Estimation of life tables in the Latin American Mortality Database (LAMBdA)

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HTTPS://WWW.SSC.WISC.EDU/CDHA/LATINMORTALITY

Data problems

- Completeness of death registration
- Completeness of censuses
- Age misreporting
  - Age heaping
  - Systematic age misreporting
- Classification of causes of deaths and treatment of ill defined

In this paper

- Describe estimation of adult mortality (over age 5) and of life expectancy at ages 5 and 60
- Describe adjustment for age misreporting
- Describe results of a large evaluation study
- Introduce uncertainty

Relative completeness of death registration: adjustment shown using well-known methods

Adult age over(under) reporting of death and population. Adjustments shown using less well-known methods

Age misreporting

Table 2: Biases due to age overstatement.

Country	Mid-Year	Unadjusted		Adjusted*	
		E(45)	E(60)	E(45)	E(60)
Argentina	1953	25.96	15.39	25.29	14.55
	2005	30.02	17.96	29.33	17.15
Brazil	1985	28.55	17.61	27.62	16.51
	2005	31.27	19.77	30.23	18.58
Chile	1956	24.44	14.57	23.72	13.64
	2006	33.20	20.45	32.16	19.33
Colombia	1957	27.34	16.68	26.46	15.67
	2008	35.09	22.29	33.86	20.96
Costa Rica	1956	29.08	17.55	28.10	16.46
	2005	34.96	22.40	33.78	21.13
Cuba	1961	30.13	18.15	29.18	17.08
	2006	33.46	20.94	32.56	19.95
Dominican Republic	1955	33.62	22.44	31.91	20.52
	2006	38.35	25.76	36.41	23.68
Ecuador	1956	28.75	17.98	27.77	16.83
	2005	37.42	25.23	35.94	23.62
El Salvador	1955	27.64	17.54	26.69	16.42
	2008	32.79	21.74	31.85	20.62
Guatemala	1957	24.44	15.06	23.68	14.07
	2005	31.39	20.22	30.42	19.10
Honduras	1955	30.55	20.37	29.14	18.64
	1989	37.33	25.06	35.61	23.17
Mexico	1955	26.57	16.69	25.80	15.71
	2005	33.04	21.13	31.97	19.95
Nicaragua	1956	32.09	21.05	30.61	19.37
	2007	36.23	24.05	34.71	22.41
Panama	1955	28.93	17.67	27.87	16.45
	2005	35.92	23.18	34.65	21.81
Paraguay	1956	32.97	20.81	31.73	19.44
	2006	34.84	22.17	33.60	20.84
Peru	1950	30.61	20.64	29.47	19.25
	2008	39.37	26.32	37.66	24.52
Uruguay	1969	26.72	15.47	26.11	14.69
	2007	30.35	18.17	29.85	17.57
Venezuela	1955	27.49	16.81	26.47	15.64
	2006	32.75	20.94	31.53	19.59

* Adjusted for age misreporting

Age misreporting (45+)

- New method(s) based on:
  - Basic statistic: cmRx(T1,T2) computed using two censuses (at T1 and T2) and intercensal deaths between T1 and T2
  - A standard pattern of age misreporting
  - Alternative techniques to estimate magnitude of age misreporting

Statistic: cmRx(T1,T2)

- From previous studies (Dechter-Preston, Del Popolo, Preston-Condran-Himes) using (a) two census at T1 and T2 and intercensal deaths in (T1,T2)

$$cmR^{o}_{x,[t_1,t_2]} = \frac{cmP^{o}_{x+k,t_2}/cmP^{o}_{x,t_1}}{1-(cmD^{o}_{x,[t_1,t_2]}/cmP^{o}_{x,t_1})}$$

Behavior of key statistic cmRx(T1,T2) under different conditions

- Main problems:
  - Unequal census completeness leads to statistic's behavior that mimics age over(under)statement
  - Intercensal migration leads to statistic's behavior that mimic age over(under)statement
- Conditions :
- Adjusted for relative completeness of census enumeration
- Closed to migration (or adjusted for it)

Age patterns and levels of age misreporting

- Main idea:
  - Detect problem with statistic
  - Reconstruct true population (matrix)
    - Age pattern of age misreporting
    - Level of age misreporting

