4 - Computational approaches

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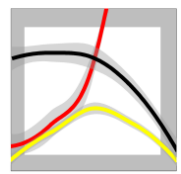

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Agenda

1. Q&A
2. Demographic micro simulation
3. Example 1: Impact of the HIV/AIDS epidemic on kinship resources
4. Example 2: Projecting older adults without kin
5. Discussion
6. Course evaluation

Q&A

- Previous days
- Questions about final assignment
- Other?

Demographic micro-simulation

- Model individual-level demographic behaviour applying set of rules
- Make up data where unavailable
- Science: compare to independent method
- Different alternatives:
  - SOCSIM
  - CAMSIM
  - NetLogo (Agent-based modelling)
  - R/python

Grow, A and Van Bavel, J. 2018. Agent-Based Modeling of Family Formation and Dissolution. In R. Schoen (Ed.), Analytical Family Demography (pp. 125-156). Springer Series on Demographic Methods and Population Analysis, (Vol. 47), Cham: Springer International Publishing.

Creating digital populations with SOCSIM

- A stochastic micro-simulation platform, 1970s at UC Berkeley
- Starting with an initial population, applies age-specific demographic rates
- Creates kinship structure similar to a full genealogy
- Now maintained at the MPIDR!

Mason, C. (2016). SOCSIM Oversimplified. UC Berkeley.
https://lab.demog.berkeley.edu/socsim/CurrentDocs/socsimOversimplified.pdf

SOCSIM

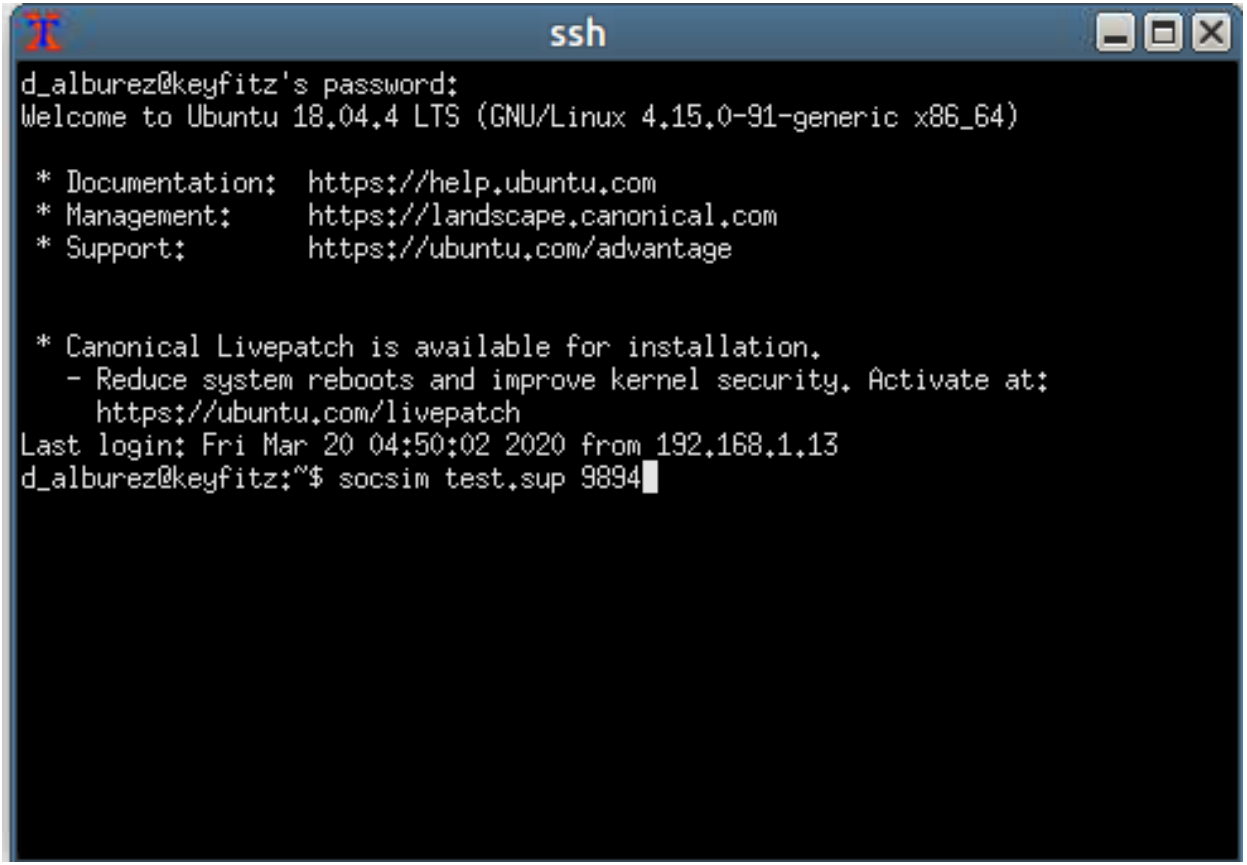


Figure 1: What microsimulation actually looks like

A SOCSIM micro-simulation of Sweden (1603-2160)

```
# Read sample Familinx data using data.table
read.csv("../../Assignment/Data/sweden_socsim.csv") %>%
  slice(1:4) %>%
  kable()
```

profileid	father	mother	birth_year	death_year
10000	2152	2390	1703	1705
10001	0	4343	1703	1707
10002	4593	5190	1703	1773
10003	0	3252	1703	1703

Zagheni, E. 2017. The Demographic Foundations of the Lived Experience of Kin Death. Working paper.

Question time!

