, it is desirable to be able to calculate expected changes in the choice of travel time, especially for car traffic. This can typically be the case when restrictive car measures aim at shifting traffic from inside the rush hours to periods outside the rush hours.
Compared to a previous model, reported in Rekdal et al 2012, our proposed model has some methodological improvements. These are briefly summarized in Table S1.

*Table S1: Main differences between old and new model.*

| Model | Rekdal et al 2012 | New model |
|---|---|---|
| What hours are redistributed? | 3 hours within rush | 24 hours |
| Allowing for shifts from rush to non-rush (and vice versa) | No | Yes |
| Distribution of time of travel in reference scenario | Exogenously calibrated | Based on with-day distributions given commuting patterns as proposed in Flügel et al 2017 |
| Sensitivity of chances | Split in elastic and inelastic demand (only elastic is shifted) | Controlled with parameters that can vary with OD-relation and trip purpose |

The currently implemented model code is adapted to the Oslo area (RTM23 +) and applied to car trips. However, with minor adjustments in the code, it can also be used for other regions and travel modes. The model is adapted for short journeys under 70 km. The mathematical model is based on within-day-distributions as estimated in Flügel et al 2017 that use information about commuting patterns to model the relationship between morning- and afternoon rush on a OD level. Changes in generalized travel costs at the hourly level give rise to adjustments in the within-day-distribution, using a logit model. The logit model includes parameters that control the propensity to change in the travel time. These parameters are partially segmented with travel purpose and information on the type of workplaces at destination
The mathematical model is implemented in Python where demand data, level-of-service (LoS) data and zonal data from RTM23 + are read in.
Figure S1 shows the modeled within-day-distribution for all trips in RTM23 +, and Figure S2 shows time profile for commuting trips between Moss-Oslo versus Oslo-Moss.

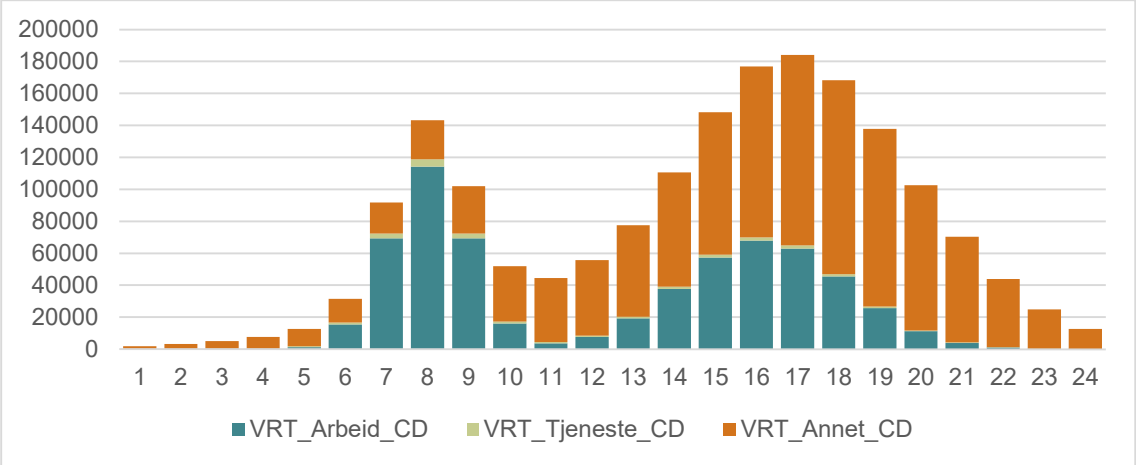


*Figure S1. Within-day-distribution of car trips for all OD-relations in RTM23+, separated by travel purpose (dark green: commuting, light green: business, orange: all other trips).*

