



## Overview

### 1. Sample designs and principles

Common methods  
IPUMS data collection

### 2. Some practical considerations

Sample size  
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## Overview

### 1. Sample designs and principles

Common methods  
IPUMS data collection

### 2. Some practical considerations

Sample size  
Creating an expansion factor

### 3. Hands-on examples

Common methods  
Creating an expansion factor

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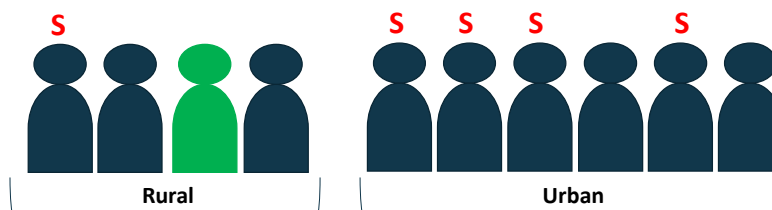
# Sample designs and principles

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## Common sampling methods - SRS

- **Simple random sampling**
  - Easy to implement.
  - Specific groups/traits may not be present in the sample.



Select randomly 1-in-2 records

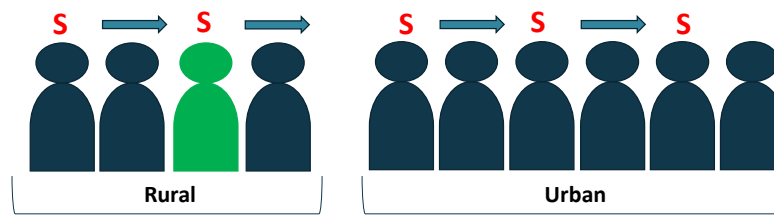
IPUMS  
INTERNATIONAL

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## Common sampling methods - Systematic

- **Systematic sampling**

- Easy to implement.
- Sample more evenly assigned along the population.
- Problematic if selection coincides with a periodic characteristic/trait.



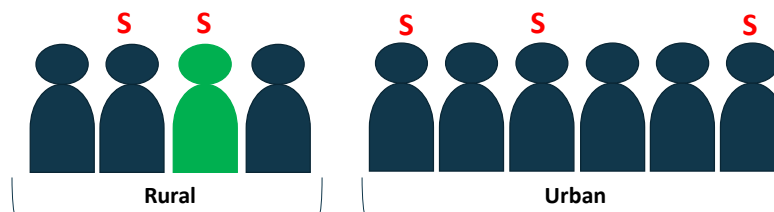
Select systematically 1-in-2 records

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## Common sampling methods - Stratified

- **Stratified sampling**

- More complex, but better representation of subgroups/strata within the population.
- Within strata, selection can be random or systematic.



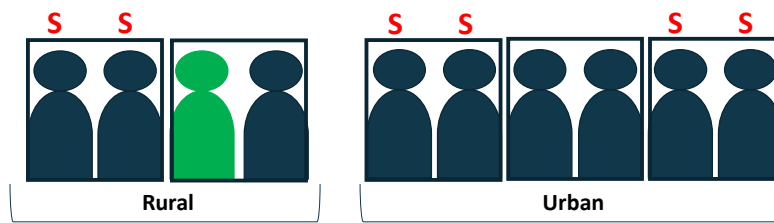
Select 1-in-2 records within urban/rural

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## Common sampling methods - Cluster

- **Cluster sampling**

- More complex, but depends on availability of “equivalent” clusters.
- Usually recommended to reduce data collection costs.



