

Feasibility of using samples of telephone numbers for Tier 1 Official Statistical Household Surveys*

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Abstract

This paper updates Statistics New Zealand and the New Zealand public sector of how changes in telecommunications technology or the telecommunications environment impact on sampling individuals or households using telephone numbers as the sampling frame.

A major objective is to provide sufficient information to decide for Tier 1 Official Statistics whether using telephone numbers (fixed or mobile) as a sampling frame for individuals or households is feasible, either as standalone frame or as part of a multiple frame approach.

It is not the intention of this paper to provide a manual outlining how to construct a telephone sampling frame or get access to it or how to sample from it. However, some information relevant to these issues will of necessity be provided in this paper.

Keywords: Telephone surveys; Sample design, Nonresponse, Coverage bias.

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1 Introduction

The advantages of telephone interviewing are well known. These include:

1. Quick;
2. Safer for interviewer;
3. Avoids need to get through building security;
4. Cost effective (interview time, travel, ...);
5. Easy to make call backs;
6. Degree of anonymity for sensitive topics;
7. Better quality assurance of the interviewing process.

The disadvantages are also well known. These include:

1. Lower response rate;
2. Competition with general use of telephone interviewing for market research and political polling surveys;
3. Only verbal communication is possible (cannot use showcards, etc);
4. Only simple questions can be asked and it is impractical to ask respondent to refer to records;
5. No control of privacy of the interview.

A good review article of the history of telephone surveying which maps out future directions is Nathan (2001) [6]. A key inference from his paper is that because telecommunications technologies such as mobile phones and Internet connections (e.g. via email or software like Skype) will become the preferred communication channel for many people, it may be better to think not of telephone surveying per se, but rather Information and Communication Technology surveying. If this is feasible, it will necessarily be a multi-mode process, with all the attendant issues that survey statisticians have come to recognize with other multi-mode surveys. A good discussion of the issues surrounding choice of a particular mode of data collection is Chapter 5 of the recent book by Groves et al. (2004) [4].

Currently in many countries the percentage of households who have switched from landlines exclusively to the new technologies, e.g. mobile phones, is less than or of the order of the percentage who have no landline. So this switch to new technologies has been seen as a smaller contributor to possible bias than non-access to landlines and hence is typically ignored. This is unlikely to remain a defensible position. See for example Blumberg et al. (2004) [2] and Tucker et al. (2004) [8] for developments in the USA.

2 Background

Statistics New Zealand has been using telephone interviewing for the Household Labour Force survey for close to 20 years. However, such interviews take place at the second and subsequent interviews, when contact has already been made. This is common practice in Official Statistical Agencies for panel or repeated surveys, where a respondent's information is collected for many time periods.

Very often because of the development timeframe required for large household surveys such as the Household Savings Survey, the time spent interviewing is a very small part of the overall time from start of the development work to publication of results. Hence the timeliness advantages, particularly interviewing, associated with telephone surveying are not so important in deciding between sampling and interviewing options. Of course with repeated surveys, such as the Household Labour Force survey, such timeliness advantages become important.

Another use of telephone surveying, which is widely used in Statistics New Zealand is for nonresponse follow-up in business surveys, which are generally repeated surveys, and for which there is clearly a list frame with telephone numbers.

The only household survey which Statistics New Zealand has carried out using a telephone sample directly has been the 1999 Gaming Survey run for the Department of Internal Affairs. It is fair to say that their experience with this survey methodology was not very encouraging.

Given the advances in technology since this time and the increasing need to run surveys efficiently, it is important to revisit the use of telephone samples for Official Statistical Surveys of households or individuals. In this paper we are focusing on Tier 1 statistics, the definition of which was still being developed by the Advisory Committee on Official Statistics when this report was written.¹

There may well be other types of surveys, or research designs e.g. client surveys, for which telephone surveying is both feasible and reliable. Indeed, in the run-up to the 2001 Census of Population and Dwellings, Statistics New Zealand contracted BRC to survey people's views on archiving Census forms. This was a telephone survey and successfully achieved the survey's objectives.

Another example would be surveys run as part of evaluation of government programs. Many of these are already run using telephone surveys. Quite often a survey is run prior to running a program to gauge a baseline measure of the population targeted by program. After the program has been running for a suitable time, a followup survey is carried out. Typically these surveys need to be done quickly in part because they are driven by operational concerns and hence the shorter time frame associated with telephone surveys comes into play. A feature which is generally uncommon to household surveys is that very often there is a list frame of the target population along with telephone numbers and characteristics of the the people. Hence very often there can be detailed analysis of any coverage bias. Of course, a program that was untargeted and related to most of the population might warrant Tier 1 status. One has the opportunity now with prepaid mobile phones of supplying respondents without telephones with prepaid mobiles for the duration of the evaluation.

¹A website for Official Statistics has been recently developed <http://www.statisphere.govt.nz/default.htm>. More information on Official Statistics can be found there.

2.1 Lessons from the Gaming Survey

Sharon Clark, who worked in the predecessor of the Statistical Methods - Household & Social Division of Statistics New Zealand, reviewed the operation of the Gaming Survey. This section borrows extensively on her report.

2.1.1 A brief outline of the gaming survey

The sample for the 1999 Gaming Survey took the following form:

1. Telephone Framework - purchased a sample of residential numbers from Telecom.
2. Sampled by simple random sampling without replacement households (listed residential numbers) within the 18 telephone directories. The population covered by these directories varied from around 1,000,000 for Auckland to around 20,000 for Westland. Sampled one person per household using a modified Kish grid.
3. There were 6,000 achieved respondents.
4. There was no stratification finer than Telecom Directory. This corresponds roughly to Regional council areas.
5. The allocation of sample was proportional to number of listed numbers in the directories.
6. Use was made of daily updated lists which meant that all lags and leakages from the Telecom Directory would be picked up. This is in contrast to the out-of datedness of using the whitepages phonebook (hardcopy or electronic) book as a sampling frame. As a result no special sample was required to account for churn in telephone numbers.
7. No provision was made for sampling unlisted numbers which were not included in the sample provided by Telecom.
8. It was decided that no oversampling or screening was done to meet additional ethnic constraints because they were not cost effective.
9. It was decided to collect information from the respondent on how many telephones were connected to the residence so correct inclusion probabilities could be calculated.

