

Population Projection using Mathematical Methods

Campinas University (UNICAMP)

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Course description

In this course, we will study some mathematical and statistical approaches to the assessment of the basic components of population dynamics (fertility, mortality, migration and mobility), also some population projection techniques using software packages.

This course is oriented for master and PhD students who interested for modern models of population dynamics in relationship with socio-economic indicators of the development of society.

The students will have possibility to get information about global trends of fertility, mortality, migration, and factors that cause them scale and direction.

We will discuss specific academic articles (case studies) and provide some technical skills used in demographic research.

Key Textbooks, Statistical and Analytical Reports

Farhat Yusuf, Jo. M. Martins, David A. Swanson (2013). Methods of Demographic Analysis. <https://doi.org/10.1007/978-94-007-6784-3>

Population Dynamics and Projection Methods (2011). Ed. by John Stillwell, Martin Clarke. <https://link.springer.com/book/10.1007/978-90-481-8930-4#toc>

The SAGE Handbook of International Migration (2020). Ed. by Christine Inglis with Wei Li and Binod Khadria. <https://us.sagepub.com/en-us/nam/the-sage-handbook-of-international-migration/book245296#contents>

Wachter, Kenneth W. (2014). Essential demographic methods. Harvard University Press.

<https://www.hup.harvard.edu/catalog.php?isbn=9780674045576&content=book>

Jeffrey M. Wooldridge (2002). Econometric Analysis of Cross Section and Panel Data. Massachusetts Institute of Technology.

<https://ipci.org/evaluation/apoio/Wooldridge%20-%20Cross-section%20and%20Panel%20Data.pdf>

The World Migration Report 2022. <https://publications.iom.int/books/world-migration-report-2022>

Population Censuses' Datasets (1995 - Present).

<https://unstats.un.org/unsd/demographic-social/products/dyb/index.cshtml#censusdatasets>

Demographic Yearbook 2021 (72-nd Issue).

<https://unstats.un.org/UNSDWebsite/Publications/PublicationsCatalogue/5675>

Topic 1. The use of mathematical methods in modern demography.

Global demographic trends. Population data sources. Distribution of the population by countries. Analysis of the dynamics of demographic processes using absolute and relative demographic indicators.

Main software packages used in demographic research.

Preliminary analysis of the demographic data. Description statistics. Graphical analysis of demographic data. Time series of population dynamics. Population density. Histogram of distribution. Age pyramids.

Practical case: Population of Brazil.

Topic 2. Fertility models.

Analysis of the dynamics of fertility by countries. Birth rate coefficients system. Total fertility rate and its dynamics by countries. Dynamics of the average age of the mother at the birth of the first child. Fertility profiles by mother's age.

Socio-economic factors of fertility.

Practical case: Econometric model of fertility: comparative cross-country study. Predicting fertility with econometric models.

Topic 3. Mortality models.

Analysis of the dynamics of mortality by countries.

The main causes of death. The structure of mortality by causes in the countries of the world. Gender differentiation of mortality.

Socio-economic factors of mortality.

Practical case: Cross-sectional econometric model of mortality from external causes in Russia. Using econometric models to predict mortality. Implications for population policy.

Topic 4. Models of migration.

Sources of data on migration. Global migration trends. Internal and international migration. The structure of migration flows. Basic theories of migration.

Socio-economic factors of migration.

Is it possible to predict migration: taking into account objective limitations and the influence of the state policy of receiving and sending countries in models.

Practical case 1: Using multivariate statistical methods to analyze the migration attractiveness of territories.

Practical case 2: An econometric model of emigration from Russia in the post-Soviet period - a regional analysis.

Topic 5. Demographic projections.

Classification of demographic forecasts. Forecasting with mathematical functions: when can we use this approach to population projections and when can we not?

Forecasting using the component method.

Practical case: United Nations Population Projections: Key Parameters and Methodology. Population projections for countries and regions of the world.

Topic 6. Presentation of individual mini-projects.

** Note: Each topic will be accompanied by practical examples using one of the software packages.*