



WHITE PAPER

**The Declining Working Phone Rate and Its Impact on RDD Efficiency:
The Pond Has Grown but the Number of Fish Remains the Same**

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Researchers know that 98% of US households can potentially be reached via telephone. As a result, telephone sampling remains the first-choice mode for many syndicated, political polling, public release and market research studies. However, those following telephony know landline telephone ownership is declining, while cell (wireless) only telephone households are increasing. Researchers conducting telephone interviewing are further challenged by the decline of the pre-screened working phone rate and decreasing cooperation rates across all modes of interviewing.

In this article, we will provide a deeper understanding of these issues. In addition, we will share actionable steps researchers can take to improve their telephone fielding efforts.

Learning the Terminology

To begin, we need to clarify terminology. In survey research, Working Phone Rate (WPR) refers to the proportion of telephone numbers in a sample that are working numbers. Non-working numbers include numbers that are not in service, disconnected or changed. A working number, however, may not be an eligible number. A more precise term is Working Residential Rate (WRR), which is the proportion of a telephone sample that connects to a residence.

For a residential telephone sample, ineligible units are those numbers that connect to an ineligible unit, such as a business, modem or fax machine. Answering machines are considered working numbers. Even though a live person has not answered, the interviewer typically has connected to a household.

WPR/WRR does not include contact rates or cooperation rates. Most researchers use WPR to mean WRR for residential samples, so we use that term throughout the article.

Understanding the Calculation—and the Anatomy of a Phone Number

Below is an example of the correct way to calculate the WPR for a sample. It is important to note that **B** is the number of sample records dialed—**not** the number of times dialed.

1000 Telephone Numbers			
Disposition determined during dialing (A)			
Disconnected	400		
Business/Government	100		
Faxes	50		
Modems	50		
		Sample Records Dialed	1000
<i>Non Residential (A)</i>	600	<i>Total Dialed (B)</i>	1000
<i>A divided by B</i>			60%
Working Phone Rate			40%



It is also important to understand the “anatomy” of a telephone number. Let’s take phone number 203-567-1234 as an example.

- 203 is the area code.
- 567 is the prefix (or exchange).
- 1234 is the suffix, where 12 is the 100-block.
 - 100 Telephone numbers can be created within the range of 1200-1299.

Defining the Issue

There has been a sharp decline in the landline working phone rate over the past few years. The exact number varies according to sampling methodology. A sample of directory-listed phone numbers typically has a higher WPR than a list-assisted landline RDD (Random Digit Dial) sample, however, it will be less representative—as it only represents about 50% of all households. Conversely, landline RDD sample will have a lower WPR than a directory-listed sample but will be more representative, covering approximately 70% of households.

The average WPR for a directory-listed sample is currently 80% but can vary by geography. On the other hand, an equal probability list-assisted landline RDD sample—a sample drawn with equal probability across eligible 100-blocks with one or more directory-listed numbers—will have a 21%-38% WPR, again varying by geography. Efficiency gains for landline RDD samples can be achieved by using non-EPSEM sampling methodologies. (EPSEM is Equal Probability Selection Method.) For example, landline RDD samples can be selected from a frame that has been truncated, based on the number of listed phones in the 100-block.

Selecting a sample from 100-blocks with three or more listed numbers or five or more listed numbers will increase efficiency. This higher efficiency, however, comes at the expense of coverage and representation—to the extent households in small blocks are different from those in blocks with more listed numbers. Probability Proportional to Size (PPS) RDD samples can also achieve higher working phone rates. PPS samples are selected using the number of listed phones in each 100-block as a measure of size (MOS) during sample selection. Such samples will be proportionate to listed numbers while still including non-listed numbers.

To help you plan, below are average WPRs by sample type:

- Listed – 80%
- PPS RDD – 42% (range 32%–53% by state)
- EPSEM – 30% (range 21%–38% by state)



Identifying the Factors that Impact WPR

For directory-listed samples, the WPR is primarily impacted by the mobility of the population. According to the American Community Survey (ACS), 16.2% of US households move in a year (the average life span of a telephone directory). As a result, an average of 16% of directory-listed numbers might have been disconnected by the time researchers select a sample in an area where a new directory is about to be published. In addition, higher mobility rates in urban areas can result in higher disconnect rates for listed samples. Conversely, lower mobility rates in rural areas can mean lower disconnect rates for listed samples.

