Master Sample of the National Integrated System for Household Surveys: review and discussion of update proposals

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Abstract *The use of Master Samples by statistics institutes is widely disseminated internationally. Master samples enable the optimization of the resources involved in research planning and execution, in addition to facilitating their operationalization. In addition, their use can also add quality to the estimation and analysis of information. The Brazilian Institute of Geography and Statistics (IBGE) carried out a project to reformulate its sample household surveys during the 2000s, in response to a growing demand for socioeconomic and demographic information from managers, researchers, and data users in general, and as a way to circumvent the limitation of financial and human resources available to conduct surveys. A new system was created in the following decade, whose methodology is based on the use of the Master Sample, which considered aspects of all surveys that would be part of the system. This article aims to detail what a master sample is and its advantages, briefly present the Brazilian context at the time of the implementation of the Master Sample, and present its different versions.*
Key words *Sampling, Household surveys, Master sample*

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Introduction

The main information available on the Brazilian population is generated from administrative records or from research carried out by the various State agencies responsible for depicting society. Of these, we can highlight the work of the National Institute of Educational Studies and Research Anísio Teixeira (*Instituto Nacional de Estudos e Pesquisas* – INEP) in the field of education, the Institute of Applied Economic Research (*Instituto de Pesquisa Econômica Aplicada* – IPEA) in the economic field, and the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* – IBGE) in the socioeconomic and demographic fields. For this article, the focus will be placed on household sample surveys carried out by IBGE, whose shared methodology is based on information and methodological advances resulting from the experiences of the Demographic Census.

The flagship of the household sample surveys conducted by IBGE is the Continuous National Household Sample Survey (*Pesquisa Nacional por Amostra de Domicílios Contínua* – PNAD Contínua), whose main goal is to provide information on the workforce and other socioeconomic information. The Household Budget Survey (Pesquisa de Orçamentos Familiares – POF), in addition to providing data on family consumption, is also the means by which the food security of Brazilians from different social strata can be assessed. Information on health, both physical and mental, as well as violence is collected by the National Health Survey (Pesquisa Nacional de Saúde – PNS) and the National Demographic and Health Survey (*Pesquisa Nacional de Demografia e Saúde* – PNDS).

These four surveys are part of the Integrated Household Survey System (*Sistema Integrado de Pesquisas Domiciliares* – SIPD) and share some methodological aspects, such as their sampling plans based on a Master Sample. This section will also provide an in-depth explanation of what a Master Sample is; the importance of understanding what this "Master Sample" is about; how it affects the estimates of studies that apply it for those who use its information and its advantages; as well as a brief presentation of the Brazilian context at the time of implementation of the SIPD and the first version of the Master Sample.

A Master Sample is, in simple terms, a sample from which subsamples can be taken for different surveys or for multiple rounds of the same survey[1-4]. The register used to remove such a sample also receives a name, called the Master Registry.

The use of Master Samples is recommended for developing nations[1], in addition to being common in countries that have large-scale household surveys in the periods between censuses[2], as is the case in Brazil. The Master Registry must be as complete, accurate, and updated as possible. It is generally created based on the most recent census, but it still requires periodic and regular updates so that the subsamples are able to reflect population changes that may have occurred between the censuses[2].

The application of Master Samples tends to optimize the production of statistics, facilitating operationalization[3] and reducing the cost of selecting a sample and preparing lists and maps for field agents[1,2]. This use also includes the potential for data integration of two or more applications of the Master Sample[2-5] and the potential for a faster response to unforeseen collection needs[2].

The reduction in the cost of the initial stages of surveys, in particular, is an attractive factor for national statistical institutes with limited resources, and is the main reason cited for the attempt to implement Master Samples by Statistics South Africa[6], the National Statistics Office of the Philippines[4] (current Philippine Statistics Authority), the Bangladesh Bureau of Statistics[5], and Statistics Canada[7], to name a few. Of these examples, South Africa, the Philippines, and Bangladesh were all successful, implementing their versions in 1998[6], 2003[4] and 2009[5], respectively. The Canadian Master Sample, in turn, was the subject of a pilot test in 2007; however, due to budget cuts during the research, it was considered a failure[7].

