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Estimating vehicle kilometres in Finland

Transmitted by the Finnish Road Administration, Finland

This paper describes briefly the model used in Finland for estimating vehicle kilometres, and the experiments done towards the end of the 1990s to estimate them by exploiting kilometre counter readings obtained in connection with vehicle inspections. The end of the paper also briefly describes the model for estimating changes in vehicle kilometres using known vehicle kilometre data for a base year.

The model used for estimating vehicle kilometres

Finland has 78,000 km of roads maintained by the state, i.e. public roads, 22,000 km of municipal streets and 350,000 km of private and forest roads. Public roads are classified according to their importance in the road network into trunk roads (class I) and main connecting roads (class II), which form the main road network, and into regional and connecting roads, forming the lower road network. Public roads are the responsibility of the Finnish Road Administration which is divided into nine road districts. Finland has 432 municipalities, each of them responsible for the streets within their area. Private road maintenance associations and local land owners are responsible for the building and maintenance of private and forest roads.

Exhaustive traffic censuses only cover public roads. A few major cities also conduct regular traffic censuses on their own street networks, while in smaller municipalities and on private roads traffic counts are only performed occasionally and at few locations.

For the traffic censuses public roads are divided into 15,500 road sections that are homogeneous in respect of their traffic volume. The entire public road network is covered in

four-yearly rotation so that a census is conducted on one quarter of the homogeneous sections every year. The traffic count on each homogeneous section is performed as a mechanical sample census by leaving the counting apparatus in position for one week twice during the census year. The first census week is in the June-August period and the second in September-October.

The results obtained from the two census weeks are used to determine what type of seasonal variation the traffic on each studied road section represents. There are altogether five types of seasonal variation. Once the type of seasonal variation has been established, the census results can be used to estimate average daily traffic using a respective regression model. Average daily traffic is estimated for all traffic as well as separately for heavy goods vehicle and vehicle combination traffic.

Apart from average daily traffic and type of seasonal variation, the parameters that must be estimated also include average weekday traffic, summer average daily traffic, types of day-to-day and hourly variations of traffic and traffic volumes of the busiest, 100th busiest and 300th busiest hour of the year.

As a rule, a traffic count is performed on each homogeneous road section once every four years. However, if necessary the rotation speed can be increased of slowed down from this. At its slowest the rotation interval may be eight years provided the average traffic volume does not exceed 150 vehicles per day. On sections with rapidly growing traffic, censuses can be made every year.

The estimates describing traffic are entered into a road data bank which also contains other data on public roads, such as lengths of the homogeneous road sections. Because the road databank must contain comparable data on each homogeneous road section, the data for the sections not included in the census in the current year must also be updated. This is done with the aid of general growth factors of traffic, which are separately determined either by individual road or road category, and by traffic volume category for each road district. Data on the development of traffic are obtained from fixed traffic counting posts, of which there are around 275 for this purpose. Most of the fixed traffic counting posts are located along the main road network, so development on the lower road network has to be estimated, for instance by utilising sample censuses. Additional data that can be used in the estimating include general information concerning fuel sales and changes in automobile stock or land use. Thus, the estimating is at least partly based on the subjective views of experts.

Once the annual average daily traffic has been estimated for an individual homogeneous road section, its annual vehicle kilometres are obtained by multiplying its daily traffic by its length and the number of days in the year. Estimates of vehicle kilometres for streets, private roads and forest roads are based on old survey results, updated with information and assessments on the development of traffic on public roads and streets. Estimates of vehicle kilometres and their development for the whole country are also obtained from the National Passenger Transport Survey conducted every six years and the annually compiled Statistics on the Transport of Goods by Heavy Goods Vehicles in Finland. In addition, general information concerning fuel sales, and changes in automobile stock and land use can be utilised in the estimating in the same way as in estimating the development of traffic on public roads.

