Understanding Weighting in Public Opinion Poll

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Whenever opinion polls on Taiwan's elections or major public policies are released, news reports almost always include a brief note in small print at the end: "The survey results have been weighted by gender, age, educational attainment, and place of residence, based on the latest population statistics published by the Ministry of the Interior."

However, many members of the public, and even political commentators, remain skeptical of the weighted survey results. Some even believe that polling agencies can use weighting to adjust the data and manipulate the poll results.

In fact, weighting is not a means of manipulating data. It is a standard statistical adjustment procedure used to correct imbalances in sample composition. In modern public opinion research, combining random sampling before data collection with statistical weighting afterward allows polling agencies to manage fieldwork costs effectively while maintaining the principles of probability sampling. To understand how this technique is applied in Taiwan's polling industry, we first need to examine the choice of sampling methods and the practical constraints of Taiwan's telephone survey environment.

1. Why not simply set proportional targets when sampling (quota sampling)?

A common question is: "If we know that people aged 20–29 account for 15% of Taiwan's population, why not simply stop interviewing young people once they reach 15% of the sample? Why do we need to collect responses randomly first and adjust the data afterward?"

In statistics, this approach, in which interviews are discontinued once a predetermined target has been reached, is known as quota sampling. Professional polling agencies in Taiwan generally favor "unrestricted random sampling followed by post-survey weighting" over quota sampling for two key reasons.

a. Quota sampling undermines randomness and makes it impossible to calculate sampling error

True probability sampling requires that every individual in the target population has a known and controllable probability of being selected. Once quotas are imposed, however, as those who are more likely to answer incoming calls fill the quotas first, the probability of selection for other individuals in the same demographic group suddenly drops to zero. This artificial cut-off introduces substantial accessibility bias, undermining the statistical validity of the survey and its ability to support reliable population-level inferences.

b. In the era of computer-assisted telephone interviewing, quotas can actually increase costs and waste resources

Traditional textbooks often describe quota sampling as a more cost-effective approach. However, this view largely reflects the realities of the paper-and-pencil face-to-face interviewing era. In modern computer-assisted telephone interviewing (CATI), the marginal cost of automated dialing is extremely low. From an operational perspective, completing an interview whenever a call is answered is often the most cost-effective approach.

If age and gender quotas are imposed, interviewers may find themselves making as many as

30 calls toward the end of a project just to reach the final 5% of a hard-to-reach demographic group, only to discover that the quota has already been filled. This creates substantial wasted screening and dialing costs.

Therefore, polling agencies in Taiwan generally adopt the following approach when conducting nationwide landline telephone polls: taking advantage of the fact that landline area codes are naturally linked to administrative regions, they can conduct stratified random sampling by geographic area at a relatively low cost. No quotas are imposed on age, gender, or educational attainment; instead, every eligible respondent who answers the phone is interviewed. The sample is then weighted to align its distributions across geographic region, age, gender, and educational attainment with those of the overall population.

2. The reality: random dialing meets the disappearance of young respondents

Even when the sampling process is entirely random, landline telephone surveys still face a major structural challenge: the raw data consistently contain a disproportionately high number of older respondents, while younger people are seriously underrepresented.

There are two main reasons for this:

a. Non-response bias

Even in households with landline phones, younger people are often away from home or simply do not bother answering when the landline rings. As a result, the people who eventually pick up the phone are often retired or older household members. Some polling agencies use "within-household sampling", asking the person who answers the phone to pass it to a younger household member. However, this approach can be difficult to implement and still faces relatively high refusal rates.

b. Coverage error

Many university students, working professionals, and young families who rent accommodation away from their family homes no longer have landline phones installed. These individuals, commonly referred to as "mobile-only users", have zero probability of being selected from a landline-only sampling frame.

Because the raw sample is heavily skewed toward older age groups, survey results that are not adjusted for these imbalances will disproportionately reflect older people's opinions, making it difficult to represent the views of the population as a whole. This is why post-survey weighting has become an essential correction procedure.

3. How does weighting work? From raking to dual-frame sample integration

To ensure that the sample accurately reflects the actual demographic composition of Taiwan's population of approximately 23 million, modern opinion polls in Taiwan generally involve two levels of sophisticated weighting procedures.

a. Adjusting demographic composition: Iterative proportional fitting (raking)

Polling agencies use the latest household registration population statistics published by Taiwan's Ministry of the Interior as the benchmark and apply iterative calculations through statistical software.

For example, if women aged 20–29 account for 7% of the actual population but represent only 3.5% of the survey sample, the weight assigned to each respondent in this group needs to be doubled. Conversely, if people aged 65 and above account for 40% of the sample but only 20% of the actual population, the weight assigned to each older respondent needs to be reduced to 0.5.

Statistical software then repeatedly adjusts the weights across multiple dimensions, including geographic region, gender, age, and educational attainment, until the weighted sample distributions align with the corresponding population statistics published by the Ministry of the Interior.

b. Dual-frame sampling: Combining landline and mobile telephone samples

To address the problem of mobile-only users being excluded from landline surveys, leading polling agencies in Taiwan have increasingly adopted dual-frame sampling, which combines landline and mobile telephone sampling frames. However, this approach introduces another methodological challenge. Landline and mobile phones represent two separate sampling frames, and people who have both a landline at home and a personal mobile phone may be selected through either frame. How, then, should the two samples be combined appropriately?