The average interview time including household information and consent forms was 15 minutes.

2.1.2 Limitations of the frame

It is not hard to see that a major source of bias is in the sampling frame. Specifically the following contributed to this bias:

Undercoverage of Populations At the time the survey was run about 4% of individuals did not have access to a landline. This increased to 14% for Māori and 16% for Pasifika.

Unlisted numbers Over recent decades there has been an increase in the use of unlisted numbers. At the time of the survey Telecom estimated that 13% of numbers were unlisted.

Mobile Phones The use of this was increasing partly because of the introduction of pre-paid connections. A pre-paid mobile phone connection where one buys a handset and buys time in advance, typically as little as \$20 per year to keep the number active. This is in contrast to plans where there is a regular monthly connection fee paid in advance and call times are billed at the end of the month. There was some evidence of people switching from landlines to pre-paid mobiles as this was a cheaper option. But there were no reliable figures on the percentage of this group.

Other Phone providers At this time Telecom dominated the residential market although Saturn (subsequently taken over by TelstraClear) had about 8000 out of about 1.2 million landlines. These were not included in Telecom samples.

2.1.3 Factors impacting on response rate

Strictly speaking, the Gaming survey did not use a “cold-calling” approach. Due to the lower than expected first field test response rate, a second field test was undertaken using a pre-notification letter which Telecom posted out on behalf of SNZ. For privacy reasons Telecom was unwilling to give SNZ Telephone numbers and address information. The response rate with pre-notification letter was 77.6%, compared with 64% in the first field test without a pre-notification letter. Hence for the main survey, a pre-notification letter was used for the main survey. The second pilot results were realized in the main survey as a response rate of 75% was achieved. However, the response rate was not uniform across age groups or ethnic groups: for example, as is usual in household surveys in New Zealand, young males had higher nonresponse rates than average. In comparison face-to-face interviews would expect to produce response rates 10% to 15% higher.

The maximum number of callbacks to households was 8, and the maximum number to the selected individual was 5. Such callbacks were made at different times of the day and or different days.

Some other factors impacting on response rates which were due to telephone sampling and telephone technology were:

- Answerphone screening;
- Redirection : Old number automatically redirected to new number;
- Reconnection : Old number disconnected, answerphone message gives new number;
- Call Diversion: Temporary redirection to other numbers, including mobile phones.

The last three items indicate that one cannot be certain that a number is in the geographic area one expected. More will be said of this later.

Post-stratification was used to adjust for both the coverage bias and the nonresponse bias. For many ethnic groups the post-stratification factors were large. An analysis of the differences between the simple rate-up (using inverse of probability of selection) estimates and the post-stratified estimates for the key output variables can give some feel for the overall bias, but probably not for separately for each of the two components: coverage and nonresponse. Hence if one can eliminate one source of bias, then bias analysis becomes a little simpler.

2.1.4 Conclusions

The use of telephone surveying in the Gaming survey resulted in lower than usual response rate. The unlisted numbers gave a frame undercoverage which was about the same magnitude as some of the undercoverage of various socio-economic and ethnic groups. Obtaining random samples of telephone numbers from Telecom gave little opportunity for the fine stratification which is a feature of SNZ's household surveys. Without address information, it is harder to control for overlap across surveys. Telecom at the time could supply the meshblocks of the sampled telephone numbers, so that in principle, one could select a new face-to-face survey in meshblocks not already used in the telephone survey, but it would not seem possible to conduct another telephone survey in the already used meshblocks, as is the practice in panel surveys such as the Household Labour Force Survey (HLFS).

3 Framework for evaluating feasibility of telephone sampling

For more than two decades, survey statisticians have recognized that the key objective in designing and running a survey is to control total survey error. A useful framework is to consider the three major processes: Sampling; Measurement; and Inference. Errors arising from the sampling process would include: coverage error, nonresponse error, etc. Errors arising from the measuring include: interviewer error, interviewee error, etc.

One of the advantages of telephone surveying which was recognized early, is that there is more room for quality assurance of the interview. For example, supervisors can listen to randomly chosen interviews to assess whether the interview is following the agreed process. This is not possible with a face-to-face interview, and randomly calling back a respondent is a less precise process since it relies on respondent recall, and the respondent is unlikely to be able to assess whether e.g. the questions were correctly asked.

The article by Steel and Boal (1988) [7] is an example of an evaluation study in Australia of the characteristics of people and households without phones and whether the coverage bias can be reduced through stratification. Although the situation has changed markedly in the nearly two decades since this was written, the issues have not changed and probably have become more complicated.

The article by Biemer (2001) [1] is a more recent example of studies which propose the design and analysis of the errors arising from telephone surveys and face-to-face surveys. Although this was a limited study based on a health survey, its findings are of use. Biemer's conclusion were that there is no uniformly best interview mode across all health characteristics. Measurement bias for either mode

was often greater than nonresponse bias. More interestingly, although the telephone interviewing often had greater nonresponse bias, this was offset by its measurement bias, so that overall there was little to choose between the modes. Thus Biemer argues that equal emphasis should be given to response errors and measurement errors. Since the telephone survey used Computer Assisted Interviewing (CAI), and the face-to-face survey used pencil and paper interviewing, the result is not controlling for one of the greatest sources of measurement error. Hence, it is likely that a face-to-face interview which used CAI, as is more common now, would have comparable measurement errors to the telephone survey. Thus, until there are detailed studies in New Zealand to prove otherwise, it seems reasonable (in contrast to Biemer's position) to consider response rate along with coverage as key determiners of quality.

4 Changing structure of telephone numbers in New Zealand

Currently there are two providers of residential telephone services in New Zealand. Telecom and TelstraClear, who took over Saturn. Telecom controls Telephone Directory services (e.g. Hardcopy and electronic Whitepages) through a separate company, hence has information on all telephone numbers.

Telecom is the original provider (privatized by the Government in the late 1980's) and its network for residential customers is generally based on paired copper wire technology and covers the whole country.