We'll review two studies. Identify the

1. **strengths**
2. **weaknesses**

of their reliance on microsimulation

Some magic sampling. . .

```
who <- sample(n, 4, replace = F)
n <- n[!n %in% who]
df <- data.frame(study=c("Zimbabwe", "Kinless"),who) %>%
      arrange(desc(study))
kable(df)
```

study	who
Zimbabwe	Alexander
Zimbabwe	Octavio
Kinless	Madalina
Kinless	Qi

Example 1: Impact of the HIV/AIDS epidemic on kinship resources

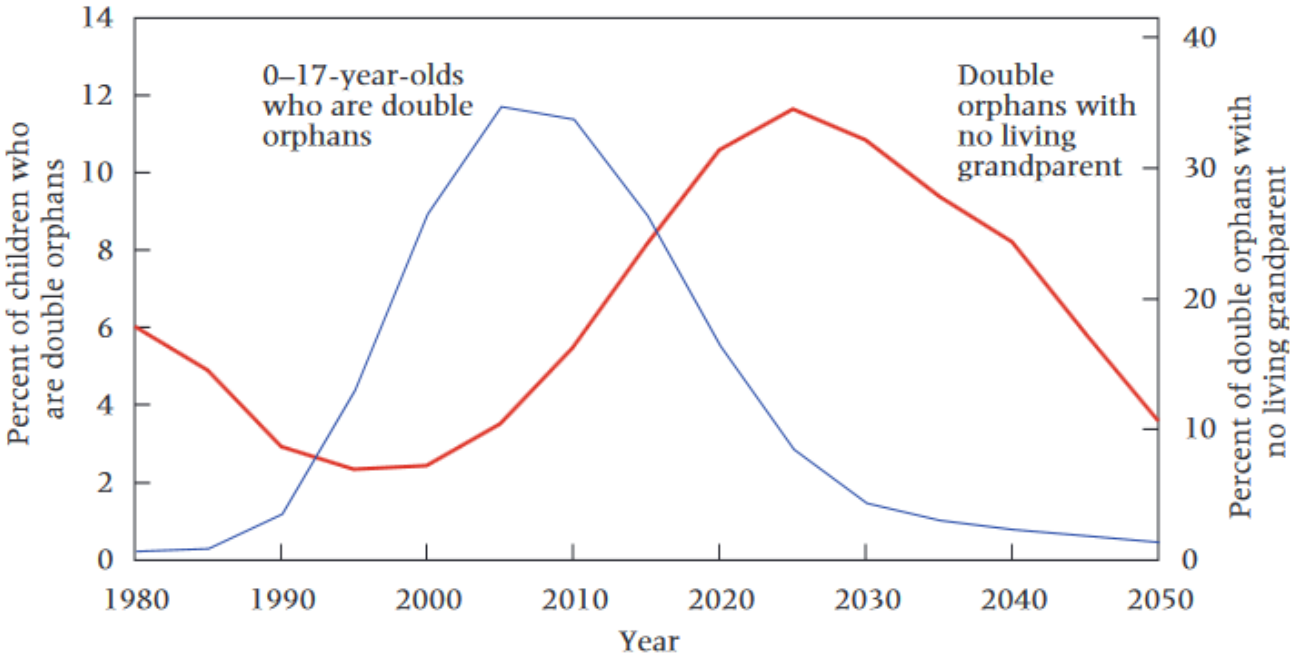
Research at a glance

- RQ: estimate and project probabilities of orphanhood and evolution of kinship structure in Zimbabwe in context of HIV/AIDS epidemic (1980-2050)
- Data: SOCSIM, with rates from UN WPP, Demographic and Health Surveys, World Fertility and Marriage Database, UN HIV infection rates
- Findings:
  - increase in double orphans with no living grandparents
  - shift of responsibilities to aunts and uncles

{Zagheni, E. 2011. The impact of the HIV/AIDS epidemic on kinship resources for orphans in Zimbabwe, Population and Development Review 74(4), 761-783.}

Double-orphans and double-orphans without grandparents

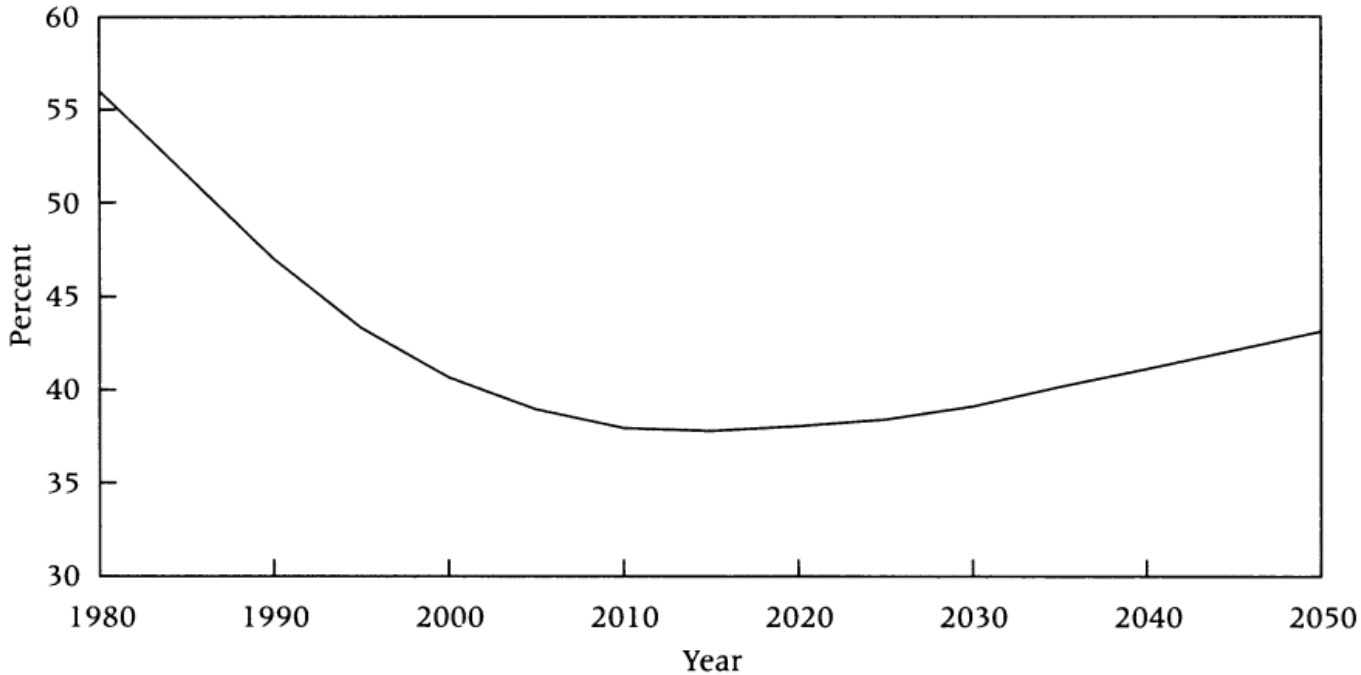
FIGURE 2 Percent of children 0–17 years old who are double orphans (left scale), and percent of these double orphans who have no living grandparent (right scale)



