Population Estimation

United Nations Statistics Division

Outline

1. The Population Balancing Equation
2. Intercensal Cohort Survival Rates
3. Cohort Component Method

Population Balancing Equation

Census coverage

Population balancing equation

If a country has:

- A relatively complete system of vital registration
- A fairly reliable estimate of the degree of under-registration

- Information on the number of intercensal births, deaths and net international migrants can be used in conjunction with the results of a previous census to evaluate the coverage of a subsequent or current census.

Population balancing equation

$$P_1 = P_0 + (B - D) + (I - E)$$

Where:

P_1= Population enumerated in the census being evaluated

P_0= Population enumerated in a previous census

B = Number of births in the period between the two censuses

D= Number of deaths in the period between two censuses

I = Number of international immigrants during the intercensal period

E = Number of international emigrants during the intercensal period

Population balancing equation

- The population balancing equation is the most fundamental equation in demographic analysis and is also used to estimate population growth.
- It is based on the logic that:

  The population of a country can increase or decrease between any two points in time ***only*** as a result of births, deaths and movement of population across national boundaries

  - Births and immigration contribute to increase the population
  - Deaths and emigration reduce the population

Population balancing equation

- For census evaluation purposes, there is a residual (*e*) needed to make the equation balance exactly
- "*e*" in the equation is referred to as the "error of closure" and represents the balance of errors in the data on births, deaths, net migration, and the coverage of the two censuses:

$$P_1 = P_0 + (B - D) + (I - E) + e$$

- *If $e < 0$ (negative), P_1 is under-enumerated relative to P_0*
- *If $e > 0$ (positive), P_1 is over-enumerated relative to P_0*

Population balancing equation – Data required

- The population enumerated in two consecutive censuses
  - P_1: Census under evaluation
  - P_0: Previous census

- The number of births, deaths and net international migration (immigrants – emigrants) during the intercensal period, adjusted for under-registration (to the extent possible)

Population balancing equation – Computational Procedure

1. Compile registered numbers of intercensal births, deaths and migrants
   - Vital registration system
   - Immigration record system (residence permit, border records, etc.)
     - Adjustment based on under-coverage of these systems including indirect estimates

2. Calculation of the "expected" census population $(E(P1))$

$$E(P1) = P0 + (B - D) + (I - E)$$

3. Calculation of the residual error or error of closure

$$e = P_1 - E(P_1)$$

Population balancing equation – Interpretation of “e”

- If P_0 has been adjusted for net coverage error, the estimated residual error (*e*) will represent an estimate of net coverage error in P_1
  - If “*e*” is positive, P_1 is over-enumerated
  - If “*e*” is negative, P_1 is under-enumerated

- If P_0 is not adjusted, “*e*” will represent an estimate of the relative level of net coverage error in P_1 in comparison with P_0

Population balancing equation – Example
Sri Lanka, 1971 and 1981 Censuses (1)

For an unadjusted census:

$E(P_1) = P_0(\text{unadjusted}) + B_{adj} - D_{adj} + M_{adj}$

$= 12,689,897 + 3,716,878 - 1,002,108 + (-446,911)$

$= 14,957,756$

$e = P_1 - E(P_1)$

$= 14,848,364 - 14,957,756$

$= -109,392$ *0.7% of $E(P_1)$*

>> P_1 is under-enumerated relative to P_0

Source: U.S. Census Bureau (1985)

Population balancing equation – Example Sri Lanka, 1971 and 1981 Censuses (2)

For an adjusted census count:

$$E(P_1) = P0(\text{adjusted}) + B_{adj} - D_{adj} + M_{adj}$$

$$= 12{,}849{,}796 + 3{,}716{,}878 - 1{,}002{,}108 + (-446{,}911)$$

$$= 15{,}117{,}655$$

$$e = P_1 - E(P_1)$$

$$= 14{,}848{,}364 - 15{,}117{,}655$$

$$= -269{,}291 \quad \textit{1.8\% of } E(P_1)$$

>> P_1 is under-enumerated relative to P_0

Source: U.S. Census Bureau (1985)

Population balancing equation – Limitations

- Incomplete and defective data on the components of population change are very common
  - Applicability of the method is limited to countries with good vital registration coverage and migration data
- It is generally not useful for obtaining estimates of net census coverage error for sub-national populations (for example regions, provinces).
  - In addition to the components of population change considered, internal migration has to be considered
  - For most practical purposes, the use of the population balancing equation is limited to analysis of net coverage error at the **national level**