Originally TelstraClear provided service in the greater Wellington urban area only (and not necessarily all streets) via an optic fibre cable network. It expanded the network to parts of Christchurch, but with the wholesaling of telephone services now offers services throughout the country using its own network and Telecom's network.

Currently there are 5 area codes: code 9 covering the Northland and Auckland Region; code 7 covering Waikato and Bay of Plenty Regions; code 6 covering the Gisborne, Hawkes Bay, Taranaki and Manawatu-Wanganui Regions; code 4 the Wellington region; and code 3 the whole of the South Island, (Tasman, Nelson, Marlborough, West Coast, Canterbury, Otago, and Southland Regions.) These are approximate: e.g. the Wairarapa is in the Wellington region but is covered by code 6.

There are around 1000 Exchange Information Numbers (EINs) (the first 3 digits of the 7 digit number) over the 5 areacodes. There are around 1.4 million residential phone lines but many households have multiple lines, e.g. for internet, fax, home businesses all of which are "residential" lines. The current electronic white pages lists about 15,000 TelstraClear numbers in Christchurch and 35,000 in the Wellington area. The rest are Telecom numbers.

Originally, TelstraClear numbers were confined to EINs in the 900 range, but with the wholesaling of telephone services and moves towards true number portability there is no point in trying to classify provider through EIN. Currently there is number portability within free-calling areas. (These are areas where the cost of calling is covered by the monthly rental, and there is no limit of the number or length of calls, and so generally the calls are regarded as "free".)

Although each EIN has theoretically 10000 numbers assigned to it, in practice the majority are not real connections. The usage of an EIN varies from as small as 1 or 2 in rural areas to over 9000

in some urban areas, although more typical usage is in the 10%-50% range. In large urban areas there can be EINs principally dedicated to business lines, but usually EINs will have both business and residential numbers. With the increase use of the Internet, and the current high cost of ASDL or cable broadband connections, the use of a second telephone line for internet connections has increased since the Gaming survey. This has led to increased utilization of EIN capacity, as well as increased noncontact through “always” engaged lines.

Traditionally EINs were attached to an exchange and within a city to specific localities around that exchange. However, there is not necessarily a 1-1 correspondence between an EIN and a locality. E.g. in Wellington 475 xxxx numbers are Kelburn numbers and 476 xxxx numbers are Karori numbers, whereas 478 xxxx numbers cover Churton Park, Johnsonville, Newlands, Broadmeadows and Khandallah. This is typical of the situation in cities, where there would be on average 3-4 localities per EIN.

Increasingly as new technology is introduced this model is becoming irrelevant. Basically an exchange has an internal number representation for its paired wires, optic fibre lines and there is a dictionary relating these to the telephone numbers. Hence the telephone number of a household does not have to be in the same EIN as other households attached to the exchange. Moreover, Telecom has moved to having fewer exchanges, fewer roadside cabinets, laying optic fibre in streets so that the “copper” part of the network may eventually be the copper wires from the telephone pole to the house or be void. So over time an EIN will map into more and more localities. Hence, the matching of telephone numbers to small geographic areas via EINs will become very imprecise. Genuine number portability will only exacerbate this.²

Mitigating this somewhat in a structured policy at Telecom Directories for allocating first time subscribers a “Telecom” number. The algorithm for allocating new numbers is complicated and they do not disclose it. Essentially when a number is relinquished it is held back for a time until the account has been cleared, any transitional forwarding has been finished, etc. Then it is added to a block of available numbers from which new allocations are made. These blocks try to preserve the traditional EIN mappings to localities. Subscribers are given some choice in the number they get: e.g. to make it more memorable. It is assumed that TelstraClear uses similar algorithms.

Because some EINs have only a few eligible numbers Telecom believe correctly that there is the possibility of identifying the subscriber so will not provide a list showing which EINs belong to which localities. Hence, it is unlikely that the information to control for this assignment will ever be available.

5 Current Market Research Company Practice

Market Research companies in New Zealand use telephone surveying for a variety of surveys, including market research, political polling and Government Department surveys. The University of Auckland (Survey Research Unit: SRU) and Massey University (Centre for Social and Health Outcomes

²Since the draft of this paper was written, Telecom has announced (see Dominion Post IT section 29 September) that it signed a deal with Alcatel to replace its public switched network with an Internet protocol network. This will do away with 600 of the current 700 exchanges and run optic fibre cable from the remaining exchanges to roadside cabinets, which typically service several hundred households. The move to an IP network will mean intelligent phone services will be able to be offered. In particular customers may be given one or more numbers which they will be able to allocate to any phone at any time and they will control this allocation. Telecom said the PSTN will be phased out by 2012.

Research and Evaluation: SHORE) also have Computer Assisted Telephone Interviewing (CATI) units, typically for conducting health and social surveys funded by the Health Research Council or the Foundation for Research and Technology, or Government Departments e.g. Ministry of Health.

These organizations have a much greater experience of running telephone surveys than SNZ. Hence we approached a number of Market Research Companies and Universities units. Our selection was somewhat purposive and included those we knew to be conducting Government funded surveys, particularly those which might be included in the Tier 1 statistics category. The comments here are not meant to be exhaustive, but rather to give an idea of the range of approaches taken and the various methods used to overcome problems in telephone sampling.

Some of the information was commercially sensitive and we have not reproduced that in this report. Clearly, if a provider was to conduct a survey which is a collection for Tier 1 Statistics then issues of commercial sensitivity versus transparency of Official Statistics would need to be resolved. It is imperative that the methodology for Tier 1 Statistics is publicly available and auditable.

We would like to thank Hugh Butcher (ACNielsen), Pete McMillen (BRC), Nandan Modak (DigiPoll), Andy Heinemann (NRB), Nina Russell (TNS) and Cate Curtis (UoA SRU) for responding to our emails and providing their knowledge and experience. We have summarized their comments below. We have confirmed some of the information they supplied about what Telecom Directories can and does do, but in the interests of clarity have included the details in an later section.

5.1 Sampling telephone numbers

It is clear that there are a wide range of approaches taken, and that to varying degrees, Market Research Companies invest a lot of research and development in constructing telephone frames, using typically Telecom's Electronic whitepages as a starting point.