Professor Yung-Tai Hung of the Department of Political Science at National Taiwan University has pointed out that simply combining landline and mobile samples using a fixed ratio, such as 1:1, or any other predetermined proportion, is methodologically unsound.

To address Taiwan's specific circumstances, Professor Hung and his research team proposed a more practical approach known as the "composite estimation method" (also referred to as the 'simultaneous equation method"). This approach combines the two datasets through post-stratification weighting based on the population distribution of different telephone user groups.

Step 1: Divide the population into three major telephone user groups

Before beginning the actual interview, interviewers ask respondents about their telephone ownership and usage. Based on their answers, respondents are classified into three groups:

(1) Landline-only users: Households with a landline phone but no mobile phone.

(2) Mobile-only users: Individuals who use a mobile phone but do not have a landline at home.

(3) Dual users: Individuals who have access to and use both landline and mobile phones.

Step 2: Combine the two datasets through post-stratification weighting based on the estimated population proportions of the three groups

Since Taiwan does not have an official population census specifically documenting telephone ownership and usage patterns, Professor Hung's research team used simultaneous equations to estimate the proportions of these three groups in the overall population. For example, landline-only users might account for approximately 10%, dual users 60%, and mobile-only users 30%.

When combining the landline and mobile datasets, weights are assigned according to the

estimated population proportions of these three groups. Respondents who belong to the dual-user group and were sampled through both frames are then combined and their weights adjusted accordingly. The resulting dataset is subsequently weighted against official population statistics for gender, age, and geographic region, among other demographic characteristics. In this way, two samples collected from different sources can be integrated into a single dataset that better represents the national population.

It should be noted that the above is a conceptual explanation of the sample integration process. In actual practice, there are different approaches to defining population groups, determining the order and number of weighting iterations, and calculating the proportions of dual users. There is currently no single universally accepted method.

Furthermore, Professor Hung's empirical research has also highlighted that although dual-frame weighting can substantially improve population coverage, mobile-only users tend to have higher refusal rates and may hold more polarized political views. If sample integration and weighting are not handled properly, the process may actually amplify estimation errors. Consequently, differences in how polling agencies integrate and weight dual-frame samples can lead to different statistical results, even when starting with the same raw survey data.

4. Weighting is not a cure-all: its limitations and trade-offs

a. Excessively high weighting factors give a small number of respondents disproportionate influence

Although weighting is a standard component of modern opinion polling, it is not a magic solution that can be applied without limits. In statistical terms, while stratified sampling before data collection can improve survey accuracy, excessively large weighting adjustments afterward can give a small number of respondents disproportionate influence over the final results, thereby increasing the overall sampling error.

For example, suppose a landline-only survey manages to interview just 10 young people, but their responses are assigned a weight of 10 to represent the views of young people across Taiwan. If just two of these 10 respondents hold relatively extreme views, their opinions could have a substantial impact on the overall survey results, potentially distorting the findings.

In practice, therefore, many polling agencies not only invest in more costly approaches, such as dual-frame landline and mobile sampling or within-household sampling, but also sometimes apply the concept of quotas to "sample allocation". For example, they may set minimum sample sizes for specific age groups or geographic regions to prevent the sample composition from becoming excessively skewed due to random variation. Combined with post-survey statistical weighting, this approach helps ensure that the final results retain a reasonable probability-based sampling foundation without becoming distorted by excessively high weighting factors.

b. The cost challenge of mobile sampling in individual counties and cities, and the bias associated with calling existing databases

However, when the survey coverage is narrowed from the national level to a single county or city, such as in mayoral or local legislative elections, mobile sampling faces a major cost challenge.

In Taiwan, mobile phone numbers beginning with 09 are used nationwide. Unlike landline numbers, whose area codes (such as 02, 04, and 07) can help identify geographic locations, mobile phone numbers provide no reliable indication of the county or city in which a respondent resides.

If a polling agency conducts a mobile-only random survey in Chiayi City or Hsinchu County, for example, 10 randomly generated calls may yield only one local resident, while the other nine respondents may live in different counties or cities and must be politely screened out. A screening failure rate of 80-90% can drive the cost of conducting a mobile-only poll in a single locality to an extremely high level.

To reduce fieldwork costs, some polling agencies instead use their existing internal databases when conducting local surveys. These lists typically consist of contact records accumulated from previous surveys, commercial marketing databases, or membership databases of specific organizations. Because the county or city of residence has already been recorded, calling these contacts is considerably more efficient.

However, people on these lists are often individuals who are more willing to participate in surveys or who have previously provided their personal information. As a result, these databases carry a clear selection bias and do not offer the representativeness of random sampling.

Since post-survey weighting can only adjust external demographic distributions, such as gender, age, educational attainment, and geographic region, it cannot change the fundamentally non-random nature of the original sampling source. Therefore, even after statistical weighting, the final results may still deviate from the actual preferences of local voters. This is one of the reasons why some local election polls produce results that differ from the actual election outcomes.

Conclusion

In summary, weighting is an essential tool that enables modern opinion polling to strike a balance between budget constraints and statistical accuracy. It can correct common age-related and contact-related biases in telephone surveys and help integrate results collected through dual-frame landline and mobile sampling.

However, the effectiveness of weighting ultimately depends on the rigor of the sampling process before data collection. Weighting can adjust demographic proportions, but it cannot replace genuine random sampling.

Understanding these basic principles allows us to approach different opinion poll reports with greater awareness, a more critical perspective, and a more objective understanding of what the results can and cannot tell us.

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