Transport for Greater Manchester

Greater Manchester Travel Diary Survey

Approach to weighting

Version	Author / Changes made by	Date	Amendment / Change
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1.1 Introduction

In 2020, TfGM commissioned Ipsos MORI to review the weighting approach for TRADS. This review recommended that the approach should be updated. TfGM agreed to adopt the recommendation for surveys from 2020 onwards.

The three stages to the new approach are outlined below.

1.2 Stage 1 - selection weights

The first stage of weighting is to create selection weights (w1), to ensure that the over-sampling of smaller population districts does not skew the estimates for Greater Manchester towards those districts with smaller populations. These weights are calculated by dividing the number of Postcode Address File (PAF) addresses in a district by the number addresses issued in a district.

The weighting needs to account for the selection of households within the addresses where there are multiple households. This selection weight (w2) is calculated as the total number of households identified at the address.

For the final step, the two selection weights are multiplied together to give the combined selection weight: w3 = w1 x w2.

1.3 Stage 2 - non-response weighting

For non-response weighting a logistic regression model is created, with household participation as the outcome measure (ineligible addresses are removed), and a range of external geo-demographic measures as the covariates. The model generates the predicted values of response, which are inverted to give the non-response weights.

The aim of a non-response model is to take account of relationships within the data between the respondents and non-respondents. Therefore, it is not crucial that the model's covariates are perfect measures, just that they are correlated to the true measures.

Tests to create a suitable non-response model with the variables available found no significant difference between respondents and non-respondents. Therefore, this stage is not currently part of the weighting. However, from 2023 new variables are being recorded such as property type, and condition of local area, and condition of street. This data will be included in a response model for 2023 to identify where there is a significant difference between respondents and non-respondents.

1.4 Stage 3 - calibration weighting

For the calibration weighting stage, TRADS uses a form of weighting called RIM weighting. It is weighted to mid-year population estimates by age and sex for each district counts (see section 1.6), as well as CACI Acorn category (see section 1.7).

The procedure works by adjusting the initial combined selection weights (w3) so that the weighted distribution for the survey matches the population estimates. If non-response weights are used these are multiplied to the selection weights to give starting weights.

The benefit of using calibration weighting is that population counts at different levels can be used. What this means is that a mix of household measures such as Acorn Category can be included with individual-level measures like age and gender. The weights are generated at the household-level, but the distribution of the household members is corrected to match the individual-level population estimates. Therefore, the weights can be used at both household-level and individual-level.

There are two main benefits to a single set of weights that can be used at both the household-level and individual-level. First, whole households participate in the survey, not individuals, so it is desirable to generate the weights at the household-level. Second, the weights generated can be used for analyses at both the household-level and the individual-level, there is no need to generate multiple sets of weights. This greatly simplifies how the weights are used are practice, but also means that the analyses that are carried out are adjusted for a wider range of measures, which should reduce bias.

The calibration (RIM) weighting is currently performed in the R software program, using the 'calib' function, with the 'raking' method, of the 'sampling' package to create g-weights. The g-weights are converted to population estimates by multiplying the g-weight with the initial combined selection weight (w3).

1.5 Trimming

Having (extreme) highly variable weights impacts on the efficiency of the sample. Everything else being equal, the more variable the weights the larger the design effect which negatively impacts the precision of the survey estimates). To reduce the size of the design effect, weights can be trimmed to make them less variable.

The key consideration when trimming weights is how many times bigger is the smallest weight to the largest weight. For example, weight of 0.25 is 16 times smaller than a weight of 4. Extreme differences are generally caused by a small number of weights, so the general practice is to calculate the weights at given percentiles (eg 2.5% and 97.5%) and trim at these values. When selecting while

percentile to trim at, a balance is needed between reducing the variance of the weights and trimming the weight to the point where the weighted estimates do not match the population estimates (which also has the impact of biasing estimates).

Generally, the efficiency of the TRADS sample is good less than 10, so there is no need to trim the weights.

1.6 Population estimates

TRADS is weighted (expanded) to the mid-year population estimates for age/sex counts for each GM district.

The mid-year population estimates are usually produced by ONS each year in June for the previous year although occasionally they can be delayed (eg the 2021 estimates were released in December 2022). Each year TRADS is weighted to the latest available mid-year population estimates are used. This usually results in the estimates being based on the population size of the previous year (ie TRADS 2022 estimates are based on the 2021 mid-year population estimates).

For each district the population is split into 13 categories: total aged 0-4; aged 5-18 male; aged 5-18 female; aged 19-29 male; aged 19-29 female; aged 30-39 male; aged 30-39 female; aged 40-64 male; aged 40-64 female; aged 65-74 male; aged 65-74 female; aged 75+ male; and aged 75+ female.

The sample is then weighted to these population estimates. Therefore, if the population of females aged 5-18 in Bolton is 27,405 then our weighted estimate will match this figure.

1.7 CACI ACORN category estimates

TRADS is also weighted (expanded) to the CACI ACORN category estimates by district. The Acorn data used is the newest available when the sample is drawn at the start of the year. For example, in 2022 the newest available data for the sample was for 2021. Therefore, 2021s data was also used for the weighting.

There are four categories used for each district, which are: Affluent Achievers and Rising Prosperity; Comfortable Communities; Financially Stretched; and Urban Adversity.

1.8 Checking the estimates

At each stage of the weighting process the estimates are checked against the population proportions, in the following ways

- District by gender - eg Bolton male, Manchester Female
- District by age - eg Bury aged +75, Rochdale aged 30-39
- Gender by age - eg male aged 65-74, female aged 19-29

First, the difference between the unweighted percentages and the actual population estimates is compared. After Stage 1 the weights are applied to the data and the population proportions are calculated again. The difference between the TRADS estimates and the Mid-year population portions should reduce. After Stage 3 the difference between TRADS and the Mid-year population estimates should be 0.

The maximum and minimum weights are compared at the district-level and regional-level to check whether any weights need trimming.

The efficiency the weights is checked (NEFF – effective sample size and DEFF – design effect) to ensure that the NEFF is close to or equal to the total sample size, and the DEFF is close to 1.

1.9 Applying the weight

As noted in Section 1.4, this approach to weighting allows the same weight to be applied at the household, person, and trip-level.

The TRADS data file is split into two files: the household person file; and the household person trip file. The household person file is used to produce estimates of population characteristics, of both households and individual, while the household person trip file is used to calculate estimates of resident's trip characteristics.

To calculate household population statistics, such as household income, or household access to a car, the household person file is used. The weight is applied, and the data is filtered by the PersonNumber variable, with the filter being set to =1.

To calculate individual population statistics, such as age, gender, and ethnicity the household person file is used. The weight is applied, but no filter is used.

To calculate trip-level statistics the household person, such as journey purpose, or mode share, the household person trip file is used. The weight is applied, but no filter is used.