In Brazil, IBGE began a project to reformulate its household sample surveys during the 2000s, pointing to a growing demand for socioeconomic and demographic information from managers, researchers, and data users in general as its main motivation[3]. Combined with this factor, the amount of resources made available to conduct research failed to keep up with the intensity of these demands, a fact common to other institutes producing official statistics worldwide. The creation of the SIPD was then proposed, to be implemented during the subsequent decade[3].

The development of the SIPD incorporated thematic motivations, arising from specific gaps in the National Statistical System, such as the production of short-term indicators on work and income with national coverage. At the same time, there were also methodological motivations, such as the requirement for conceptual harmonization between research, as well as the optimization of resources involved in planning and executing research[3].

In the main text concerning the SIPD project, the IBGE outlined what it considered to be the advantages of adopting a Master Sample:

From a methodological perspective, the adoption of selection registers and shared sample designs stands out, elements that, in international experience, are widely used to optimize the production of statistical information about household units. In addition to the operationalization that is facilitated, when samples are drawn on the same infrastructure, advantages are added from the point of view of the quality of estimates, the analysis of information and the combination of information[3] (p. 11).

The IBGE Master Sample is planned based on information obtained from Demographic Censuses, and is supported by the Territorial Base (which contains all census sectors) prepared for each census. It thus follows that any methodological advances in the censuses will be reflected in the Master Sample, and subsequently, in household sample surveys.

Before characterizing the ways in which the Master Sample was designed in Brazil in its different versions (2000, 2010, and 2022), it is important to highlight that the number of documents to which this research had access was small. This fact is common in relation to technical texts on methodologies from several national statistical institutes, which remain restricted to internal communications, and needs to be debated in order to point out the difficulty of independent researchers to investigate such topics. Taking this into account, let us now turn our focus to describing the different versions of the Master Sample.

Master Sample 2000

The Master Sample was designed not to be the best possible sample for each of its surveys, but rather to be the best sample for the group as a whole, representing the main pillar of the SIPD methodology. Its creation, therefore, considered aspects of the research that would integrate the system, in particular the Continuous PNAD and the POF[8]. Other surveys were considered, but, due to budgetary reasons, were not carried out, such as a continuous version of the POF, a survey on victimization and the Urban Informal Economy Survey (*Pesquisa de Economia Informal Urbana* – ECINF).

The first step in designing a sample is defining its target population and geographic scope. For SIPD, the target population must encompass all target populations of all surveys, that is, all residents in all households belonging to the geographic coverage area defined by the census sectors used in demographic censuses[8].

For Master Sample 2000, the Geographic Operational Base 2000 was used, which is compatible with the 2001 municipal network for the entire national territory. These sectors also contained information on administrative divisions, population counts, among other sociodemographic characteristics obtained in the 2000 Demographic Census[3].

For operational reasons, and because they did not belong to the scope of IBGE household surveys at the time, some areas were excluded: military barracks, military bases, accommodations, squatter settlements, boats, penitentiaries, penal colonies, prisons, jails, asylums, orphanages, convents, and hospitals[8].

Based on this list, totaling 214,836 census sectors (983 sectors in the excluded areas), the primary sampling units (PSUs) were defined, that is, the units that were selected from the Master Registry. In general, for this type of research, these PSUs are defined by area units with a certain minimum population size. The PSU cannot be undersized so as to guarantee a sufficient number of households or people, but it must also not be oversized, as this would decrease the total number of PSUs. The census tracts were chosen as PSUs due to their large number and sizes which, at least on average, are sufficient, in addition to allowing a greater spatial dissemination of the sample[8].

The sectors were then stratified, that is, divided into subpopulations from which independent samples were taken to obtain the Master Sample. This stratification makes it possible to guarantee valid estimates for different dissemination domains, that is, to guarantee that enough elements will be removed from each stratum in order to obtain statistics not only for the set as a whole, but also for each partition, thereby controlling the precision of the estimates.

Four stratification stages were defined: stratification by administrative division; geographic and spatial stratification; stratification by sector situation; and statistical stratification.

The main IBGE surveys provide results for the Brazilian states, each being treated as a stratum. Within each state, the municipalities were also classified into:

1. Capital;

2. Other municipalities belonging to Metropolitan Regions (MRs) or Integrated Development Regions (IDRs);

3. Municipalities belonging to IDRs with headquarters in another state; and

4. Other municipalities in the state.

After classification by administrative division, we then move on to geographic and spatial stratification. In group 1, a spatial stratification method was applied to classify the 2000 Census weighting areas, based on the average income of those responsible for households and the unemployment rate. In group 2, the same method was applied to classify the municipalities, also including demographic density and the proportion of people employed in agricultural activities[4]. For the municipalities in group 3, the grouping took place by geographic strata, based on the divisions into mesoregions and microregions, and knowledge derived from other research conducted by the IBGE Geosciences Department (*Diretoria de Geociências*).

