# Small area population estimation









## **Demographic data challenges**

### The goal: gridded population estimates

Approx. 100m



High pop. count Low pop. count

## Administrative units / Health units

### **Settlement extents**

### Custom e.g. specified proximity/distance



Gridded population data: Flexibility in aggregation of population estimates





Keybrard shortcare Map data @2004

## Mapping correlates of demographic variations





# Statistical models: leveraging geospatial data and spatial relations to map populations



## **Co-development**

-What are the needs? -What data exist to meet these needs? -What skills exist to design solutions? -Co-develop outputs and training plans and work together







https://www.worldpop.org/case\_studies/mapping\_afg\_pop/

## Afghanistan: Moving on from 1979 projections

WorldFop

Nigeria + DRC: Modelling from bespoke surveys to support vaccine delivery

TEN BEOAINCE (EFFOR

USAI

Leasure et al (2020) PNAS; Boo et al (2022) Nature



GRID<sup>3</sup>

MINISTERE DE LA







NATIONAL STATISTICAL OFFICE

About us v Concile & Surveye V Documents

#### POPULATION

Topics Economy Education Health Population Social

Users will find population data collected and produced by the National Statistical Office, such as documents, tables, graphs other other formats available.

#### Population Estimates 2021

Total Population 11,781,559	<sup>Males</sup> 6,142,585	Females 5,638,974
2021	2021	2021

#### Population Key Indicators

Key Indicators	Estimates
Sex ratio ((no. of males/no. of females) X 100)	108.9
Percentage of working age population (15 $-$ 64 years old)	61.6
Percentage of older populaton (65 years old and over)	2.7
Percentage of youth (15 to 24 years old)	21.6
Total dependency ratio (0 - 14 + 65 years old)/ 15-64 years old	62.4
Children dependency ratio (0-14 /15-64 years old)	58.1
Old-age dependency ratio (65 years old and over/ 15-64 years old	4.3
Median age, both sexes	21.2
Median age, Male	20.8
Median age, Female	21.7
Percentage of population aged 18 and over	57.2
Percentage of women who are of reproductive age (15 to 49 years old)	55.3

### https://wopr.worldpop.org/?PNG/Population, www.nso.gov.pg/statistics/population

## Papua New Guinea: Use of health campaign data









## Scaling up: globally consistent gridded estimates







## Key messages



**WorldFop** 

- 'Traditional' datasources (e.g. census, surveys) remain vital.....
- ....but they can be outdated, incomplete and unreliable in some settings.
- 'New' datasources (e.g. satellites, GPS, phones) can help compliment traditional sources – but they are not perfect: need to understand limitations, measure/use uncertainty metrics.
- Local ownership, partnership and co-development with decision makers are vital for sustainable uptake and use.

## Training materials

25 50

100 Kilometer



License

References

Small area population estimates using random forest top-down disaggregation: An R tutorial WorldPop, University of Southampton

#### 1 Introduction

2021-04-29

The purpose of top-down disaggregation is to estimate population counts at a finer spatial resolution than the available population totals for administrative units. WorldPop top-down disaggregation implements a dasymetric mapping approach that uses the random forest machine learning algorithm to disaggregate projected census totals to estimate population counts for 100 mgrd cells (Sortcheat et al. 2015, Stevens et al. 2015). Dasymetric mapping estimates population counts at a finer resolution than the input population totals based on relationships with high resolution geospatial countains like full discutations and networks.

In this tutoriat, we will demonstrate how to implement this method in the R statistical programming environment. We will adapt the method to estimate population couris for census enumeration areas (EAs) rather than 100 m grid cells. To demonstrate the approach, we will dissagnegrate population totals from municipatiles in Brazil to estimate populations in finer-scale census EAs (Fig. 1.1).



random forest top-down disaggregation random utorial : the **popRF** 'R' package

Small area population estimates using

pp-down disaggregation is to estimate population counts at a finer spatial resolution e-population totals for administrative units. There are multiple ways of doing this



Statistical population modelling for census support

Statistical population modelling for census support

Last compiled on 2022-02-11

WorldFop



Statistical population modelling is a powerful tool for producing gridded population estimates to support census activities. WorldPop at the University of Southampton is a global leader in developing these methods and has partnered with the United Nations Population Fund (UNFPA) to provide support to national statistics offices in training and production of high-resolution gridded population setimates from existing data sources (e.g. household surveys, building footprints, administrative records, census projections).

This website provides a series of tutorials in **Bayesian statistics for population modelling** and hands-on experience to start developing the necessary skills. It includes example code and other resources designed to expedite the learning curve as much as possible.

The key concepts that are covered in the tutorial series include:

1. Introduction to software for Bayesian statistical modelling: R and Stan,

2. Simple linear regression in a Bayesian context,

3. Random effects to account for settlement type (e.g. urban/rural) and other types of stratification in survey data,

4. Quantifying and mapping uncertainties in population estimates and

5. Diagnostics to evaluate model performance (e.g. cross-validation).

The material has been used during a remote workshop with the Brazilian Stats Office, Instituto Brasileiro de Geografia e Estatística (IBGE), in October 2021.

#### https://wpgp.github.io/bottom-up-tutorial/

## Further details





https://gkhub.earthobservations.org/packages/b0rhf-h1878

Knowledge Package

Metadata-only



https://gkhub.earthobservations.org/packages/yztvc-2r753

### A.J.Tatem@soton.ac.uk