Episode 2.
Generalized Growth Balance Method

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Module 3. Episodes

- Episode 1. Methods for Evaluating Coverage of Deaths of Women of Reproductive Age
- **Episode 2. Generalized Growth Balance Method (GGB)**
- Episode 3. Synthetic Extinct Generation Method (SEG) and Combined GGB and SEG method
- Annex 0. Methods for Evaluating Population Age and Sex Distributions
- Annex 1. Details on GGB method
- Annex 2. Details on SEG method

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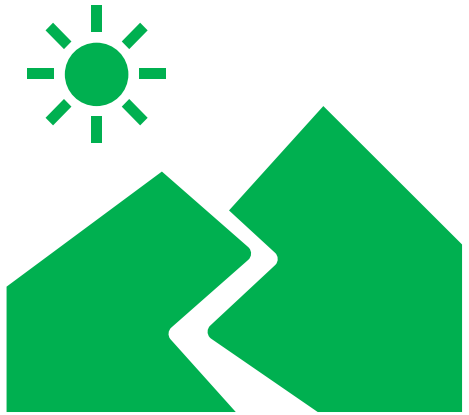
Goal

- To provide a basic description of the Generalized Growth Balance (GGB) method and its application in evaluating coverage of population and deaths recordings using data from two censuses.

Road Map

- Assumptions of the GGB method.
- Data requirements.
- Logic behind the GGB method.
  - Population Balancing Equation and Intercensal Growth Rates.
  - Estimation of adjustment factors.
- Interpretation.



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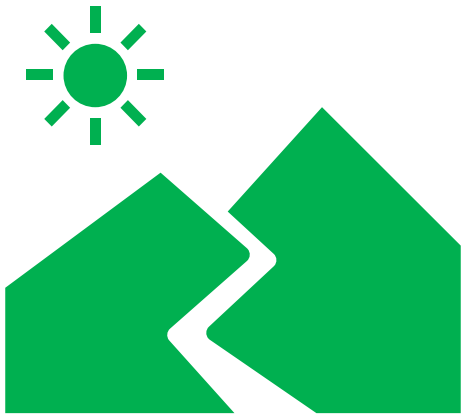
Road Map (Con.)

- Adjustment of mortality rates for incompleteness of reporting.
- Checks and validation.
- Caveats and reminders.
- Learning assessment.



Assumptions

- Reporting of ages in census data is reasonably accurate.
- The recording of deaths and population does not vary with age.
- Deaths as recorded have the same age pattern as did deaths during the entire intercensal period.
  - Only if mortality is not changing will the estimate reflect actual coverage in the census reference period.
- The population is little affected by migration.

Data Requirements

- Distribution of population by sex and 5-year age group from two censuses (less than 15 years apart).
- Number of deaths by sex and 5-year age group from two censuses.
- Number of pregnancy-related deaths by 5-year age group from two censuses.

Logic Behind the GGB Method

The method uses population counts from two censuses to estimate:

- Growth rates.
- Entry rates.
- Death rates.

The method estimates:

- Completeness of census data.
- Completeness of death recordings for the intercensal interval.

Logic Behind the GGB Method

- The main difference with the Brass Growth Balance method described in episode 1, is that the GGB method does not assume a stable population model.

Logic Behind the GGB Method

The GGB method derives from the demographic balancing equation:

$$b(x+) = r(x+) + d(x+)^{true}$$

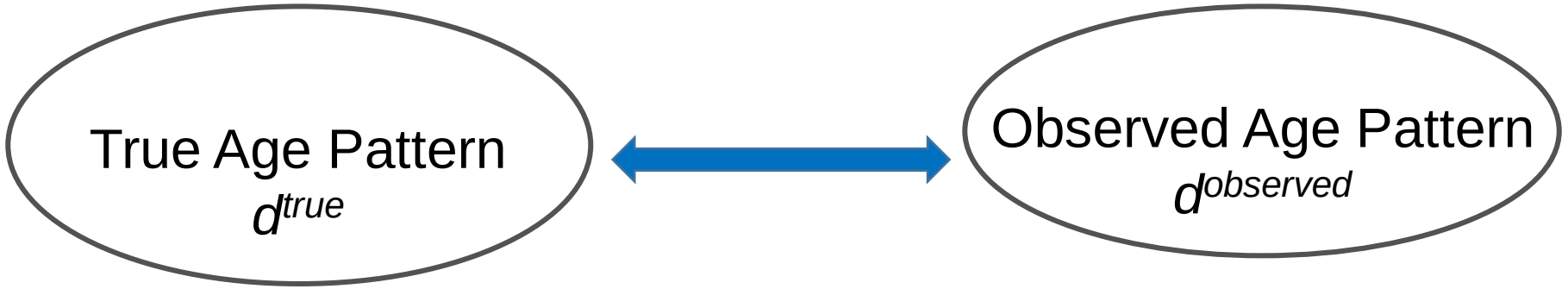
where:

b(*x+*) is the entry rate at age x (as a result of birthdays) to the age group *x* and over.

r(*x+*) is the population growth rate to the age group *x* and over.

d(*x+*)^{true} is the true death rate (exit rate) of the age group *x* and over.

Logic Behind the GGB Method



- The method compares true and observed patterns of age-specific death rates.
  - The true pattern assumes age-specific death rates implied from the population balancing equation.
  - The observed age-specific death rates are calculated from the deaths in census data.