Creating strata so that they are homogeneous increases the precision of estimates, while considering spatial aspects "allows for the allocation of permanent teams in each of these regions, streamlining and enabling greater control of field operation activities, in addition to reducing costs of displacement between sample units"[8] (p.15).

Stratification by situation derives from the strata resulting from previous stages and divides them, when possible, into urban and rural. In the end, 144 urban and 124 rural strata were obtained[8].

Statistical stratification was historically present in POF samples, one of the reasons why it was incorporated into the Master Sample design. For the previous strata, other strata were created based on the total income of those responsible for the households, a variable chosen after studies on its use and/or the unemployment rate[8]. In the end, the size of the 2000 Master Sample was 12,800 sectors for each quarter[9].

To avoid burdening the informant, it was defined that a household will only be selected for the sample of a survey if it has not participated in the sample of any survey for at least one year and if it has participated in the Continuous PNAD, only after ten years[10].

A process of updating the Master Registry was also planned in an attempt to completely renew the sample at the end of 10 years (40 quarters), replacing 2.5% of the sectors each quarter in the PSUs, which will undergo a rotation of the household sample in the Continuous PNAD (described in the next section)[10]. In this sense, the Master Sample for a given year would consist of the sectors selected for the first quarter plus the sectors selected to be substitutes in the following three quarters[8].

The 2008-2009 POF based its sampling plan on the previous round of the same survey (2002-2003), most notably to ensure comparability between surveys, but with the difference being the use of the Master Sample, with a subsample of around 40% of sample. The dissemination domains present in the Master Sample stratification that did not serve the scope of the research were grouped without losing the characteristics of the original stratification[9,11].

In 2008, the Master Sample was applied in the Survey of Ethnic-Racial Characteristics of the Population (*Pesquisa das Características Étnico-Raciais da População* – PCERP), which, in its sampling plan, selected only elements from the Master Sample in the geographic area of five states – Amazonas, Paraíba, São Paulo, Rio Grande do Sul, and Mato Grosso – and the Federal District[12]. A third round of the Urban Informal Economy Survey (carried out in 1997 and 2003) was also scheduled for 2008, but was not conducted.

Master Sample 2010

After the research mentioned in the previous section, as well as the tests for the Continuous PNAD in 2009, the suitability of the Master Sample for the SIPD can be assessed. Based on the updated sector network and data from the 2010 Census, a new Master Sample was designed, with some changes in relation to the previous planning, incorporating some adjustments deemed to be necessary to the design[10].

An initial change was the exclusion of census sectors classified as indigenous villages and agricultural villages from rural settlement projects, in addition to the other types already excluded in the previous version. Census sectors located on indigenous lands[10] were also excluded.

Another change related to the Geographic Operational Base was the need to add census sectors to construct the PSUs, ensuring that they had enough households to meet the demands of different surveys[10]. The minimum size of the PSUs was at least 60 permanent private households (PPHs), based on several factors related to the Continuous PNAD, such as the sample rotation scheme, the average length of stay in the sample, and the size of the household sample in each PSU in the Continuous PNAD[9].

Aggregation was performed to maximize the number of groups, bringing together as little as

possible, with restrictions on contiguity, minimum size, and characteristics of the sectors, taking into account subsequent stratifications. Of a total of 316,574 census sectors, 310,329 were part of the Master Sample and were grouped into 292,067 PSUs[10].

The stratification of PSUs in the new Master Sample was defined with minor changes in relation to the 2000 Master Sample. In the stratification by administrative division, the groups were redefined:

1. Capital;

2. Other municipalities belonging to MR or IDR;

3. Municipalities belonging to the belt or metropolitan expansion or to another MR;

4. Municipalities belonging to IDRs with headquarters in another state and

5. Other municipalities in the state.

In the geographic and spatial stratification stage, there was a change in the group of capitals, taking into account the internal divisions of the municipality, such as district, sub-district, and neighborhood, no longer using the weighting areas. The other groups were stratified following the same criteria as in the previous version[10].