Another contributing factor to WPR rates is the accuracy of the compilation process. For major compilers, scanners and direct downloads from various operating companies have replaced data entry. The accuracy of the scanning process depends on a variety of factors, including font size, bleeding effects and paper quality.

Even the most sophisticated scanners can have problems differentiating between a 3 and an 8, a 1 and a 7, or a 5 and 6 when the font size is only 8 or 9 points. This means that some percent of scanned 10-digit numbers will be incorrect.

In addition, although area code and exchange combinations can be validated to the ZIP Code of the address, the 4-digit suffix cannot be confirmed. Finally, not all business listings can be identified as a business during the compilation or business number purging processes. This contributes to the number of ineligible numbers in a directory-listed sample.

It is important to note that for landline RDD samples, the WPR will be significantly lower than for directory-listed samples. List-assisted landline RDD samples offer better coverage of telephone households than directory-listed samples. This enhanced coverage results from including numbers that are not found in directories (ex-directory), through Directory Assistance or in operating company databases (unlisted) but are in 100-blocks that contain other directory-listed numbers.

Many of these not-listed landline RDD numbers, however, are either nonworking or ineligible resulting in a lower WPR. In landline RDD samples, unlike directory-listed samples, nonworking numbers include those that have never been assigned, as well as those that are no longer assigned.

We will discuss in greater detail the four key factors, which singly or in combination affect the working phone rate:

- Universe Dynamics
- Number assignment policies
- Sample Design/Methodology
- Geography

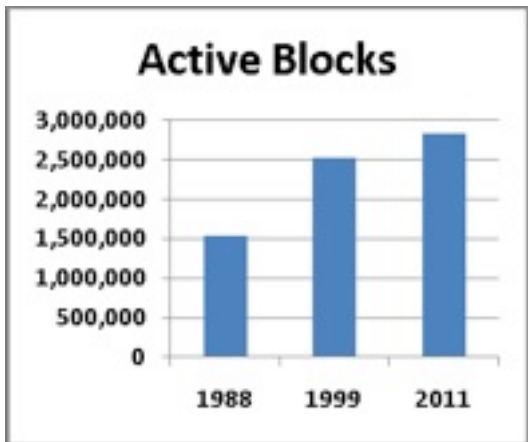
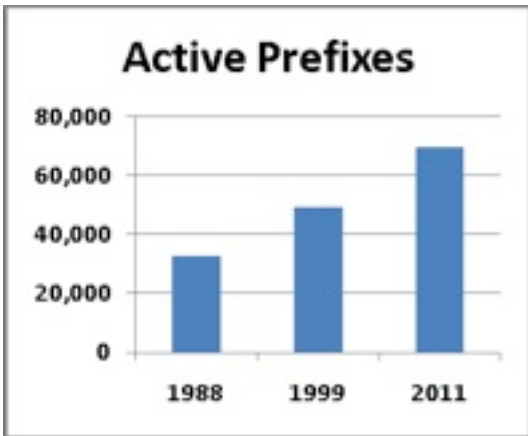
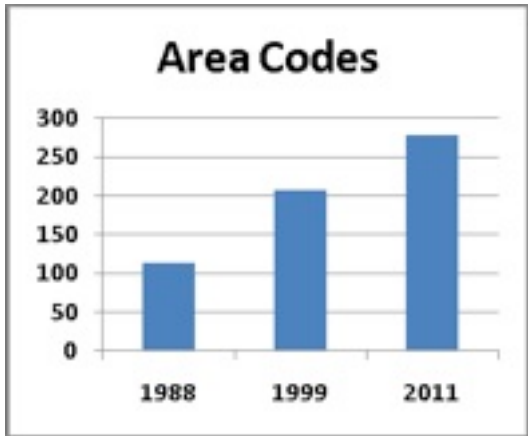