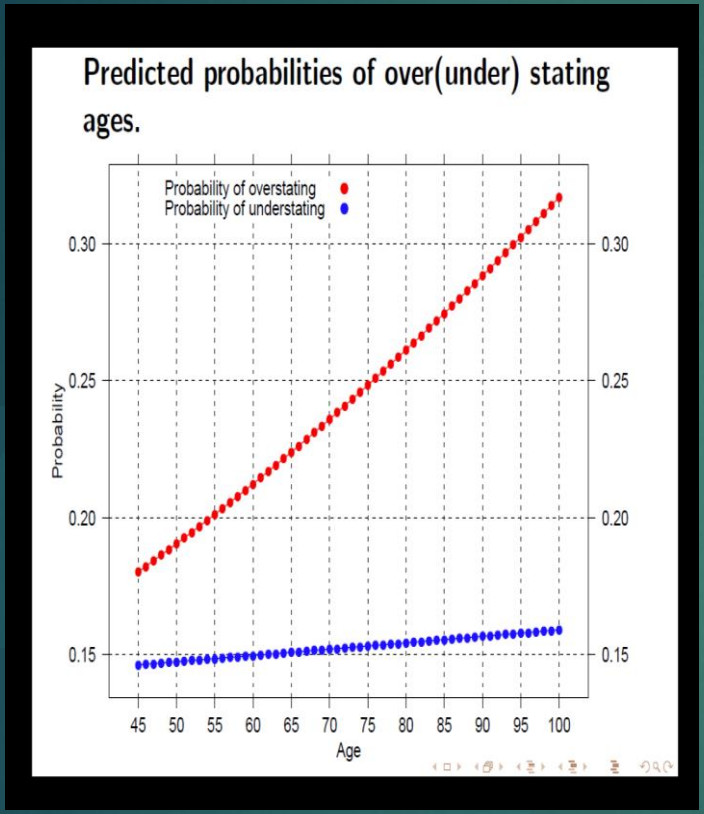
- From previous studies
  - India (Bhat)
  - Latin America (Ortega)
  - US: Medicare records (Preston et al)

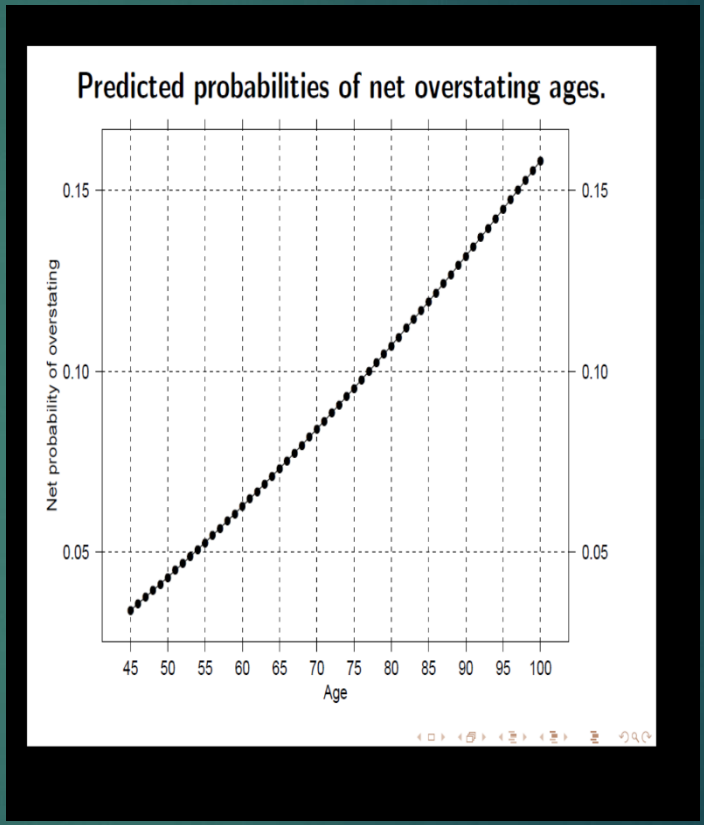
- We use Costa Rica 2002 matching study (census-voting register) and estimate standard patterns of
  - Population age misreporting
    - Probability of over(under) stating age at age x
    - Conditional probability of over(under) stating age by 1-10 years given over(under) statement at age x
    - The above is referred to as “standard pattern of age misstatement”
    - Generates a “standard matrix” of population transfers across ages