Select randomly 3-in-5 clusters

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## Sampling in IPUMS International (1)

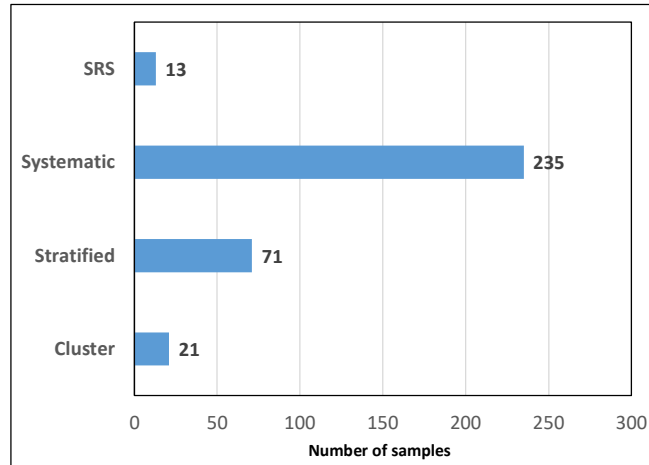
- Total of **400 census samples** and **147 surveys** (population or LFS)
- How were the samples created?
  - Public use files.
  - Long-form questionnaire.
  - Ad-hoc sample drawn by the NSO or IPUMS.
- Sample fraction: **~9.5%** for census (2.3 million persons!) \*
- Selection of entire households with all their person records
- Average: **3.7 samples per country**, covering about 30 years \*

\* Only post-1950 censuses, excludes surveys

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## Sampling in IPUMS International (2)

### IPUMS International: Sampling method for post-1950 censuses



Note: Count of cluster samples overlaps with other methods.



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## Hungary: Population and Housing Census 2011

EUROPEAN CENSUS DATABASE	UNIT DATA
Population, thousand people	9,938
Number of households, thousand	4,106
Number of families, thousand	2,713
Housing stock, thousand units	4,390

<https://www.ksh.hu/nepszamlalas/?lang=hu>



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## Hungary: Population and Housing Census 2011

The screenshot shows the website interface for the 2011 Hungarian census. The main navigation bar includes 'OPENING PAGE', 'DATA', 'PUBLICATIONS', 'ABOUT THE CENSUS', and 'DATA PROTECTION'. The 'DATA' section is active, displaying a list of categories under 'DETAILED INFORMATION'. The selected category is 'User information about the census microdata file for educational purposes'. The page content includes an introduction to the microdata file, its purpose for educational institutions, and a list of available files with their sizes and descriptions. The URL [https://www.ksh.hu/nepszamlalas/oktatasi\\_mikroadat](https://www.ksh.hu/nepszamlalas/oktatasi_mikroadat) is displayed at the bottom.

**népszámlálás 2011**

OPENING PAGE | DATA | PUBLICATIONS | ABOUT THE CENSUS | DATA PROTECTION

**DETAILED INFORMATION**

- Characteristics of family types
- Demographic data
- Employment, unemployment, commuting
- Daily commuting and transportation of employees
- People with disabilities
- The situation of people with disabilities and their social care
- Living conditions of households and families
- Education data
- Apartments and their residents
- Housing conditions
- Nationality data
- Economic activity of the population
- Education of the population
- Stratification of society
- Religion, sect
- Data of the individual parliamentary constituencies

**User information about the census microdata file for educational purposes**

KSH aims to continuously monitor new user needs and satisfy them as quickly and to the greatest extent as possible. Today, there is a growing demand for microdata files from our recordings. "Raw" communication of such files is not possible for data protection reasons, therefore either the range of users and the place of use must be very precisely defined, and then the research results must be subject to a data protection control, or the microdata files must be anonymized to such an extent that, despite their wide availability, they do not allow the identification of our data providers or the disclosure of some of their characteristics.

Since 2007, the KSH has been providing research opportunities for scientific purposes on detailed microdata files that are not suitable for direct identification in the central research room of the KSH. To start research, you must have a research plan and a scientific background.

As the first step in opening up to a wider range of users, in March 2014 we published the so-called *test files*. Although these files can be freely downloaded by anyone, the target users are researchers who wish to analyze the census files in a secure environment (research room access, remote access, remote execution). The test files are intended to facilitate the preliminary writing and testing of program files, and are not suitable for analysis or research purposes.