Cohort Survival Ratios

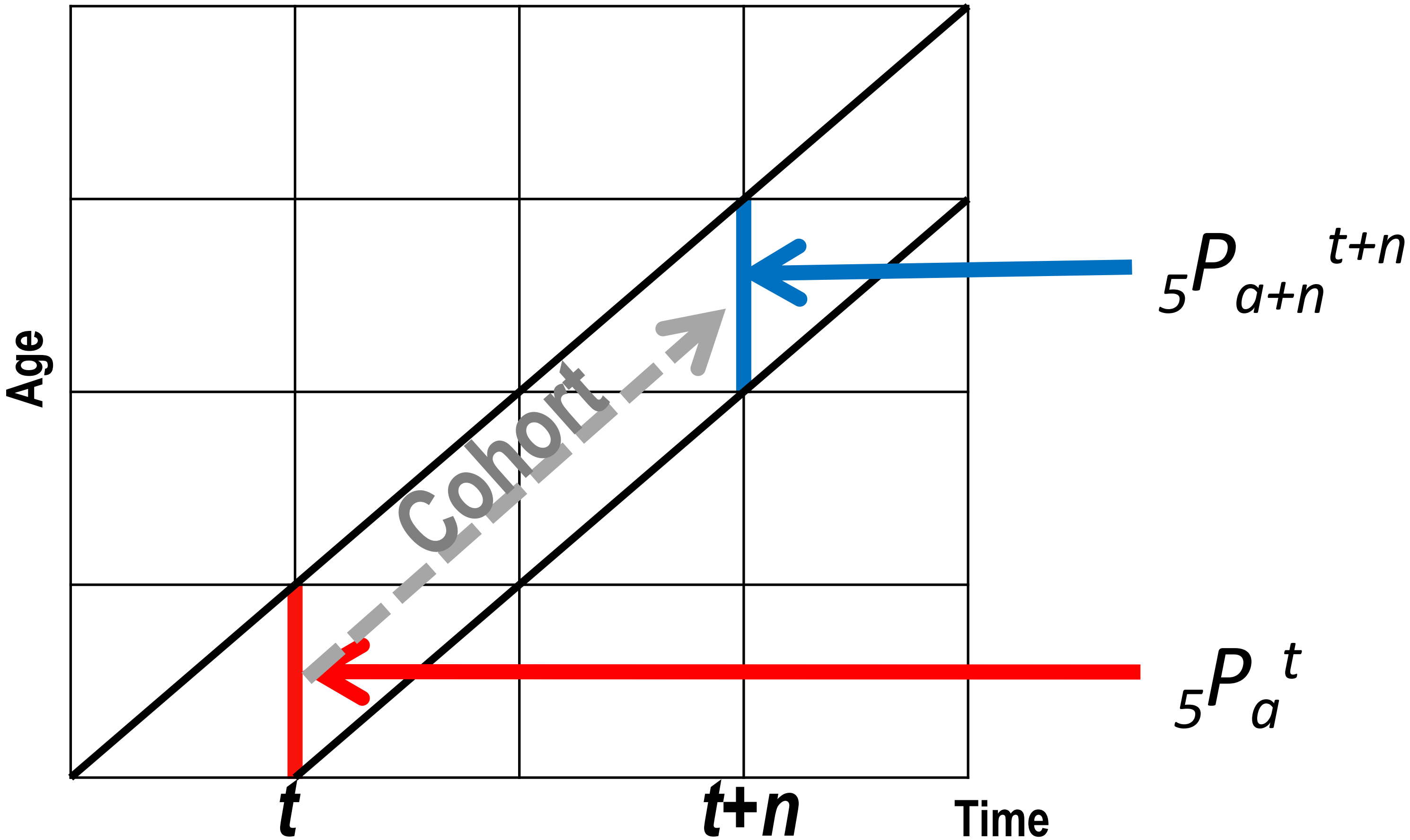
Mortality and census coverage

(Intercensal) Cohort survival ratios (*CSR*)

- This technique is based on a comparison of the size of birth cohorts enumerated in successive censuses
- In the absence of census errors, the ratio of the number of persons in a cohort enumerated in the second census to the number enumerated in the first census should approximate the survival rate that would be expected on the basis of mortality conditions
  - E.g. we have a cohort of males aged 40-44 at the time of the first census, say in 2000
  - If the next census is held exactly 10 years later, in 2010, this cohort will be aged 50-54
  - In the absence of other factors, we expect their numbers to have been reduced only by the life table quantity ${}_{10}d_x = l_x - l_{x+n}$, the number of deaths to those aged x over the subsequent 10 years

Source: U.S. Census Bureau (1985); Moultrie et al. (2013)