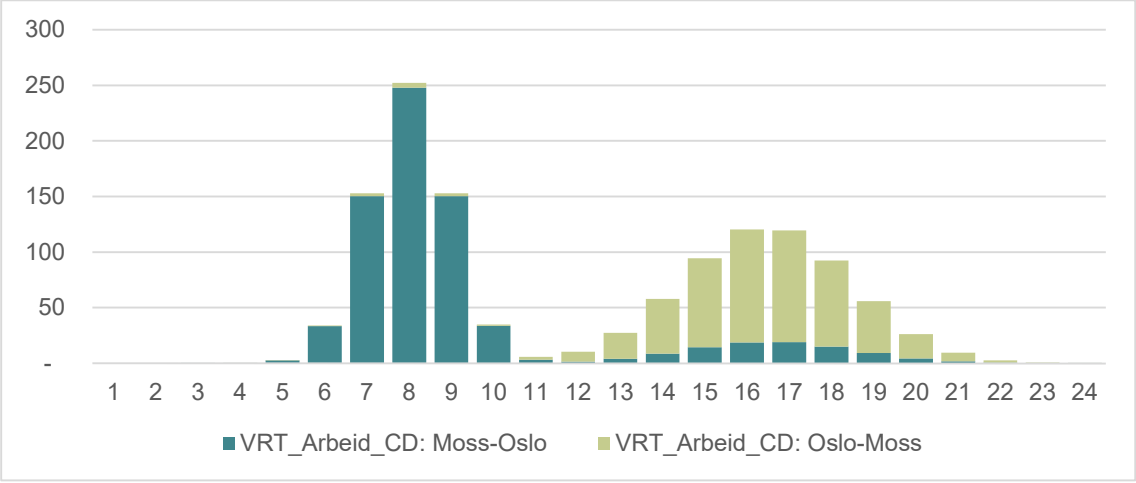


*Figure S2. Within-day-distribution of commuting trips by car between Oslo and Moss (light green) and Moss and Oslo (dark green).*

Figure S3 shows a hypothetical example with an increase in travel costs (+20 NOK) between 07:00 and 08:00. The figure shows that demand is shifted to before and after the time period with increased price.

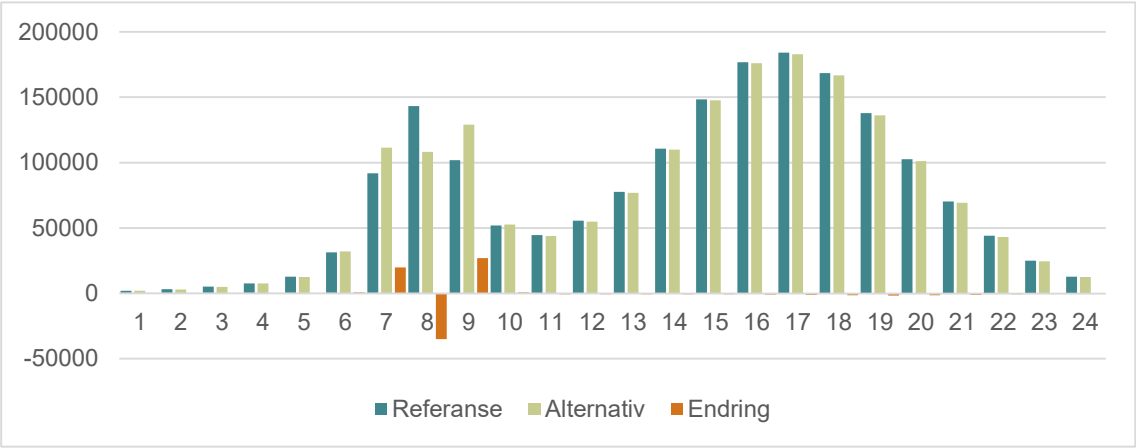


*Figure S3. Changes in within-day-distributions after an increase in travel costs between 07:00 and 08:00.*

Our preliminary empirical tests show that

- The within-day distributions in the reference situation have intuitive forms, both in total and subdivided by travel purposes.
- The within-day distributions for commuting trips is a function of commuter flows and provides the expected relationship between morning and afternoon rush at on OD level
- When the supply worsens in a certain time period, the demand is shifted to hours before and after that time period. The opposite is true when improving the supply. Then there will be more trips in that period on the expense of the hours before and after that period.
- The sensitivity of the change depends on the travel purpose and the type of workplaces at the destination.

We are more uncertain about to what extent changes in LoS-data give the correct order of magnitude of results (sensitivity). This is largely connected to the fact that the value of sensitivity parameter values in the model are set by intuition (and not empirically). It is recommended to further test the model and improve the calibration of the parameters.

The implemented model is a stand-alone application as of today. It uses RTM output data ("post-processing") without sending data back to RTM and without passing data on to tolls for cost-benefit analysis. This can lead to inconsistencies. After the model has been tested better, one should evaluate to what extent the model can be integrated into RTM model system.