{Zagheni, E. 2011. The impact of the HIV/AIDS epidemic on kinship resources for orphans in Zimbabwe, Population and Development Review 74(4), 761-783.}

Percent of double orphans

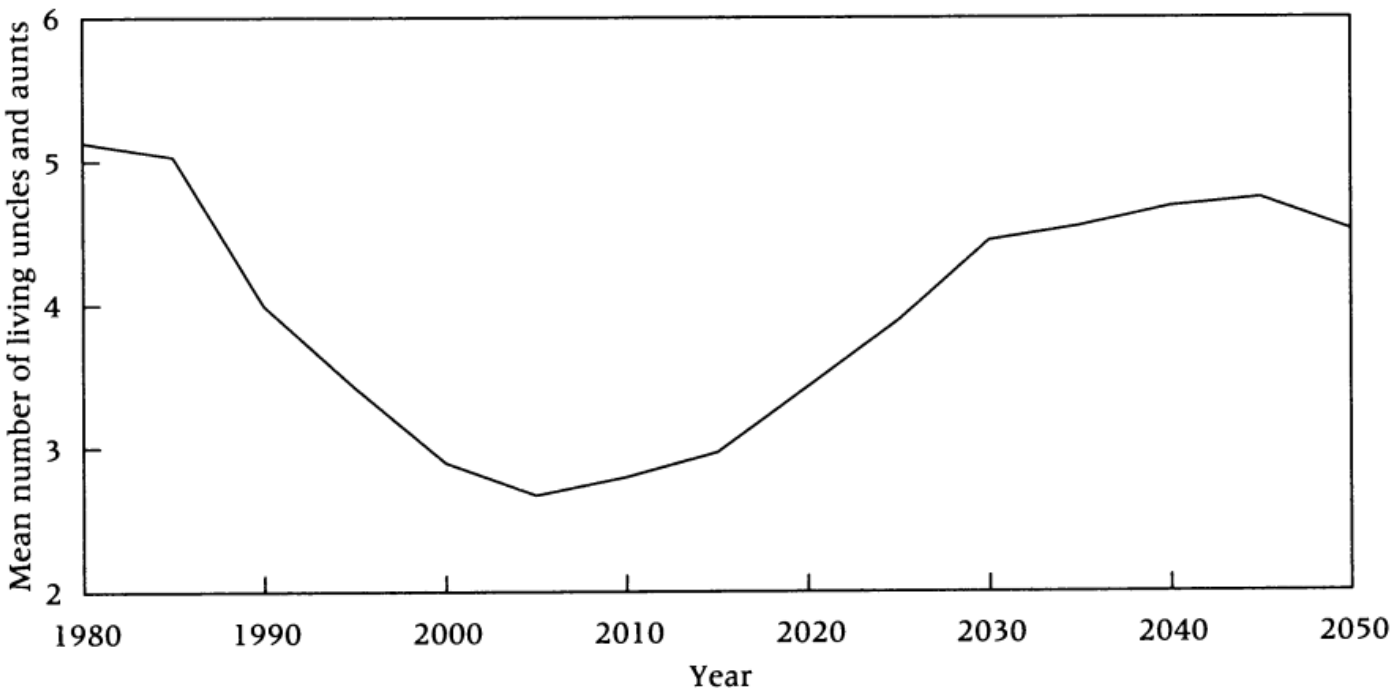
FIGURE 4 Estimates and projections of the percent of double orphans younger than 10 years who have at least one living sibling older than 15 years, Zimbabwe 1980–2050



{Zagheni, E. 2011. The impact of the HIV/AIDS epidemic on kinship resources for orphans in Zimbabwe, Population and Development Review 74(4), 761-783.}

Availability of aunts and uncles

FIGURE 3 Estimates and projections of the average number of living uncles and aunts of double orphans 0–17 years old, Zimbabwe 1980–2050



{Zagheni, E. 2011. The impact of the HIV/AIDS epidemic on kinship resources for orphans in Zimbabwe, Population and Development Review 74(4), 761-783.}

Example 2: Projecting older adults without kin

Research at a glance

- RQ: Examine the changing population of kinless individuals in US society over the coming decades
- Data: Rates from US census, Human Fertility Database, official statistics
- Findings:
  - Increase of adults 50+ with no living close family members, especially Black
  - Mechanisms: Declines in marriage, one-child families, mortality