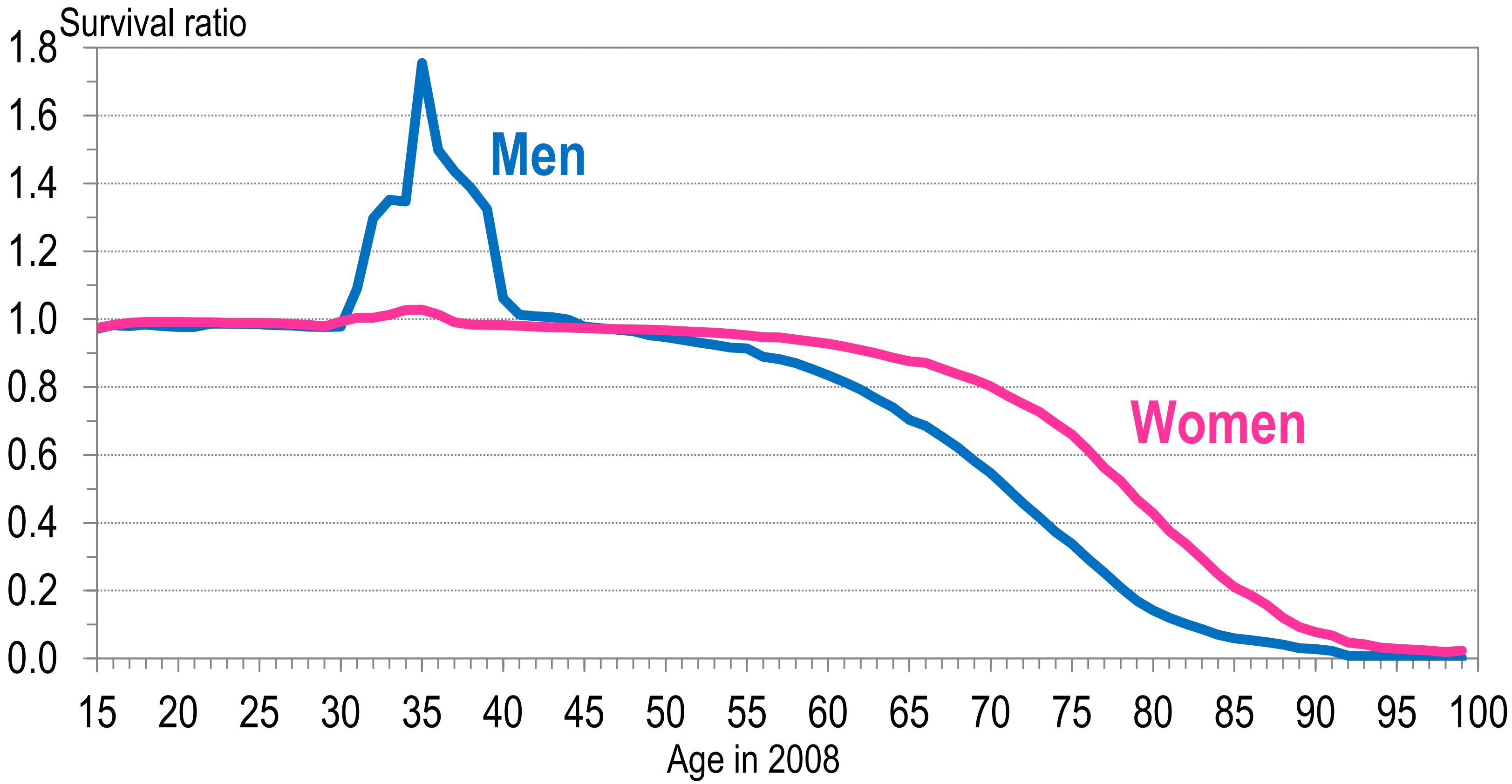
Cohort survival analysis: the principle



Cohort Survival Ratios: Caveats

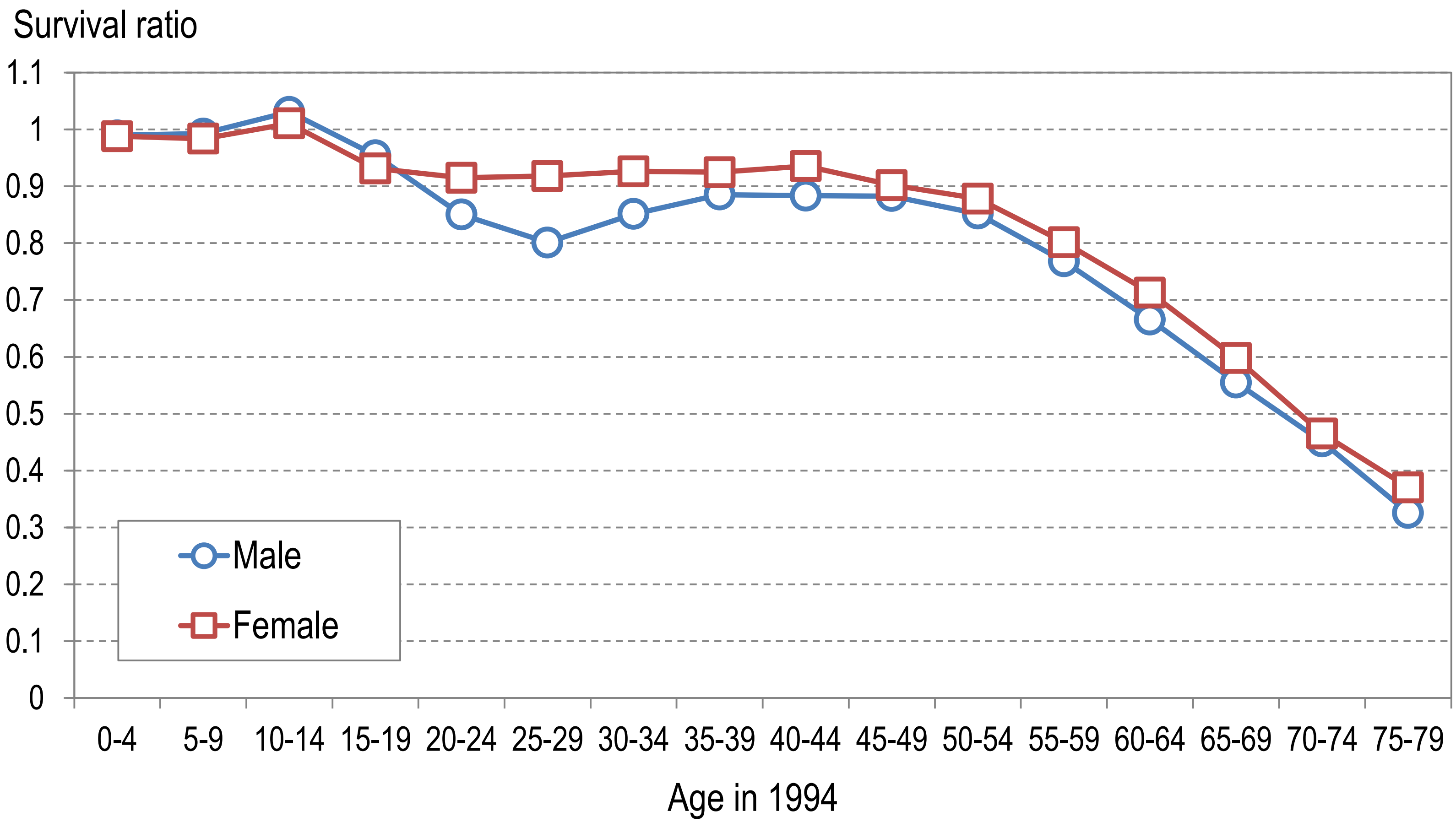
- The method is less useful when other factors make it difficult to determine whether deviations from the expected CSR are due to census error or something else
  - Substantial net migration (unless there are accurate estimates of net migration by age)
  - Changes in country borders between censuses
  - Changes in the population groups included in the two censuses (e.g. active military, nomadic groups) if the size of these groups is substantial

Cohort Survival Ratios: DPR Korea (1993-2008)



Source: Spoorenberg & Schwekendiek (2012).

Cohort Survival Ratios: Jordan, 1994 & 2004 Censuses



Calculating *CSR* (1)

Intercensal cohort survival rates are defined as:

$$ {}_{n}CSR_{x}(a) = \frac{{}_{n}P_{x+a}(t+a)}{{}_{n}P_{x}(t)} $$

Where:

- t = time of first census
- a = number of years between censuses
- ${}_{n}P_{x}(t)$ = size of the cohort at the time of the first census
- ${}_{n}P_{x+a}(t+a)$ = size of the cohort at the time of the second census

Calculating *CSR* (2)

The ratio of the observed intercensal cohort survival rate to the corresponding life-table survival rate

$${}_nR_x = \frac{\dfrac{{}_nP_{x+a}(t+a)}{{}_nP_x(t)}}{\dfrac{{}_nL_{x+a}}{{}_nL_x}}$$

Where:

- ${}_nP_{x+a}(t+a)$ = size of the cohort at time of the second census
- ${}_nP_x(t)$ = size of the cohort at the time of the first census
- ${}_nL_{x+a}$ = life table number of person-years lived in age interval $x+a$ to $x+a+n$ years
- ${}_nL_x$ = life table number of person-years lived in age interval x to $x+n$ years

Cohort Survival Ratio - Interpretation

In the **absence of census error**, the expected value of the ratio (${}_{n}R_{x}$) would be **1.0**

Ratio values for any particular cohort which **exceed 1.0** would indicate **over-enumeration** of the cohort in the second census relative to the first census

Ratio values of **less than 1.0** would indicate **under-enumeration** of the cohort in the second census relative the first census

Cohort Survival Ratio – Possible bias

Discrepancies can be due to 3 factors:

- Actual census errors
- Deficient data/adjustments for migration
- Wrong life table

Cohort survival ratios – Example (1)

Step 1: Adjustment for migration (*if appropriate*)

- In countries experiencing significant levels of net intercensal immigration, the number of net immigrants in each cohort may either added to the cohort enumerated in the first census or subtracted from the cohort enumerated in the second census
- In cohorts experiencing net intercensal emigration, the number of net intercensal emigrants can either added to the second census or subtracted from the first census
- Should be confident that migration data is reasonably accurate before making any adjustments

Cohort survival ratios – Example (2)

Step 2: Calculation of census survival rates using two consecutive censuses >> ${}_nP_{x+a}(t+a) / {}_nP_x(t)$

1 Aug 2000			1 Aug 2010			Cohort Survival Ratio 2000 - 2010	
Age	Male	Female	Age	Male	Female	Male	Female
0 - 4	8,326,926	8,048,802	0 - 4	--	--	--	--
5 - 9	8,402,353	8,139,974	5 - 9	--	--	--	--
10-14	8,777,639	8,570,428	10.14	8,725,413	8,441,348	1.0479	1.0488
15 - 19	9,019,130	8,920,685	15 - 19	8,558,868	8,432,002	1.0186	1.0359
20 - 24	8,048,218	8,093,297	20 - 24	8,630,227	8,614,963	0.9832	1.0052
25 - 29	6,814,328	7,035,337	25 - 29	8,460,995	8,643,418	0.9381	0.9689
30 - 34	6,363,983	6,664,961	30 - 34	7,717,657	8,026,855	0.9589	0.9918
35 - 39	5,955,875	6,305,654	35 - 39	6,766,665	7,121,916	0.9930	1.0123
40 - 44	5,116,439	5,430,255	40 - 44	6,320,570	6,688,797	0.9932	1.0036
45 - 49	4,216,418	4,505,123	45 - 49	5,692,013	6,141,338	0.9557	0.9739
	…	…		…	…	…	…

