Lecture 3
Assessing the Completeness of Birth Registration

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Outline

- Comparison with World Population Prospects
- Reverse survival method
- Applying fertility rates from survey data (e.g. DHS)

1. Comparison with WPP estimates

- The United Nations provides estimates of annual births for each country of the world
- Estimates based on a variety of methods, with the important constraint that their estimates of births must be consistent with their population estimates and mortality/fertility estimates
- Useful starting point for evaluating completeness of birth registration

Comparison with WPP estimates (cont'd)

$$\text{Completeness in year } t = \frac{\text{CRVS births in year } t}{\text{UNWPP births in year } t} \cdot 100$$

- For Year 0 completeness: numerator should use CRVS births for year t after adjusting for mechanical delayed registration
- For ultimate completeness: numerator should use CRVS births for year t after adjusting for all late registration
- Ideally, calculate both Year 0 and ultimate completeness

Example

- South Africa 2011-2019

Figure 9: Completeness of births relative to the UNWPP, South Africa 2011-2019

	A	B	C	D	E	F	G	H	I	J
1	ESTIMATION OF COMPLETENESS									
2	Registration of births (both sexes) - South Africa 2011-2019									
3								Completeness relative to		
4		Registrations		Comparator estimates			UNWPP		Other	
5	Year	Year 0	Ultimate	UNWPP	Other		Year 0	Ultimate	Year 0	Ultimate
6	2011	935 153	1 036 220	1 203 621			77.7%	86.1%		
7	2012	948 094	1 033 715	1 206 745			78.6%	85.7%		
8	2013	956 676	1 028 529	1 207 107			79.3%	85.2%		
9	2014	969 346	1 030 901	1 205 147			80.4%	85.5%		
10	2015	930 020	982 360	1 201 362			77.4%	81.8%		
11	2016	884 718	930 373	1 196 240			74.0%	77.8%		
12	2017	905 180	949 407	1 190 279			76.0%	79.8%		
13	2018	934 273	983 442	1 183 984			78.9%	83.1%		
14	2019	954 532	1 019 948	1 177 806			81.0%	86.6%		

Figure 10: Estimated completeness of registration of births, South Africa 2011-2019
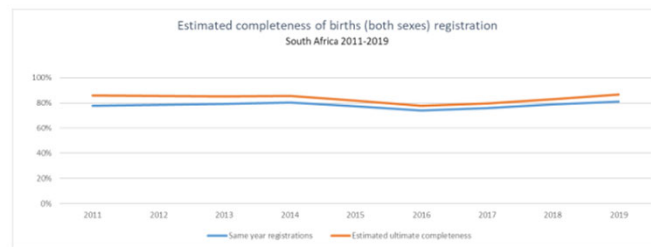
2. Reverse survival

- In theory, invididuals born at time *t* who survive to the date of a subsequent census taking place at time t+x should be counted in that census as individuals aged *x*
- Census counts of individuals aged x can be used to estimate births at time t
- Reversal survival takes into account individuals born at t who did not survive to the time of census – they need to be « added back » to the cohort size to obtain an estimate of births
- Assumption that international migration is negligible

Needed data

- Census population count by single year or five-year age groups for the population aged less than 15 years
- Life table by single year or five-year age groups
  - From survey data or models
  - Needed life table quantity: $_1L_x$ (single-year age groups) or $_5L_x$ (five-year age groups)

Formulas

- t=exact date of the census (e.g., 2020.25 if April 1, 2020)
- Formulas for single-year age groups:

$B[t-1,t] = {_1N_0} * l_0 / {_1L_0}$
$B[t-2,t-1] = {_1N_1} * l_0 / {_1L_1}$
$B[t-3,t-2] = {_1N_2} * l_0 / {_1L_2}$
Etc..

- Formulas for five-year age groups:

$B[t-5,t] = {_5N_0} * 5 * l_0 / {_5L_0}$
$B[t-10,t-5] = {_5N_5} * 5 * l_0 / {_5L_5}$
$B[t-15,t-10] = {_5N_{10}} * 5 * l_0 / {_5L_{10}}$

Births by calendar year

- Reverse survival method estimates births for 1-year periods or 5-year periods before the date of the census
- These will not coincide with calendar years unless the census takes place on January 1
- Need to use interpolation to estimate births by calendar year
  - Assume that births for 1-year period takes place on average .5 year before the census
  - e.g., if census date is 2020.25, births will be estimated for 12-month periods centered at 2019.75, 2018.75, 2017.75, etc.
  - Use interpolation to produce estimates of annual births at the mid-year of each calendar year: 2019.5, 2018.5, 2017.5, etc.
- These estimates of annual births give the denominator of completeness estimates

Interpolation example

Figure 11: Input and output from the 'Interpolation of Data' sheet

	A	B	C	D	E	F
1	This sheet implements linear interpolation of data to the middle of each calendar year.					
2	Select the sort-order of the data you wish to paste in cell **B6**, and place the data in cells **A10:B24**					
3						
4						
5						
6	Sort order	Descending (reverse)	▼			
7						
8						
9	Date	Estimate		Date	Interpolated value	
10	2007.67	295 328		1994.5	408 106.8	
11	2006.67	281 062		1995.5	404 671.7	
12	2005.67	290 118		1996.5	332 929.9	
13	2004.67	312 409		1997.5	361 365.5	
14	2003.67	306 453		1998.5	312 861.2	
15	2002.67	324 644		1999.5	345 537.6	
16	2001.67	325 997		2000.5	340 273.2	
17	2000.67	337 355		2001.5	327 920.8	
18	1999.67	354 583		2002.5	324 873.0	
19	1998.67	301 184		2003.5	309 534.2	
20	1997.67	370 118		2004.5	311 400.1	
21	1996.67	318 451		2005.5	293 893.8	
22	1995.67	403 924		2006.5	282 596.4	
23	1994.67	408 337		2007.5	292 911.4	
24	1993.67	406 976				
25						

Caution

- Method is sensitive to census underenumeration as well as age misreporting (e.g., age heaping)
- Should be not used going back more than 15 year prior to the census
- Mortality assumption is not very consequential

3. Applying fertility rates from survey data

- A number of survey programs produce estimates of age-specific fertility rates (DHS, MICS, etc.)
- Often more reliable than fertility estimates based on births reported in the census
- Together with population counts, fertility rates can be used to estimate annual births, i.e., the denominator of the completeness formula

Needed data

- Age-specific fertility rates in five year age groups, from age 15-19 until 45-49, taken from a recent survey: $_5F_{15}$, $_5F_{20}$, $_5F_{25}$, $_5F_{30}$, $_5F_{35}$, $_5F_{40}$, $_5F_{45}$
- Determine if fertility rates calculated for 3-year or 5-year period preceding the survey
- Counts of women in five year age groups, from age 15-19 until 45-49, taken from census or annual population estimates
  - Should pertain to time t-1.5 or t-2.5, with t=date of the survey, depending on the period over which fertility rates are calculated (3- or 5-year period)
  - Use interpolation if census or population counts do not exactly match these dates

Formula

$$Births(t) = \sum_i ASFR(i,t).Women(i,t)$$

- Use estimated annual births as the denominator of the completeness formula

Caution

- Sensitive to census underenumeration
- Survey-based fertility estimates come with uncertainty due to small sample size – results should be interpreted with uncertainty in mind