It is not unusual for Market Research companies to use different approaches and maintain different databases depending on the type of survey. They may have one method where they want high coverage of the population, and another where they can tolerate lower coverage, and consequently a lower cost per interview.

A traditional method of sampling telephone numbers from hardcopies (or these days scanned hardcopies) takes the following form: *select every n th listing from every y th column of every z th page...* Although this gives a clustered sample, it provides address information, and it is possible to eliminate ineligible (business) numbers. The advent of auto-diallers and CAI has meant a move away from this sort of sampling.

5.1.1 Random digit dialling

It is usual to use auto-diallers to implement random digit dialling (RDD). Often dialler filters are used to block out unused/disconnected numbers. The technology is improving all the time so that it is probably feasible now for auto-diallers to be able to test the status of a line (active or not issued) without ringing the phone at the other end. So it may well become possible to construct independently of Telecom Directories a list of active numbers.

Various methods are used to achieve RDD. These include:

- using the Waksberg-Mitofsky algorithm, (WMA) or some modification of it. See Waksberg (1978) [9] or Nathan (2001) [6] for a detailed description of this. Essentially it is a two-stage sampling scheme using EINs or smaller blocks of numbers which reduces the probability of sampling banks of numbers which have few eligible numbers.
- Choosing known EINs and then randomly choosing last digits. This allows for sampling unlisted numbers. This is a quasi WMA. With auto-diallers it is less important to have efficient blocks.
- Taking random samples from the white pages and using a $\pm k$ factor to generate additional numbers to pick up unlisted numbers.

The RDD with a seed $\pm k$ system, widely used around the world, requires that phone numbers are issued in blocks so that there is a high probability of finding another residential number in close proximity to a given number. This no longer holds true for NZ numbers for mobile phones (in particular pre-paid mobile phone numbers seem to be randomly generated), and, in particular, for residential landline customers of TelstraClear. Experience suggests the further from the source number one moves when creating random numbers, the more likely one encounters dead or non-existent, business numbers, etc.

5.1.2 Electronic whitepages

Telecom Directories will supply an electronic copy of the whitepages. Many Market Research companies purchase this but not frequently (maybe once every 1-2 years) as it is expensive.

This database is known not to represent households who specify that their phone numbers shall be “unlisted”. Also, there is an option available to households or individuals who are listed in the hard copy white pages to have their numbers withdrawn when the database is provided for the purpose of “Telemarketing”, which is the only form of the database which Telecom will provide for Marketing Research companies.

As well some method has to be used to update the database, which is typically done as surveys are conducted and numbers are found to be no longer working numbers or changed to business numbers. Market Research companies are looking at better ways to update this database without referral to Telecom. Typically these look at ways of generating all eligible numbers in all eligible EINs.

There was some difference in opinion about what Telecom would supply in the way of information, and we found it difficult to get information from Telecom. See the section below.

We were told that a database with full suburb and street name details (but not street numbers) has been supplied. This is useful for geographic mapping to TAs but without street number there will be some error in mapping to meshblocks.

On the other hand we were also told that because of a Court case a couple of years ago the Court determined it was a breach of privacy for Telecom to supply name and address. This does not necessarily contradict the above information as although a name might be identifying, a street name may have been determined to be not identifying enough to breach privacy.

Telecom will also supply a random sample of telephone numbers from geographic areas so that one approach is to buy at regular intervals a large list of telephone numbers and then use the seed $\pm k$ system on this list until a new list is purchased.

5.2 Geographic allocation

It is still reasonably common when using RDD to rely of the EIN to provide rough suburb or location information although it is recognized that this does not work with TelstraClear numbers. Frequently screening questions about location are included in the survey. This means that any fine geographic stratification would to be carried out after the survey. However, currently it seems that the pre and post geographic classification match rate for Territorial Authorities (TAs) (or suburbs in large TAs such as the metropolitan areas) is very high.

It is recognized that Telecom's move to reducing exchanges, etc will have an impact of current approaches. One way around this may be two-phase sampling schemes of the sort described by Brick et al. (2002) [3].

Of course the need for filter questions to obtain geographic information will add to the length of the questionnaire. More importantly, it is likely that obtaining fine geographic information, e.g. being able to code respondent to meshblock, will be seen as an invasion of privacy, especially where the number is in fact an unlisted one.

5.3 Multiple frames

Under Section 112(3) of the Electoral Act 1993 if a survey is about human health or for scientific research the Electoral roll can be used as a list frame of people aged 18 and over. It gives information on name and address, as well as age information (either 1 year bands for health studies or 5 year bands for scientific research). It is possible to get information on whether the person is of Maori descent, but no other ethnic information.

It is therefore possible for appropriate surveys to contemplate matching the electoral roll to telephone numbers using Telecom's telematching. Market Research companies have done this but suggest that the matching rates are very low and that this is not viable.

It is not clear whether this would be allowed now in view of the Court decision mentioned above.

Another problem is the accuracy of the Electoral roll itself. At General elections or Local Government elections it may be reasonably accurate with respect to address information but outside of those times, given the mobile population NZ has, it is unlikely to be a useful frame.

If an areal based frame is used as a second frame (to account e.g. for unlisted numbers, people not on a phone, or using mobile phones only) then for many surveys there may be little cost saving in using a telephone survey given that the percentage of the sample using the areal frame will be high, and that there will be additional processing and estimation costs, both for the initial release of estimates and subsequent analysis.

5.4 Mobile phones

Although use of mobile phones as the only phone connection is increasing, Market Research companies are only starting to consider mobile phone number dialling and how to adjust their methodologies. Everyone agrees that cost is an issue, since the cost of calling mobiles is very high in New Zealand compared with other OECD countries.

5.4.1 Is the environment appropriate for interviewing?

There was a range of opinion about whether conducting an interview on a mobile phone was the appropriate environment for surveying. Clearly the question is motivated by considerations such as people answering the mobile phone whilst at work, driving a car, on the street, in restaurants, etc. Indeed, it was argued by some that cold-call telephone surveying using landlines was an inappropriate mode for conducting the type of surveys that might fit into the Tier 1 category. On the other hand others argued there were ways to manage the environment and that response rates were not much different, although nothing was mentioned about the quality of the data collected.