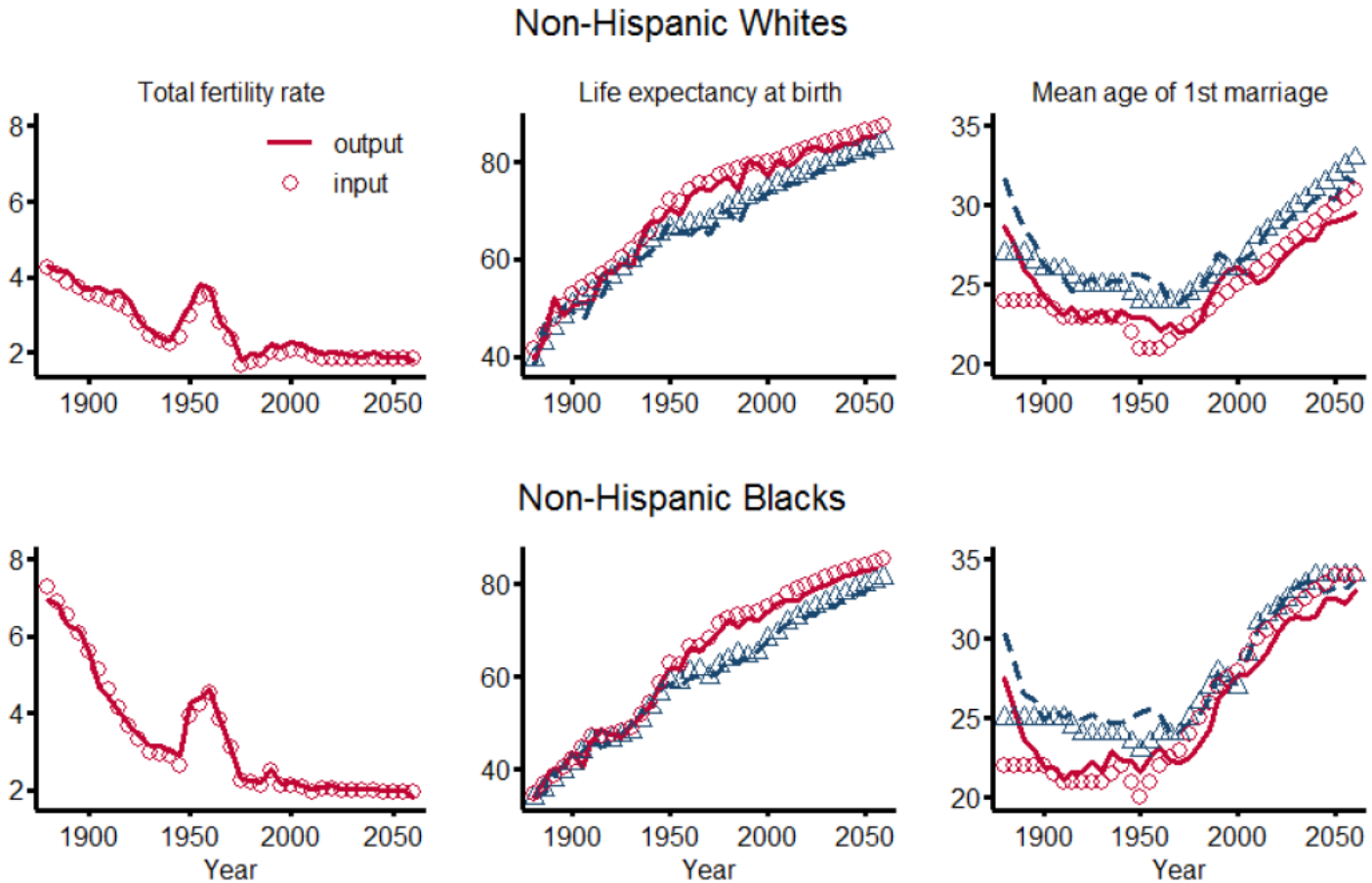
Verdery, A.M. and Margolis, R. (2017). Projections of white and black older adults without living kin in the United States, 2015 to 2060. Proceedings of the National Academy of Sciences 114(42):11109–11114.

Data sources

SI.1. Sources of demographic parameters for the simulation models.

Demographic parameter	Time period	Source
Initial Populations		
	1880	(1)
Life expectancy at birth		
	1880-1949	(3)
	1950-2014	(5)
	2015-2060	(6)
Total fertility rate		
	1880-1939	(3)
	1940-1979	(3, 8)
	1980-2013	(7)
	2014-2060	(9)
Proportion male at birth		
	1880-2060	(12)
Marital status birth proportions		
	1901-2060	(1)
Parity status birth proportions		
	1901-2060	(10)
Marriage rates		
	1880-2010	(13)
	2011-2060	Extrapolation
Remarriage rates		
	1880-2060	(14, 15)
Divorce rates		
	1880-1967	(16, 17)
	1968-2014	(16, 18)
	2015-2060	Extrapolation
Partnership rates	1880-1997	Non-marital childbearing
	1998-2005	(19, 20, 22, 24)
	2006-2060	Extrapolation and assumptions
Aging and population size scaling		
	1880-2060	(1, 6)

Sanity checks: comparing to ground-truth



Key rates, historical and projected changes over time and simulated outcomes, 1880- 2060.

Verdery, A.M. and Margolis, R. (2017). SI Appendix. Projections of white and black older adults without living kin in the United States, 2015 to 2060. Proceedings of the National Academy of Sciences 114(42):11109–11114.

