Day or date model

A comparison between two methods of calculating change in vehicle mileage
Summary
In the Nordic countries two different methods are used to estimate the change in vehicle mileage. The *date-method* compares the traffic a specific day with the traffic the exact same date one year before. The *day-method* compares the traffic a specific day with the traffic from a ‘similar’ day one year before. E.g. if the 28th of October 2019 is the last Monday in October, the traffic for this day can be compared with the traffic from the last Monday in October 2018, a ‘similar day’. While the date-method would compare the 28th of October 2019 with the 28th of October 2018 irrespective of what weekday it is.

When estimating the change in vehicle mileage for a 12-month period the difference between the two methods is almost negligible. However, when estimating the change in vehicle mileage on a monthly basis the two methods can for some months give very different estimates. These differences are mainly due to the day-method using days outside of the month of the comparison year which are not included in the date-method.

It is not possible to say that one method is more correct than the other since they are actually estimating slightly different parameters. However, an important difference between the methods is that the date-model is in practice completely automatic in the matching of days while the day-method has a subjective component in deciding how to match days that are supposed to be similar.

This report recommends the date-method over the day-method. This recommendation is due to that the differences between the two methods over time are small and the date-method is the more objective of the two methods.
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Guideline
Version 1.1
Date: 2019-10-26
Project ID: 885295
Publisher: NordFoU
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1 Summary

In the Nordic countries two different methods are used to estimate the change in vehicle mileage. The date-method compares the traffic a specific day with the traffic the exact same date one year before. The day-method compares the traffic a specific day with the traffic from a 'similar' day one year before. E.g. if the 28th of October 2019 is the last Monday in October, the traffic for this day can be compared with the traffic from the last Monday in October 2018, a 'similar day'. While the date-method would compare the 28th of October 2019 with the 28th of October 2018 irrespective of what weekday it is.

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It is not possible to say that one method is more correct than the other since they are actually estimating slightly different parameters. However, an important difference between the methods is that the date-model is in practice completely automatic in the matching of days while the day-method has a subjective component in deciding how to match days that are supposed to be similar.

This report recommends the date-method over the day-method. This recommendation is due to that the differences between the two methods over time are small and the date-method is the more objective of the two methods.

2 Introduction

Statisticon AB were assigned by NorSIKT/Trafikverket to compare the Swedish day-method for measuring change in vehicle mileage with the date-method used in the other Nordic countries. The two methods differ in the way dates are matched from the current year to the comparison year.

Swedish data from January 2012 to September 2017 was used in the evaluation. Two different parameters are evaluated: a) the monthly change, a comparison of the vehicle mileage for one month compared to the corresponding time period the year before and b) the twelve month comparison, is a similar comparison but for a twelve month period compared to the corresponding twelve months the year before.

The results show that the two methods generally give similar results. However, in the monthly comparison, some months showed rather large differences between the methods. The recommendation is to use the date-method to avoid the subjective component present in the matching of comparable days in the day-method.
3 Data and method

The data used to evaluate the two methods are number of cars from 83 measure points in Sweden. For each day, hourly measures are reported giving 24 estimates of number of cars each day at respective measure point. For each measure point a corresponding sampling-weight for the point is given and used to estimate the change in total vehicle mileage. The available data ranges from January 2012 to September 2017. Since the change in vehicle mileage is compared with the previous year the earliest comparing possible is for January 2013.

3.1 Missing data

For both methods each day (present day) is matched to a corresponding day the year before. If data is missing for the present day or the corresponding day that day is not included in the calculation. If data is only available for part of a day (e.g. 04:30 to 11:45) the data from the same part of the day (04:30 to 11:45) is used for the matching day. Since the two methods have different rules for deciding the corresponding day data could be missing with one method but not with the other.