Where mobile phones are used, the typical practice seems to be the following. Inform the potential respondent before the interview starts how long it will take to complete it. If it is convenient, the respondent does the survey. Otherwise a suitable time to call back is arranged and the CATI software brings up the number at the exact time. A large number of callbacks are made to the number to attenuate the environmental effects.

5.4.2 Problems constructing a mobile phone frame

One problem is that the technology is changing quickly as is the telephone structure for mobile numbers. For example Telecom has introduced TG3A technology (the 027 network) which has 7 digit numbers in contrast to the original 025 network which has 6 digit numbers. Similarly Vodafone, the other major mobile phone company (the 021 network), has a mixture of 6 and 7 digit numbers. Hence RDD technology seems to be infeasible at this stage.

Furthermore, the numbers have no geographic information embedded in them like the EIN. Hence the ability to design a stratified samples of mobiles based on geographic and other socio-demographic characteristics, typically linked to geographic area such as meshblock, e.g. The New Zealand Deprivation Index, is lost.

Moreover an obvious difficulty with calling mobile phone numbers as well as or instead of landline numbers, is that there is no database of in-service numbers available unlike the landline numbers.

Currently Telecom has about 1.5 million mobile phone connections and Vodafone about 1.9 million. However, many of these connections are under business plans. The growth in "personal" mobile phone use has been in pre-paid connections. Typically the mobile phone company has little or no information on the owner of pre-paid connection, in particular address information.

So it is not normal to attempt to include in sample frames households whose only phone is a mobile phone. However for list-based surveys (such as when the survey is of clients or customers of an orga-

nization) mobile phone-only contacts are often provided. However for reasons of cost and environment an alternative landline number is obtained so that the person can be recontacted at an agreed time.

5.4.3 Monitoring mobile phone coverage

Where a Market Research Company conducts a large number of face-to-face interviews for various surveys in the course of a year they often include questions on mobile and landline usage as part of the standard classification questions for these households. So they are able to track the proportion of household with only mobile phone access. Generally this data is confidential.

Although such questions might be appropriate in the Census of Population and Dwellings, the 5 yearly interval between censuses is probably too long to provide useful ongoing information on the changing usage of mobile phones. There could be a case for an ongoing Government funded annual survey. On the other hand SNZ could via the HLFS produce such data. The HLFS would sample around 16000 households a year and so this should provide accurate enough estimates.

6 Overseas experience

The Official Statistical Agencies which SNZ has usually turned to for advances in methodology are the Australian Bureau of Statistics (ABS), Statistics Canada (StatCan), and the United Kingdom Office of National Statistics (ONS). So we approached contacts in these organizations to get their thoughts on telephone surveying and the impact of technology changes. Unfortunately we did not get any reply from the ONS.

Statistics New Zealand has also had contacts with Westat in the USA, and so that also seemed a sensible place to get information about the US experience. The ABS also recommended them as a source.

A summary of the email exchanges is given below. We would like to thank Frank Yu (ABS), Dave Paton (StatCan) and Graham Kalton and Mike Brick (Westat) for conversations and responding to our emails and providing their knowledge and experience.

6.1 ABS

The ABS have never been keen about the idea of cold-calling telephone surveying. In the 1990's there was a belief that cold calls would have problems with low response, undercoverage, and authentication issues and so they did not invest in the direction. With the popularity of mobile phones, multiple connections etc, they believe there is even less motivation in the method.

In many Australian states cold-call phoning is used to collect data for some health surveys. As an example, the Australian Institute of Health and Welfare carried out a survey of drugs use in 2004, which is also their principal measure of tobacco use. Part of the survey was done by CATI, this yielded 5,336 interviews. The response rate (their term is participation rate) was 37.8%. This is substantially lower than even their drop-off/pick-up approach at 47.8%.

6.2 StatCan

They have been conducting cold-call RDD surveys for over twenty years now and there are various ways that they check on the quality. The two most important concerns that they have for the RDD cold-call surveys are coverage and nonresponse.

They monitor coverage by using other surveys that use an area frame and ask questions about telephone service. The penetration of telephone service is quite high in Canada and has been generally rising over time so that nearly 99% of households now have telephone service. However, they also are facing the problem that there is an increasing proportion of households that have a mobile phone but no landline phone. For several reasons including confidentiality it is their policy to not conduct surveys over mobile phones. Hence the mobile-only households become another part of their non-covered population, with the result that their RDD coverage peaked at around 98% in the late 1990's and has now dropped to near 96%.

In magnitude nonresponse has always been a bigger problem than noncoverage. For many years they had nonresponse rates of between 15 and 20% . These seem to be increasing at present, partly due to some operational changes (e.g. fewer attempts made to convert nonresponses), but also for unexplained reasons.

6.3 Westat

Westat have not used the Waksberg-Mitofsky RDD approach for over 10 years. Their current approach uses a list of telephone numbers that are banks of 100 numbers (00-99) that have one or more directory listed telephone number. They did research in the early 1990s and found some (3%) undercoverage but very little bias. Geographically assigning numbers is a problem, but they are minor now at the state level. They have always used or should have used filter questions for local areas that do not map well to the geographic detail of the telephone numbers.

They have just started exploring the mobile problem and the research is still in its infancy. Generally RDD surveys do not sample them. They did a research study last year which they are presenting later in this year.

Blumberg et al. (2004) [2] and Tucker et al. (2004) [8] give the number and characteristics of mobile use in the USA.

Mike Brick mentioned an interesting study done by Keeter et al. (2000) [5] on voting and mobiles (including pre-paid). They found that despite this coverage problem in young people who tend to be higher users of pre-paid mobiles, when the data were post-stratified by age the biases were minimal. He suspected that this is not going to be an uncommon finding, but suggested more work needed to be done to confirm this.

Mike Brick had some interesting results on whether mobiles provide a suitable environment for conducting surveys. He said that the mobile survey they conducted had 13% of the mobile sample driving a car when they were first contacted. This and other issues are still being sorted out. His view was that it means that the interviewer training needs to include instructions to ask the respondent if the conditions are OK for the interview. The implication of such training is that callbacks (and lower response

rates) are thus to be expected and even encouraged in many cases, which is counter to agencies usual policy of trying to get as much done right away.