Kinlesness by gender and ethnicity in the US

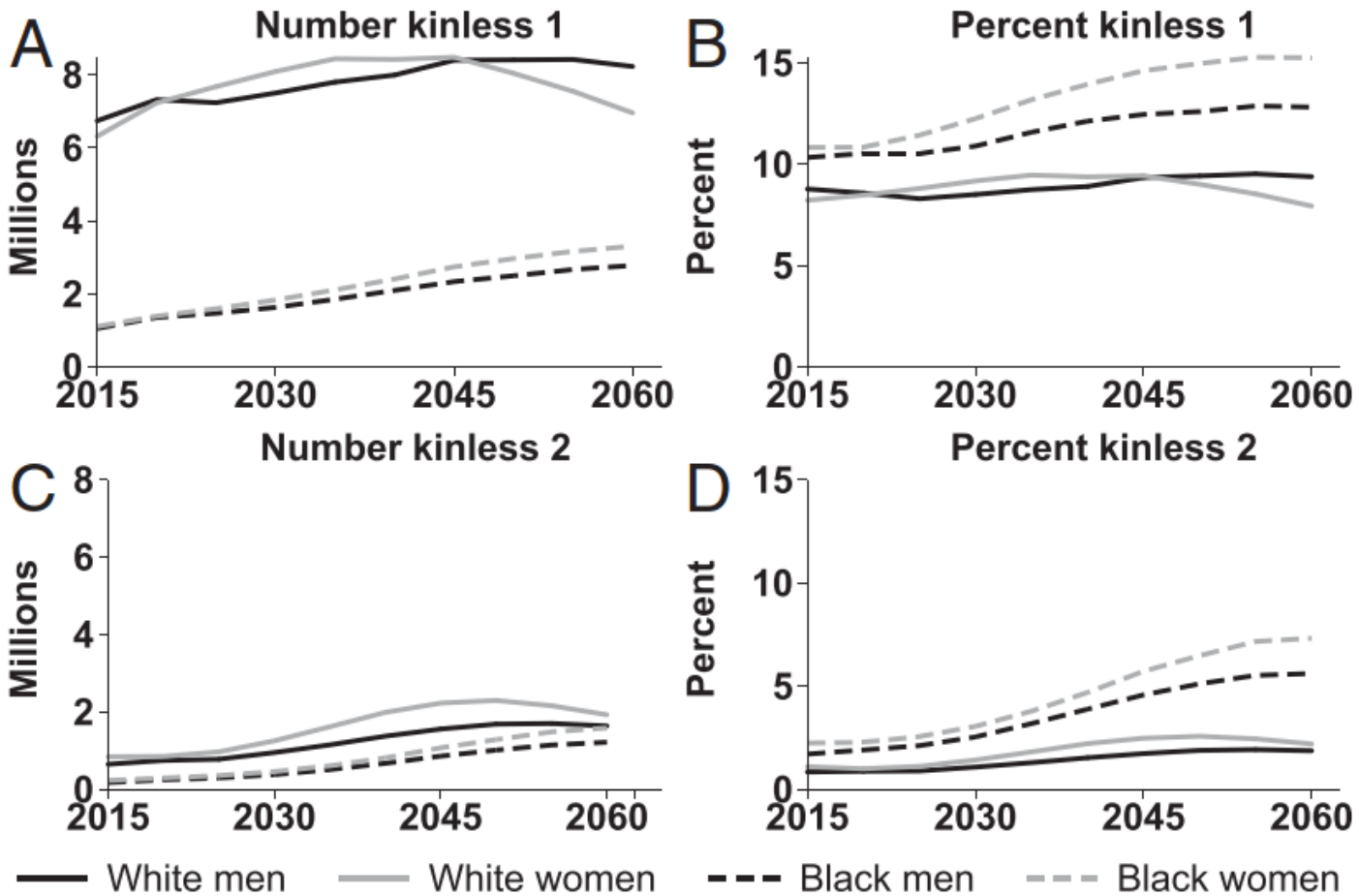


Fig. 1. Projected numbers kinless 1 (*A*), percent kinless 1 (*B*), numbers kinless 2 (*C*), and percent kinless 2 (*D*), people age 50 and older, by year, sex, and race.

Verdery, A.M. and Margolis, R. (2017). Projections of white and black older adults without living kin in the United States, 2015 to 2060. Proceedings of the National Academy of Sciences 114(42):11109–11114.

Beyond description: looking at mechanisms

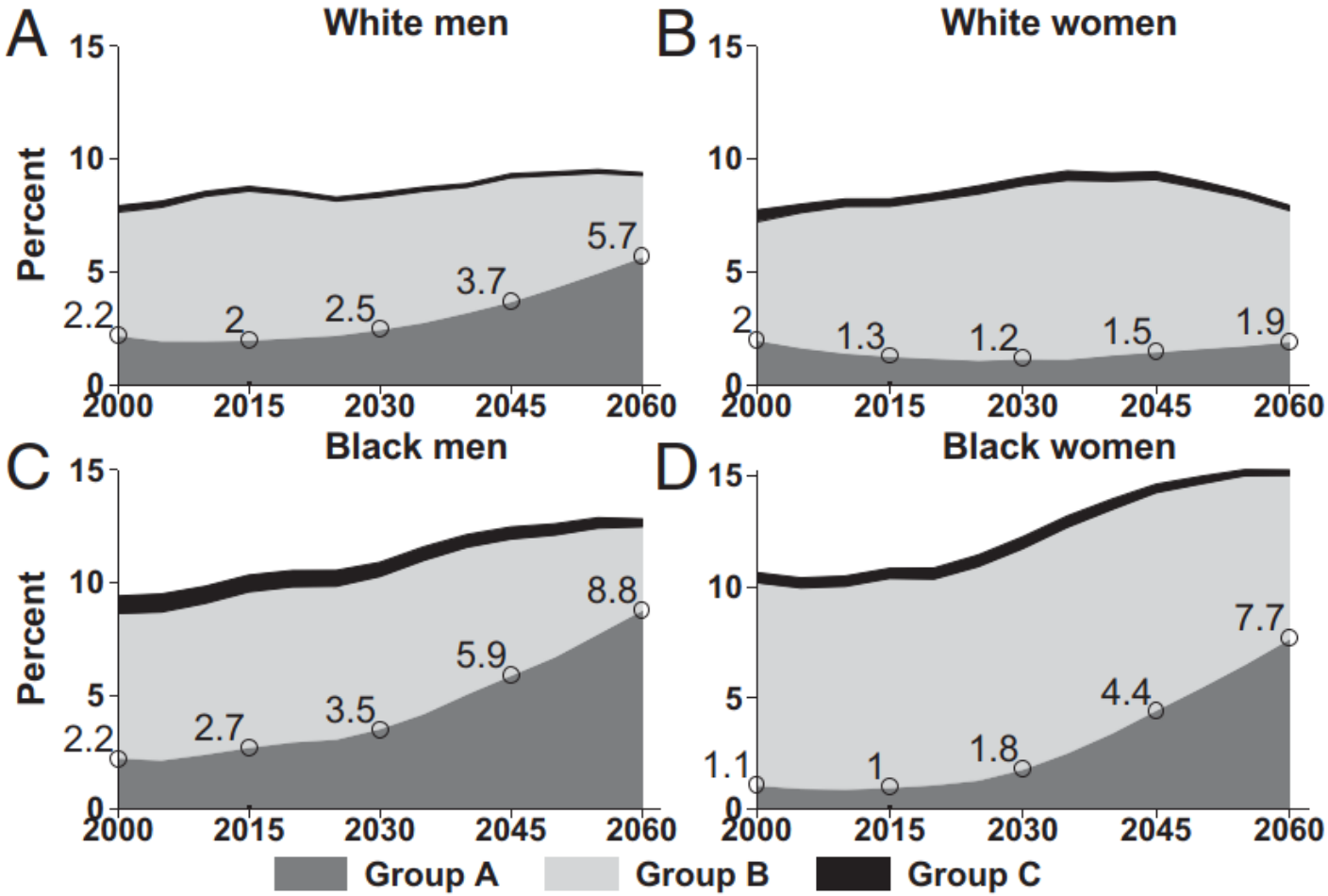


Fig. 3. Stacked percentages of White males (*A*), White females (*B*), Black males (*C*), and Black females (*D*) ages 50 and older without a living partner or biological children, 2000–2060. Note: percentages in group A in key years

Verdery, A.M. and Margolis, R. (2017). Projections of white and black older adults without living kin in the United States, 2015 to 2060. Proceedings of the National Academy of Sciences 114(42):11109–11114.

Discussion

Question time (refresher)!

We'll review two studies. Identify the

1. **strengths**
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of their reliance on microsimulation

```
kable(df)
```

study	who
Zimbabwe	Alexander
Zimbabwe	Octavio
Kinless	Madalina
Kinless	Qi

Impact of the HIV/AIDS epidemic

- Pro: No alternative data source
- Pro: accounts for clustering of mortality
- Con: comparison to ground-truth?
- Con: high uncertainty of projected rates used as input in this context

Projecting older adults without kin

- Pro: unpacks demographic dynamics leading to outcome
- Con: model assumptions about marriage market
- Pro: different divorce and marital rate trajectories
- Pro: comparison to ground-truth?
- Con: cannot account for future mortality shocks

Comparing to ground truth

SI.3. Comparison of Simulation Estimates to Population Surveys.

