**A review of the non-response methodology used by the UK Office for National Statistics**

Andy Fallows, Office for National Statistics (ONS)

**Introduction**

In recent years response rates have continued to drop on ONS’s household surveys. Response rates have dropped below 60% and in some cases below 50%. Similar decreases have been seen around the world by a variety of different survey organisations. Accordingly, non-response adjustments are seen as increasingly important mechanisms for dealing with the potential resulting bias. The aim of this paper is to discuss how ONS has dealt with this problem and what the best approach might be.

**Overview**

 The UK’s largest household survey, the Labour Force Survey (LFS), does not have a non-response adjustment, though there has been a lot of research looking into the impact non-response might have. One such piece of research (Weeks et al, 2013) utilised the 2011 Census Non-Response Linked Study (CNRLS). This analysis used matched census-survey data to look at the characteristics of non-respondents. Having identified potential differences between respondents and non-respondents, a logistic regression model was created using these variables to predict the propensity to respond. This model was used to create non-response weights to adjust design weights before calibration. Estimates were compared to figures produced without the non-response adjustment.

 Broadly, the differences identified were fairly minimal and so it was decided not to implement non-response weights on the LFS at that time. Other surveys such as the Living Costs and Food Survey (LCF) do utilise non-response weights derived from the census-survey linked data, these use age, sex, region and number of cars in the possession of the household. LCF uses non-response weights because it was demonstrated that they reduced bias in estimates.

 The Life Opportunities Survey (LOS) used Output Area Classification (OAC)[[1]](#footnote-1) as the basis for non-response classes in Wave 1. OAC is an area classification created using several data sources (including census) to classify geographic areas according to their socio-economic characteristics. This classification is available to ONS to use free of charge and so is convenient to use. The classification is hierarchical and so depending on the size of the survey a decision can be made on which level to apply. Similarly, Wave 1 of the Wealth and Assets Survey (WAS) used a commercially available classification called Financial ACORN[[2]](#footnote-2). This is a similar tool but makes use of commercial data in its derivation. The use of area based classifications is based on the assumption that people living within the same area have the same characteristics and so responding persons are representative of those who did not.

 Some surveys such as Opinions (OPN) and the Survey on Living Conditions (SLC) do not have a direct non-response adjustment, though SLC as a panel survey does have a logistic regression based attrition adjustment. All also apply calibration using the Generalised Estimation Software (GES) macro written by Statistics Canada. ONS household surveys are calibrated to Age-Sex and Region totals. This gives some protection against non-response bias where survey outcomes are associated with those used in the calibration. There is potential for adding additional variables to the calibration stage, though the addition of too many variables will have a negative effect on the variance.

**Methods**

In deriving non-response weights using a census-survey linked dataset, logistic regression was used. This model sought to predict the probability of response using variables which relate to both non-response and the survey variables of interest. The difficulty of using this method is the challenge of balancing the number of variables used in the model - complexity against explanatory power. In many cases there may be a category of a variable which has good explanatory power, but because of small cell sizes it is not that useful. There is a need for parameter estimation to collapse categories to ensure a sufficient number of respondents in each class. It is also necessary to be able to explain the model, whether a respondent answered a question on the census can often be a good predictor of non-response (e.g. religion), but may be unsuitable for use on a collection with a different mode.

 Although the final models created were binary in nature, we collect more detailed information on non-response. Interviewers record whether an address was a non-contact or a refusal (or ineligible). The characteristics of these two types of non-respondent differ and so using a common model to explain both of them will invariably be limited. Some attempt was made to create an ordinal logistic model where the outcome was non-contact, refusal or responding. These models are useful to explain the differences between non-contacts and refusals (which is useful information for future interviews) but with regards to potential non-response bias, do not provide a solution because of the difficulty in justifying two weighting adjustments.

 The regression analysis gives two potential methods to create a non-response adjustment. Firstly it gives a propensity; the inverse of this can be applied directly. Alternatively, using the variables identified in the regression, the ratio of the number observed in the census compared to that observed in the survey can also be used.

An alternative to using logistic regression is to make use of decision trees. These allow individuals to be grouped by the variables available on the census, according to their propensity to respond. This seems like a sensible way to create non-response factors. But can be prone to creating groups which are difficult to explain, for example, grouping regions which do not appear to be genuinely similar.

 The use of logistic regression to create an attrition adjustment for panel or longitudinal surveys makes sense as there will be a large number of variables to use (from Wave 1) to create the model, the nature of the data means that we have information on those who have dropped out and so can build good models.