7 Characteristics of landline and mobile users

The information in this section has come from the most recent 2003/04 Household Economic Survey run by SNZ. It is an face-to-face survey with expenditure diary based on an areal frame. It has a response rate of 73% and there were 2854 responding households.

Although sampling error has to be taken into account³, the following tables show that there seem to be groups of the population who have higher than average access to only mobile phones. As expected these tend to be people with the lowest income, Māori or Pasifika, single parents or those with no educational qualifications. These groups have many of the same people in common. These groups also have lower than average access to either phone or landline

Looking at health data a similar situation holds for landline access. For example, the Ministry of Health's 2002/3 National Health Survey was conducted by NRB. In this surveys every participating household was asked whether they had a landline phone in the home that was presently connected. This survey of nearly 12000 households estimated that 6.4% of all households, and 7.3% of households in which the respondent was in the eligible population did not have access to a landline. For the questions about smoking, the survey estimated that the people who smoked 1 or more cigarettes a day was 20.3% for those with a landline, and 55.8% for those without a landline.

These example show that typically a large bias will result from ignoring people who have no access to telephones. It is usually thought that age, sex and ethnic post-stratification or calibration will attenuate some of this bias, but because e.g. of the large differences observed within household composition types, this may not be the case.

³The sampling errors here were calculated using simple random sample errors adjusted for average design effects and hence are approximate

Table 1: Percentage of households with landline and mobile phone access by type of household composition.

Household Composition Type	Both	Land only	Mobile only	none
Couple only	71%	26%	2%	1%
Couple with one dependent child	79%	14%	4%	3%
Couple with two dependent children	80%	19%	1%	0%
Couple with 3 or more dependent children	78%	17%	4%	1%
All other couples with Child(ren) only	88%	10%	1%	1%
One parent with dependent child(ren) only	52%	25%	16%	7%
All other one parent with child(ren) only households	77%	19%	2%	2%
Other one family households	75%	18%	7%	0%
One person household	37%	50%	8%	4%
All other households	81%	10%	6%	2%

Table 2: 95% halfwidth confidence intervals for percentage of households with landline and mobile phone access by type of household composition.

Household Composition Type	Both	Land only	Mobile only	none
Couple only	4%	4%	1%	1%
Couple with one dependent child	7%	6%	3%	3%
Couple with two dependent children	6%	6%	2%	1%
Couple with 3 or more dependent children	7%	6%	3%	1%
All other couples with Child(ren) only	6%	5%	2%	1%
One parent with dependent child(ren) only	9%	7%	6%	4%
All other one parent with child(ren) only households	12%	11%	4%	4%
Other one family households	9%	8%	5%	0%
One person household	4%	4%	2%	2%
All other households	7%	6%	4%	3%

Table 3: Percentage of households with landline and mobile phone access by total regular and recurring household income group.

Income Group	Both	Land only	Mobile only	none
< \$15,000	42%	41%	7%	10%
\$15,000 to \$21,099	31%	59%	5%	4%
\$21,100 to \$25,999	50%	38%	9%	3%
\$26,000 to \$32,899	55%	28%	11%	6%
\$32,900 to \$41,199	62%	29%	8%	1%
\$41,200 to \$51,899	71%	24%	4%	1%
\$51,900 to \$62,699	77%	19%	4%	0%
\$62,700 to \$77,099	82%	15%	2%	1%
\$77,100 to \$101,599	83%	14%	2%	0%
\$101,600 and Over	89%	11%	0%	0%

Table 4: 95% halfwidth confidence intervals for percentage of households with landline and mobile phone access by total regular and recurring household income group.

Income Group	Both	Land only	Mobile only	none
< \$15,000	9%	9%	5%	5%
\$15,000 to \$21,099	6%	6%	3%	2%
\$21,100 to \$25,999	7%	7%	4%	3%
\$26,000 to \$32,899	7%	7%	4%	3%
\$32,900 to \$41,199	7%	7%	4%	1%
\$41,200 to \$51,899	6%	6%	3%	1%
\$51,900 to \$62,699	6%	5%	3%	0%
\$62,700 to \$77,099	5%	5%	2%	1%
\$77,100 to \$101,599	5%	5%	2%	1%
\$101,600 and Over	4%	4%	1%	0%

Table 5: Percentage of individuals with landline and mobile phone access by age group.

Age Group	Both	Land only	Mobile only	none
15-24	83%	10%	5%	2%
25-34	77%	15%	6%	2%
35-54	79%	16%	3%	2%
≥ 55	57%	40%	2%	1%

Table 6: 95% halfwidth confidence intervals for percentage of individuals with landline and mobile phone access by age group.

Age Group	Both	Land only	Mobile only	none
15-24	3%	2%	2%	1%
25-34	3%	3%	2%	1%
35-54	2%	2%	1%	1%
≥ 55	3%	3%	1%	1%

Table 7: Percentage of individuals with landline and mobile phone access by ethnic group.

Ethnic Group	Both	Land only	Mobile only	none
Asian	87%	10%	2%	0%
European/Pakeha	74%	23%	2%	1%
Māori	59%	20%	14%	7%
Other	84%	15%	1%	0%
Pacific Islander	59%	28%	9%	4%

Table 8: 95% halfwidth confidence intervals for percentage of individuals with landline and mobile phone access by ethnic group.

Ethnic Group	Both	Land only	Mobile only	none
Asian	4%	4%	2%	1%
European/Pakeha	2%	2%	1%	1%
Māori	6%	5%	4%	3%
Other	7%	7%	2%	1%
Pacific Islander	7%	6%	4%	3%

8 What Telecom will do

Attached as an appendix are two documents supplied by Telecom Directories on sampling telephone numbers.

