IDEM 128: "Matrix Approaches to Modelling Kinship: Theory and Applications"

Last updated: May 10, 2023

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Start: 3 May 2023
End: 12 May 2023
Location: Max Planck Institute for Demographic Research, in person

Instructors:

- Hal Caswell
- Iván Williams
- Diego Alburez-Gutierrez

This in-person course will present the theory underlying new matrix approaches to the formal demography of kinship networks.

Organization

- On Wednesday, May 3, the PHDS team will give a 30-minute introduction to the workings of the Institute from 9:30-10:00am, which is mandatory for visiting students and optional for everyone else. Lectures that day will start at 10am.
- From Thursday, May 4 to Thursday, May 11, lectures and lab sessions will take place between 9am and 4pm, including a lunch break between 12pm and 1pm.
- On Friday, May 12 we start at 9am and finish at 3pm, with a lunch break between 12pm and 1pm.
- There will be plenty of breaks and group activities.

Website

You can access the course's website here (still under construction): https://ivanwilli.github.io/matrix_kinship_course_lab/index.

Examination

Students will be evaluated on the basis of computer exercises and class participation.

Readings for kinship models

Students are expected to complete the **required** readings by the dates indicated below. The other readings provided include useful materials on matrix models in demography or showcase interesting extensions or applications of the methods discussed. These are important background material for the lectures on Wednesday - Friday of the first week. You should definitely look at them (see notes below) Readings can be downloaded from: https://www.dropbox.com/t/iM06GB0D5fXboWYu.

Required readings

- **Read by Friday, May 5**: Caswell, H. (2019). The formal demography of kinship: A matrix formulation. *Demographic Research*, *41*, 679–712. https://doi.org/10.4054/DemRes.2019.41.24
- **Read by Monday, May 8**: Caswell, H., & Song, X. (2021). The formal demography of kinship. III. kinship dynamics with time-varying demographic rates. *Demographic Research*, *45*, 517–546
- **Read by Tuesday, May 9**: Caswell, H. (2022). The formal demography of kinship IV: Two-sex models and their approximations. *Demographic Research*, *47*, 359–396. https://doi.org/10.4054/DemRes.2022.47.13
- **Read by Wednesday, May 10**: Caswell, H. (2020). The formal demography of kinship II: Multistate models, parity, and sibship. *Demographic Research*, *42*, 1097–1146. https://doi.org/10.4054/DemRes.2020.42.38

Readings for matrix population models

Here is some guidance for the references for the matrix section of the course. In the shared folder https://www.dropbox.com/t/iM06GB0D5fXboWYu:

- In the folder `matrices`, you should read Appendix A; it is a condensed introduction to some of the basics of matrix algebra. For things that still confuse you, try some online search and come prepared to ask questions (a general rule is to always ask questions). The two chapters (3 and 7) from Keyfitz and Caswell provide resources for material that will be covered on Wednesday and Thursday.

- The folder `multistate models` contains a long paper (Ecological Monographs) that presents in detail the theory for these matrix models. Maybe too long to read in detail, but do take a look at it. The paper by Hernandez et al. is an example of an application. These are both relevant to the material that will be coverred on Thursday afternoon.
- The folder `markov chains` contains two papers that outline the basic use of Markov chains to model demographic transitions. These methods will someday replace life tables. The topic will be discussed on Friday morning.
- Finally, the folder `markov chains with rewards` adds an extra dimension to Markov chain models. We will investigate this on Friday afternoon, with an application to health demography.
  - The paper by Caswell and Zarulli gives a (fairly) clear presentation of the basic methodology, for prevalence-based healthy longevity. You should read this one.
  - The paper by van Daalen and Caswell gives the theory in detail. Provided as a resource.
  - The paper by Caswell and van Daalen (stars in the sky...) uses multistate models to do the calculations for incidence-based healthy longevity. Probably won't be able to talk about this very much, but it's a resource.
  - Finally, the paper by Ebeling et al. is an application to Covid mortality, as a resource.

Agenda (subject to change)

First Part: Matrix Models in Demography

The first part of the course (3-5 May) will introduce the matrix formulation of demographic analyses, linking the dynamics of individuals, cohorts, and populations.

Wednesday, May 3

Morning

- Welcome to the course and introduction
- Matrix model theory: Formulation and scope of MPMs; i-states and p-states, life cycle graphs. Population projection. Types of models. Asymptotics and transients.

Afternoon

- Lighting talks by students: what are you currently working on and how does it relate to kinship (if at all)? Each student prepares a 3-minute presentation (max one slide).

Thursday, May 4

Morning

- Matrix model theory: Asymptotic dynamics and stable population theory (eigenvalues, eigenvectors, population structure and reproductive value).
- Lab session

Afternoon

- Matrix model theory: Multistate models and the vec-permutation method. Health demography as a motivation.
- Lab session
- Q&A on topics covered so far

Friday, May 5

Morning

- Matrix model theory: Markov chains and transition matrices. Individual stochasticity (longevity, occupancy, eventual fate)

Afternoon

- Matrix model theory: Markov chains with rewards. Rewards as a flexible concept. Variability in lifetime outcomes.
- An intuitive introduction to matrix kinship models

Second Part: Matrix Kinship Models

The second part of the course (May 8-12) will focus on matrix kinship models that describe the development of the network of kin surrounding a focal individual, as they age from birth onward.

Monday, May 8

Morning

- Why kinship?
- Kinship theory: Age-classified time-invariant one-sex kinship models
- Lab session: analyzing a kinship model 'by hand'

Afternoon

- Lab session: introduction to the package and setting things up. Practical exercise using time-invariant one-sex models in DemoKin.
- Discussion: what is ignored by age-classified time-invariant one-sex kinship models?

Tuesday, May 9

Morning

- Current topics in kinship demography
- Kinship theory: Age-classified time-varying one-sex kinship models

Afternoon

- Lab session: Practical exercise using time-varying one-sex models in DemoKin (and continuing work on the time-invariant model as needed).

Wednesday, May 10

Morning

- Kinship theory: Age-classified time-invariant two-sex kinship models
- Lab session: Two-sex models and their approximations using DemoKin (and continuing previous models as needed).

Afternoon

- Modelling kinship using demographic microsimulations: contrasts and similarities with analytic models.
- Lab session: Two-sex models and their approximations using DemoKin (and continuing previous models as needed).

Thursday, May 11

Morning

- Kinship theory: Multistate kinship models with applications to health
- Discussion: What are some interesting applications of different kinship models studied so far?

Afternoon

- Lab session: Examples of multistate models using DemoKin

Friday, May 12

Morning

- Group exercise: come up with a research question for a potential project using kinship models. Which data would you need? Which models would you use? How would existing models need to be adapted?
- Discuss potential projects to your colleagues

Afternoon

- Summary of topics covered, Q&A and, concluding discussion