Main results from Costa Rica study

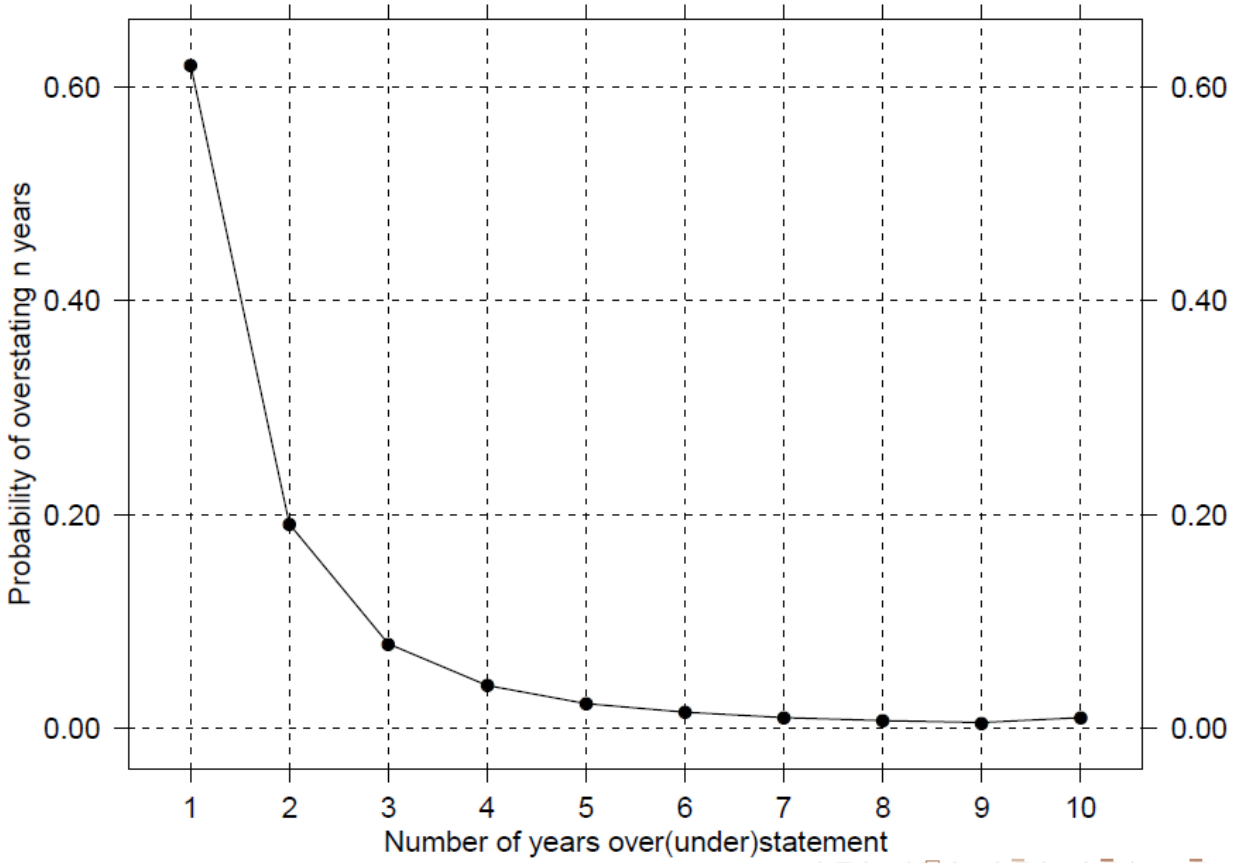
- Gender differences in age misreporting: marginal
- Age differences in prob. of misreporting: large
- Overstatement overwhelms under statement

Age patterns of age misreporting





Conditional probabilities of overstating age by *n* years.



Outcome

- Matrix of net "age transfers" is a standard pattern of age misreporting that we assume prevails in all countries
- Observed patterns produced by identical standard but different levels of age misreporting (age specific probability of misreporting)
- Standard death and population patterns of age misreporting are identical

Strategy

- Estimate model predicting prob of age net overstatement as a function of age
- Estimate negative binomial model for conditional probability of overestimation
- Generate the Costa Rican standard of age net overstatement
- Allow shifts in levels of net overstatement: the shifts or magnitude of age misreporting are estimated from data

Identification conditions

- We can estimate both LEVELS of net overstatement of ages at death and population
- BUT:
- Cannot identify simultaneously population over and under statement, only net overstatement
- Must assume age patterns of over (under) statement of ages at death and population are identical
- Must assume that standard is appropriate for observed population

METHODS TO ESTIMATE MAGNITUDE OF AGE MISREPORTING DEATH AND POPULATION

- Brute force iterative procedure :
  - plausible but time consuming
- Inverse regression based on regression models estimated in simulated population. The estimates are then used in observed population
  - Optimal, economic
- Parametric using observed data only
  - Too sensitive at higher ages