Our summary of these documents as well as email and phone contact with Telecom is:

- residential landline number are covered including TelstraClear numbers.
- Samples can be drawn:
 - over the whole country
 - by Directory coverage area
 - by City, Suburb and/or street
 - Meshblock, TA, Electoral District, or some customized area. It is not clear whether the Random option means that this is the case where the samples are drawn SRSWOR, and the other cases are not.
- In compliance with the NZ privacy Act 1993, names will not be supplied with any residential data.
- Addresses can be released [if this means street number as well as street address then pre-notification letters are possible]
- Matching of telephone numbers to other lists of addresses is possible.
- The current costs for drawing samples are:

Standard Option	
Telephone Only	\$35 per 1000
Phone & Suburb	\$42 per 1000
Phone, Street Name & Suburb	\$45.50 per 1000
Addresses Only	\$35 per 1000
Set up Fee	\$100 per run
Special Setup Fee (for Meshblock, TLA, Electoral, Custom Format)	\$150 per run
Random Option	\$185 per 1000 (incl. Setup Fee)
Data Manipulation (if required)	negotiable

9 Does telephone surveying provide the right environment?

While RDD can overcome the problem of households which are not listed in the White Pages, it raises a problem more than just the percentage unlisted. (There are probably more than the 13% of all homes recorded in 1999.) These people have consciously de-listed their phone numbers to avoid being contacted this way, whether for a survey or not. When a survey interviewer rings their phone unexpectedly, they may well provoke a hostile attitude. So this contact is unlikely to produce an interview. Thus “de-listed phone” households can probably be added to non-phone households from the perspective of undercoverage.

Telephone surveys rarely use a secure procedure such as the Kish Grid for selecting the respondent from all who are eligible. This is because it is difficult to ask a householder to give the names of all occupants over the phone. It is harder to establish trust over the phone than at the doorstep. For this reason phone surveys generally fall back on the “person who last had a birthday”. This “last birthday” selection procedure leads to either the phone answerer selecting themselves into the survey, or failure to get access to the true respondent who receives the request once removed and can more readily opt out. This results typically in unbalanced age and gender samples.

As telemarketing, canvassing and surveying by the growing number of CATI rooms increases, we can expect to see an increase in public resistance to receiving requests for interviews on the telephone.

10 Conclusion

The requirements for surveys for Tier 1 statistics had not been announced when this report was written.⁴ Nevertheless, the authors thought it likely that the following requirements would be included.

- frame(s) with high coverage of target population;
- response rates better than 70%;
- verifiable random selection of respondents;
- mechanisms to ensure respondents are not over-surveyed (overlap control).

So telephone surveys need to meet these requirements. However, practical experience suggests many of them will not be satisfied.

Landline use is declining as more people switch to mobile only phone access. We suggest that SNZ via the HLFS monitor the changing coverage of landline and mobile phones, and that Telecom is asked to provide the number of unlisted numbers, so that the undercoverage can be assessed reliably for a telephone survey

Because refusal is easier on the phone, response rates are usually very much lower than 70%. For telephone surveys to be adopted, more work on methodologies to increase response rates, such as pre-notification letters is required. As in the case of pre-notification letters, such methodologies may require use of the Telecom directory frame.

Overlap control needs quite detailed address information. Such information is unlikely to be offered over the phone. So to get such information one would need to use the Telecom Directory frame with its high undercoverage.

Increasingly surveys which might fall into the Tier 1 statistics category need to provide good subpopulation estimates. The subpopulations might be ethnic groups, such as Māori and Pasifika, or regions such as regional councils, or other broad government defined areas, e.g. District Health Boards, Regional Sports Trusts, etc.

To achieve appropriate samples requires a judicious mixture of targeting (via stratification) and screening. So telephone surveys must be able to do both of these things. It is likely that targeting would again require use of the Telecom Directory frame. Screening would appear to be efficient across the phone, but given the lack of use of Kish Grid methods for selecting respondents because of trust issues mentioned above, this needs to be tested.

Given that telephone technology is rapidly evolving, perhaps to the point that there may only be “mobile” phones in five to ten years time, a commitment to using telephone surveys for Tier 1 statistics would necessitate ongoing methodology development to keep up with the changes. It would not be possible, e.g. as for the areally based HLFS to plan on a five year cycle with perhaps a mid cycle update of the areal frame to account for growth in meshblocks. These changes are likely to happen first in

⁴For details on the current portfolio of Tier 1 Statistics see the webpage: <http://www.statisphere.govt.nz/AboutOfficialStatistics/default.htm>.

large metropolitan areas and only gradually move out to rural areas. It would not be sufficient for Tier 1 statistics to ignore the old technology areas, since these may be exactly where subpopulations of interest predominate, e.g. Māori in rural areas. This methodology development would entail considerable cost which when amortized over the few telephone surveys run mean that the cost benefit of the telephone surveys would be negative.

In conclusion, then, our view is that Telephone surveys for Tier 1 statistics are unlikely to be feasible, nor cost effective.

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11 Appendix

11.1 Telecom documents

These are attached at the end of the file.

Table 9: Percentage of individuals with landline and mobile phone access by highest qualification.

Highest Qualification	Both	Land only	Mobile only	none
Aged over 64	46%	53%	1%	1%
No qualification	66%	22%	9%	3%
School Certificate; NCEA level 1; NCEA level 2	77%	16%	5%	1%
UE;Bursary; Scholarship; NCEA level 3	85%	11%	3%	1%
Vocational or trade certificate	81%	13%	4%	2%
Bachelors degree or diploma	86%	13%	1%	0%
Post-graduate qualification	81%	18%	1%	0%
Part degree or other qualification	83%	12%	4%	2%
nonresponse	70%	23%	6%	1%

Table 10: 95% halfwidth confidence intervals for percentage of individuals with landline and mobile phone access by highest qualification.

Highest Qualification	Both	Land only	Mobile only	none
Aged over 64	4%	4%	1%	1%
No qualification	3%	3%	2%	1%
School Certificate; NCEA level 1; NCEA level 2	3%	3%	2%	1%
UE;Bursary; Scholarship; NCEA level 3	3%	3%	1%	1%
Vocational or trade certificate	3%	3%	1%	1%
Bachelors degree or diploma	3%	3%	1%	1%
Post-graduate qualification	5%	5%	1%	1%
Part degree or other qualification	8%	7%	4%	3%
nonresponse	11%	10%	6%	2%



TeleMatching

Through TeleMatching you can check the accuracy of your existing customer or prospect database and correct inaccurate or incomplete data.

