CURRENT STATE OF LANDLINE SURVEY METHODS

Annotated Bibliography

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Transportation Tomorrow Survey 2.0

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Title	SCOPE AND COVERAGE OF LANDLINE AND CELL PHONE NUMBERS APPENDED TO ADDRESS FRAMES
Author(s)	Rachel Harter, Joseph McMichael

Summary	• Flag containing addresses for which a telephone number was available (match on landline phones)
	• Compared with 2 sample houses that had multiple sources of landline and cell numbers
	• City-style addresses have far more phone appends than any other type of address
	• Cell phone numbers appended from American List Counsel (ALC)
	• Matching Phone to Address:
	  ○ No phone – 29%
	  ○ Phone – 71%
	  ○ LL Only – 29%
	  ○ LL & Cell – 24%
	  ○ Cell only – 17%

Potential Applications	• Outlines a method for combining landlines and cell phone numbers to create a joint frame, that could be applied to the final design of the TTS 2.0 survey
Strengths	• Provides evidence of differences between urban and suburban cell phone travel survey requirements
Weaknesses	• There were no respondents per se – nobody had to complete a survey • Only involved checking feasibility of combining land line and cell phone frames

Title	DUAL-FRAME WEIGHTS (LANDLINE AND CELL) FOR

THE 2009 MINNESOTA HEALTH ACCESS SURVEY

Author(s)	Kanru Xia , Steven Pedlow , Michael Davern
Summary	• When a sample frame overlap happens, the households in the overlap are double-covered since they could have been selected from the landline frame or the cell phone frame. • Weight adjustments to take care of this • Composite weighting - multiply the weights in one sample (landline in this case) by a weighting adjustment factor λ, and multiply the weights in the other sample (cell phone in this case) by (1-λ). • Even though respondents in the overlap still have a chance to be in either the landline or cell phone samples, their weights are corrected so that their phone usage category is not overrepresented through the weights. • Population represented by the sample (the sum of the weights) determines λ
Potential Applications	• Direct application for calculating weights in a potential joint cell phone and landline sampling frame
Strengths	• Provides a scientific theory for empirically calculating frame weights and expansion factors during survey analysis.
Weaknesses	• Assumptions are made regarding availability of overall cell phone and land line population data. • Not a travel survey

Title COMBINING LANDLINE AND MOBILE PHONE SAMPLES A DUAL FRAME APPROACH

Author(s)	Mario Callegaro, Oztas Ayhan, Siegfried Gabler, Sabine Haeder, Ana Villar
Summary	• German dual frame telephone survey CELLA1 • One survey on fixed line phones and one survey on mobile phones with around 1,000 interviews each. • In the screening approach the interviewers terminate interviews with cell phone respondents who have at least one landline phone in the household and thus could potentially be reached through the landline sample frame. • In the overlap approach the interview is conducted regardless of the frame from which the respondent is selected (landline or cell) and their phone ownership status, and information about each respondent phone status is collected from both frames • 8.1% cell phone-only households, 6.5% landline-only households, and 85.4% households where both landline and cell phones were present. • Researchers assumed the probability of two members of the same household being interviewed in different ways was negligible – FUNDAMENTAL ASSUMPTION • Advanced SMS message to cell-phone users had a positive effect on response rate (increase from 32% to 40%)
Potential Applications	• Provides methodologies for carrying out a dual frame survey through interviews by calling respondents
Strengths	• Respondents are actually contacted and asked questions – This survey is a lot similar to the pilot
Weaknesses	• Researchers assumed the probability of two members of the same household being interviewed in different ways was negligible – This assumption may not hold for TTS