Cohort survival ratios – Example (3)

Step 3: Calculation of life table survival rates based on the expected level of mortality $_nS_x = \frac{_nL_{x+a}}{_nL_x}$

For first age group (here age 5-9): $_nS_x = \frac{_nL_{x+a}}{_1L_0 + {_4L_1}}$

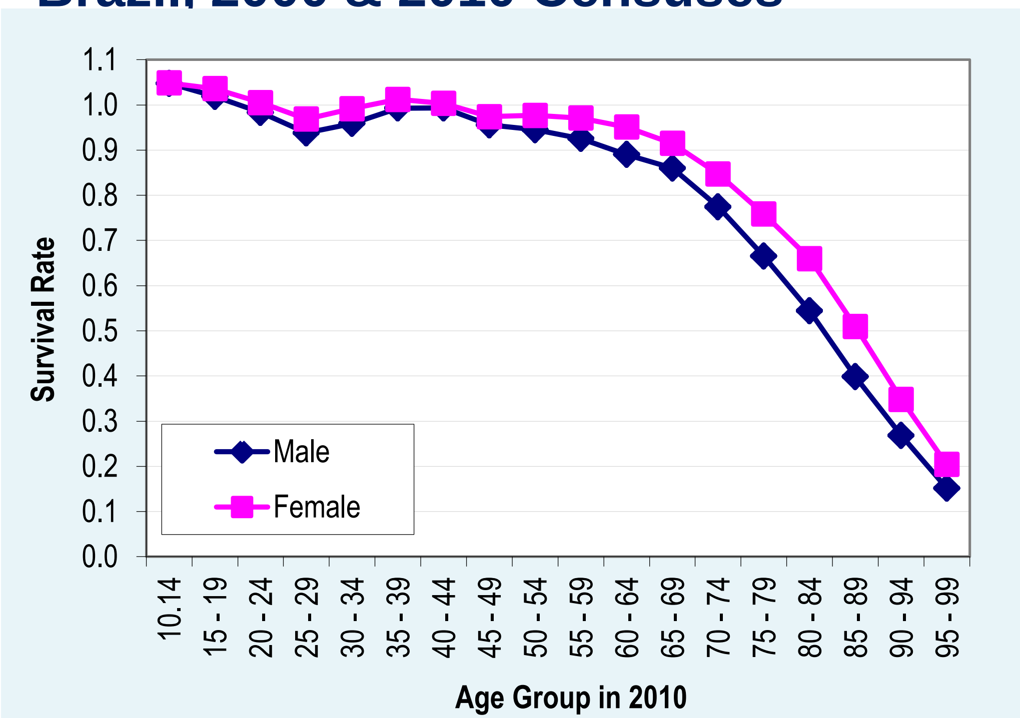
For open-ended age group: $_wS_x = \frac{_wT_{x+a}}{_nT_x}$

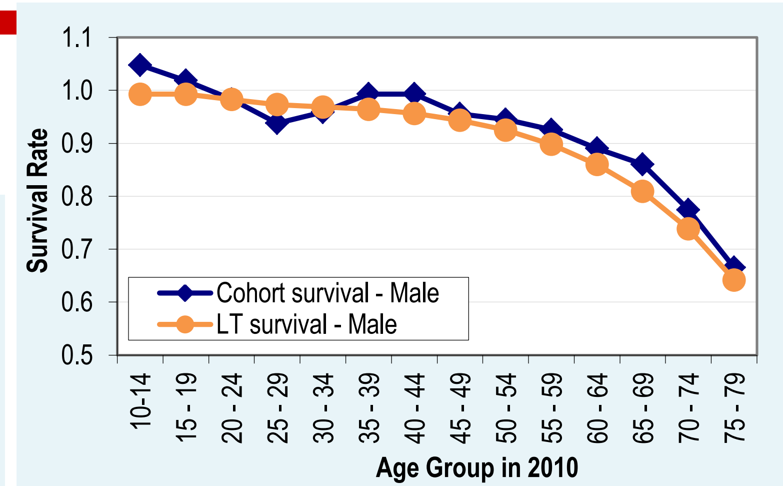
Step 4: Calculation of cohort survival ratios (*nRx*)

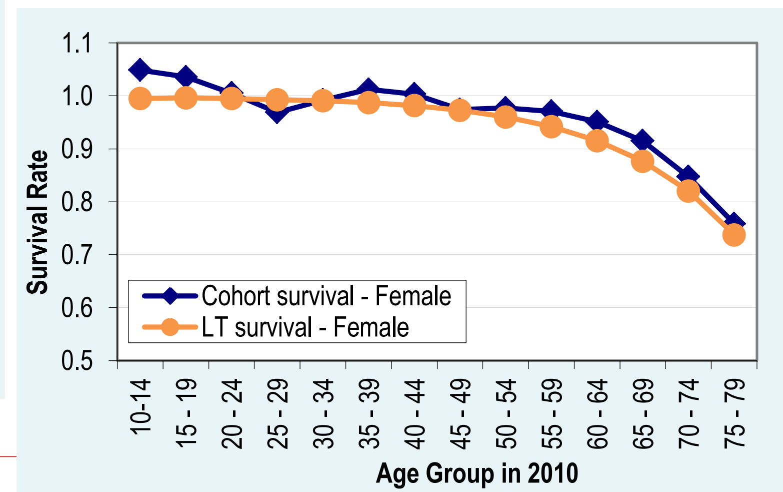
1 Aug 2000			1 Aug 2010			Cohort Survival Ratio 2000 - 2010		Life Table Survival Rate		nRx	
	Male	Female		Male	Female	Male	Female	Male	Female	Male	Female
0 - 4	8'326'926	8'048'802	0 - 4	--	--	--	--	--	--	--	--
5 - 9	8'402'353	8'139'974	5 - 9	--	--	--	--	--	--	--	--
10-14	8'777'639	8'570'428	10.14	8'725'413	8'441'348	1.0479	1.0488	0.9928	0.9950	1.0554	1.0541
15 - 19	9'019'130	8'920'685	15 - 19	8'558'868	8'432'002	1.0186	1.0359	0.9928	0.9966	1.0261	1.0394
20 - 24	8'048'218	8'093'297	20 - 24	8'630'227	8'614'963	0.9832	1.0052	0.9830	0.9951	1.0002	1.0102
25 - 29	6'814'328	7'035'337	25 - 29	8'460'995	8'643'418	0.9381	0.9689	0.9733	0.9930	0.9639	0.9758
30 - 34	6'363'983	6'664'961	30 - 34	7'717'657	8'026'855	0.9589	0.9918	0.9685	0.9907	0.9901	1.0011
35 - 39	5'955'875	6'305'654	35 - 39	6'766'665	7'121'916	0.9930	1.0123	0.9643	0.9873	1.0298	1.0253
40 - 44	5'116'439	5'430'255	40 - 44	6'320'570	6'688'797	0.9932	1.0036	0.9566	0.9818	1.0383	1.0222
45 - 49	4'216'418	4'505'123	45 - 49	5'692'013	6'141'338	0.9557	0.9739	0.9436	0.9729	1.0128	1.0010