Examining Universe Dynamics

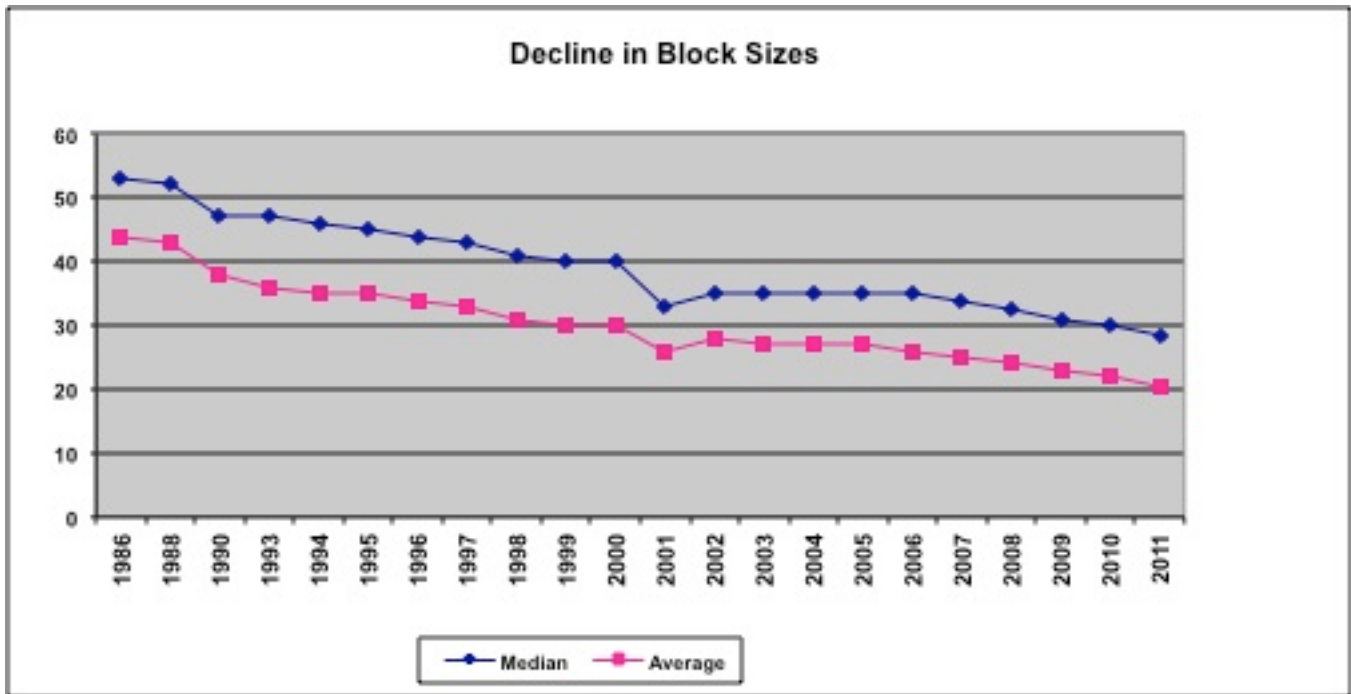
First, it is helpful to understand that the WPR for a landline RDD sample is directly proportional to the number of residences present in the frame of possible landline RDD numbers. In the late 1990s and early 2000s, in an effort to meet the demand for more telephone numbers, telephone companies in the US and around the world modified their numbering systems. The introduction of new area codes, overlays and exchange partitioning in the US and the standardization of telephone number lengths in many countries negatively affected working phone rates by substantially increasing the pool of possible RDD numbers in RDD frames.

The original North American Number Plan in 1947 included 78 US area codes. In the 42 years between 1947 and 1989, only 36 new area codes were added, creating a total of 114 area codes. Today there are 278 area codes.

Since 2000, the US RDD frame has grown 18% while the number of landline and wireless telephone households has only grown by 11%. When taking into account the almost 30% of telephone households that have only a cell phone, the number of landline telephone households has actually declined by 6%. The RDD frame has increased, while the need has decreased.



The working phone rate of a sample is directly proportional to the number of listed and unlisted telephone households in the sample. Over the past 25 years, the number of listed and (by inference) unlisted households in a 100-block has steadily declined. There are now more blocks with fewer listed numbers.



The *average* proportion of listed phones in a 100-block (and consequently in an EPSEM sample) has declined from 44% in 1986 to 20% today. The median block size (reflecting the proportion of listed numbers in a PPS sample) has declined from 53% to 28.5%. As long as the pool of possible numbers continues to increase, landline RDD samples, regardless of methodology, will continue to have fewer listed numbers today than in the past, even though listed rates have not declined appreciably.