Title	IMPROVING PUBLIC HEALTH SURVEILLANCE USING A DUAL-FRAME SURVEY OF LANDLINE AND CELL

PHONE NUMBERS

Author(s)	S. Sean Hu, Lina Balluz, Michael P. Battaglia and Martin R. Frankel
Summary	• Biases resulting from exclusion of adults with cell phones only from the landline-based survey were found for 9 out of the 16 health indicators. • Although the majority of the adult population is contained in the landline stratum, the proportion of the population in the cell-phone-only stratum has been rapidly growing. • The allocation of the total sample to the 2 strata can be determined using the optimum allocation, which seeks to minimize the variance for a specified total cost proportion of the total sample that should come from the cell-phone-only stratum = $\frac{p}{p + (1-p)\sqrt{\frac{c_{\text{cell-only}}}{c_{\text{landline}}}}}$, where p = estimated proportion of adults with cell-only while c refers to cost of conducting the interview type.
Potential Applications	• Provides a mathematical formulation to figure out how many people should be contacted using cell phones and how many using land lines based on existing land line and cell phone populations
Strengths	• Mathematically rigorous formulation • Takes into account the cost associated with each method of contact and looks to minimize the cost
Weaknesses	• Assumptions are made regarding availability of overall cell phone and land line population data. • Not a travel survey

Title SURVEYING HOUSEHOLDS ON CELL PHONES—RESULTS AND LESSONS

Author(s)	Angela Yangyang Yuan, Bruce Allen, J. Michael Brick, Sarah Dipko, Stanley Presser, Clyde Tucker, Daifeng Han, Laura Burns, and Mirta

	Galesic
Summary	Issues and Challenges facing Cell phone surveys: • Regulations from the U.S. Federal Communication Commission (FCC) in its implementation of the U.S. Telephone Consumer Protection Act (TCPA). • Safety concern posed by cell phone surveys is that the respondent may be involved with other activities, such as driving a car that require full attention. Use of text messages as an alternative form of prenotification improves response rates
Potential Applications	• Provides information on issues and challenges to consider before designing cell phone surveys.
Strengths	• Wide variety of applicable challenges are outlined, from response rate issues to safety and regulation guidelines restricting survey reach
Weaknesses	• No solutions outlined to solve these issues. • These guidelines do not directly pertain to travel surveys

Title	STUDY ON A STRATIFIED SAMPLING INVESTIGATION METHOD FOR RESIDENT TRAVEL AND THE SAMPLING RATE
Author(s)	Fei Shi
Summary	Sampling size overview and advantages: • Dividing the parent population into several types or layers and

	then sampling randomly from each layer, not sampling randomly directly from the parent population. The advantage of this method is it narrows the difference between different types of individuals through classification, which is conducive to extracting representative samples and reducing the sample size. • The main advantages of stratified sampling are that parameter estimation of each layer can be obtained; the sample for stratified sampling is more representative than that for random sampling, thereby improving the accuracy of the parameter estimation; and it greatly reduces the investigation sample size compared with random sampling. Comparison between Kunshan City and random sampling surveys used in other cities of China corroborate this conclusion. Case study in China to determine optimal sample size for a stratified sampling survey: • The sample size is mainly decided by the following: the degree of variation of the survey objects; requirements and the allowable size of error, that is, accuracy requirements; the required confidence coefficient, which, in general, is taken as 95%; the population; and the sampling method.
Potential Applications	• Guidelines on how to conduct a stratified sampling survey are provided within the article
Strengths	• Provides an overview of the advantages of stratified sampling and where they are most effective • Provides factors that affect optimal sample size
Weaknesses	• Not a lot of theoretical or even empirical proof is provided for determining factors that affect optimal sample size

Title	CHOICE SET IMPUTATION: A TWO STEP WEIGHTED STRATIFIED AND HAZARD-BASED APPROACH
Author(s)	Mehran Fasihozaman Langerudi, Mahmoud Javanmardi, Abolfazl (Kouros) Mohammadian, P.S. Sriraj
Summary	• Provides an example of how a random sampling survey can be

	converted into a weighted stratified sampling method which is consistent with universal choice set estimation. • In stratified sampling, the choice set has a number of alternatives from each stratum that is proportional to its real frequency. • Determines how to calculate strata based on real frequency and distribution of mode choices available
Potential Applications	• Test a small-scale survey in the pilot to determine applicability for widespread use.
Strengths	• Mathematically complete formulation for accurately representing and predicting choice for each stratum
Weaknesses	• Might be too complicated for a household travel survey. • If the strata are pre-defined, then there is no need for this approach. • No way to integrate it in a core-satellite survey design if necessary.