The microdata file for educational purposes was also created from the data file of the 2011 census. It can primarily be used by educational institutions during statistics courses, but we recommend it to all those who want to get acquainted with statistical methods in practice.

The stock

- 10,000 records - approx. A selection rate of 1‰ (one in a thousand) - and
- 13 variables

contain. The definition of the variables and the nomenclatures are contained in the `oktatasi_mikroadat_rekordleiras.xls` file, and the sampling methodology and limitations of usability can be found in the `oktatasi_mikroadat_modszertan.pdf` document.

- Terms of Use for Public Microdata Files (399kB)
- Methodological documentation of the educational microdata file from the 2011 census (696 kB)
- Educational census microdata file (1,135 kB)
- Record descriptions and code lists (41 kB)

[https://www.ksh.hu/nepszamlalas/oktatasi\\_mikroadat](https://www.ksh.hu/nepszamlalas/oktatasi_mikroadat)

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## Hungary: Population and Housing Census 2011

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**népszámlálás 2011**

OPENING PAGE | DATA | PUBLICATIONS | ABOUT THE CENSUS | DATA PROTECTION

**DETAILED INFORMATION**

- Characteristics of family types
- Demographic data
- Employment, unemployment, commuting
- Daily commuting and transportation of employees
- People with disabilities
- The situation of people with disabilities and their social care
- Living conditions of households and families
- Education data
- Apartments and their residents
- Housing conditions
- Nationality data
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- Education of the population
- Stratification of society
- Religion, sect
- Data of the individual parliamentary constituencies

**TERITORIAL DATA**

- National data
- Budapest

**User information on census test files**

The researchers using the KSH research room had a legitimate demand that they should not have to write and test the program codes necessary to carry out the work in the research room in the research room, but that they should be able to write them in advance at home or in the research institutes, and in the KSH research room they could just run the pre-programmed code, written program codes.

In response to this demand, the KSH prepared, first from the 2011 population census files, the so-called test files.

With the test files, the researcher interested in the 2011 census no longer has to collect the technical information (names of variables, types of variables, set of values, missing data, etc.) needed to write the program code in the research room. The test files contain these just like the production files: among other things, they also have the complete set of variables of the production files. Consequently, they are perfectly suitable for writing and preliminary testing of program code. In the test files, the individual variables take real values corresponding to the set of values of the production file.

Test files are files in which individual records are fictitious: they contain data of non-real people. The logical connections between the variables are not fulfilled either (e.g. they may include a doctor with a primary school education with the identifier of Fejér County, but with the identifier of a settlement in Budapest, etc.). This means that the stocks are not representative of any variable (e.g. region, county, etc.).

It follows from all of this that the test files are completely unsuitable for analysis and research purposes, and for drawing meaningful conclusions, they are only intended to assist in the preparation of program files.

However, the program code written in advance based on the test files can also be run on the live files in the research room, the results obtained from it are of course already suitable for drawing real conclusions and formulating empirical correlations.

**Attention!** The results of the stratification study conducted on the basis of the 2011 census data were presented in the analytical publication *The stratification of society*. In order for researchers to be able to investigate based on their own criteria, the 10% population census sample available in the Research Room was supplemented with the stratum variables according to the three types of stratification scheme. The record description and public test files have been updated.


- Personnel public microdata file (1,974 kB)
- Family file public microdata file (262 kB)
- Household file public microdata file (332 kB)
- Apartment file public microdata file (313 kB)
- Record descriptions and code lists (696 kB)

<https://www.ksh.hu/nepszamlalas/tesztallomanyok>

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## Hungary: Population and Housing Census 2011



**HUNGARIAN  
CENTRAL  
STATISTICAL  
OFFICE**

Pressroom   Contact   Hungarian

Themes
Data, publications
Services
Methodology
Classifications
Data Collection
About

**Research room**

For the purpose of scientific research of statistical data, a Research room has been created where the access to anonymised microdata is provided in strict compliance with the high-level protection of individual data and the rules of data protection. Services of the Research room are available only after the Research room contract and the Confidentiality declaration were signed.


