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International Steering Committee for Transport Survey Conferences

Workshop Synthesis: Representativeness in surveys: challenges and solutions

Jimmy Armoogum^a, Adrian B. Ellison^b, Marie-José Olde Kalter^c

^aUPE-IFSTTAR-AME-DEST, 14-20 Boulevard Newton - Cité Descartes - Champs sur Marne, F-77477 Marne la Vallée, France.

^bInstitute of Transport and Logistics Studies, The University of Sydney, Australia.

^cGoudappel Coffeng, The Netherlands.

Abstract

During this workshop on “representativeness in surveys: challenges and solutions” for mobility surveys, we discussed various issues of representativeness in travel surveys. Issues such as lack of coverage of sampling frames, nonresponse mechanism and measurement error bias were investigated along with models that can help to reduce the impacts of these issues and preserve data quality for transport analysis. According to the participants of the workshop, the best way to avoid problems with representativeness in surveys is to tackle the problem upstream (good sampling frame, follow-up with respondents, incentives, response facilitators, etc.). But still at the end of the day we will need to reweigh the respondent sample to account for differential probabilities of selection among subgroups; effects arising from nonresponse; inadequacies in sample frame, etc. and bring the respondent sample data up to the dimension of the study population.

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Keywords: Representativity; Sampling Frame; Coverage Errors; Total Nonresponse; Measurement Errors; Data Quality.

1. Introduction

In this workshop on “representativeness in surveys: challenges and solutions” for mobility surveys, as there is no clear definition of representativity in surveys, we first spent some time on its definition. What is a representative

* Corresponding author. Tel: 01 81 66 86 07
E-mail address: jimmy.armoogum@ifsttar.fr

survey? Is it based on demographics, where we know the population? Is it based on travel behaviour, where we do not know the universe? Does representativeness vary depending on the purpose of the study? The participants of the workshop decided on the following definition: an accurate estimation of interest indicators. We also reported that it is important to portray general mobility using a standard measurement method to allow for cross-study comparisons and then run some other specific surveys to go into detail about population segments or topics.

Previous ISCTSC conferences included several related workshops. For example, Bonnel et al. (2015) discussed using different survey modes to improve response rates but noted that this can introduce other sources of bias. Armoogum and Dill (2015) identified the potential issues with attempting to survey entire households which introduces bias towards smaller households or those with less mobility. These issues are a particular problem for some hard to reach groups which require different approaches that were discussed in a workshop chaired by Ampt and Hickman (2015).

Continuing on these themes, this workshop – and this synthesis – discussed three main themes that are thought to cause issues in the representativeness of mobility surveys. These are:

- Sampling frame and sampling;
- Total nonresponse;
- Measurement errors and proposed solutions and best practices to limit these biases.

The best way to avoid problems with representativeness in surveys is to tackle the problem upstream (good sampling frame, follow-up with respondents, incentives, response facilitators, etc.). Still, at the end of the day we will need to reweigh the respondent sample to account for differential probabilities of selection among subgroups; effects arising from nonresponse; inadequacies in sample frame, etc. and to bring the respondent sample data up to the dimensions of the study population (see Yang Lin et al., 2017).

This synthesis provides a section for each of the three themes and ends with concluding statements and future research priorities.

2. Defects of the sampling frame

The defects of sampling frame include differences with the target population of the survey (under or over coverage), presence of duplicates, lack of updates or errors in the information used or collected and limited sample for some combinations of demographics, locations and travel modes.

In recent years, the sample frame has received notable attention as the use of landlines has declined with a corresponding increase in cell phones. Simultaneously, thanks to large amounts of data coming from individuals volunteering their data (crowdsourcing), smartcards and other passive data collection techniques, the characteristics of survey participants and their data have changed. This suggests a need for alternative frames or methods of surveying to compensate and take advantage of these new data sources.

The statistical unit under review should define the sampling frame and the sample design should be dependent of the topic of the survey. The sampling frame should be complete to avoid some coverage errors. For instance, we should use, when possible, an exhaustive list such as the census, population register, Block listing, The Geocoded National Address File (G-NAF), etc.

Furthermore, we should not force interviewees to respond with a specific survey mode and let them choose: with or without interviewer; a specific mode or mixed mode. But, in the case of a mixed mode it is necessary to have validations and comparative studies.

This is particularly the case for longitudinal surveys, as the representativeness of the net sample in longitudinal studies may be influenced by non-random attrition (see Hoogendoorn et al., 2017). Issues in the sampling frame can also be magnified as the period of study increases. Due to attrition it may be necessary to recruit additional respondents between waves or to over recruit certain groups so that they are representative in the final sample.

We also have considered the temporal stability of travel patterns based on key demographic and geographic characteristics to identify sampling priorities suitable to help guide the development of sampling plans for small sample household travel surveys.

The participants stated that first the sample should meet the needs of the study and it is better to have a core sample to have a general portrait of mobility and then have specific surveys on targeted topics. The core sample should be

chosen carefully and with a minimum bias that serves the main purpose and can be used as the standard level of mobility.

3. Total nonresponse

Total nonresponse is the failure of a unit in the sample frame to participate in the survey which could be important for some hard to reach populations. In the context of travel diary surveys, unit nonresponse can arise for a number of different reasons including, refusal, non-contact, infirmity or temporary absence. While nonresponse results in a reduced sample size, a more important concern of researchers is the possible impact of nonresponse bias. Indeed, bias is introduced when those that do not respond to the survey are systematically different from those that do respond. Thus, in computing estimates from the data collected, we may face biases, the size and direction of which are unknown.