Simply stated, the pool of possible residential telephone numbers has grown faster than the target population of telephone households. But the question is why?

During the 1990s, the demand for telephone numbers dramatically increased, driven by a rapidly changing telephony environment. Key changes include competition for local exchange service; a rise in ownership of computers, faxes and, pagers; increased usage of unified messaging services, such as e-fax; and the growing popularity of cell phones. After a decade of rapidly expanding the telephone-numbering frame to meet these new demands, the resulting decline in landline RDD WPR in the US and around the world has been exacerbated by the recent drop in demand for telephone numbers.

We actually are seeing a decline in demand for multiple phone lines, as households and businesses are substituting DSL and Cable Voice (VoIP) for second and third lines. Although some of these numbers may be recycled to new subscribers, many remain unused or not-in-service.



As early as 2001 we began to see a trend that would significantly alter the telephone landscape: the increase in cell phone subscribers. Cell phone only households (aka wireless, mobile) have steadily increased every year—to 30% in 2011. But the area codes (and phone number possibilities) that were opened in the late 1990s and early 2000s have not gone away. They are just no longer “filled” with subscribers, which makes dialing a landline RDD sample less effective than in the past.

Local Number Portability (LNP) has also had an adverse effect on sample efficiencies. In 1998, the FCC instituted Local Number Portability (LNP), which is the ability to change telephone service providers within a particular Rate Center without changing telephone numbers. By March 2010, some 67 million landline numbers had been ported to another landline provider. Another 2.9 million landline numbers had been ported to wireless service as of April 2011.

Porting requires two 10-digit numbers for each telephone line. One is the original subscriber number. The other is the number associated with the switch belonging to the new carrier and to which the call is connected. In most cases, the new “ghost” numbers do not connect if dialed, but their presence in RDD frames contributes to the overall decline in WPR. Today, there are an estimated 70 million ported landline telephone numbers that won’t connect, which is nearly 25% of possible landline numbers.

Recent declines in the demand for landline telephone numbers combined with Local Number Portability have adversely affected sample efficiencies. In addition, the way that local telephone companies assign telephone numbers may also affect the WPR.

Reviewing Number Assignment Policies

As a refresher, each telephone number contains an area code, exchange (prefix) and the number suffix. In the phone number 203-567-1234:

- 203 is the area code.
- 567 is the exchange.
- 1 is the 1000-block.
 - 1000 Telephone numbers can be created within the range of 1000-1999.
- 12 is the 100-block.
 - 100 Telephone numbers can be created within the range of 1200-1299.

How local telephone companies assign telephone numbers within their allotted pool of numbers may affect WPR. As the demand for telephone numbers exploded in the late 1990s, and further anticipating the additional drain on resources that Local Number Portability was going to have, administrators of the North American Number Plan became concerned about the real possibility that we were in danger of exhausting the pool of available numbers.



In an effort to forestall this scenario, in 1998 the telephone regulatory administrative agency mandated 1000-block pooling to conserve telephone numbers. This conservation measure declared that service providers in most Metropolitan Statistical Areas (MSAs) could no longer monopolize all 10,000 possible phone number combinations in a prefix, (exchange). The service provider had to return unused 1000-blocks to a pool administrator. 1,000-blocks returned to the pool administrator, can then be reassigned to any service provider needing an additional pool of numbers in that rate center—regardless, of the type of service they provide. Roughly half of active prefixes are pooled. Although there was the possibility that this conservation effort would have a positive effect on block densities and working phone rates, we have not seen any substantive improvement to date.

The Federal Communications Commission (FCC) reported that in 2011, only 47.9% of numbers available for assignment to end users nationally have been assigned to residences and businesses. However, the percent of numbers assigned varies greatly by carrier type, service type and geography. For example, incumbent Local Exchange Carriers (LECs) utilized less than 50% of their available number pool, and Competitive Local Exchange Carriers (CLECs) (mostly cable and VoIP service providers) only about 34%. Conversely, Cellular Carriers utilized over 65% of their number pool.