The stratification by household situation did not change in its definition, only an update of the sectors that changed from rural to urban between one census and another.

After testing the Master Sample 2000, the planning stage that underwent the most testing was the final stage: statistical stratification. One interesting study measured the efficiency of this stratification over time. This test concluded that stratification continued to provide improvements in the accuracy of estimates even with a distance of 10 years between planning and data collection. Stratification began to use the variables of total household income (no longer only those responsible for the household) and total PPHs. Some situation strata were not divided into statistical strata because they were not large enough[10].

Master Sample 2010 was applied several times, in particular for the Continuous PNAD, which greatly influenced its design, mainly in the size of the Master Sample, which is used completely in each quarter of the survey, although only a fixed number of households from each PSU (14) is selected in a second selection stage[9].

The Continuous PNAD has a sample rotation scheme designed to avoid overloading informants and thus increase the response rate. After several comparisons between alternative schemes[10], it was decided to use scheme 1-2(5),

that is, the household is interviewed in one month and leaves the sample for two subsequent months, returning until it completes five visits[13]. This scheme enables a longitudinal comparison, with an expected overlap of 20% of the sample from one quarter to the same quarter of the following year[10], as well as the existence of a batch of new households corresponding to 20% of the sample from one quarter[14].

The PNS was applied in the field for the first time in 2013, using a subsample of the Master Sample, with a minimum sample size of 1,800 households per state, enabling the estimation of nine indicators with the desired precision at the state level, while the others maintained a lower level of precision, although still at acceptable levels[9]. The second edition of the PNS carried out in 2019 had a larger sample size than the previous edition, based on the precision obtained from the 2013 estimates[16].

The 2017-2018 POF used the same sampling plan as the previous 2008-2009 edition, with the difference of using a subsample from the new version of the Master Sample, with its new registry of census sectors as defined for the 2010 Census[17].

Master Sample 2022

Among all the sections of this article, this is the one that lacks the most sources, being based only on the summary and presentation of the work "Process of renewal and transition of the Master Sample of the Integrated Household Survey System (SIPD) of IBGE" by Viviane Quintaes and Gabriel Assunção for the VI School of Sampling and Research Methods (VI ESAMP), congress held between November 16 and 18, 2023. It is important to be careful when reading this section, as different proposals are presented here that were still under study while writing this article.

Two sets of proposed changes to the Master Sample 2010 were presented, one focused on changing the stratifications (Chart 1), while the other was related to the transition to the new Master Sample. In addition to other issues that will be analyzed in more detail later, we can highlight a concern in the integration of information produced by IBGE itself after the implementation of the 2010 Master Sample, such as urban concentrations (CURB, presented in 2016[18]), intermediate, and immediate geographic regions[19] and the results of the 2022 Demographic Census.

We will now analyze these proposals for changes in stratifications in the order presented

in Table 1. The substitution between metropolitan regions and urban concentrations is not the only proposal related to the stratification of municipalities, with an option to consider both MRs and CURBs, as well as another option to maintain only the MRs, which is also being studied by IBGE, each with its own advantages and disadvantages (Chart 2).

In addition to there being differences between the metropolitan regions included in the 2010 Master Sample and those that currently exist, there are also divergences between some CURBs and MRs, with CURBs from four states having municipalities that are not included in the respective metropolitan regions, namely: Acre (does not include Rio Branco), Pernambu-co (does not include Paudalho), Rio de Janeiro (does not include Mangaratiba or Saquarema), and Sergipe (does not include Carmópolis, Divina Pastora, General Maynard, Laranjeiras, Maruim, Riachuelo, Rosário do Catete, or Siriri). An example of the differences in the municipalities that make up the different groupings can be seen in Chart 3.

The geographic and spatial stratification was proposed to adapt to the new IBGE division into immediate and intermediate regions, introduced in 2017, replacing the mesoregions and microregions initially proposed in 1989. The stratification of the scenario had the urban regions divided into two categories: special urban, representing favelas and urban communities, and non-special urban,

Chart 1. First set of proposals being studied for stratifications.

