Ph.D. in “Life Course Research” – Socio-demographic curriculum

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Formal demography and mortality

Prof. Piero Manfredi

University of Pisa, *piero.manfredi@unipi.it*

Prof. Giambattista Salinari

University of Sassari, gsalinari@uniss.it

Objectives

The goal of this course is twofold: (i) to introduce a few fundamental topics and tools in formal demography including population dynamics, the spread of communicable infections, and the formal analysis of mortality, (ii) to show a range of research areas using such tools. Specifically, the course will focus on the theory of stable population, diffusion processes, and the so-called 'frailty models' for the analysis of mortality.

Program

Monday morning (PM)

The stable population model. A stable population represents the limit to which a closed, age-structured, population will converge over time when subjected to constant age-specific mortality and fertility schedules. This result, first due to Lotka using the continuous renewal equation (1906) was later extended in many different modeling settings and represents the door to other fundamental modeling issues and concepts (e.g., reproduction numbers). Topics: the model different formulations, solution, insights, applications. Some major extensions: immigration, multistate demography, poverty vs low-fertility traps.

Tuesday morning (PM)

Infectious diseases dynamics 1. Topics. Basic concepts of infection transmission and control. Reproduction numbers. Epidemic infections. Basic models: pure contagion-full immunity-waning immunity. Endemic infections and their control. Mass vaccination programs and their possible perverse impacts.

Wednesday morning (PM)

Infectious diseases dynamics 2. Advanced topics. General definition of reproduction numbers. Herpes zoster. HIV/AIDS. The (stable) multi-phasic dynamics of mitigated epidemics: COVID-19 as an example. Behaviour: denialism vs vaccine hesitancy. The control of threatening epidemics after the COVID failure.

Thursday morning (GS)

Individuals in a population differ in many ways: they may vary due to factors like education levels, incomes, sex, place of birth, etc. However, even when we account for these observed characteristics, individuals in a population will continue to differ in other, non-observed traits. In survival analysis, this heterogeneity, which is not explained by the observed characteristics of individuals, is called unobserved heterogeneity or hidden frailty. Hidden frailty is believed to be responsible for surprising phenomena such as mortality deceleration and crossovers at older ages. This class will focus on simple frailty models, such as the gamma-Gompertz and the gamma-Gompertz-Makeaham models.

Suggested readings

Missov Trifon I., Németh László (2015). Sensitivity of model-based human mortality measures to exclusion of the Makeham or the frailty parameter. Genus, Vol. 71, No. 2-3. https://www.jstor.org/stable/10.2307/genus.71.2-3.113.

Keyfitz N, Caswell H (2008) Applied mathematical demography, Wiley.