A list of measure points containing data deemed too low quality was also supplied by Trafikverket. These evaluations are made for specific time periods and were excluded before the calculations. Trafikverket publish an estimate of the monthly change in vehicle mileage as soon as they have data available (“snabbskattnings”). For this estimate there is not time to do imputation and rigorous quality checks of the data. Once a year Trafikverket evaluate the quality of all the data and do quality checks and imputations. The dataset used in this analysis was the dataset with higher quality but then it was not possible to replicate Trafikverkets estimates published as “Snabbskattnings” since they are derived based on a slightly different dataset.

3.2 Method

3.2.1 Time periods

The change in vehicle mileage is derived for two different time periods. The first is change in monthly vehicle mileage for single months compared to the corresponding month the year before. The second is for rolling twelve month periods compared to the previous twelve months. The change in vehicle mileage for the two different types of periods is calculated using the method described in “Metodbeskrivning – Undersökningen av trafikarbets förändring”¹.

A note of importance is that Trafikverket measures the 26th the previous month to the 25th as the cut-off time points for a time period. For example, the measure for change in monthly vehicle mileage January 2017 is for the period 26th of December 2016 to 25th of January 2017.

3.2.2 The Date-method

In the date-method each day a specific month is match to the same date the same month a year before. So the 3rd of April is matched with the 3rd of April the previous year. This means that the matching of individual days can be rather non-comparable. One year the 3rd of April could be a weekday but the previous year it was a weekend. Or the 3rd of April could be a holiday during the eastern one year that is matched with a regular weekday the previous year. However, since there are approximately 30

¹ https://www.trafikverket.se/contentassets/a0b610ad9e24f29227708349b31f13b/metod_pm_if_131031_3.pdf
days that are matched each month in most cases the difference observed in the matching at the day-level will even out over a whole month. The main difference can occur when eastern is in one month one year but in another month the previous year. An observed difference in vehicle mileage with this method could then be due to the shift in the location of eastern rather than a change in ‘true’ vehicle mileage.

3.2.3 The Day-method

In the day-method the ambition is to reduce the effect of holidays and number of weekends per month. Hence, if the 3rd of April is the first Saturday of the month the present year it’s matched with the first Saturday the previous year. And big holidays, e.g. Maundy Thursday, are matched with Maundy Thursday the previous year.

So the Day-method strives to reduce the effect of holidays and that the same month can have different number of weekdays different years.

For the big holidays there are clear rules how to do the matching (described in Trafikverket 1996?). However, for regular weekends and weekdays there will be a subjective component in the decision how to do this matching.

4 RESULTS

4.1 Monthly changes in vehicle mileage

Figure 1 gives the estimates for the monthly change in vehicle mileage. The two different methods follow each other’s movement fairly close. There are some exceptions as for example January 2017 where there is a huge spike in the date-method and not any particular movement upwards in the day-method.

The difference between the two methods is better visualized in figure 2. It is clear that there is no systematic difference between the two methods. The deviations go in both directions although the largest spikes are positive. The mean deviation is -0.07% and the mean absolute deviation is 0.74%.

Figure 1. Change in monthly change in vehicle mileage day- and date-method

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7 Regler Överföringstablå, Intern dokumen från Trafikverket, 1996-09-01
Figure 2. Difference between monthly change in vehicle mileage between the date and day-method. Arrows indicate the month for Eastern.

A hypothesis could be that the big differences between the methods would occur the months where Eastern occurs. But it’s not possible to see any relationship between eastern and the difference between the methods. [Eastern occurred in March 2013 and 2016 and in April 2012, 2014, 2015 and 2017. Indicated with arrows in figure 2.]
4.2 The case of January 2017

The measure of change in monthly vehicle mileage for January 2017 yields the largest difference between the two methods. The day-method estimates a change of 3.2% while the date-method gives an estimate of 7.7%. Since there is a large difference this comparison gives a good example of the cause of differences between the two methods.