**The following topics can be currently researched:**

- a 5-percent anonymised sample from the 2001 census
- a 10-percent anonymised sample from the 2011 Census
- the dataset of the 2005 microcensus
- Labour Force Surveys 2003-2013
- Household Budget and Living Conditions Surveys 2005-2013
- Farm Structure Survey-EUOFARM datasets for 2003, 2005, 2007, 2010

If the above topics do not fully correspond to a certain research purpose, on the basis of a separate agreement, the researcher may ask for producing a special dataset meeting his/her requirements and ensuring access to it in the Research room.

The demand for research can be initiated by completing the research application form, which will be judged by the department competent in the topic. If the data request is problematical, the research purpose is not justified or doubts arise over the reliability of the researcher(s) named in the application, the request will be refused.

[https://www.ksh.hu/research\\_room\\_tart](https://www.ksh.hu/research_room_tart)



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## Hungary: Population and Housing Census 2011, Sample


- **Public use file** (scientific research of statistical data) \*
- **Sample fraction:** 5%
- **Sample design:**
  - One stage SRS of dwellings (and all associated person records).
  - Plus a SRS of persons in institutions and homeless persons.
  - Self-weighting (expansion factor = 20).

\* *Sample drawn to be included in IPUMS*


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# Colombia: General Census 2005 at NADA



ARCHIVO NACIONAL DE DATOS



INFORMACIÓN PARA TODOS

PÁGINA PRINCIPAL / CATÁLOGO CENTRAL DE DATOS / MICRODATOS / DANE-DCD-CGRAL-2005

MICRODATOS

Identificación

Alcance

Cobertura

Productores patrocinadores

## Censo General 2005

**Colombia, 2005 - 2006** Demografía y población. Microdatos - DANE

Dirección de Censos y Demografía - DCD

Creado el **September 25, 2017** Última modificación **September 25, 2017**
● Visitas a la página 1.223.717
● Descargar 855.370
📄 Documentación en PDF

📄 metadata
ODI/XML
JSON

Descripción de la operación estadística
Materiales Relacionados
Diccionario de Datos
➔ Obtener Microdatos

### Identificación


**Idno**  
DANE-DCD-CGRAL-2005

<https://microdatos.dane.gov.co/index.php/catalog/421>




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# Colombia: General Census 2005 at NADA



ARCHIVO NACIONAL DE DATOS



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● Descargar 855.375
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📄 metadata
ODI/XML
JSON

Descripción de la operación estadística
Materiales Relacionados
Diccionario de Datos
➔ Obtener Microdatos

### Archivos de datos

Hogares_rural	<b>Long form</b>	📄 Descargar [ZIP, 13.44 MB]
Personas1_rural	<b>(persons,</b>	📄 Descargar [ZIP, 160.93 MB]
Personas2_rural	<b>households,</b>	📄 Descargar [ZIP, 128.63 MB]
Personas3_rural	<b>dwelling)</b>	📄 Descargar [ZIP, 154.32 MB]



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## Colombia: General Census 2005 at NADA



### *Sample methodology:*

- Sample design
- Sample sizes
- Expansion factors and calibration
- Estimation using the sample


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## Colombia: General Census 2005, Sample

- *Long-form sample*
- *Sample fraction:* ~20% (overall), varies according to municipality size
- *Sample design:*
  - One stage stratified sample, with Bernoulli selection of households (selection in real time during data collection operation).
  - Strata: municipality capital versus rest, locality/commune in large cities.
  - Not self-weighting, depends on sample fraction by strata.
- *Representativeness:* locality/commune with population of 150,000+ persons in large cities, municipality capital versus rest, 1<sup>st</sup>-2<sup>nd</sup> levels of administrative geography, and national level.