Cohort survival ratios – Example (4)

Cohort survival ratios by sex, Brazil, 2000 & 2010 Censuses







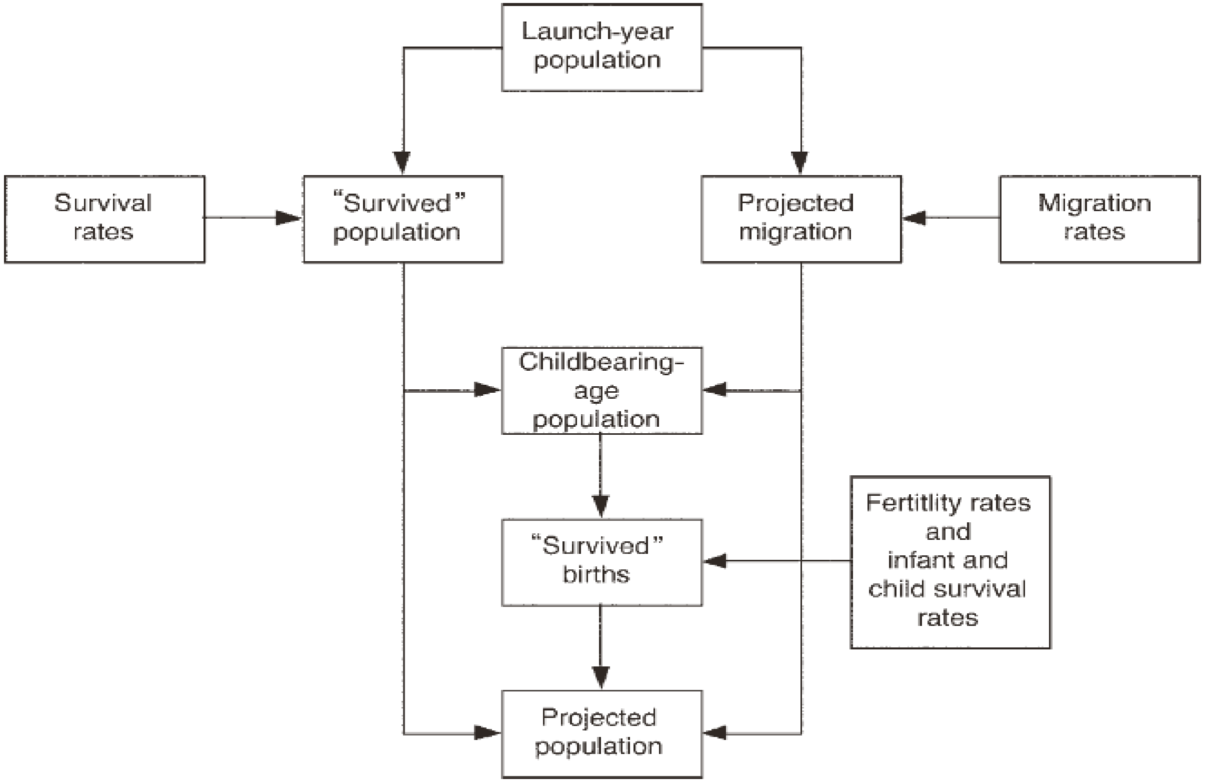
Cohort Survival: Uses and limitations

- It is a widely applicable approach for examining error in consecutive censuses
- Method requires relatively little information
  - Information on the level of fertility is not required since the method does not assess the coverage of the population born between two censuses
- Method is complicated by migration etc. as discussed
- When only two censuses are available, the method suffers from the limitations shared by many demographic methods, namely difficulties in separating census errors from real irregularities caused by extraordinary events
  - The utility of census survival approaches increases significantly when three or more censuses are available

Cohort Component Method

Population estimation

Overview of cohort-component method



Smith, S., J. Tayman, and D. A. Swanson. 2001. *State and Local Population Projections: Methodology and Analysis*. New York: Kluwer Academic/Plenum Publishers.

Cohort component method (CCM)

- In this approach, the population enumerated in the first census is projected to the reference date of the second census based on estimated levels and age schedules of fertility, mortality and migration during the intercensal period
- The expected population from the projection is then compared with the actual population enumerated in the second census
- Data for intercensal births, deaths and migration are taken from estimates and/or assumptions regarding the level and age schedules of these parameters rather than directly available data based on registration systems

Cohort component method (CCM) – data required

1. Population enumerated in two censuses by age and sex
2. Age specific fertility rates for women aged 15 to 49 (in 5-year age groups), assumed to represent the level and age structure of fertility during the intercensal period
3. Life table survival rates for males and females, assumed to be representative of mortality conditions during the intercensal period
4. An estimate of sex ratio at birth
5. Estimates of the level and age pattern of net international migration during the intercensal period if the level of net migration is substantial

CCM– overview of computational steps

1. "Survive" the age distribution at the initial census to the time of the second census
   a) Multiply each age group population by life table survival rates
   b) Open-ended interval requires special handling
2. Calculate the total number of births (total, by sex) during the period
3. Make any necessary adjustments for migration
   a) Average initial and projected population for each age group between 15-49 to estimate mid-period female population
   b) Apply age-specific birth rates to these populations to generate total numbers of births during time period
   c) Apply sex ratio factor to get female and male births from total births
4. Apply life table survivorship to these births to determine number that survive to time of the second census
5. Compare the estimated population by age group with the enumerated population at the second census

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CCM – Step 1 (survive initial age distribution)