In figure 3 the matching of the five first days are illustrated. The first days are in December as 25th is used as cut-off time point. We see e.g. that December 26, 2016 is matched with December 26, 2015. However, December 28, 2016 is matched with December 21, 2015. Here there are several other possible days that could have been used, e.g. December 28, 29 or 30. There is no clear answer which day is right or wrong in this case. But December 21th is a day just before Christmas when there is more than average traffic which causes the comparison period in this case to be a period with high traffic and this is one reason why the change in vehicle mileage is smaller with the day-method compared with the date-method for January 2017.

*Figure 3, Illustration of the matching of the five first day for January 2017 with the day-method. (The first five days are December 26 to December 30, 2016 that are matched with corresponding days 2015.)*

In table 1 that matching is presented for the whole month. The red cells highlights days which are only used in one of the methods and not in the other. These differences are due to the fact that the day-method use days from outside of the comparison period. For example, the days from 2016-12-27 to 2016-12-30 are in the day-method matched with the days 2015-12-20 to 2015-12-23 which are days not used in the direct matching of the date-method. The validity of matching these days is not evaluated in this report but this example is merely used to highlight what causes the difference in the two methods.
The orange marking highlights days that are used more than once in the day-method. These days are included also in the date-method but only once. Using a day multiple times will get the consequence that some days are not included at all in the comparison. So in this example the 12th and 13th of January are used twice in the day-method.

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### 4.3 12 month comparisons

The expected result for the twelve month comparisons were smaller differences between the two methods. For example, in the one month comparison the day-method may use days in the month period before from the comparison year. However, for the 12 month comparisons this difference is only likely to occur for the first and last month of the 12 month period. However, the effect of using multiple days or zero days from the comparison year in the day-method compared to all days in the date-method will still remain.

Figure 4 shows the 12 month estimates of change in vehicle mileage. The two methods follow the same trends throughout the examination period. However, there is an autocorrelation in the differences. Because if there is a large difference for one month this difference will affect the twelve coming comparisons as well since we have a twelve month rolling window. In figure 5 it can be seen that the direction of the difference lasts for longer periods than what could be seen in the monthly comparison.

The mean deviation for the 12 month comparisons is -0.04. This means that over the whole examination period the difference between the two models is very small. The mean absolute deviation is 0.23 which is also quite small.

Figure 4, 12 month change in vehicle mileage day and date-method
So in summary the reasons for different estimates between the two methods are:

- The day-method can use days outside the comparison period.
- The day-method can use some days several times and some days not at all.
- The decision which days that should be considered as comparable involve a subjective component which can affect the result. Different persons doing this matching could come up with different results.
- Since only data for time-points that are available in both the present day and the comparison day can be used different data for the same day can be used with the two methods.

5 CONCLUSION

This report applies two different methods for measuring change in vehicle mileage. The true value of the change in vehicle mileage is not known and therefore this comparison between the two methods cannot make any claims as to which method is the closest to the true change in vehicle mileage. Instead the main results of the comparison are the degree of similarity of the two models.

The monthly comparison shows that the two methods mostly follow the same trends in the change in vehicle mileage. However, there are a few months where the two methods yield substantial differences. These differences are mainly due to the day-method using days outside of the month of the comparison year which are not included in the date-method.

The two methods are not supposed to measure exactly the same parameter. Hence, we should expect some differences. Specifically, when eastern occur in different months for the two years that are compared.
The 12 month comparisons show small differences between the two methods. This could be expected as the difference in which days that are included in each method will decrease.

As noted this report is not able to show which method best measures the true value of vehicle mileage. However, it is shown that the difference between the models is generally small. The day-method have some rules for the matching of days but also room for subjective judgements in the matching process. This means that the model requires a subjective assessment from the person making the matching list. This makes the method dependent on the person making the list and could lead to systematic differences when a new person is assigned to making the matching list.

The date-method on the other hand has no subjective assessments and the comparisons over years are for the same calendar-periods. This report recommends the date-method over the day-method. This recommendation is due to this report showing that the differences between the two methods over time are small and the date-method is the more objective of the two methods.
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