Use of kilometre counter readings in vehicle kilometre estimations

Exploitation of kilometre counter readings obtained in connection with vehicle inspections in estimating vehicle kilometres was studied in Finland towards the end of the 1990s. The scope of the study was limited to passenger cars and vans – corresponding data concerning lorries and buses were collected with inquiries conducted among transport companies. Besides kilometre counter readings, age and motive power (petrol, diesel) of vehicles were used as additional regressors for vehicle kilometres. In respect of passenger cars, engine capacity and total weight, as well as information about the municipality of registration and owner of the vehicle were also included among the variables. If the owner was a private person, his or her age and sex could also be used as background data. Around 260,000 kilometre counter readings were available for good 165,000 vans, and over 450,000 readings for around 200,000 passenger cars. Annual vehicle kilometres were estimated for the total stocks of passenger cars and vans by utilising data on average drive kilometres by age and motive power of vehicle.

The study observed a linear dependency between age and annual drive kilometres by type of vehicle: the newer the vehicle the more it was driven. In addition, considerably more kilometres are driven with diesel-powered cars than with petrol-powered ones. The engine capacity and the total weight of vehicle also correlate positively with the number of drive kilometres. Men drive slightly more kilometres than women, middle-aged people more than young people and old people, and business enterprises more than private persons and public corporations. The volume of drive kilometres also varies by area. The more precisely the structure of the stock and the background of the owners of automobiles are known, the more accurately vehicle kilometres can be estimated.

A few technical aspects hamper the utilisation of kilometre counter readings for the estimating of vehicle kilometres. A new automobile is only inspected for the first time in the third year and for the second time in the fifth year following its registration, and obligatory annual inspections only start after this. Thus, no accurate data on vehicle kilometres are obtained from vehicle inspections during the first years of vehicle use. In addition, for taxation reasons there is certain wavering between types of automobiles so that in certain instances it is more economical to register a passenger car as a van and, correspondingly, a van as a lorry, and this produces some disparity with traffic censuses where automobiles are classified by their technical features or appearance. The rules concerning taxation have also varied over the years, which causes more vacillation in the time series. All in all, different types of studies have produced highly divergent and partially also conflicting estimates of total vehicle kilometre volumes.

The study about the exploitation of kilometre counter readings included an effort to arrive at common expert views about amounts of vehicle kilometres by type of automobile in Finland. Four types of automobiles were examined, passenger cars, vans, lorries and busses. Year 1998 was set as the base year, and the views were based on the results from all studies concerning vehicle kilometres conducted in Finland in the 1990s, as well as on estimates about typical fuel consumption by type of automobile. The basic amounts were agreed at a meeting attended by representative from all organisations in Finland that compile statistics on vehicle kilometres. Average fuel consumptions and vehicle kilometres were agreed at the meeting so that the computational total consumption corresponded with the volumes of fuel supplied to road traffic.

Once vehicle kilometres had been agreed for the base year, simple regression models were constructed for calculating annual changes in the vehicle kilometres of light and heavy automobiles. In the model the group of light automobiles comprised passenger cars and vans, while lorries and buses formed the group of heavy automobiles. Change in vehicle kilometres was described with a vehicle kilometre index. For light automobiles the regressors in the index were the average price of petrol at the 1995 value of currency, number of light automobiles at the end of the examined year, income recipients' taxable income after tax at the 1998 value of currency, gross domestic product at the 1995 value of currency, and number of employed people at the end of the examined year.

The formed model worked quite well. Its rate of determination was 0.985 and standard error 0.5. However, the basic data needed for the model are obtained at a considerable time lag, so the model cannot be used in situations where data on vehicle kilometres are desired soon after the turn of the year or even mid-year. A more concise model was composed for this, selecting as regressors number of light automobiles at the end of the examined year, gross domestic products at the 1995 value of currency and number of first registrations of light automobiles. The rate of determination obtained for this model was 0.977, with a standard error of 0.7. In the respective model for heavy automobiles, the regressors were gross domestic product at the 1995 value of currency, number of first registrations of heavy automobiles for licensed use and volume of diesel oil sold to road traffic. For this model the rate of determination was 0.958 and standard error 1.0.

Unfortunately, the model was not used extensively. It was, nevertheless, tested during a couple of years, but traffic censuses were also improved at the same time so that heavy vehicles could be classified more precisely into different types. Confidence was thus strengthened in the traffic census-based model and a second model for estimating vehicle kilometres was no longer considered necessary.