Title	ASSESSING THE QUALITY OF ORIGIN–DESTINATION MATRICES DERIVED FROM ACTIVITY TRAVEL SURVEYS: RESULTS FROM A MONTE CARLO EXPERIMENT
Author(s)	Mario Cools, Elke Moons, and Geert Wets
Summary	• 2000 random stratified samples are drawn from Belgian 2001 census data to assess quality of O-D matrix formulations derived from household activity surveys. • For each sample, O-D matrices are derived at 3 levels – one at municipality level, one at district level, one at provincial level. • It is found that no accurate O-D matrices can be derived from these stratified samples. In fact, only when half the population is queried is an acceptable O-D matrix obtained at the provincial level. i.e sample size needs to be quite big. • Unless stratified samples are used to target a specific small population, stratified sampling is not a good strategy for widespread transportation demand modeling.
Potential Applications	• Use stratified samples only to target small populations in the pilot
Strengths	• The paper provides recommendations for improving accuracy of O-D pairs – such as augmenting activity surveys with vehicle intercept surveys, integrating behavioural underpinnings of destination choices, triangulation of travel demand modeling with small area estimation models.
Weaknesses	• The paper only looked at O-D pairs associated with commuting to work. Non-motorized trip modes and variable activity trips were not measured as part of the survey.

Title	HOW MANY RUNS? ANALYTICAL METHOD FOR OPTIMAL SCENARIO 2 SAMPLING TO ESTIMATE THE VARIANCE OF TRAVEL TIME DISTRIBUTIONS IN 3 VEHICULAR TRAFFIC NETWORKS
Author(s)	Jiwon Kim, Hani S. Mahmassani
Summary	The study addresses the optimal sample size allocation problem to each individual strata in connection with stratified sampling. 3 different allocation methods are tested: • Optimal allocation for mean - The total sample size needs to be distributed across each individual strata in proportion to the product of stratum probability and stratum standard deviation. • Proportional allocation – allocation based on stratum weights, i.e stratum population • Uniform allocation – each strata gets the same sample size • It is found that optimal allocation for mean best predicts travel-time behaviour
Potential Applications	• Test optimal allocation of mean methodology for a stratified sampling approach in the pilot for a small population to determine accuracy of prediction.
Strengths	• The paper tests the most accepted sample allocation techniques to determine which is the most accurate. • The formulations are mathematically rigorous and the comparison between predictions and actual results is accurate because of overall controlled size and good quality of the data.
Weaknesses	• The paper assumes that the population is divided into distinct strata (i.e no overlap) • The paper tried to estimate variance of travel time distributions and not specifically household activity behaviour. It remains to be seen if the approach highlighted will work for activity-based surveys.

Title	NONRESPONSE BIAS IN A DUAL FRAME SAMPLE OF CELL AND LANDLINE NUMBERS
Author(s)	J. Michael Brick, Sarah Dipko, Stanley Presser, Clyde Tucker and Yangyang Yuan
Summary	• 1,592 screener interviews were completed (943 from the cell sample and 649 from the land sample). • Dual frame weighting to combine the two samples and to adjust for non-response • Weighting classes for the cell sample were revised to reflect the number of call attempts required for first contact • Further adjusted to account for households that had multiple chances of being sampled because they had more than one telephone number. This adjustment was done separately for the cell and land samples by dividing the weight by the number of eligible telephone numbers in the household. • Households with cell phones are greatly overrepresented in the land sample. Topic salience could account for this. Both the advance letter sent to the land sample cases with addresses and the screener interview introduction said the study was "about new technologies such as cell phones." Thus, persons interested in cell phones were probably more disposed to cooperate. Further findings: • Proxies tended to underreport their partner's behavior and proxy reports about activities were the least accurate of the measures they examined • Self-reporting persons indicate taking more daily, long distance, bike and walk trips and a greater proportion report using public transportation • Men are over twice as likely as women to have proxy responses. Non-drivers were also more likely (1.96 times) to have a proxy response. • Elimination of proxy reports would have an adverse impact on response rates.
Potential Applications	• Comprehensive methodology to determine non-response bias in a dual frame cell and land line survey