	Simulation (2010) Ages 50+ NH Whites	Simulation (2010) Ages 50+ NH Blacks	HRS (1998-2010) Ages 55+ All races	GSS (2010-14) Ages 50+ All races	NSFH (1992-94) Ages 50+ All races	ISSP (2001) Ages 50+ All races	PSID (2011) Ages 55+ NH Whites	PSID (2011) Ages 55+ NH Blacks
Percent without each kin type								
No biological children	19.2	18.0	10.5	13.8	9.1	17.0	18.0	26.0
No siblings	14.3	23.1	16.6	NA	14.5	14.4	NA	NA
No spouse	36.5	53.8	38.5	38.6	35.0	51.8	36.0	60.0
No biological parents	69.5	75.5	79.1	NA	73.3	65.4	61.0	77.0
Percent Lacking Kin Constellations								
No spouse or biological children	8.4	10.2	6.6	8.7	6.4	13.5	NA	NA
No spouse, children, parents, or siblings	1.1	2.1	1.1	NA	1.7	1.8	NA	NA

When should we use real and simulated populations?

- Use real data whenever possible
- Improve the interval validity of simulations
  - Calibration
  - Methodological triangulation
  - Comparing simulations to ground-truth

A SOCSIM micro-simulation of Sweden (1603-2160)

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Where did this SOCSIM simulation come from?

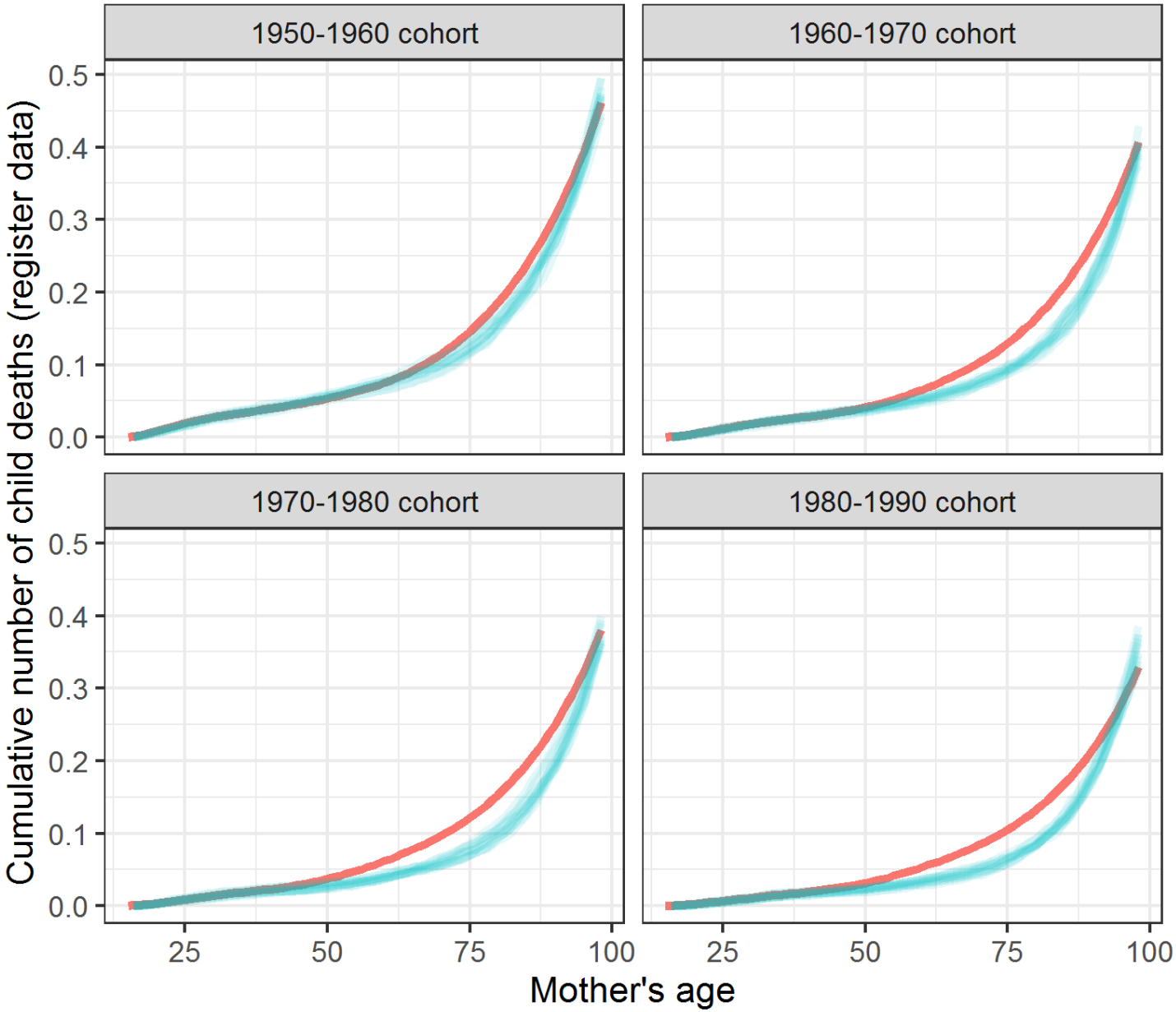
1. Initial population
2. Age-speficid fertility rates
3. Age-speficid mortality rates
4. Marriage transition rates
5. Model for marriage market
6. Other parameters (inheritance of fertility, etc.)