Still need to estimate youngest cohorts based on fertility data

1. "Survive" the age distribution at the initial census to the time of the second census

$$_nS_x = \frac{_nL_{x+a}}{_nL_x}$$

First age group (age 5-9):

$$_nS_x = \frac{_nL_{x+a}}{_1L_0 + \ _4L_1}$$

Open-ended age group:

$$_wS_x = \frac{_wT_{x+a}}{_nT_x}$$

with a = time between census

Age	Total population, 2000 Census		Life table survival ratio		Projected population, 2005	
	Male	Female	$_5L_x^M$	$_5L_x^F$	Male	Female
0-4	124,482	121,541				
5-9	144,315	141,349	0.99201	0.99393	123,487	120,804
10-14	159,294	158,140	0.99746	0.99838	143,949	141,121
15-19	133,327	130,031	0.99659	0.99819	158,750	157,855
20-24	118,023	117,728	0.99302	0.99669	132,396	129,601
25-29	107,962	108,690	0.98837	0.99491	116,650	117,129
30-34	92,473	95,399	0.98261	0.99263	106,084	107,889
35-39	84,846	87,760	0.97579	0.98965	90,234	94,411
40-44	62,619	64,601	0.96477	0.98415	81,856	86,369
45-49	40,562	42,326	0.94594	0.97379	59,234	62,908
50-54	27,707	30,128	0.92103	0.95724	37,359	40,516
55-59	27,379	28,516	0.89899	0.93869	24,908	28,281
60-64	20,778	21,514	0.85823	0.91338	23,497	26,046
65-69	15,982	19,433	0.79296	0.87437	16,476	18,811
70+	18,232	28,356	0.58241	0.64549	19,927	12,544

CCM – Step 2 (adjust for migration ***if needed***)

If net international migration is substantial, the “survived” cohort population must be adjusted to reflect the effects of migration

- The introduction of net migrants by age group at the mid-point of the projection period and the survival of net migrants to the end of the period:

$$ {}_n\hat{M}_{x+i} = \frac{1}{4}\,{}_nM_x\left(1+{}_nS_x\right)+\frac{1}{4}\,{}_nM_{x+i}\left(1+{}_nS_{x+i}\right) $$

Assumptions:

i) An equal distribution of net migrants across years of the intercensal period,

ii) Migrants have the same fertility and mortality level as the enumerated population

CCM – Step 3 (Calculate births)

1. Calculate the average number of women in each childbearing age group (15-49) during the intercensal period in order to estimate the number of births during the projection period

$$ {}_{n}\overline{P}_{x} = \frac{{}_{n}P^{0}{}_{x} + {}_{n}P^{t}{}_{x}}{2} $$

${}_{n}\overline{P}_{x}$ = average number of females aged x to $x+n$ in the projection period

${}_{n}P^{0}{}_{x}$ = number of females aged x to $x+n$ at the beginning of the projection period

${}_{n}P^{t}{}_{x}$ = projected number of females aged x to $x+n$ at the end of the projection period

CCM – Step 3 (Calculate births)

2. Calculate total births during the period, for 5-year projections:

$$B = 5 \cdot \sum_{x=15}^{49} \left({}_n\bar{P}_x \cdot {}_nf_x \right)$$

Where

B = estimated number of births in the projection period

${}_n\bar{P}_x$ = average number of females aged x to $x+n$ in the projection period

${}_nf_x$ = Age-specific fertility rate for women age x to $x+n$ years during the projection period

	Female population, 2000 census	Female population, 2005 projected	Female population, mid-period	*ASFR, ${}_5F_x$*	Number of births, B
	(a)	(b)	(c) = ((a)+(b))/2	(d)	(e) = (c)*(d)
15-19	130,031	157,855	143,943	0.02155	3,102
20-24	117,728	129,601	123,664	0.12858	15,901
25-29	108,690	117,129	112,909	0.12671	14,307
30-34	95,399	107,889	101,644	0.08179	8,314
35-39	87,760	94,411	91,086	0.04031	3,672
40-44	64,601	86,369	75,485	0.01262	953
45-49	42,326	62,908	52,617	0.00357	188
TFR				2.08	
Total 5*∑e					**232,183**

CCM – Step 3 (calculate M/F births)

3. Calculate proportion of male and female births

For female births:

$$B^f = \left(1 - \frac{sex\ ratio\ at\ birth}{1 + sex\ ratio\ at\ birth}\right) \cdot B$$

$$B^f = \left(1 - \frac{1.05}{1 + 1.05}\right) \cdot B = 0.488 \cdot B \quad \rightarrow B^f = 0.488 \cdot 232{,}183$$

$$B^f = 113{,}305$$

For male births:

$$B^m = \left(\frac{sex\ ratio\ at\ birth}{1 + sex\ ratio\ at\ birth}\right) \cdot B$$

$$B^m = \left(\frac{1.05}{1 + 1.05}\right) \cdot B = 0.512 \cdot B \quad \rightarrow B^m = 0.512 \cdot 232{,}183$$

$$B^m = 118{,}877$$

CCM – Step 4 (Survive intercensal births)

4. Apply life table survivorship to these births to determine number that survive to time of the second census

For girls:

$${}_5P_0^f = B^f \cdot {}_5S_0^f \qquad \text{with} \qquad {}_5S_0^f = \frac{{}_5L_0^f}{5 * l_0}$$

$${}_5S^f{}_0 = 480{,}143/500{,}000 = 0.96029$$

$$\rightarrow {}_5P^f{}_0 = 113{,}305 \cdot 0.96029 = \mathbf{108{,}805}$$

For boys:

$${}_5P_0^m = B^m \cdot {}_5S_0^m \qquad \text{with} \qquad {}_5S_0^m = \frac{{}_5L_0^m}{5 * l_0}$$