Strengths	• Can be directly copied over for a TTS pilot involving a dual frame survey
Weaknesses	• Does not provide a methodology to measure non-response bias in any other kind of survey (single frame, core-satellite etc)

Title	NONRESPONSE IN HOUSEHOLD TRAVEL SURVEYS
Author(s)	Michele Zimowski, Roger Tourangeau, Rashna Ghadialy, and Steven Pedlow
Summary	Article tries to measure non-response in household travel surveys in rudimentary land line frames. • Proxy respondents reported, on average, about 25 percent fewer trips per travel day, and about 20 percent fewer miles traveled and driven than persons responding for themselves,
Potential Applications	• If not for the pilot, the methodology indicated in this paper may be used to estimate non-response bias in the 2016 TTS and earlier land-line surveys
Strengths	• Provides a methodology to measure non-response bias in household surveys
Weaknesses	• Methodology only valid for land-line surveys • Further, non-response behaviour might vary on web surveys and as such this methodology may be faulty even if it is somehow transcribed to fit a web survey

Title

COGNITIVE PROCEDURES FOR CORRECTING PROXY-RESPONSE BIASES IN SURVEYS

Author(s)	Alexander Todorov
Summary	Provides a psychology and statistics oriented methodology to estimate non-response bias and correct it based on contextual information about knowledge imbalance between respondent and the person who is being proxied. • The higher the judged relatedness of disabilities/modes, the more likely proxies' over-reporting of modes. • Proxy-reports are systematically biased. When respondents are asked to report about others but do not have sufficient infor, they appear to rely on inferences grounded in lay theories about the domain of questions. In the case of disabilities, respondents rely on theories about how disabilities are related to each other. This will lead to over-reporting of disabilities seemingly related to a previously reported disability and to under-reporting of disabilities seemingly unrelated to the previously reported disability. • The standard way of approaching differences between self- and proxy-respondents in field surveys is to introduce statistical control for confounding variables. • The total variance of self/ proxy differences can be partitioned into variance due to real differences, variance due to proxy-response biases, and error variance. Statistical analyses controlling for demographic differences can estimate the variance due to true differences, whereas analyses based on procedures as the ones in the current study can estimate the variance due to systematic proxy-response bias.
Potential Applications	• This methodology can be tested on a small sample in the pilot to determine proxy response characteristics in travel surveys
Strengths	• Provides a statistical means to correct non-respondent bias given contextual information.
Weaknesses	• Makes assumptions about prior knowledge of demographic differences and other respondent characteristics • The paper does not contain any considerations that pertain directly to travel surveys.

Title	TOTAL DESIGN DATA NEEDS FOR THE NEW GENERATION LARGE SCALE ACTIVITY MICROSIMULATION MODELS
Author(s)	Konstadinos G. Goulias, Ram M. Pendyala, Chandra R. Bhat
Summary	This paper describes an ideal data collection scheme with core and satellite survey components that can inform current and future model building. Provides examples of pertinent satellite surveys: • One week activity and travel diary – accounts for day-to-day variation in activity scheduling • Highway and transit accessibility to capture changes in activity opportunities and the transportation system. • Vehicle utilization and allocation within households • Resident, workplace and school location choice – predicts future trip development and O-D matrices • Willingness to pay tolls – crucial for congestion management • Active living questions – to determine receptability to institute attitudinal changes towards greener and non-motorized modes. • Energy consumption and emissions estimation
Potential Applications	• Some of the satellite surveys highlighted above can be implemented in the pilot if required.
Strengths	• Provides good rationale for the importance of each of these satellite surveys
Weaknesses	• Does not provide any examples of surveys that have implemented a core-satellite design. • Does not provide strategies to deal with the data fusion problems that will inevitably arise with multiple satellite surveys.