 When considering the use of a non-response adjustment, we first need to establish that it is related to non-respondents and survey variables of interest. Having done that, we want to consider the impact it will have. When ONS makes use of area based socio-economic classifications, it is inevitably area based because of the nature of the frame we use – the postcode address file (PAF). The only thing we know in advance of an interview is where the theoretical respondent lives. These area based classifications will work well if an area is homogeneous with regards socio-economic characteristics. 2011 census output areas were specifically built from clusters of postcodes using household type and tenure to be as socially homogeneous as possible, but the degree of homogeneity will vary based on the area and variable considered. Ethnicity for example tends to be more diverse in urban areas.

 It is interesting to note that all of these non-response methods ultimately make use of the UK census. The CNRLS method uses it directly, the area based classifications make use of census data to classify areas and calibration uses estimates derived from the census. The census is run every 10 years and so the quality of the non-response adjustments will vary depending on how close the survey year is to the census year.

**Bias versus variance**

 Bias is the difference between a survey estimate and the true value; because the true value is generally unobserved we can only estimate the size of the bias. The census-survey matched data does give us an opportunity to assess bias, subject to timing, mode differences and slight differences in the wording of questions. Analysis comparing an estimate based on census returns for survey respondents only, to an estimate based on census returns for all selected addresses indicated a very small actual bias. Bearing in mind also, the findings of Weeks et al (2013) that the differences in estimates where a non-response adjustment was used compared to where one was not was small, it could be concluded that non-response bias is negligible. A more accurate conclusion would be that we do not have any evidence of significant bias. Since adding a non-response adjustment adds variability to the weights and will increase survey variances, adding such an adjustment is not a decision that should be made lightly.

 Mean squared error (MSE) is a measure which incorporates the variance and bias, and could therefore be used to assess whether an adjustment should be added. ONS has recently taken on a new survey – the National Survey for Wales (NSW), where a non-response adjustment based on local areas was considered. The MSE with and without an adjustment was comparable, so the decision made not to include it.

**External data sources**

 Administrative data is a tempting option when compared to the above census based methods because it is not tied to any point in time. The recent Digital Economy Act 2017 in the UK has given ONS the legal means to investigate new sources of data. Perhaps the key issue with administrative data is the timeliness factor; people living at an address can change several times within one year. The coverage is also difficult to ascertain. UK household surveys cover the UK private household population, administrative data does not necessarily cover the same population. There may be under and over coverage. There may also be difficulty matching different data sources. To make use of administrative data may require the adding of questions to questionnaires, increasing respondent burden. Recently ONS considered the use of Council tax bands as the basis for a non-response adjustment (Council tax is a property based tax which takes into account property valuation), but found that most properties fell into the same few brackets and so did not distinguish between groups of people with different response propensities.

 ONS is currently considering alternative administrative data sources; depending on the nature of this data, if it possible to merge it on to the PAF then it can be used directly as a non-response adjustment. If the data is not available to use at record level then it may be possible to use at an aggregate level for use in calibration, household type for instance.

 There was a collaborative project between City University, London and the London School of Economics called ADDResponse[[3]](#footnote-3). It concluded in 2016 and explored external data sources which could be used as part of a non-response adjustment. Specifically it looked at small area administrative data, commercial data as well as geocoded information and interviewer observations. The project concluded that interviewer observations were helpful, but that it was difficult to find a model which did a good job of predicting non-response.

**Conclusion**

 Non-response is an increasing problem for UK household surveys, attempts to correct for it have typically used the census in some way, which given the high coverage makes sense. Given the granularity of the census it perhaps seems strange that we use data which is at such a high level. The biggest problem with the census is its frequency; potentially a survey could be using census information which is 10 years out of date. The solution to this would seem to be alternative sources of data, but these offer their own problems. Administrative data also has its own unique problems, particularly around the population of interest. The key questions are how homogenous are local areas? Equally, how similar are people who move to an address to the people that have moved out? There is much work to be done investigating administrative data, but it is still necessary to demonstrate that the non-response adjustment is genuinely compensating for non-response bias whilst considering the implications for the variance.

**Questions for discussion**

* Should we continue to use the census as the basis for non-response adjustment?
* How can we estimate non-response bias?
* What administrative data might work well for non-response adjustment?

**References**

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1. www.areaclassification.org.uk [↑](#footnote-ref-1)
2. The Financial ACORN codes are supplied by CACI. See www.caci.co.uk for details. [↑](#footnote-ref-2)
3. https://blogs.city.ac.uk/addresponse [↑](#footnote-ref-3)