

A Bayesian approach on reconstructing multistate populations and education specific fertility rates

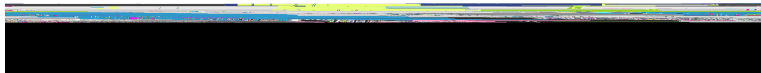
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Outline

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Introduction

- Consistent time series for population by educational attainment is required to comprehensively assess the returns to investments in

Introduction

- Two approaches to rebuild past populations: back projection and **reconstruction**.
- Back projections by educational attainment (Wrigley and Scho eld 1982, Lee 1978, Barro and Lee 1993, Lutz et al. 2007, Goujon et al. 2016).
- **Bayesian modelling** for **simultaneously** estimating past population by **age, fertility, mortality** and **net migration** (Wheldon et al. 2013).

Data sources - Brazil (1980-2010)

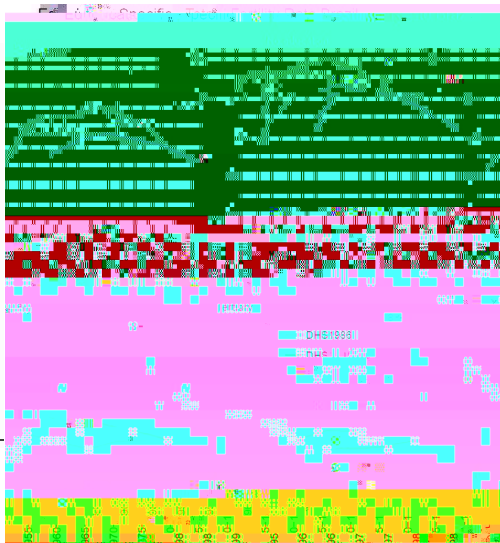
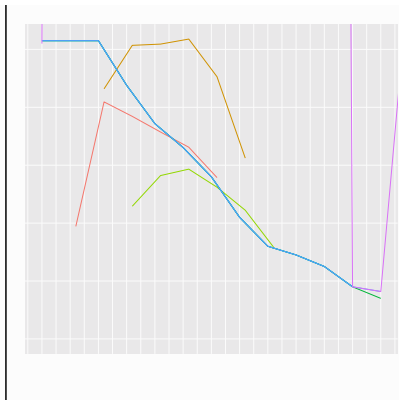
- Population counts by age, gender and educational attainment:
 - IPUMS-International database for education distribution
 - The Brazilian Institute of Geography and Statistics (IBGE) reconstructed census counts
 - Precision: Size of 95% CI equals to 3%, 5% and 10% of the population
- TFR and ASFR:
 - IBGE reconstructed fertility rates
 - Precision: Highest standard deviation from DHS surveys and applied to all



Brazil population by educational attainment

Year	Sex	No education	Primary	Secondary	Tertiary
1980	Male	55.1%	33.0%	10.1%	1.7%
1990	Male	48.2%	33.7%	15.4%	2.8%
2000	Male	39.1%	34.7%	23.0%	3.3%
2010	Male	32.5%	28.2%	33.4%	6.0%
1980	Female	56.0%	32.0%	10.8%	1.2%
1990	Female	47.5%	33.0%	16.9%	2.6%
2000	Female	37.5%	33.1%	25.7%	3.6%
2010	Female	30.6%	25.8%	35.6%	6.0%

Available fertility data





Level 1: Modelling census counts

$\log n_{a;s;t;e}$ Normal ($\log n_{a;s;t;e}; \frac{n}{a;s;t;e}$) $t = 1970; 1980; 1990; 2000; 2010$

Level 2: Cohort component population projection method

Level 3: Modelling initial estimates

$\log f_{a;t}$ Normal ($\log f_{a;t}; \frac{f}{a;t}$)

$\log \text{TFR}_t$ Normal ($\log \text{TFR}_t; \frac{\text{TFR}}{t}$)

$\log \text{ESTFR}_{t;e}$ Normal ($\log \text{ESTFR}_{t;e}; \frac{\text{ESTFR}}{t;e}$)

$\log \text{ESASFR}_{a;t;e}$ Normal ($\log \text{ESASFR}_{a;t;e}; \frac{\text{ESASFR}}{a;t;e}$)

Level 3 continued:

$\log n_{a;s;t_0;e}$ Normal ($\log n_{a;s;t_0;e}; \frac{n}{a;t_0;e}$)

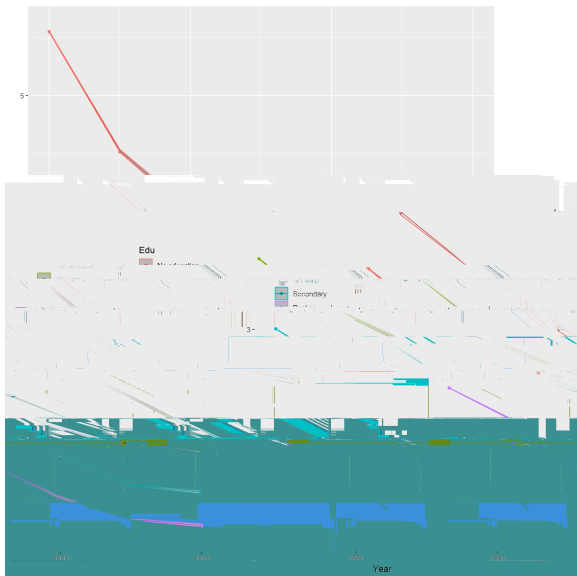
$h_{a;}$ Normal ($h_{a;}; \frac{h}{a;}$)

Multistate model

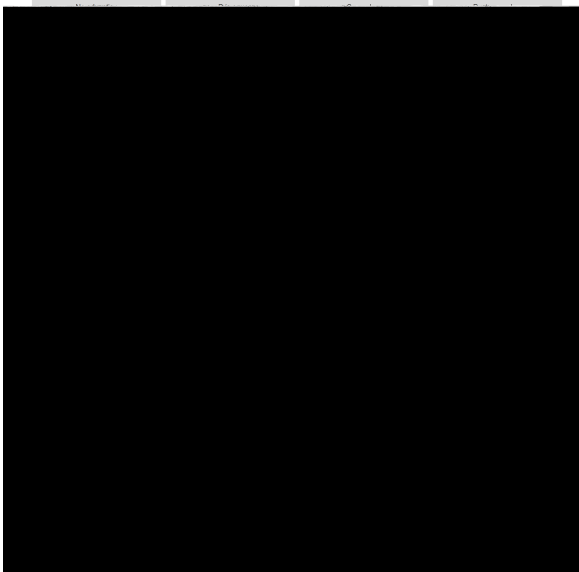




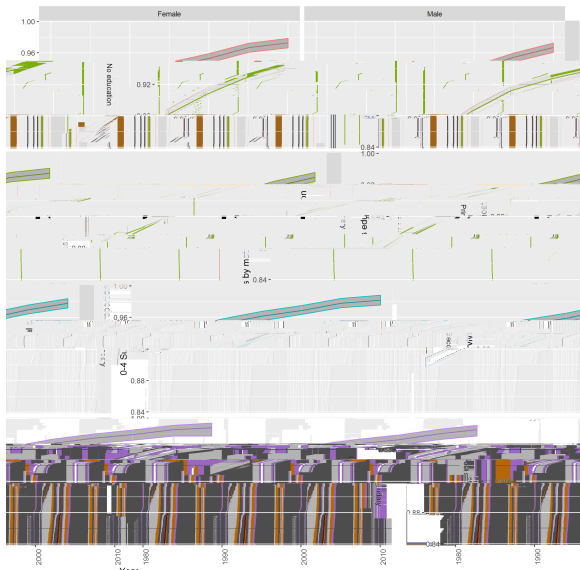
ESTFR



ESASFR



0-4 Survival proportions



Introduction

Data Sources

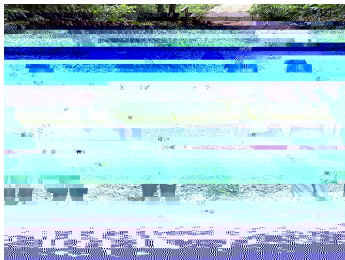
Methodology

Results

Software and computational details

Conclusion and future work

- Better precision values
- Sensitivity analysis
- Better prior transition proportions
- Net migration
- Expert opinion
- ASFR patterns
- Comparison with back projection estimates



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