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## Mexico: Population and Dwelling Census 2010



[English](#) [Otros idiomas](#) [Contacto](#) [+A](#)

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Temas
Programas de información
Sistemas de Consulta
Infraestructura
Acerca del INEGI

Buscar... Enviar

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Inicio / [Programas de información](#) / Censo de Población y Vivienda 2010

### Subsistema de Información Demográfica y Social

Censos y Censos

Censos y Censos de Población y Vivienda

2020


2010

2005 (Censo)

2000

1995 (Censo)

#### Censo de Población y Vivienda 2010


 Del 31 de mayo al 25 de junio se realizó el Censo de Población y Vivienda 2010 en el que más de 108 mil entrevistadores, recorrieron todo el país con el propósito de visitar cada vivienda y hacer algunas preguntas sobre éstas y sus ocupantes.


**Nota:** Derivado de la sentencia emitida por el Pleno de la Suprema Corte de Justicia de la Nación respecto a la Controversia Constitucional 41/2011, se publican, con fecha 26 de junio de 2013, todos los resultados del Censo de Población y Vivienda 2010 para los municipios de Tultepec, Nextlalpan y Tlaxiácala, estado de México.

[Ver más presentación](#)

Documentación
Tabulados
Microdatos
Datos abiertos
Publicaciones
Herramientas

En cumplimiento con lo dispuesto en el [marco regulatorio](#), el INEGI proporciona varias formas de acceso a los microdatos, así


<https://www.inegi.org.mx/programas/ccpv/2010/>



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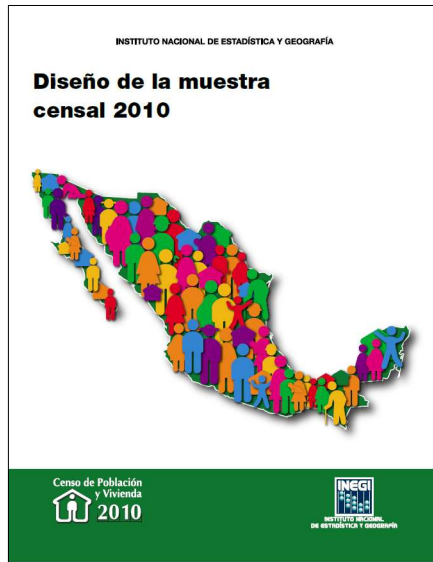
## Mexico: Population and Dwelling Census 2010

Título ↓	Periodo ↓	Formatos
⊖ Censo (cuestionario básico)		
<b>Short form (examples)</b>		
⊕ Bases de datos (ejemplos)		
⊖ Documentación de la base de datos		
Descripción de la base de datos	2010	<span style="background-color: #0070C0; color: white; padding: 2px 5px;">XLS</span> 80.5 KB
<a href="#">Clasificaciones</a>		
Integración General de Localidades (CIGEL)	2010	<span style="background-color: #0070C0; color: white; padding: 2px 5px;">DBF</span> 3.61 MB
⊖ Muestra (cuestionario ampliado)		
<b>Long form</b>		
⊕ Bases de datos		
⊖ Documentación de la base de datos		
Introducción	2010	<span style="background-color: #C00000; color: white; padding: 2px 5px;">PDF</span> 70.6 KB
Descripción de la base de datos	2010	<span style="background-color: #0070C0; color: white; padding: 2px 5px;">XLS</span> 142 KB
Diseño de la muestra censal	2010	<span style="background-color: #C00000; color: white; padding: 2px 5px;">PDF</span> 2.07 MB



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## Mexico: Population and Dwelling Census 2010



### *Sample methodology:*

- Sample design (population, sampling units, sampling frame)
- Stratification
- Sample sizes and selection
- Expansion factors
- Estimation using the sample

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## Mexico: Population and Dwelling Census 2010, Sample

- *Long-form sample*
- *Sample fraction:* ~10.6% (overall), varies according to municipality size
- *Sample design:*
  - One stage stratified cluster sample.
  - Strata: three groups of municipalities by size (<1.100, 1.100-4.000, >4.000 dwellings) combined with locality size within municipality.
  - Clusters: Group of dwellings in a locality selected by SRS within strata.
  - Not self-weighting, depends on sample fraction by strata.
- *Representativeness:* localities with 50,000+ persons, municipality, state by locality size (4 categories), state, and national.

