DYNAMIS-POP

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DYNAMIS-POP Background

A portable dynamic socio-demographic micro-simulation platform for developing countries

- Based on micro-data readily available in most countries: Census + DHS or MICS
- Portable: so far Mauritania 2013, Nepal 2001, Nepal 2011
- Main focus (to date, -POP) on detailed population projections, complementing available national and regional projections by adding information on education careers, family demographics, ethnicity, health
- Ability to reproduce existing aggregate projections, but adding geographic and life-course detail, modeling in family and regional context
- Modular platform, extendable for applications in a variety of policy-relevant fields

DYNAMIS-POP Philosophy

Maximum automation of workflow

- Automated generation of model parameters (from standardized files)
- Most simulation code generic
- Scripts for ex-post analysis and visualization
- o Reproducible
 - Detailed documentation incl. step-by-step analysis and implementation guide
 - All software components freely available for download
- o User friendly: graphical user interface (GUI) and intuitive parameters
- Rich Output
 - Output tables (exportable: incl. coefficients of variation of each table cell)
 - Micro-data output (cross-sectional panel data; individual histories)

Current modules

- Demographic core reproducing a cohortcomponent model
 - o Fertility
 - o Mortality
 - Migration: immigration, emigration, internal migration
- Other core modules going beyond macro projections
 - Primary education ,fate'
 - Transmission of ethnicity
 - First marriage

Refined and optional modules

- Educational transmission
- Refined Fertility by parity, education, marital status, time since last birth
- Child mortality by mother's characteristics
- Primary education tracking: following students through grade system
- School planning: required classrooms, teachers etc.
- Secondary education
- Stunting + HCI

Modules: Fertility

o Base Version

- Age-specific fertility distribution by year
- o Total Fertility Rate (TFR) by year
- o Extended Version
 - First births by age, union status, education, province
 - Higher order births by education, time since last birth
 - Separate trends by birth order
- Alignment: forcing the model to reproduce aggregate outcomes while respecting relative fertility differences thereby generating realistic life-courses. Choices:
 - Not aligned
 - Aligned to total births of base version (same number of births)
 - Aligned to total births by age of base version (same age-specific fertility rates)

Example: Births (%) by mothers never in school

Births Mothers No School, 2001



Births Mothers No School, 2020



Births Mothers No School, 2010



Births Mothers No School, 2030



Source: Microsimulation projection based on 2001 data, Illustration only

Modules: Mortality

- o Base Version
 - Standard life table of age-specific rates by sex
 - Life expectancy by calendar year and sex
- o Refined child mortality model (ages 0-4)
 - Age baseline
 - Relative risks by mothers education and age group
 - Age-specific overall trends
- Alignment options (refined model)
 - o Without
 - Initial alignment to base model trends from base
 - Initial alignment to base model specific trends

Example: Children (0-4) deaths 2015-35

- Base Scenario: Education following current trend
- o Alternative Scenario: Universal primary education for all born 2001+



Child Deaths

	2016-25	2026-35
Base Scenario - North-West	11930	7730
Universal Primary Scenario - North-West	11200	5550
	-6.1%	-28.2%
	2016-25	2026-35
Base Scenario - Nepal	148960	101290
Universal Primary Scenario - Nepal	143560	86840
	-3.6%	-14.3%

Source: Micro-simulation projection based on 2001 data, Illustration only. Validation: UNICEF 24.000 child deaths in 2012, the projected number in the micro-simulation is 21.230 for 2012

Modules: Education

o Base Version

- Probability to enter and graduate from primary education by sex, year of birth, district. (typically modeled by logistic regression containing a logarithmic trend)
- Period model for secondary education (parameterized by intake, progression, repetition, dropout rates as available e.g. by UNESCO)

o Refinements

- Education transmission by mother's education + effect of stunting (odds ratios; outcomes can be aligned for one or all years)
- Students tracked through school system by grade (using intake, progression, repetition, dropout information (e.g. from UNESCO) aligned to modeled outcomes)
- School resource planning of required classrooms and teachers: Target path for classroom sizes and teacher/student ratios

Example: Children 9-11 out of school

School Absence (9-11), 2001



 Vordel Bank, DYNAMIS-POP v2.0
 2010

School Absence (9-11), 2020



School Absence (9-11), 2030

School Absence (9-11), 2010



Source: Microsimulation projection based on 2001 data, Illustration only

Implementation

- Implemented in Modgen (Statistics Canada), a generic microsimulation programming language based on C++
- o Graphical User Interface
- Scenario support
- Rich, exportable table output
- Various table views: values, coefficient of variation
- Fully documented (Help files for user interface and model)
- Fast (can simulate millions of interacting agents on a standard PC)