$${}_5S^m{}_0 = 476{,}147/500{,}000 = 0.95229$$

$$\rightarrow {}_5P^f{}_0 = 118{,}877 \cdot 0.95229 = \mathbf{113{,}206}$$

Mongolia, projection of the 2000 census population

Age	Total population, 2000 Census		Life table survival ratio		Projected population, 2005	
	Male	Female	$_5L_x^M$	$_5L_x^F$	Male	Female
0-4	124,482	121,541	0.95229	0.96029	113,206	108,805
5-9	144,315	141,349	0.99201	0.99393	123,487	120,804
10-14	159,294	158,140	0.99746	0.99838	143,949	141,121
15-19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	157,855
20-24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	129,601
25-29	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	117,129
30-34	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	107,889
35-39	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	94,411
40-44	62,619	64,601	0.96477	0.98415	81,856	86,369
45-49	40,562	42,326	0.94594	0.97379	59,234	62,908
50-54	27,707	30,128	0.92103	0.95724	37,359	40,516
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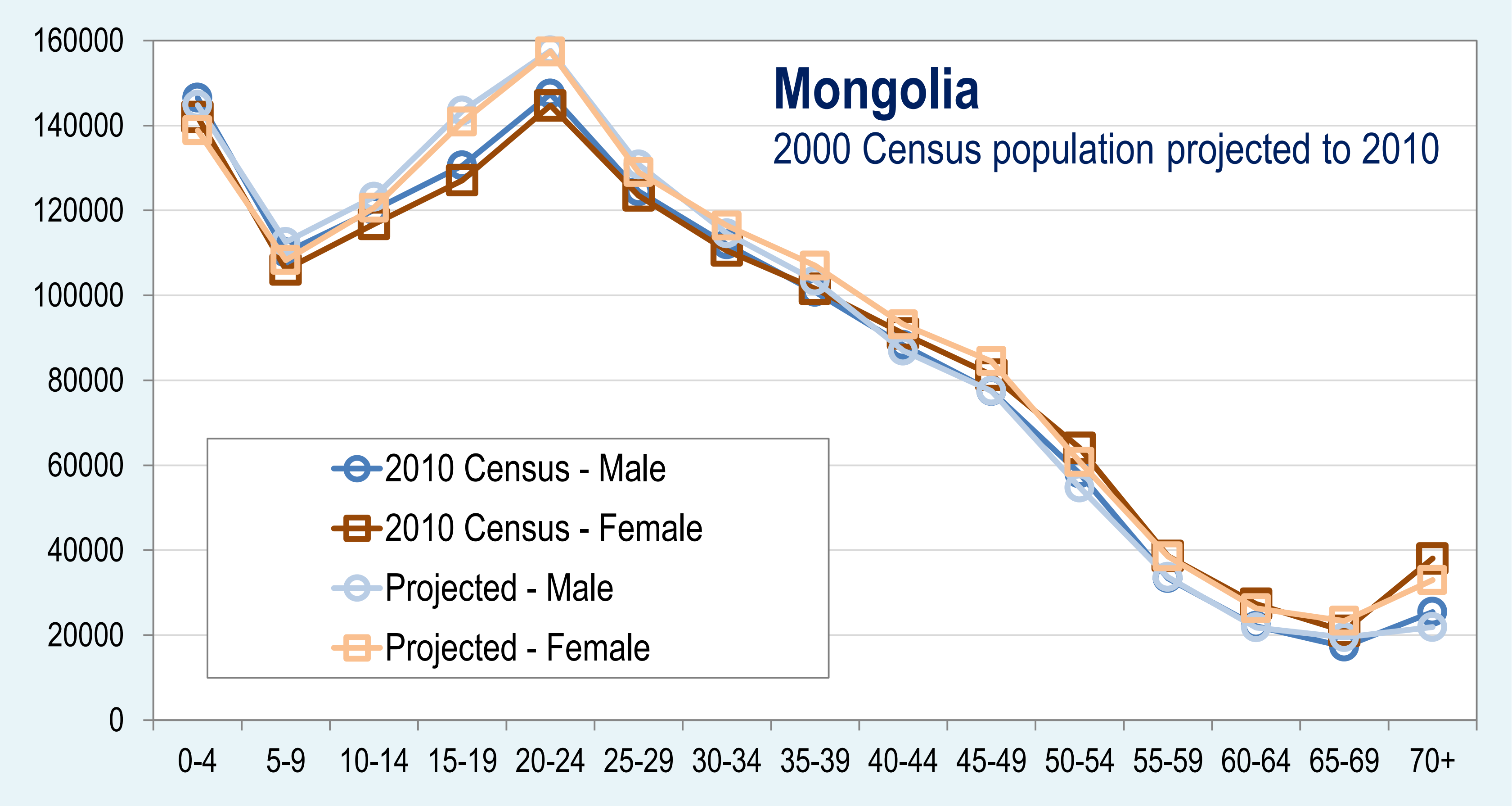
60-64	20,778	21,514	0.85823	0.91338	23,497	26,046
65-69	15,982	19,433	0.79296	0.87437	16,476	18,811
70+	18,232	28,356	0.58241	0.64549	19,927	12,544

Procedure is repeated until the next census in 2010

CCM – Step 5 (compare with enumerated population)

	Projected population, 2005		Life table survival ratio		Projected population, 2010		2010 Census	
	Male	Female	$_5L_x^M$	$_5L_x^F$	Male	Female	Male	Female
0-4	113,206	108,805	0.96434	0.96995	144,818	138,833	146,516	141,981
5-9	123,487	120,804	0.99409	0.99529	112,537	108,293	110,117	106,097
10-14	143,949	141,121	0.99739	0.99845	123,165	120,617	120,064	116,801
15-19	158,750	157,855	0.99664	0.99822	143,465	140,870	130,560	127,085
20-24	132,396	129,601	0.99296	0.99705	157,633	157,390	147,472	144,711
25-29	116,650	117,129	0.98781	0.99544	130,782	129,010	124,490	123,493
30-34	106,084	107,889	0.98236	0.99382	114,592	116,404	111,976	110,546
35-39	90,234	94,411	0.97525	0.99153	103,459	106,975	100,819	101,564
40-44	81,856	86,369	0.96365	0.98640	86,954	93,128	88,273	90,994
45-49	59,234	62,908	0.94665	0.97800	77,489	84,469	77,475	81,281
50-54	37,359	40,516	0.92422	0.96612	54,745	60,777	58,009	64,073
55-59	24,908	28,281	0.90131	0.95089	33,672	38,526	33,384	38,605
60-64	23,497	26,046	0.87393	0.92990	21,768	26,298	22,106	27,347
65-69	16,476	18,811	0.82943	0.89626	19,490	23,344	17,262	20,970
70+	19,927	30,847	0.58241	0.64549	21,873	32,944	25,445	38,029