EVALUATION STUDY

- To adjust for completeness
- To correct for age misstatement

Evaluation study

- Objective: identify error distribution of estimates associated with different methods under multiple conditions violating assumptions
- Precursor study by Hill et al. Our is a generalization
- Main ingredients
  - 5 population profiles (see Appendix 1 for definition)
  - Patterns of errors of census/death completeness
  - Patterns of age over-reporting
  - Age dependent completeness
- Total of up to 94500 different simulated populations
- Measurement of error of main parameter: relative completeness of death registration
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Adult mortality adjustments

- Relative completeness
  - Methods: Bennett Horiuchi, Bennet-Preston, Preston Hill, Brass-Hill, Brass-Martin etc...A suite of 8-12 methods (depending on how one counts them). They differ:
    - Data required: one or two census, nature of death time series
    - Assumptions made: Stability, no migration, age invariance of completeness, etc...
    - Sensitivity: errors when basic assumption are violated
- Age misreporting
  - Method previously described

Performance of methods.

Indicator	A. Stable and Nonstable			B. Stable			C. Nonstable			D. Nonstable*			E. Nonstable*			F. Nonstable†		
	Median	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median	Std. Dev.	Min	Median	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median	Mean	Std. Dev.
Brass-Hill Census (BHill)[1]	0.003	0.003	0.003	0.005	0.005	0.003	0.002	0.003	0.002	0.001	0.001	0.000	0.002	0.003	0.002	0.002	0.003	0.002
Bennet-Horiuchi 1 (BH_1)	0.016	0.062	0.081	0.011	0.052	0.072	0.019	0.064	0.083	0.023	0.061	0.076	0.010	0.013	0.011	0.178	0.192	0.034
Bennet-Horiuchi 2 (BH_2)	0.015	0.063	0.084	0.011	0.053	0.074	0.018	0.065	0.086	0.022	0.060	0.076	0.011	0.013	0.010	0.180	0.196	0.038
Bennet-Horicuhi 3 (BH_3)	0.015	0.062	0.081	0.010	0.052	0.072	0.018	0.064	0.083	0.024	0.061	0.075	0.010	0.013	0.011	0.178	0.191	0.033
Bennet-Horiuchi 4 (BH_4)	0.015	0.063	0.084	0.011	0.053	0.074	0.018	0.065	0.086	0.023	0.060	0.076	0.011	0.013	0.010	0.180	0.196	0.038
Brass-Martin (BMartin)[2]	0.080	0.107	0.083	0.038	0.038	0.021	0.112	0.124	0.084	0.061	0.070	0.059	0.112	0.124	0.084	0.111	0.124	0.084
Brass-Hill (BHill)[1]	0.044	0.046	0.027	0.038	0.038	0.021	0.045	0.048	0.028	0.043	0.005	0.003	0.044	0.048	0.028	0.045	0.048	0.028
Preston-Bennet (PB)	0.053	0.239	0.413	0.017	0.173	0.293	0.068	0.256	0.437	0.033	0.189	0.349	0.031	0.051	0.049	0.546	0.768	0.542
Preston-Hill 1 (PH_1)	0.183	0.203	0.158	0.010	0.068	0.098	0.225	0.236	0.152	0.236	0.243	0.153	0.203	0.226	0.146	0.266	0.261	0.165
Preston-Hill 2 (PH_2)	0.228	0.230	0.157	0.069	0.103	0.068	0.249	0.262	0.156	0.258	0.270	0.156	0.241	0.258	0.146	0.292	0.273	0.180
Presto-Lahiri 1 (PL_1)	0.026	0.132	0.223	0.081	0.086	0.134	0.030	0.143	0.239	0.066	0.127	0.229	0.021	0.023	0.015	0.294	0.439	0.270
Preston-Lahiri 2(PL_2)	0.029	0.120	0.190	0.094	0.078	0.118	0.034	0.130	0.203	0.034	0.113	0.193	0.021	0.027	0.021	0.263	0.384	0.225

Recommended procedure

- I. Estimate Brass/Hill relative census completeness
- II. Estimate Bennet-Horiuchi
- III.Adjust cmRx(T1,T2) function using (I)
- IV Estimate lebvel of age misreporting using optimal (regression based method)
- V. Adjust mortality rates and construction life tables from age 5 on

Uncertainty

- Evaluation study produces
  - Metapopulation====== error distributions of each candidate method under different conditions violating assumption
- Can attach probability (of error) measure to each candidate method
- Can use them explicitly in estimation thus generating bounds of uncertainty of target parameters

THANK YOU