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## Mexico: Population and Dwelling Census 2010, Sample

### Mexico 2010 Census: Sample size by municipality classification

Municipality classification		Dwellings in the sample	Total municipalities
Municipalities with less than 1.100 dwellings or the 125 municipalities with the lowest HDI		Census	766
Municipalities with 1.101 to 4.000 dwellings		800	794
Municipalities with more than 4.000 dwellings	Without localities of 50 thousand or more persons	1,100	703
	With localities with 50 thousand or more persons (excluding those localities)	800	193
	Each locality with 50 thousand or more persons	At least 2,000	
National total			2,456

Source: INEGI (2010), Sample Design for the 2010 Census.



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## Benin: Population and Housing Census 2002

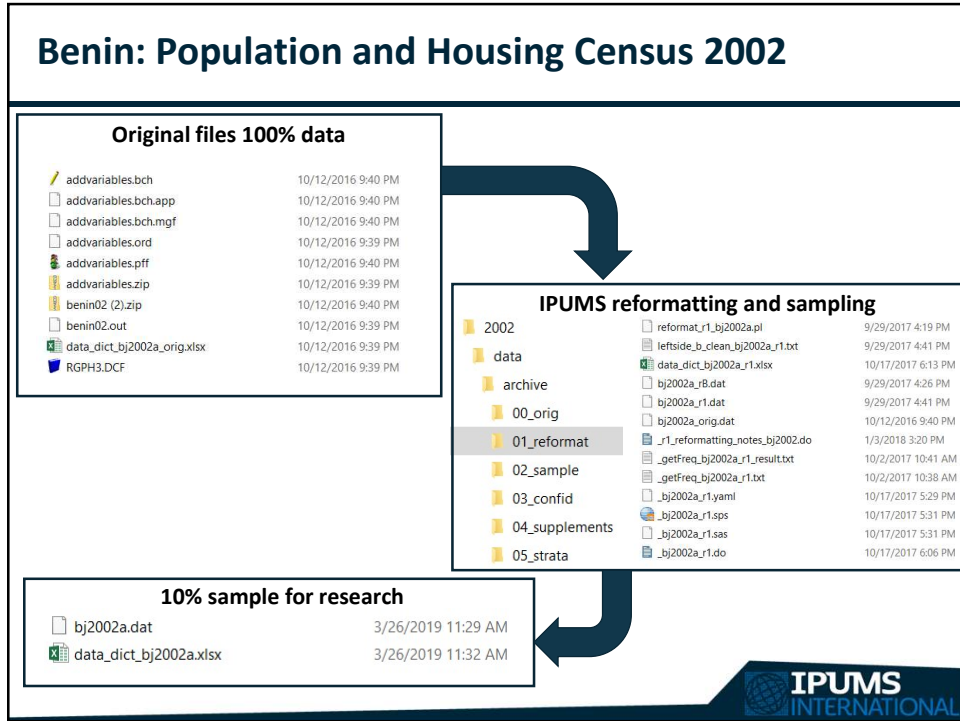
### Bénin - Troisième Recensement Général de la Population et de l'Habitation 2002