A quick example of such a comparison

- Cumulative number of child deaths for a woman surviving to a given age
  - Estimate from SOCISM-generated genealogy
  - Estimate formally:

$$\underbrace{CD_{(a,c,p)}}_{\text{Child deaths}} = \underbrace{\sum_{x=15}^{x=a} {}_1F_{(x,c,p)}}_{\text{Children born}} - \underbrace{\sum_{x=15}^{x=a} {}_1F_{(x,c,p)} l_{(a-x,c+x,p)}}_{\text{Children surviving or } CS_{(a,c,p)}} \quad (1)$$

Methodological triangulation: model and formal estimates



More validation: Compare to 'gold-standard' data

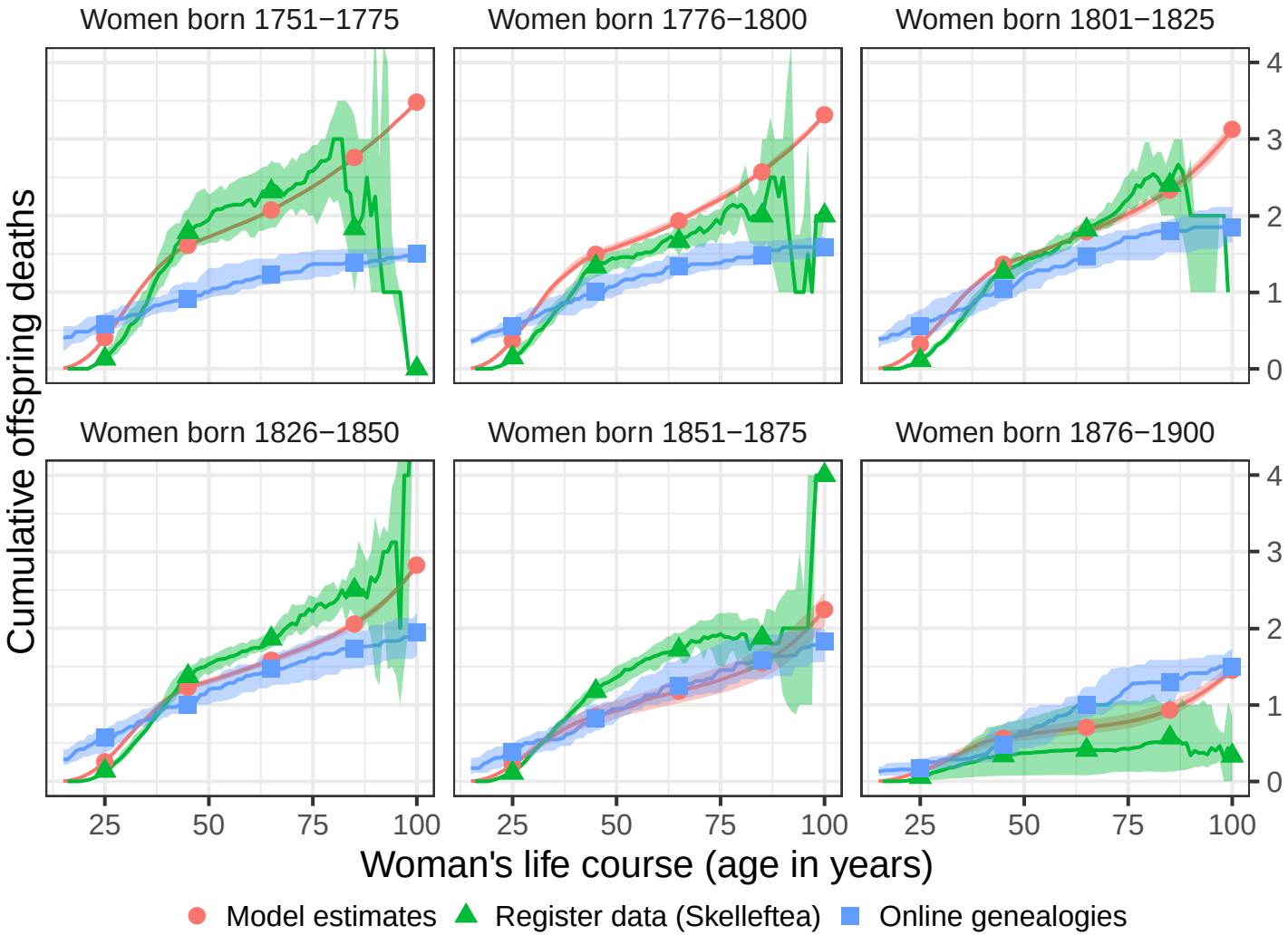


Figure 3: Expected number of child deaths

Another example: sandwichness

- 'Sandwiched' between having a young child and a parent close to death
- Double care responsibility
- Change over time

$$S(a,c) = \underbrace{(1 - \prod_{x=1}^{5} 1 - F_{a-x,c})}_{\substack{\text{Prob. of having given} \\ \text{birth in 5 preceding years}}} \times \underbrace{M_{a,c}}_{\substack{\text{P. mother} \\ \text{is alive}}} \times \underbrace{(1 - \frac{M_{a+5,c}}{M_{a,c}})}_{\substack{\text{Prob. that mother} \\ \text{dies within 5 years}}}$$