Title

ANSWER YOUNG PEOPLE JUST LIKE OLD PEOPLE? – IMPACTS AND CONSEQUENCES OF DIFFERENT HOUSEHOLD TRAVEL SURVEY METHODS

Author(s)	Kagerbauer Martin, Manz Wilko
Summary	The paper compares survey modes and methods, from paper pencil interview (PAPI) to computer assisted telephone interview (CATI) to computer assisted web interview (CAWI). 5,500 households were surveyed in the Stuttgart region. Participants were asked to record all trips made in the course of one week including departure and arrival times, trip length in kilometers, trip purpose and modes used: • PAPI – Questionnaires were sent to respondents by mail and the participants returned them to field work institute after completion in a postage paid envelope. • CATI – All relevant documents are sent to participants in advance. Memory joggers to help participants take notes were also sent. Participants are called by phone every two or three days and asked to report on the previous days' travel activities. • CAWI – Participants receive an announcement and basic information about the survey as well as login data. Participants can enter answers and trips as they go along the week. • As expected, younger participants are overrepresented in the CAWI method while older participants are overrepresented in the CATI method • Participants in CATI walk more while CAWI participants are more likely to travel by car or public transport
Potential Applications	• The use of memory-joggers is a novel way of reminding participants to take note of their travel behaviour and accurately report it. It can be implemented in the pilot.
Strengths	• Some strategies are detailed that improve response rate and accuracy of reported data.
Weaknesses	• The paper does not provide any new information about travel behaviour or socio demographic differences between respondents who are more likely to use web vs landline.

Title	PRIMER ON URBAN PASSENGER DATA COLLECTION: KEEPING UP WITH A CHANGING WORLD
Author(s)	Transportation Association of Canada
Summary	Provides an overview of the data collection methods available for a core-satellite survey methodology: • Population based surveys – These are typically going to constitute the core survey • Choice-based sample surveys – Satellite surveys that address particular questions for particular populations – such as transit on-board surveys for people to comment on the level of service experienced for their transportation system. • Non-survey data collection techniques – typically using smartphones that passively collect data without explicitly asking respondents to answer questions. Makes a distinction between integration by content rather than integration by method – this means that the core is determined by what content we want to survey, rather than which method is most easy to implement on a widespread basis. Provides a hypothetical example application of an object-oriented data model to illustrate how fusion by design would work.
Potential Applications	• A simplified version of the hypothetical example can be used to test fusion methodologies in the pilot
Strengths	• Details the striking need for a core-satellite design to gather richer data and the institutional commitments necessary to successfully implement this survey design. • Details the limitations currently facing the core-satellite methodology
Weaknesses	• Provides no examples of core-satellite designs to draw real-life information from.

Title	THE FUTURE MOBILITY SURVEY: EXPERIENCES IN DEVELOPING A SMARTPHONE-BASED TRAVEL SURVEY IN SINGAPORE
Author(s)	Caitlin D. Cottrill, Inês Ferreira Dias, Hock Beng Lim, Moshe Ben-Akiva, P. Christopher Zegras
Summary	Smartphone-based travel survey developed by MIT and conducted in Singapore. • A vague core-satellite design methodology can be seen, with a multi-modal web and smartphone strategy. • The two different modes allowed for a richer set of data to be collected, with the smartphone being used for modes, routes and locations information while the web could be used for contextual trip information such as purpose and validation of data. • As more sensors are developed on the smartphone, additional satellite surveys could be integrated with the main core design.
Potential Applications	• Useful to test a core-satellite design with a smartphone core
Strengths	• Provides a detailed approach for a good core survey strategy that can be extended to landlines and not just smartphones.
Weaknesses	• Smartphone based means that the sample was skewed to a younger and more urban population. • The survey also did not take care to account for this biased sampling frame or for non-response error. • Inherently individual, and unclear if methodology can be replicated for household surveys.