	ID de référence	BEN-INSAE-RGPH3-2002-V1.0	Créé le	Dec 17, 2019
	Année	2002	Dernière modification	Jun 30, 2022
	Pays	Bénin	Affichage par page	488272
	Producteur(s)	INSAE - Ministère du Développement et de l'Analyse Economique		
	Bailleur(s)	Coopération Suisse - - Partenaire Technique et Financier UNFPA - - Partenaire Technique et Financier Banque Mondiale - - Partenaire Technique et Financier Gouvernement du Bénin - - Partenaire Technique et Financier		
	Collection(s)	Recensement Général de la Population et de l'Habitation		
	Métadonnées	Documentation au format PDF		
<p>Informations connexes <a href="#">Description de l'enquête</a> <a href="#">Dictionnaire de données</a> <a href="#">Charger les microdonnées</a></p>				
<p>Aperçu Échantillonnage Collecte des données Traitement des données Évaluation des données <b>Politique d'accès</b> Exportation des métadonnées</p>				
<p><b>Data Access</b></p> <p><b>Autorité pour l'accès</b> INSAE (MDAEP), <a href="http://www.insae-bj.org">www.insae-bj.org</a></p> <p><b>Confidentialité</b> Les données sont libres d'accès.</p> <p><b>Conditions d'accès</b> Données disponibles sans aucune restriction</p>				

<http://nada.insae-bj.org/index.php/catalog/22>



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## Benin: Population and Housing Census 2002

[HOME](#) | [SELECT DATA](#) | [MY DATA](#) | [SUPPORT](#)

DATA CART  
 YOUR DATA SUMMARY  
 0 VARIABLES  
 0 SAMPLES

SAMPLE CHARACTERISTICS: BENIN

1979
1992
2002
2013

#### Census/survey characteristics

Type	Census
Title	Third Population and Habitation Census
Statistical agency	National Institute for Statistics and Economic Analysis
Population universe	All persons present on the territory of the Republic of Benin on census day
De jure or de facto	De facto
Census/survey day	February 11, 2002
Questionnaire	A single census form for persons and dwellings
Type of fieldwork	Direct enumeration

#### Microdata sample characteristics

Sample design	Systematic sample of every tenth household drawn by IPUMS from 100% microdata
Sample fraction	0.1
Sample size (person records)	685467
Sample weights	Self-weighting (expansion factor=10)

#### Units identified in microdata

Dwellings	No
Vacant units	No
Households	Yes
Collective dwellings	Yes
Smallest geography	Commune

### *Sample methodology:*

- Sample design
- Sample sizes and selection
- Expansion factors

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## Benin: Population and Housing Census 2002, Sample

- *Ad-hoc sample drawn by IPUMS*
- *Sample fraction:* 10%
- *Sample design:*
  - One stage systematic sample of households (plus all person records).
  - Self-weighting (expansion factor = 10).

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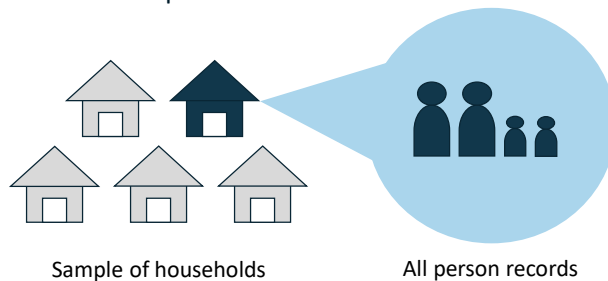
## General recommendations

- Probability sample! -- Known probability of selection to measure precision of estimates.
- Well documented sample design and available to users.
- Data should include expansion factors and other relevant variables for statistical inference from the sample.
- Broad availability of census variables with a large enough sample size to be used in research applications.

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## Standard Sample Design in IPUMS

- **What do we recommend?**
  - Sampling frame (census data) sorted by (very) detailed geography.
  - Systematic sample by selecting 1-in-10 households (10%), along with all associated person records.



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## Questions...?

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# Some practical considerations

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## Calculate Sample Size (1)

- Formula to calculate sample size for a proportion:

$$n_0 = \frac{(p)(1-p)(Z_{\alpha/2})^2}{E^2}$$

Where: p is the proportion, Z from the normal distribution, and E is margin of error.