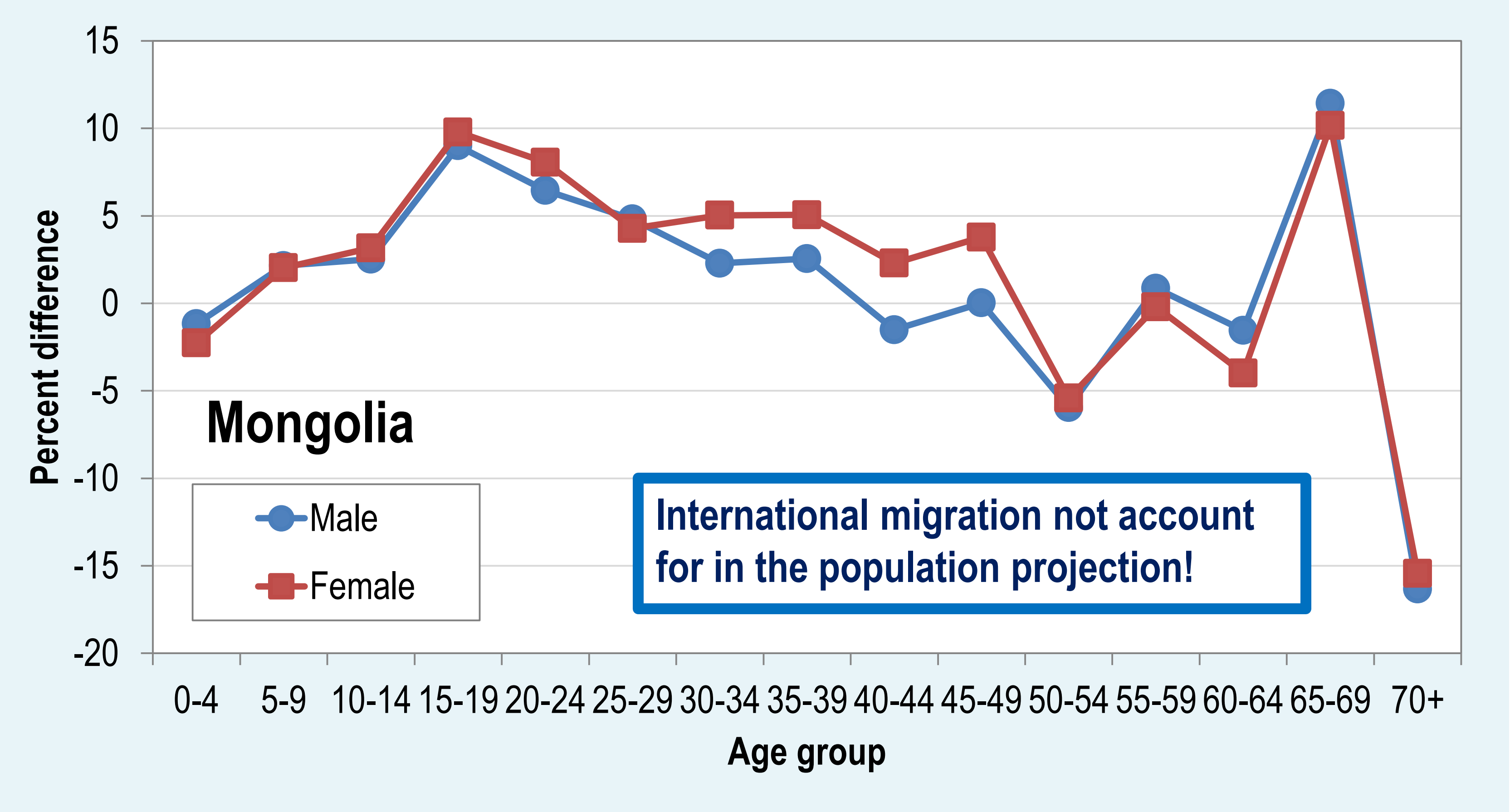
CCM – Step 5 (compare with enumerated population)



CCM – Step 5 (compare with enumerated population)

	2010 Projected population		2010 Enumerated population		Absolute difference (Projected - Enumerated)		Percent Difference (Abs. diff./Projected*100)	
	Male	Female	Male	Female	Male	Female	Male	Female
0-4	144818	138833	146516	141981	-1698	-3148	**-1.2**	**-2.3**
5-9	112537	108293	110117	106097	2420	2196	**2.2**	**2.0**
10-14	123165	120617	120064	116801	3101	3816	**2.5**	**3.2**
15-19	143465	140870	130560	127085	12905	13785	**9.0**	**9.8**
20-24	157633	157390	147472	144711	10161	12679	**6.4**	**8.1**
25-29	130782	129010	124490	123493	6292	5517	**4.8**	**4.3**
30-34	114592	116404	111976	110546	2616	5858	**2.3**	**5.0**
35-39	103459	106975	100819	101564	2640	5411	**2.6**	**5.1**
40-44	86954	93128	88273	90994	-1319	2134	**-1.5**	**2.3**
45-49	77489	84469	77475	81281	14	3188	**0.0**	**3.8**
50-54	54745	60777	58009	64073	-3264	-3296	**-6.0**	**-5.4**
55-59	33672	38526	33384	38605	288	-79	**0.9**	**-0.2**
60-64	21768	26298	22106	27347	-338	-1049	**-1.6**	**-4.0**
65-69	19490	23344	17262	20970	2228	2374	**11.4**	**10.2**
70+	21873	32944	25445	38029	-3572	-5085	**-16.3**	**-15.4**
Total	1346442	1377877	1313968	1333577	32474	44300	**2.4**	**3.2**
Both sexes	2724319		2647545		76774		**2.8**	

Percentage difference between expected (projected) and observed population, 2010 Census



Main findings from example of Mongolia

- Suggests overenumeration of more than 75 thousand people, or **2.8%** of the population
- Slight underenumeration of youngest age group (age 0-4)
- Overenumeration starting from age 5-9 until 35-39 for males and 45-49 for females
    - Point to the fact that we did not account of international migration
    - Need to incorporate migration data
- Significant overenumeration of people age 65-69
    - Possibly related to age declaration
    - Possible also that life table used is not accurate for these ages

Cohort component method in MortPak (1)

- Computations made in Excel can be automated and done with more precision using the application PROJCT in MORTPAK
- PROJCT runs single-year population projection
- Data needed:
  - Population by age and sex,
  - Age patterns of mortality, fertility and migration,
  - Level of mortality, fertility and migration
- Results available by single years – use drop-down menu to select year you want

>> Example of Mongolia using PROJCT

Cohort component method – uses and limitations

- It is applicable when registration data are not-existent or deficient to such an extent that satisfactory adjustment is not possible
- Sufficient information to derive estimates of fertility and mortality levels should be available
  - Mortality estimates can be complicated by HIV/AIDS – with a generalized epidemic, one life table is generally not sufficient to model mortality patterns over a 10 year period
- Lack of information on international migration is often a problematic issue when applying this method
- In case where sufficient information exists to derive reliable estimates of demographic parameters, the method is perhaps the most powerful among the alternative demographic approaches for the evaluation of censuses, since it provides age and sex specific estimates of net census error

Tools

PROJCT application in MORTPAK – The United Nations software package for demographic measurement, available online: http://www.un.org/en/development/desa/population/publications/mortality/mortpak.shtml

DemProj module in Spectrum, available online at: http://www.futuresinstitute.org/spectrum.aspx

- DemProj is recommended for projection in contexts in which HIV/AIDS prevalence exceeds a few percent – better modeling of mortality conditions
- Requires more data input, including prevalence and treatment estimates for HIV/AIDS
- Data input options somewhat less flexible than MortPak

References

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To conclude…

"The problem of estimating demographic measures from incomplete data is a challenging one, one for which there is no universal answer and one which therefore requires in the demographer the qualities of resourcefulness and imagination."

(Pollard et al. 1990: 164)

Thank you ကျေးဇူးတင်ပါတယ်။

Questions?

>> until 12 December:

>> After 12 December: **spoorenberg@un.org**