Title	NON-MOTORIZED TRAVEL IN THE SAN FRANCISCO BAY AREA
Author(s)	Chandra R. Bhat, Jessica Y. Guo, Rupali Sardesai
Summary	The report outlines some strategies to reduce underreporting of non-motorized modes in household activity surveys: • Frame the survey question differently – instead of asking ""what portion of trips involve only non-motorized travel", we ask "what portion of trips involve some non-motorized travel", 20-30% of non-motorized urban trips would be included and active modes would be recognized as common and important. • Targeted non-motorized travel surveys can also be conducted to deal with this problem. Pertinent information that can be gathered are travel frequency, nature of trips, reasons for not biking/walking if the option was present, perception of safety, facility availability, community design, sociodemographics etc. • Attitudinal surveys asking hypothetical questions can identify the relative importance people place on environmental and other factors. The note of caution is that the results are influenced by the wording of the questions and only reveal what people might do rather than what people will do. Unless carefully designed, the surveys can significantly overestimate response to bike or pedestrian improvement. • Health surveys about geographic variations in health status and sociodemographics can be used to predict receptability to improvements in bike or pedestrian improvements.
Potential Applications	• Trial of each type of survey during the pilot on small populations to determine the best strategy
Strengths	• The report details the factors that affect non-motorized mode usage and how best to measure them
Weaknesses	• While the report provides some examples for different strategies, it does not specifically tell us how to design the strategies themselves or which strategy is the most optimal.

Title	SHORT AND SWEET: ANALYSIS OF SHORTER TRIPS USING NATIONAL PERSONAL TRAVEL SURVEY DATA
Author(s)	Todd Litman, Victoria Transport Policy Institute
Summary	The paper summarizes information on shorter trips, based on 2009 National Household Travel Survey data: • About 12% of total trips are by non-motorized modes. • Nearly a third of trips of 3 miles or less are by walking or biking. • Non-motorized modes are particularly represented in non-commuting activities. Provides causes for underreporting of shorter trips: • Older surveys were designed primarily to provide data for traffic models, and so only counted peak-period trips between TAZs. They ignored shorter trips within TAZs, and off-peak trips. • Surveys also ignored non-motorized links of trips that include motorized travel. For instance, bike-bus-walk would only measure bus as a transit trip. • Respondents often have trouble remembering shorter trips.
Potential Applications	• By taking care to avoid the inherent causes for underreporting, we can try to minimize its effect. • For instance, knowledge from this paper, tells us that it would be useful to specifically ask respondents about their off-peak usage to jog their memory about non-motorized trips.
Strengths	• The paper details the inherent flaws in older surveys that facilitate underreporting. • The paper provides lots of statistics about the nature of short trips, i.e information on distance, time of day, frequency, locations, mode share (bike, walk etc)
Weaknesses	• Provides no specific tested strategies to estimate or counter the underreporting in non-motorized modes.

Title	MEASURING NON-MOTORIZED ACCESSIBILITY: ISSUES, ALTERNATIVES, AND EXECUTION
Author(s)	Michael Iacono, Kevin J. Krizek, Ahmed El-Geneidy
Summary	This paper explores the issues related to the development of accessibility measures for non-motorized modes, namely bicycling and walking through a small study are in Minneapolis, MN – particularly problems arising from insufficient modeling data: • Since employment and housing are all measured zonally (with them located at zone centroids), a lot of the intra-zonal trips which tend to be non-motorized are underreported or completely ignored in travel demand modeling. • Even if we somehow manage to get respondents to perfectly represent non-motorized modes, there are problems associated with modeling the data. This is because the networks used for vehicular modeling are too coarse to represent the route choices used by pedestrians or bicyclists. • In addition, route choices are also not dependent as much on travel times or congestion (as would be considered in regular logit models for motorized modes). Instead they are more likely to be dependent on experiential and qualitative measures based on aesthetical and environmental factors.
Potential Applications	• While there may be no direct application for a pilot, this paper further highlights issues associated with modeling non-motorized behaviour.
Strengths	• The paper talks about issues that pertain to the 3rd and 4th steps in the 4-step process, as opposed to other papers that mainly talk about how to get better data.
Weaknesses	• Provides no specific tested strategies to estimate or counter the underreporting in non-motorized modes or how to solve the modeling data problem.