- If we assume  $p=0.5$ ,  $Z_{\alpha/2}$  (95%) = 1.96, and  $E=0.025$ , then:

$$n_0 = \frac{(0.5)(0.5)(1.96)^2}{(0.025)^2} \approx 1537$$

- Finite population correction factor (pop. = 250k hhs):

$$n = \frac{n_0 N}{n_0 + N - 1} = \frac{1537 * 250k}{1537 + 250k - 1} \approx 1528$$



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## Calculate Sample Size (2)

- We can calculate sample sizes by geography:

Geography units	Total households	Sample size per unit
Unit 1	25,000	1,448
Unit 2	25,000	1,448
Unit 3	25,000	1,448
Unit 4	25,000	1,448
Unit 5	25,000	1,448
Unit 6	25,000	1,448
Unit 7	25,000	1,448
Unit 8	25,000	1,448
Unit 9	25,000	1,448
Unit 10	25,000	1,448
<b>Total</b>	<b>250,000</b>	<b>14,480</b>

**Assumptions:** Persons=1M, Household size=4, Households=250k



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## Calculate Sample Size (3)

- We can calculate sample sizes by geography:

Geography units	Total households	Sample size per unit
Unit 1	250,000	1,528
Unit 2	250,000	1,528
Unit 3	250,000	1,528
Unit 4	250,000	1,528
Unit 5	250,000	1,528
Unit 6	250,000	1,528
Unit 7	250,000	1,528
Unit 8	250,000	1,528
Unit 9	250,000	1,528
Unit 10	250,000	1,528
<b>Total</b>	<b>2,500,000</b>	<b>15,280</b>

**Assumptions:** Persons=10M, Household size=4, Households=2.5M



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## Creating an expansion factor

- **Base weight: Inverse of the selection probability**

- Selection probability ( $P_i$ ):

$$P_i = \frac{n}{N}$$

- Expansion factor ( $W_i$ ):

$$W_i = \frac{N}{n}$$



Where: n is the number of records to select and N is the total number of records.

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## Creating an expansion factor: Examples

- **SRS or Systematic sample of 1-in-10 households**

- Probability of selection = 1/10
- Expansion factor = 1/(1/10) = 10 (constant across the sample)

- **Stratified sample with differential sample fraction by urban/rural**

- Probability of selection = 1/10 in urban, 1/8 in rural
- Expansion factor = 10 for urban and 8 for rural (constant per stratum)

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## Adjusting weights

- **What if we have undercount?**
  - Without undercount, each sampled record represents  $N/n$  records.
  - With undercount, each sampled record represents  $N/n$  by the inverse of the proportion of enumerated records  $1/C$ .
- **Simple approach: adjust weights using undercount rate**

$$W_a = \frac{N}{n} * \frac{1}{C}$$

- If we assume  $N/n=10$  and  $C=98\%$ , then:

$$W_a = 10 * \frac{1}{0.98} \approx 10.2$$



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## Raking weights (1)

- Problem: non-response.
- Raking weights uses marginal distributions of control variables to ensure that the weighted sample matches the population.
  - Tables from census reports!
  - Control variables: age, gender, race, urban/rural, etc.
  - In Stata: ipfraking/ipfweight commands.
  - Note: Weight adjustment may increase the variance of estimates.



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## Raking weights (2)

- Method: iterative process that starts with base weight and satisfies the following condition (Kolenikov, 2014):

$$\sum_{j \in S} W_{Cj} X_j = T[X_j]$$

Where  $W_{Cj}$  are the calibrated weights,  $X_j$  are selected control variables, and  $T[X_j]$  is a population result.

- *Source*: “Calibrating survey data using iterative proportional fitting (raking)”, Kolenikov (2014)

## Questions...?

# Hands-on examples

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## Examples with code (Stata)

- **Common methods for sample selection:**
  - Simple random sampling
  - Stratified sampling
  - Systematic sampling
- **Practical considerations:**
  - Raking weights
  - Substituting records with issues

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**Questions...?**



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**Thank you!**

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