The best way to cope with nonresponse is to try to avoid it by attempting to increase response rates by creating more effective survey instruments. This can include survey design, gamification (see workshop B6 - Increasing survey participation levels without changing travel behaviour), lowering respondent burden and other approaches. Nonetheless, some nonresponse is to be expected and it is important to understand to what extent this may influence the collected data. Additionally, the participants of the workshop raised the question of the response rate and if it is appropriate to force a household to respond. What is better: nonresponse or bad response? Depending on the quality of the response, but we should care about who to consider as respondent.

Ultimately, the question that arises is: are the people who participated in the study representative of those that did not? We assumed that it is necessary to have for each travel survey an analysis of:

- Immobile population (see workshop B5 - Immobility and survey nonresponse), it seems to be a good indicator of the quality of the response;
- The response mechanism (who are those people responding to our surveys? Do they belong to specific groups such as busy people?). It is also essential to investigate whether or not the non-respondent populations are related to mobility or travel behaviour (see Christian et al., 2017). If the nonresponse mechanism is related to travel behaviour the nonresponse mechanism is considered as non-ignorable (see workshop B5 - Immobility and survey nonresponse).

The analysis of the response mechanism should guide the weighing procedure, as it gives the auxiliary variables that should be used for the weighing procedure.

The workshop participants have examined the total nonresponse for cross-sectional travel surveys but also for longitudinal studies such as the influence of panel attrition on the intrapersonal dynamics in self-reported trip rates, (see Ellison et al, 2017).

To compensate for total nonresponse biases, a weighing method can be used. For example, the use of calibration on margins, which is a weight-class method, used when the total of each auxiliary information is known. Rendina et al. (2017) discussed how this and other measures are best used and when they should be used.

4. Measurement errors

The measurement error is the difference between a measured value of quantity and its true value. There are several sources of measurement error: social desirability bias about the behaviour; interviewer effect (in person versus paper/web); desire to influence policy; memory; imprecision and proxy responses. These will differ depending on what, how and from whom the data are collected (La Paix et al, 2017). Measurement errors lead to overreporting or underreporting, the best way to cope with these errors are to avoid them (Verreault and Morency, 2017), by:

- Making pilots and testing the questionnaires;
- Recruiting good and motivated interviewers;
- Announcing well in advance which diary date to fill in;
- Doing follow up of interviews; and
- Making travel surveys with the help of technology (see Ampt et al., 2017).

If the diary is empty or missing entries, it is necessary to suggest missing activity in the completed diary but also ask specific questions about the reason of “immobility”. Participants suggested that the paper of “Immobility in travel diary surveys” (Madre et al., 2007) should be updated.

Can multiple sources of data from the same individuals or households be used to reduce measurement errors? There is likely to be a degree of overlap, and indeed interactions, between these issues (see workshop A7 - Comparing and combining methods for travel survey sampling and data retrieval). For instance, using multiple sources of data with a data fusion approach may be useful for reducing (or at least accounting) for measurement errors but it may also increase participant burden which will itself have an impact on the data collected and, indeed on nonresponse and attrition (see Kagerbauer and Stark, 2017). In some cases using different sources of data may introduce their own biases, particularly where participants only provide data using one method. Given the costs and resources involved in collecting data, to what extent can we prepare for these issues in advance and design our data collection accordingly and what needs to be done post data collection during data cleaning, processing or analysis? (see workshop A8 - Validation under "ground truth" in surveys).

5. Conclusion and research priorities

In this workshop we addressed three different issues. We tackled the questions of sampling frame and sampling then we discussed total nonresponse and measurement errors and proposed solutions or best practices to limit these biases.

The best way to avoid problems with representativeness in surveys is to tackle the problem upstream (good sampling frame, follow-up with respondents, incentives, response facilitators, etc.) but it is recognised that even when best practice is followed there is still a need to reweigh the respondent sample to account for differential probabilities of selection among subgroups; effects arising from nonresponse; inadequacies in sample frame, etc. and bring the respondent sample data up to the dimension of the study population. For these reasons it is important to put some effort in the study of the response mechanism. This analysis is also needed to weigh the survey responses after data collection.

One way to cope with measurement errors is to ease the response burden. One way to do so is to use new technology, for instance, with logs we can derive origins, destinations, times of departure and arrival which have the effect of reducing the burden of the interviewees. The participants of the workshop agreed that it is better not to have a long questionnaire survey (to reduce the burden) but instead use a core survey completed by all participants and use modular / satellite surveys to collect different types of information from subsamples. Within the core survey we should collect only questions on household description and questions to portray mobility. We advise to do the maximum to get a high response rate for this core survey. Then, the modular survey can focus on some specific questions to understand behaviour (for instance carpooling). The idea is to weigh the modular sample with the help of the core survey.

During our discussion, we identified research priorities to improve the representativeness of travel surveys:

- Sampling frame: We should assess different lists as basis of sampling frame and the relative advantages and disadvantages of each;
- Strong focus on identifying best practice for targeted interviewer training and assessment;
- Standardized questions for comparison of core travel measures (trip rates, etc.) across surveys;
- Core and modular surveys: What questions should be in the core survey, which should be in the modular or satellite surveys?;
- Nonresponse: We should include validation questions for weighing our questionnaires. We should identify the response mechanism to clarify the weighing procedure; and
- New technology: How to reduce the burden and capture greater quality of data with the help of technology or logs.

For the next ISCTSC conference, we determined that we should improve our communication with policy makers on how best to conduct travel surveys. We also identified a need to share our experience on what works well, but also what has been attempted but did not work as well as expected. There should be a workshop on respondent burden and how solutions to burden can improve (or not) the quality of data collected. We should also continue to follow the evolution of representativeness of travel surveys as survey modes evolve.

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