	Current sample	**New sample**
Stratification of municipalities	Considering the administrative divisions: 1. Capital 2. IDR or MR 3. Belt or metropolitan expansion or other MR in the state 4. IDR headquartered in another state 5. Rest of the state	Considering information on urban concentration: 1. Capital 2. CURB regions in the surrounding vicinity of the capital 3. other CURBs 4. CURB municipalities in another State 5. Other municipalities in the State
Geographic and spatial stratification	Groups of municipalities considering: Capital, MR/IDR, mesoregion, microregion.	Groups of municipalities considering: Immediate and intermediate regions
Stratification by situation	Urban and rural	Special urban, non-special urban, and rural
Statistical stratification	Income	Other variables beyond income

Source: Authors, adapted from Quintaes and Assunção[20].

Chart 2. Favorable and unfavorable points for the proposal to change the strata of municipalities.

	Favorable points	**Unfavorable points**
Considering MR and CURB	Would meet everyone's demands	Greater complexity in sample planning Difficulty in obtaining separate estimates for each subgroup
Considering only MR	Represents the majority of urban concentrations Would meet the demand of most CURBs efficiently Relevant role for national policies	Exact comparability with the past will not be possible due to changes in the territorial profile
Considering only CURBs	More stable and leaner than MRs Aligned with the 2022 Census, which also released data by CURB	No comparison with the past It would have to be linked to the CURB of 2016, based on data from the 2010 Census

Source: Authors, adapted from Quintaes and Assunção[20].

Chart 3. Differences in the metropolitan regions of the Master Samples 2010 and 2022, and the urban concentration of Rio de Janeiro.

Municipality	Metropolitan region PNADC	Metropolitan region 2022	Urban concentration
Belford Roxo	X	X	X
Duque de Caxias	X	X	X
Guapimirim	X	X	X
Itaboraí	X	X	X
Itaguaí	X	X	X
Japeri	X	X	X
Magé	X	X	X
Maricá	X	X	X
Mesquita	X	X	X
Nilópolis	X	X	X
Niterói	X	X	X
Nova Iguaçu	X	X	X
Paracambi	X	X	X
Queimados	X	X	X
Rio de Janeiro	X	X	X
São Gonçalo	X	X	X
São João de Meriti	X	X	X
Seropédica	X	X	X
Tanguá	X	X	X
Cachoeiras de Macacu		X	
Petrópolis		X	
Rio Bonito		X	
Mangaratiba			X
Saquarema			X

Source: Authors, adapted from Quintaes and Assunção[20].

for other urban households[20]. This proposal implies an expansion of dissemination areas to also cover favelas, making it possible to produce regular information about these territories.

Unlike other stratifications, statistical stratification is related to the precision of the estimates and not to the different estimation domains, which avoids issues related to possible breaks in the historical series. Still, this stratification also needs many studies, so that the balance between parsimony and precision can be found.

According to sampling theory, stratification does not generate a loss of precision: either precision does not change or it increases with stratification[21]. Thus, in theory, it would be possible to include infinite variables to obtain gains in the precision of estimates. However, the more a finite population is partitioned, the fewer individuals are part of each of the divisions, and, as mentioned previously, the different sectors of the Master Sample must have a minimum number of households. The aim of statistical stratifica-

tion is, therefore, to achieve the greatest gain in precision, with the smallest number of variables possible, which raises the need to study various combinations of variables.

The other set of proposals to change the Master Sample through a transition is to merge the new sample with the current one throughout 2025, gradually, until the 2026 Master Sample is completely renewed: the sample for the first quarter of 2025 would be of 80% of the current sample and 20% coming from the new sample, the second quarter would be made up of 60% of the current sample and 40% of the new sample, and so on until the first quarter of 2026, with 100% of the new sample[20].

This proposal would imply an optimization of resources and avoid an abrupt interruption in estimates, thereby avoiding significant changes. On the other hand, considering the two registries as independent creates the possibility of the same sector being in more than one different interview in a quarter. Furthermore, more studies are need-

ed to verify how estimates from two independent registries will be obtained and ensure their comparability.

Considering all the proposals, the institute's care is noted in ensuring an update of the Master Sample with the least impact on the regular production of statistics, and with an improvement in their precision. Also important is the proposal to incorporate favelas and urban communities as their own stratum, which would allow their integration into the set of regular dissemination domains, which would in turn provide necessary information for the implementation of and follow-up on various public policies.

Collaborations

All authors participated equally in all stages of the article.

