Alive and Connected

Translating Demographic Rates into Family Network Data

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Summary

The family, genealogically defined, represents a unique site for exploring the direct consequences of demographic trends on human network structures. This is given by the simple fact that family network structures are formed and altered by the entering and exiting of members according to clearly-defined demographic events. The work presented here advances a new method, which allows the translation of demographic data (head counts and rate schedules) into social network data (adjacency matrices), thus bridging the analytic gap between formal demography and network analysis of the family.

As a demonstration of this technique, we translate the demographic rate schedules of black and white Americans observed in 2000 into their implied kinship network data. We then estimate select network characteristics to highlight a few key differences in the family structures of these black and white national populations.

Methods

The main workhorse of this translation procedure is SOCSIM, a well-validated microsimulator hosted by the Department of Demography at UC Berkeley. In a nutshell, SOCSIM generates fictive individuals who behave, on aggregate, to reproduce observed population fertility and mortality patterns. As the simulation runs, the complete genealogical relatedness of all individuals over their entire lifespans is tracked and recorded. This genealogical data is then transformed into a set of network data tables (adjacency matrices) that describe the full set of kinship ties that exist between all pairs of individuals in the simulation.

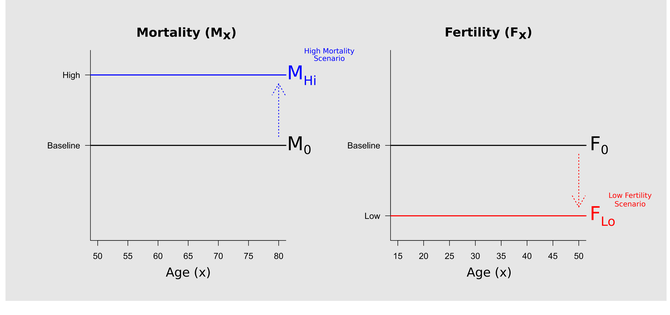
For the purposes of the present demonstration, we select as our inputs to SOCSIM age- and sex-specific mortality and fertility rate schedules derived from NVSS lifetables and NCHS central fertility tables for black and white Americans in 2000.

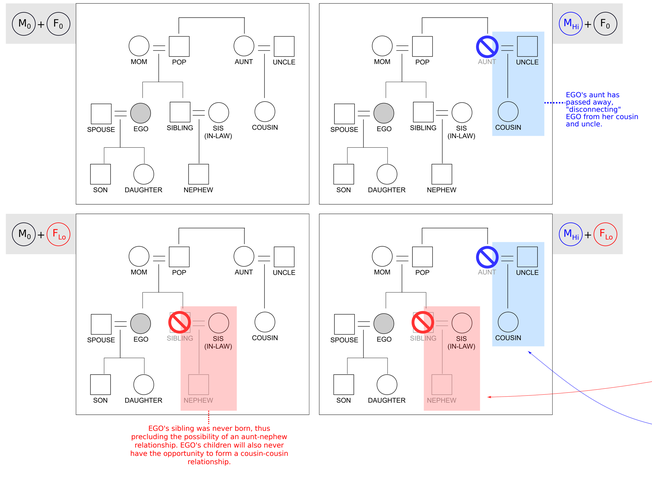
Next Steps

In the final paper, we will investigate more sophisticated measures of network configuration specific to kinship (e.g. "matrimonial circuits" as formally defined by Klaus Hamberger). We will hypothesize the theoretical relationship between these network measures and the underlying demographic forces that condition them; and then we will test these hypotheses empirically with the microsimulation method presented here.

1 The Mechanical Relationship between Demography and Kinship Structure

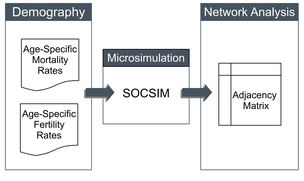
The nature of kinship relations (genealogically-defined) is such that a complete accounting of births, partnering, and deaths in a population can perfectly identify the family network structures of that population. Consequently, as mortality and fertility rates change, family structures change in predictable ways. To illustrate the point, we examine four highly-stylized kinship scenarios where mortality (at older ages) and fertility is varied in systematic fashion.





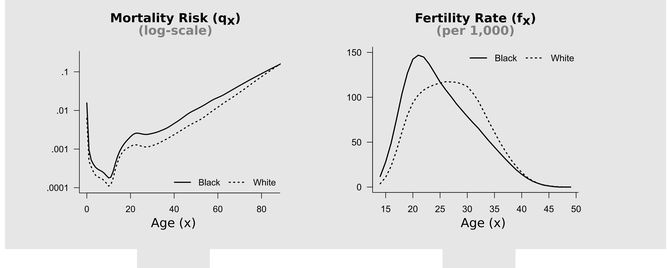
2 Bridging the Gap

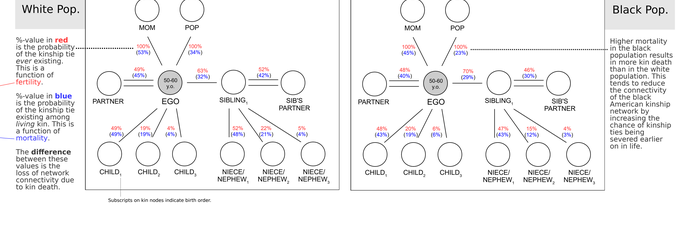
Despite the direct connection between demography and genealogy, there have been very few efforts to translate known demographic characteristics of a national population into their implied kinship networks. Often the closest we get to such kinship data is data on household structures, but these are often insufficient as they do not track kinship ties beyond residential boundaries, and thereby miss all information on non-cohabiting kin (e.g. adult children, siblings, and cousins). As a way to overcome these limitations, we advance a microsimulation technique to directly estimate the implied kinship structures of a given demographic regime.



3 Black and White Americans in 2000

As an example of this technique, we translate the known demographic rate schedules of black and white Americans in 2000 into their implied kinship network data. Below, we visualize the strong differences (by race) in observed mortality and fertility patterns, and then characterize the resulting differences in tie probability in a set of typical kinship network graphs.



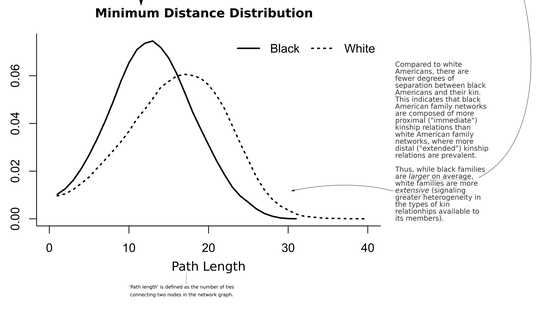


4 The Network Structure of Black and White American Families in 2000

Using the kinship network data generated in the previous step, we are able to measure a full suite of formal network properties of black and white Americans in 2000. We present a small subset of them here.

Network Measure	Black Pop.	White Pop.
% Kinless (Isolates)	21.0%	19.9%
# Individuals per Family (Component)	10.7	9.1
Mean Minimum Distance to Kin	12.9	15.8

These numbers are calculated excluding isolates and with ties counted only for living individuals (i.e. death "severs" ties).



SOCSIM Microsimulator

Additional information regarding SOCSIM, the microsimulator used in this demonstration can be found at:

http://lab.demog.berkeley.edu/socsim

Code and Data

All code and data resources necessary to reproduce this demonstration are freely available in an open github repository:

https://github.com/p-chung/dem_networks