Available Number Utilization by Carrier Type

	Total	Non-Rural	Rural
Incumbent Local Exchange Carriers (LEC)	47.3%	51.0%	14.8%
Competitive Local Exchange Carriers (CLEC)	34.0%	34.7%	6.6%
Cellular/PCS Carriers	66.7%	67.6%	21.7%
Paging Carriers	5.9%	5.9%	5.1%

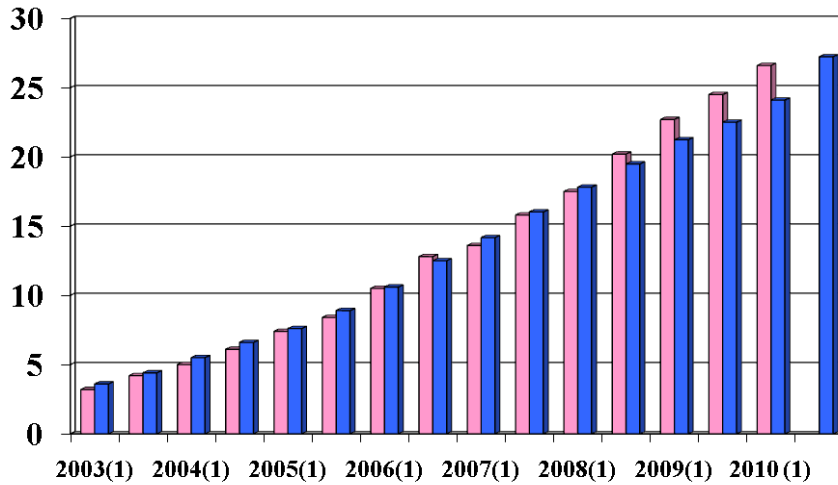
The substantially lower utilization rates for CLECs and for rural areas suggest that Working Phone Rates can be depressed in these areas. Depression occurs to the extent that local phone companies have assigned numbers across all 10,000 numbers in an exchange rather than assigning them more selectively in 1000-banks or 100-banks.

On the surface, it may appear that listed rates have declined over the years, when we use Census telephone households as the denominator of these rates. In reality, however, the percent of landline households that are directory listed has not really changed much. The decline in the number of directory-listed households is a result of the growth of wireless substitution since 2002.

While the pool of possible RDD numbers continues to increase, RDD sample efficiencies have been impacted by the steady and significant trend toward wireless substitution. As stated above, the working “residential” rate is the proportion of the sample that connects to a residence. Not only has the pool of possible numbers been steadily increasing, but the number of residences with wireline (aka landline) service has been decreasing as more and more households give up their wireline service for wireless service.



Cell-Only Household Prevalence—Coverage Bias:



■ NHIS ■ MRI

Data Source: © Mediamark Research Inc 2001-2010 and CDC/NCHS 2003-2010

Full Landscape:

As of May 2011		% of Households	% of Telephone Households	% of Landline Households
Total US Households**	112,611,029			
Est. Telephone Households**	109,423,567	97.2%		
Est. Cell Only Households*	32,198,000	28.6%	29.4%	
Est. Landline Households	77,225,567	68.6%	70.6%	
Directory Listed Households	57,531,144	51.1%	52.6%	74.5%
List-Assisted RDD Frame	283,738,000			
* Mediamark Research Fall 2010	** ACS 2010			

While our “pond” of eligible numbers continues growing to accommodate a variety of telephony demands, the number of fish—aka wireline (landline) telephone households—continues to decline. The result is a declining WPR.



Understanding Sample Design/Methodology

There are several common landline RDD methodologies, EPSEM and SSI's RDD A and RDD B are examples. Historically, RDD landline samples were built on these basic assumptions behind list-assisted RDD:

- Unlisted households are likely to be found in the same 100-blocks as directory listed numbers.
- The number of listed phone numbers in a 100-block will affect sample efficiencies.