References

1. Petersson H. *Household sample surveys in developing and transition countries: design of master sampling frames and master samples for household surveys*. United Nations Statistics Division; 2005.

2. Turner AG. *Sampling frames and master sample*. United Nations Statistics Division; 2003.

3. Hypólito EB, Quintsler MMM. *Sistema Integrado de Pesquisas Domiciliares: SIPD*. Rio de Janeiro: IBGE; 2007.

4. Barcenas ML. The Development of the 2003 Master Sample (MS) for Philippines Household. In: *Proceedings of the 9th National Convention on Statistics*. Manila; 2004.

5. Maligalig DS, Martinez Jr A. Developing a master sample design for household surveys in developing countries: a case study in Bangladesh. In: *Survey Methods: Insights from the Field* 2013; DOI: 10.13094/SMIF-2013-00009

6. Daniels RC. A framework for investigating microdata quality, with application to South African labour market household surveys. In: Daniel RC. *How data quality affects our understanding of the earnings distribution*. Singapore: Springer; 2022. p.7-36.

7. Tombay JL, Laflamme G, Gambino J. The Canadian experience in creating a master sample. In: *Proceedings of the 57th Session of the International Statistical Institute*. Durban; 2008.

8. Freitas MPS, Lila MF, Azevedo RV, Antonaci GA. *Amostra Mestra para o Sistema Integrado de Pesquisas Domiciliares*. Rio de Janeiro: IBGE; 2007.

9. Bianchini ZM, Albieri S. *Principais aspectos de amostragem das pesquisas domiciliares do IBGE – revisão 2015*. Rio de Janeiro: IBGE; 2015.

10. Freitas MPS, Antonaci GA. *Sistema Integrado de Pesquisas Domiciliares. Amostra Mestra 2010 e Amostra da PNAD Contínua*. Rio de Janeiro: IBGE; 2014.

11. Instituto Brasileiro de Geografia e Estatística (IBGE). *Pesquisa de orçamentos familiares 2008-2009: tabelas de composição nutricional dos alimentos consumidos no Brasil*. Rio de Janeiro: IBGE; 2011.

12. Instituto Brasileiro de Geografia e Estatística (IBGE). *Características étnico-raciais da população. Um estudo das categorias de classificação de cor ou raça*. Rio de Janeiro: IBGE; 2011.

13. Instituto Brasileiro de Geografia e Estatística (IBGE). *Pesquisa nacional por amostra de domicílios: notas metodológicas*. Rio de Janeiro: IBGE; 2014.

14. Coêlho SC. *Consistência das respostas individuais da Pesquisa Nacional por Amostra de Domicílios Contínua sobre as condições de ocupação no mercado de trabalho brasileiro* [dissertação]. Rio de Janeiro: ENCE; 2021.

15. Instituto Brasileiro de Geografia e Estatística (IBGE). *Pesquisa nacional de saúde 2013: indicadores de saúde e mercado de trabalho*. Rio de Janeiro: IBGE; 2016.

16. Instituto Brasileiro de Geografia e Estatística (IBGE). *Pesquisa nacional de saúde 2019: informações sobre domicílios, acesso e utilização dos serviços de saúde*. Rio de Janeiro: IBGE; 2020.

17. Instituto Brasileiro de Geografia e Estatística (IBGE). *Pesquisa de orçamentos familiares 2017-2018: primeiros resultados*. Rio de Janeiro: IBGE; 2019.

18. Instituto Brasileiro de Geografia e Estatística (IBGE). *Arranjos populacionais e concentrações urbanas do Brasil*. Rio de Janeiro: IBGE; 2016.

19. Instituto Brasileiro de Geografia e Estatística (IBGE). *Divisão regional do Brasil em regiões geográficas imediatas e regiões geográficas intermediárias*. Rio de Janeiro: IBGE; 2017.

20. Quintaes V, Assunção G. Processo de renovação e transição da Amostra Mestra do Sistema Integrado de Pesquisas Domiciliares (SIPD) do IBGE [Internet]. 2023. [acessado 2024 fev 8]. Disponível em: https://proceedings.science/vi-esamp/trabalhos/processo-de-renovacao-e-transicao-da-amostra-mestra-do-sistema-integrado-de-pesq?lang=pt-br

21. Bolfarine H, Bussab WO. *Elementos de amostragem*. São Paulo: Editora Blucher; 2005.