Tel : 0800 501 515 or 64-9-525 5015

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Email : datasolutions@yellowpages.co.nz



Product Description

With over 1.6 million listings, our TeleMatching service validates and enhances your database. It is a core component of many successful marketing campaigns in New Zealand.

Source

TeleMatching match your data against the WHITE PAGES™ print and online directories. Listings are updated daily as new telephone connections are made.

Validation

By identifying potential errors, you can start cleaning up your customer data, saving time and money in wasted direct marketing activity.

Enhancement

TeleMatching will enhance your existing database based on their match level:

- Add the latest published telephone numbers to accurately matched records (Confidential/unpublished phone numbers will not be supplied)
- Add post code to all successfully matched records
- Add correct unit/flat number to addresses
- Amend/add correct street number to addresses with missing or incorrect street numbers

Typical applications include

- Adding current phone or address details for existing databases
- Detecting customer change of addresses

Features

- New Zealand's most complete business and consumer telephone databases
- More than 1.6 million listings
- Updated daily

Benefits

- Up-to-date customer databases
- Save time and money by reducing wasted marketing activity
- Reduce churn when customers move
- Create telemarketing databases from Direct Mail databases

Delivery

2-3 working days from order

File Format

Excel, csv, txt, dbf

Pricing *(All prices exclude GST)*

Set up Fee \$10.00 per 1000
(minimum \$100)

Cost per successful match \$200 per 1000

Data Manipulation negotiable

More Information

- Matching Levels
- Data Format
- Address Stripping
- Confidentiality



Free Trial - To give you a better understanding of how the TeleMatching service works and to ascertain the likely matching success rate with your information, we offer a free trial of up to 100 records. Please contact us for further details.

TeleMatching

Matching Levels

TeleMatching matches to six different levels. Telephone numbers are added to successful matches (Levels 0 to 2). Please note that although we also append the phone number to Match Level 3, this is not regarded as a successful match because we are not 100% certain we have identified the correct person.

Match Description	Level	Match Details	Enhancement
Full Match	0	Complete match on all records supplied	☎ ☒
Soft Locality Match	1	Customer matched but an error is detected in either the city or suburb field	☎ ☒
Soft Number Match	2	Customer matched but an error in the unit/flat number is identified	☎ ☒ û
Street Number Mismatch	3	Customer possibly matched, but street number is missing or incorrect	☎ #
Address Mismatch	4	Surname not found at the supplied address	
Invalid Surname	5	Surname not found in the directory	

Key: ☎ telephone number added ☒ postcode added û unit number added # Street Number added

Data Format

Our TeleMatching service uses the information you already have on your customers. To assist in the processing of your file, and to improve the match rate, please ensure the data you supply is as close to the following format as possible.

Field	Surname	Street Name	Street Number	Suburb	City	Reference
Data Type	Text	Text	Text	Text	Text	Your choice
Field Length	15	9	6	20	20	30
Examples	Bloggs	Wairau	25	Glenfield	Auckland	1234560
	Johnson	Ridell	4/56	St Heliers	Auckland	1234561
	McDonald	Greenway	20	Devonport	Auckland	1234562
	Douglas	P O Box	1769	Johnsonville	Wellington	1234563
	Toby	Private	9231	Papamoa	Tauranga	1234564
	James	R D 1		Te Rapa	Te Rapa	1234565

Tel : 0800 501 515 or 64-9-525 5015

Website : www.ypds.co.nz

Fax : 0800 501 516 or 64-9-525 5092

Email : datasolutions@yellowpages.co.nz



Address Format Stripping

If your database has a single address field and you are unable to break it into its components, we are able to strip down your records into the acceptable format. Simply supply your data in excel or comma-separated file format. Additional charges might apply to databases requiring extensive manipulation.

Confidentiality

Telecom Directories Limited undertakes to treat your information, as supplied to us on computer disk and/or Email, in the same way as we do our own confidential information. We will neither make copies of your information, nor retain it on the hard disk of our computers beyond the time needed to perform the processing tasks that you have asked us to carry out. All information will be returned to you in accordance with your instructions.

Tel : 0800 501 515 or 64-9-525 5015

Website : www.ypds.co.nz

Fax : 0800 501 516 or 64-9-525 5092

Email : datasolutions@yellowpages.co.nz



TeleRanges

TeleRanges will provide you with the consumer telephone or address data you require for your telemarketing or direct mail campaigns.

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Product Description

With over 1.1 million households listed, our TeleRanges service provides you with comprehensive and up-to-date information of published residential telephone numbers or addresses for specific locations. It is a core component of many successful consumer marketing campaigns in New Zealand.

Source

TeleRanges data is derived from WHITE PAGES™ print and online directories.

Updates

Listings are updated daily as new telephone connections are made.

Data Selection

Data can be selected by:

- Directory Coverage Area
- City, Suburb and/or Street
- Random
- Meshblock, Territorial Local Authorities (TLA), Electoral, Custom Area

Typical telemarketing applications include

- Charities and Fund Raising Campaigns
- Consumer Prospecting by Location
- Market Research Phone Surveys
- Real Estate Agent Introductions
- Utility Prospecting

Privacy Act Compliance

In compliance with the New Zealand Privacy Act 1993,

Features

- New Zealand's most complete consumer telephone databases
- More than 1.1 million listings
- Updated daily

Benefits

- Save time and money by reducing wasted marketing activity
- Target specific streets and suburbs

Delivery 2-3 working days from order

File Format Excel, csv, txt, dbf

Pricing *(All prices exclude GST)*

Standard Option

Telephone Only	\$35 per 1000
Phone & Suburb	\$42 per 1000
Phone, Street Name & Suburb	\$45.50 per 1000
Addresses Only	\$35 per 1000
Set up Fee	\$100 per run

Special Setup Fee

(for Meshblock, TLA, Electoral, Custom Format) \$150 per run

Random Option \$185 per 1000 (incl. Setup Fee)

Data Manipulation negotiable

(if required)



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