SSI's **Landline** RDD Methodologies offer trade-offs based on each client's research objectives:

Random A:

- Equal probability of selection for all numbers in 100-blocks with one or more listed numbers
- Most representative but less efficient
- National WPR 29.9% (21% in DC vs. 37.6% in WV)

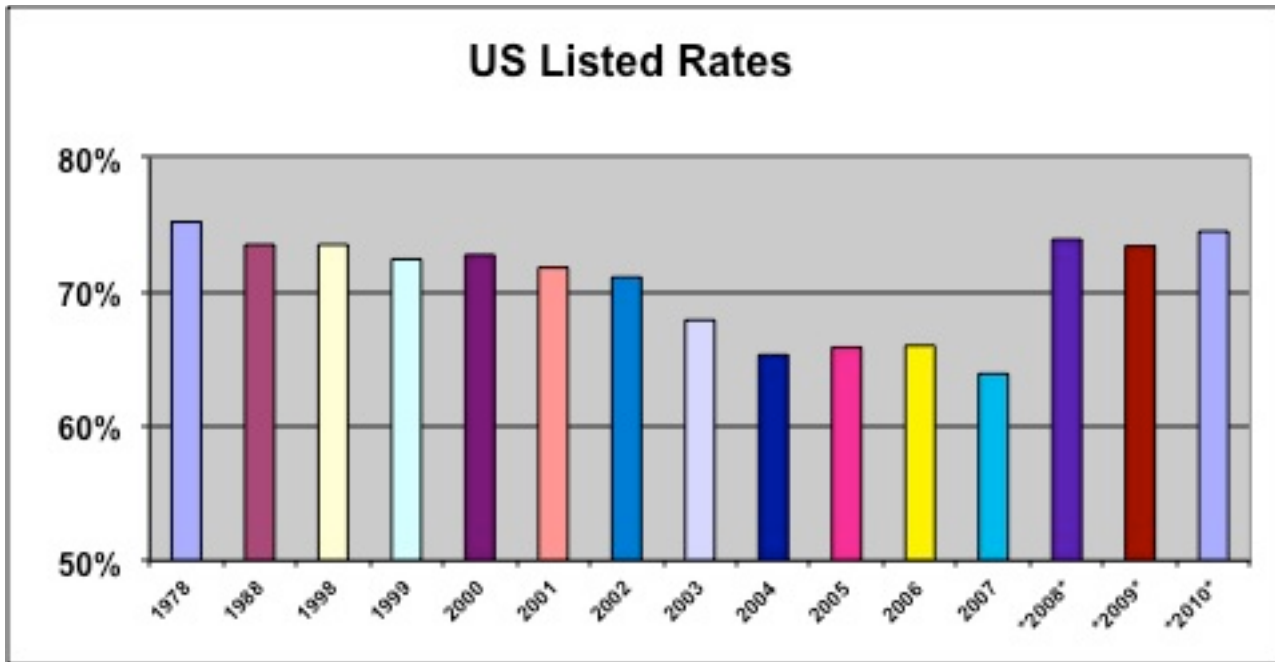
Random B:

- PPS—probability proportionate to number of listed numbers in the 100-block
- Less representative but more efficient
- Higher skew to dense blocks
- National WPR 42.1% (32% in DC vs. 53% in WV)

The decline of the landline telephone household has altered our basic assumptions. It may be hard to believe but, as mentioned earlier, landline telephone directory-listed rates remain very constant year over year. What has dramatically changed is the number of cell phone only households.

Data from Mediamark Research Inc. states that as of Spring 2011, 30.6% of households are cell phone only. These households have disconnected from the traditional landline telephone system and are typically not "listed" in the published telephone directories. As these households disconnect from the landline system, "listedness rate" in the working blocks declines. Among landline telephone households, however, listedness rates remain constant.





***2008-2010* denominator adjusted from telephone households to landline households to reflect wireless substitution.**

The increasing popularity of cable/VoIP as a replacement for traditional telephone company phone service has further reduced the number of listed residential landline numbers in working blocks. Again, a block is defined as the last two digits of the phone number suffix (203-567-**1234**).

As our default, SSI considers a block to be working if it contains one or more directory-listed numbers. However, some telephone numbers of VoIP and cable service customers are not eligible for selection within working blocks. This is because VoIP and cable service providers may not provide subscriber numbers to directory publishers or Directory Assistance. Therefore, these numbers may often be found in zero banks or low-density banks.