Comparing model and simulated estimates

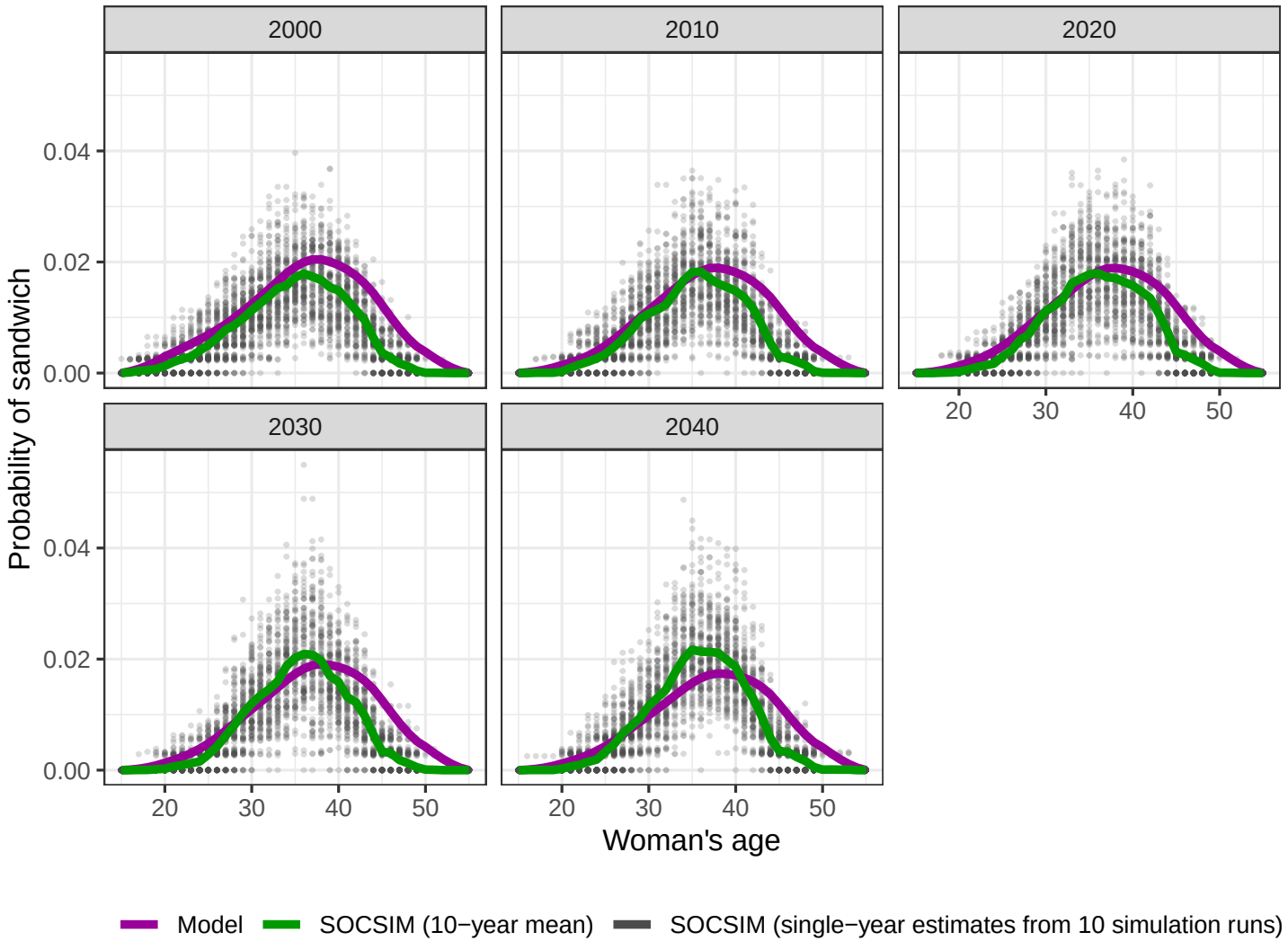


Figure 4: Expected number of child deaths in the USA

Make yourself heard!

1. Brainstorming on project ideas?
2. How does all of this relate to your interests?
3. Final thoughts?

Evaluation time

1. Course evaluation in Moodle
2. Mini-survey on online teaching

Historical and projected demographic processes

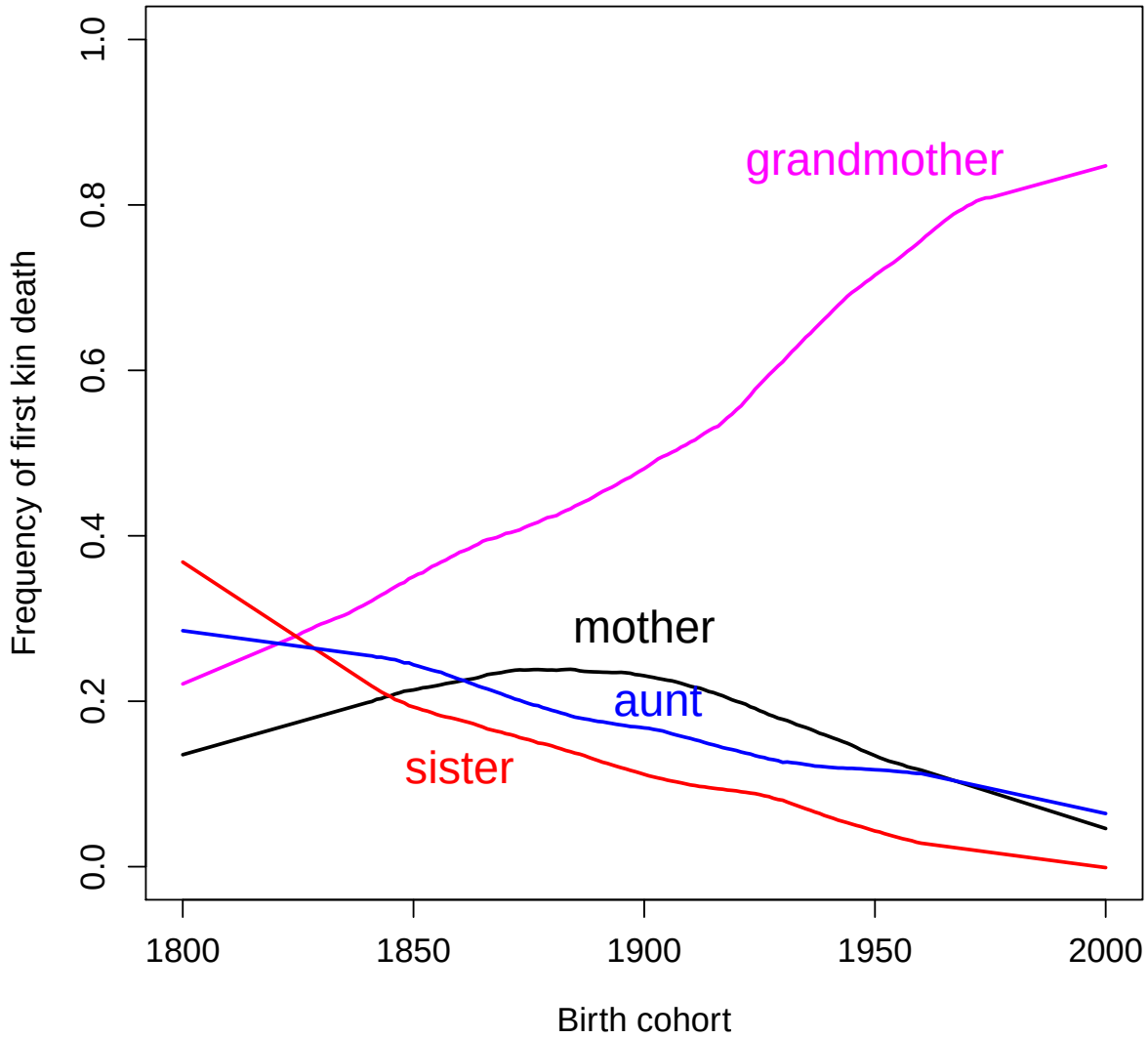


Figure 5: Frequency of different types of kin death, Sweden (SOCSIM)