Work-Flow – Creation of a new country version

- Data preparation: creation of 4 standardized micro-data files. Some other files: macro projections, shape files for map output
- Country-specific R setup script: file names and locations and calendar time values as models might start at different start years.
- Run R input analysis scripts: (currently 16 numbered scripts) for parameter estimation, production of all parameter files and a the starting population.
- Country specific simulation code file: one (of the currently 33) code files (modules) is country specific: name of districts, mapping to regions, start year, etc.
- o Compile and start the new model

HCI Index (Demo, Nepal, projected from 2001)

- Module for stunting: stunting rates by sex and mother's education from DHS (projects composition effects only, no trends)
- Preschool module: ad-hoc
- Module for HCI: Output of all components, aggregated HCI and average individual index
- o General mortality: period rates frozen from 2018 onwards
- Child mortality by mother's age and education
- Primary school: cohort model by sex, mother's education, stunting, region, trend
- Secondary: time-invariant take-up, repetition, progression rates
- School quality: current national average

HCI Index (Demo, Nepal, projected from 2001)



What DYNAMIS can add: (1) cohort studies

- HCI Projections: retrospective, prospective
- Benchmark projections: helping to assess policy effects
 - Status quo on individual level: how would HCI change if nothing changes for given individual parental, ethnical, regional... background.
 - How would HCI change if existing population projections are accurate?
- **Downstream effects / what-if scenarios:** e.g. effect universal primary schooling
- Regional disaggregation
- o **Decomposition of changes**
 - Impact of changes in component (e.g. child mortality improvements)
 - Decomposition of changes within components (e.g. composition versus other effects)

What DYNAMIS can add: (2) population studies

- Projections of the human capital of the (e.g. working age) population
 - o Imputation of human capital to current population of all ages
 - Different perspectives: human capital of population alive
- o Economic modeling
 - Production functions require input of human capital of active population
 - Modeling of labor force participation by individual characteristics
- What-if / policy scenarios from population perspective
 - E.g. How would educational improvements in specific population groups impact the future labor force participation and human capital
 - What is the timeline of such changes

Supplementary information

Data requirements

• Data requirements met for most countries by:

- A population Census
- Survey data on demographic events:
 - MICS: Multiple Indicators Cluster Surveys (UNICEF)
 - DHS: Demographic Health Survey

• Four essential data files:

- o Residents
- Recent emigrants
- o Children
- Birth histories

M_WEIGHT	Weight (123.456)
M_AGE	Age (in years, 16.789)
M_MALE	Sex (female 0, male 1)
M_DOB	District of birth (0m, m = abroad)
M_DOR	District of residence (0n)
M_PDIST	District 12 months ago (0m, m = abroad)
M_EDUC	Primary education (0 non, 1 some, 2 graduated)
M_PARITY	Parity (0, 1)
M_BIR12	Number of births past 12 months (0, 1, 2)
M_AGEMAR	Age at first marriage (in years, 16.789, 999 never married)
M_AGEBIR	Age at most recent birth (in years, 16.789, 999 childless)
M_ROB	Region of birth (0b, b = abroad)
M_ROR	Region of residence (0a)
M_PREG	Region 12 months ago (0b, b = abroad)
M_ETHNO	Ethnicity (0y)

WEIGHT	Weight (123.456)
PDIST	District 12 months ago (0n)
PREG	Region 12 months ago (0x)
AGE	Age (in years 18.901)
MALE	Sex (0 female, 1 male)
_BIRTH	Birth of child (month since 1900)
_DEATH	Death of child (month since 1900; 9999 if alive)
_MALE	Sex of child (0 female, 1 male)
_WEIGHT	Weight (123.456)
_AGEMO	Age group of mother when giving birth (months)
_EDUCMO	Primary education of mother (0 non, 1 some, 2 graduated)
_INTERV	Time of interview (month since 1900)
_B01	Month of 1st birth (months since 1900; 9999 for non)
_B14	Month of 14th birth (months since 1900)
_WEIGHT	Weight (123.456)
_BIRTH	Birth (months since 1900)
_EDUC	Primary education (0 non, 1 some, 2 graduated)
_REG	Region of residence (0n)
_INTERV	Time of interview (months since 1900)
_MAR	Time of first marriage (months since 1900; 9999 never married)

Data Issues

- Complementary project and R packages for addressing typical data issues and for synthetic population generation
 - Age Heaping
 - Under-reporting of children
 - Imputation of missing variables
 - Generation of synthetic datasets



Census and back-projected children 2001 age 0-4 using number of children age 10-14 from 2011 Census