Looking at Geography: Urban/Suburban/Rural variations

Researchers may see that small-area samples have unusually low or unusually high Working Phone Rates. Listed samples in rural areas tend to have a higher WPR, because they have lower mobility rates, fewer privacy concerns and fewer businesses. Rural areas, however, may have a lower RDD WPR because there are fewer new listings, less chance of coming across a non-listed number (because listed rates are higher), and more underutilized exchanges and blocks. Urban areas generally tend to have a lower listed and RDD WPR, because they have higher mobility rates, more renters, more businesses, potentially more ported numbers and more wireless-only households. Suburban communities, with their higher growth rates and higher unlisted rates, generally have a higher WPR.



In summary:

- Rural areas tend to have fewer unlisted numbers, fewer businesses, lower mobility rates and more underutilized blocks and exchanges—no churn.
- Urban areas tend to have more unlisted numbers, more businesses, higher mobility rates and more small blocks—high churn.
- Suburban areas are more densely populated and have larger block sizes, fewer businesses and better utilization of numbers—medium churn.

Small-area samples (a single county, ZIP(s), Census Tract, etc.) can have abnormally high or abnormally low WPRs. They may be affected by the presence or absence of any or all of the factors mentioned above.

Determining What You Can Do: Strategies for Improvement

1. Calculating Sample Need

It is important when calculating sample need to use an accurate estimate of the working phone rate. Due to the decline of the working residential rates, researchers will need more telephone numbers to complete interviews. Researchers who have an expectation ratio from the early 2000s, will consistently be short of sample in field, causing time delays and interviewer frustration. Data collection suppliers have actual fielding experiences to share, and SSI’s offline consultation team is always available to share its knowledge and expertise.

As a general rule, SSI uses the following simple formula to determine the number of telephone numbers needed to achieve a completed interview. For example, on a general population Continental US project with a 50% product incidence, SSI recommends 35 telephone numbers to achieve one completed interview.

Completed Interviews	100
Working Phone Rate RDD B	.43
Product Incidence	.50
Demographic Incidence	.90 General Population study
Geographic Incidence	1 n/a
Contact, cooperation & completion rate	.15
Suggested RDD B telephone numbers	3445 ---- 3500

2. Removing Business Numbers

SSI uses four different B2B sources to identify and remove known business numbers from our consumer sample products. Many businesses, however, have multiple voice lines (rollover lines and Direct Inward Dial lines) which are not listed in directories or business files. This means that consumer samples will always contain unlisted business, fax, and modem numbers. The percent of unidentified business numbers in a consumer sample will naturally be higher in urban areas and lower in rural areas.



3. *Screening for Working Numbers*

There is technology that will take a sample and determine if the number is working or not. This pre-screening for disconnected numbers identifies nearly 90% of the disconnected numbers naturally associated with RDD dialing. Keep in mind that when landline RDD is generated, there may be as many as 70% disconnected numbers. So when requesting a sample of 1000 Continental US RDD B numbers, and then request for it to be pre-screened for disconnected numbers, the sample delivered will be around 450 numbers of which we expect approximately 87% to be working residential numbers. Using the correct initial sample size calculation formula, the numbers delivered will be enough to achieve your desired completes.

4. *Altering the Working Block Selection Threshold*

SSI works to assure the integrity of each of our samples. We openly share our methodologies and in 2008 launched a dedicated business unit within SSI to specifically work on offline sample methodology and quality. Our commitment to our heritage of telephone sampling and our brand promise of the “science of sampling” remains strong. While methodological rigor is in our DNA, we understand the practical pressures our clients face. Since 1993, both our full service and SSI-SNAP™ desktop ordering system have given researchers the option to lower costs and increase productivity by adjusting their own working block thresholds.

As a reminder, a block is the last 2-digits of the 4-digit phone number suffix. SSI considers a block to be working if it has one or more listed (directory published) numbers. Our default working block threshold for RDD B samples is three or more listed numbers.

The working block threshold can easily be altered. However, it is important to understand that there are trade-offs between coverage and field efficiency gains.

By reducing the number of working blocks in a sample, researchers shrink their universe. Samples will be generated from those working blocks that contain more directory-listed telephone numbers, positively affecting the working phone rate and the amount of sample needed to order and dial.

Each geography will be different, but below is a Continental US distribution example:

Listed numbers in the block	3+	15+	20+	25+	35+	50+
% of listed numbers in RDD B Sample	31%	35%	37%	41%	49%	60%

Stratifying your sample to more densely listed blocks will certainly improve your working phone rate—but researchers should be cautioned. Raising the working block threshold eliminates blocks based on listedness rate. If the households systematically eliminated from a sampling frame are different from those included, researchers threaten the accuracy of their research results.

Those who list in telephone directories tend to be older and more suburban with middle income. Telephone numbers provided by cable companies/VoIP tend to be in smaller blocks. While the landline directory-listed rates are relatively stable, the continued growth of the cell phone only household will certainly have an impact on accuracy. Including wireless sample in your project design may mitigate these concerns.



In a Continental US sample:

- Using Block Size 3+: eliminates 7.8% of 100-blocks but only 0.5% of listed numbers.
- Using Block Size 5+: eliminates 12.8% of blocks but only 1.4% of listed numbers.
- Using Block Size 10+: eliminates 24.9% of blocks and 5.5% of listed numbers.
- Using Block Size 15+: eliminates 38.2% of blocks and 13.4% of listed numbers.
- Using Blocks Size 20: eliminates 52% of blocks and 25% of listed numbers—starting to result in substantial coverage bias.

These numbers will change based on geography and even demography. Raising the working block threshold will result in higher fielding productivity—but we cannot predict the impact on research results.

5. *Using Directory Listed (Published) Sample*

The sampling frame is households listed in the white pages of telephone directories, or available through Directory Assistance or directly from service carriers. Again, this methodology may not be representative of the universe being studied (51% of households), but it does provide fielding efficiencies, raising the working phone rate to a national average of 80%.

6. *Using Wireless/Mobile Sample*

As stated earlier, the number of households that have disconnected from the traditional wireline (landline) system continues to grow. There are challenges to fielding a wireless sample. However, with household cell phone penetration at 90% or better a wireless sampling frame is representative. There are fewer rate centers populated with more subscribers, when compared to the traditional telephone companies, resulting in a typical WPR of 60%.

The main challenges associated with dialing wireless sample are well documented and include cost (due to compliance with the TCPA); higher refusal rates; technology issues, such as dead zones and battery life; and integrity of the interview based on the respondent's environment.

7. *Choosing Directory Listed/Wireless*

There is growing support for using directory-listed sample combined with wireless/mobile (aka cell) phone sample. The directory listed sampling frame provides fielding efficiencies, and the wireless/mobile sample provides coverage of the demographic and geography pockets that are missing in the directory listed sampling frame.



8. *Combining Modes with Address-Based Sampling*

If time permits, using modified USPS delivery sequence files and appending name and telephone numbers where available provides a robust sampling frame. With this approach, mixed modes of contact (telephone/mail) are possible for at least half of the records. Alternatively, researchers can mail to the entire sample, allowing for mixed modes of response.

9. *Moving to Online or Mixed*

While online sampling is considered non-probability, it should be considered as an option when fielding efficiency is paramount over coverage. Researchers also may choose to combine online and offline to most efficiently reach specific audiences. This approach is particularly effective for B2B studies.

Conclusions

We are facing challenges. The landline working phone rate will continue to decline as the universe of eligible numbers continues to increase. The increasing popularity of cell phones and various non-residential uses of telephone numbers will continue to erode the incidence of residential telephone numbers in wireline frames. Using alternative sample designs such as listed frames, truncated frames or PPS sampling can improve working phone rates but at the expense of coverage and representation. Missing or underrepresented households may cause error; and to the extent that missing or underrepresented households are different, may introduce bias. These alternative sample designs, however, may meet some research objectives.

SSI continues to explore solutions and has released several enhancements in the past few years, including:

- An Enhanced Screener that identifies more disconnected numbers, saving time and cost in the field
- More business sources as part of our business number removal process
- Our Wireless sampling frame, released in 2007 and continually enhanced
- Our online Dynamix™ sampling platform, allowing for diverse sourcing of online respondents
- Our senior research and development team that is continuously experimenting with new sampling frames, including mixed mode to maintain coverage and improve efficiency

It is a challenging yet exciting time for research. There are no simple solutions. Each methodology has pros and cons to explore. There are always decisions to make, weighing coverage and efficiency against research objectives. SSI remains at the forefront of product and service innovations—and is dedicated to the science of sampling.