Estimation of Adjustment Factors

Step 1: Estimate entry, death, and growth rates for open-ended age segments (see Annex I).

Step 2: Estimate residual death rates (or the differences between entry and growth rates).

Step 3: Run orthogonal regression on the residual death rates and observed death rates.

$$d^{resid}(x+) = b(x+) - r(x+) = I + S * d^{obs}(x+)$$

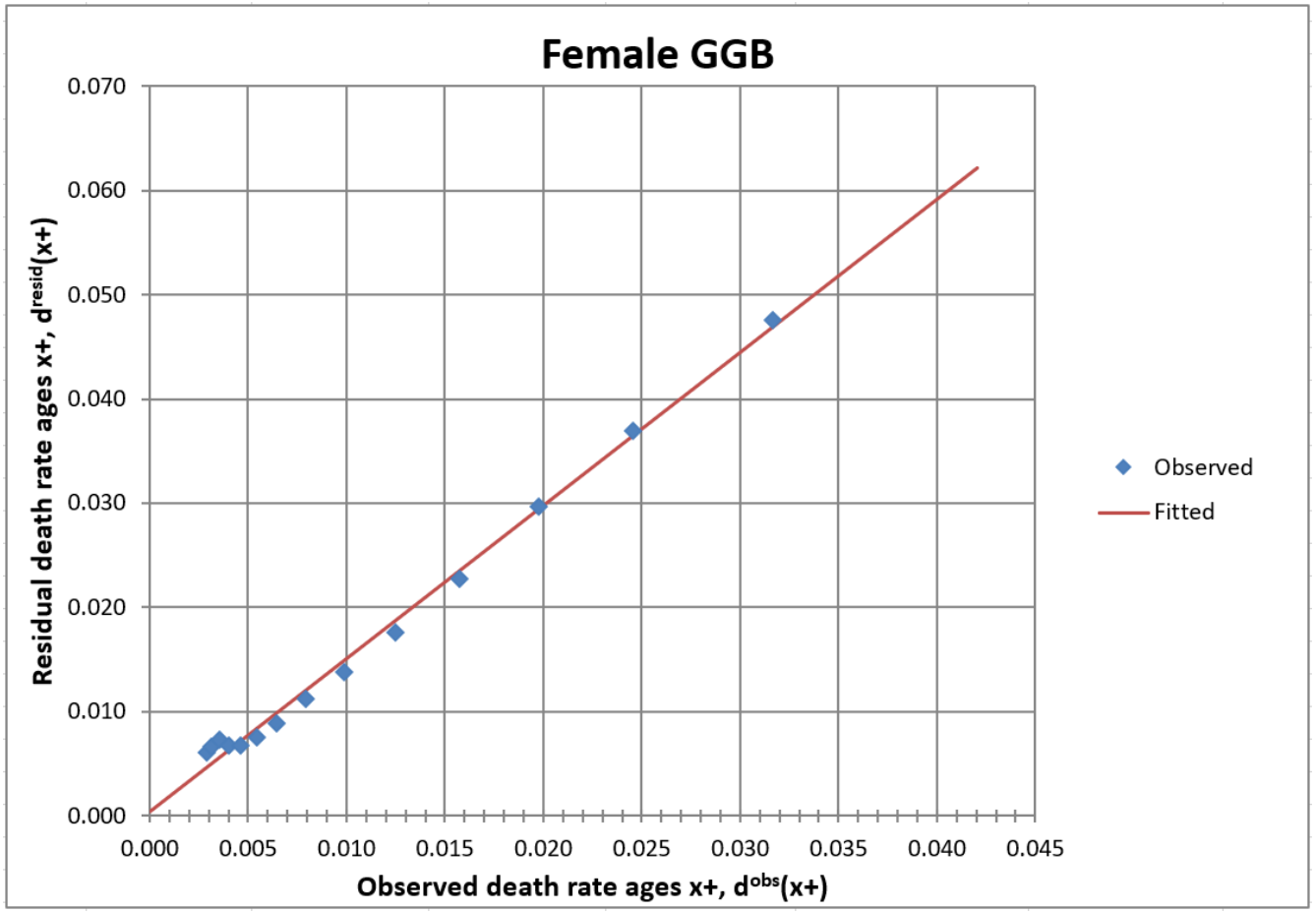
Estimation of Adjustment Factors

Step 4: Find the population (k1) and death reporting (c) coverage factors.

$$d^{resid}(x+) = b(x+) - r(x+) = \frac{1}{t}\ln\left(\frac{k1}{k2}\right) + \left(\frac{\sqrt{k1 \times k2}}{c}\right) d^{obs}(x+)$$

$$d^{resid}(x+) = b(x+) - r(x+) = \quad I \quad + \quad S \quad * \; d^{obs}(x+)$$

Female Deaths: Vietnam 1999 to 2009



GGB Method

Slope = 1.4678

Intercept=0.0005

Death completeness =0.6797

Census 1 completeness=1.000

Census 2 completeness=0.9955

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Interpretation

- If the points line up nicely with intercept close to 0 (e.g., Vietnam 1999-2009), choice of points to fit makes little difference.
- If the points don't line up nicely, choices have to be made:
  - For population known to be exposed to net migration, fit line to ages 30+ to 65+.
  - Otherwise, accept wide uncertainty in adjustment.

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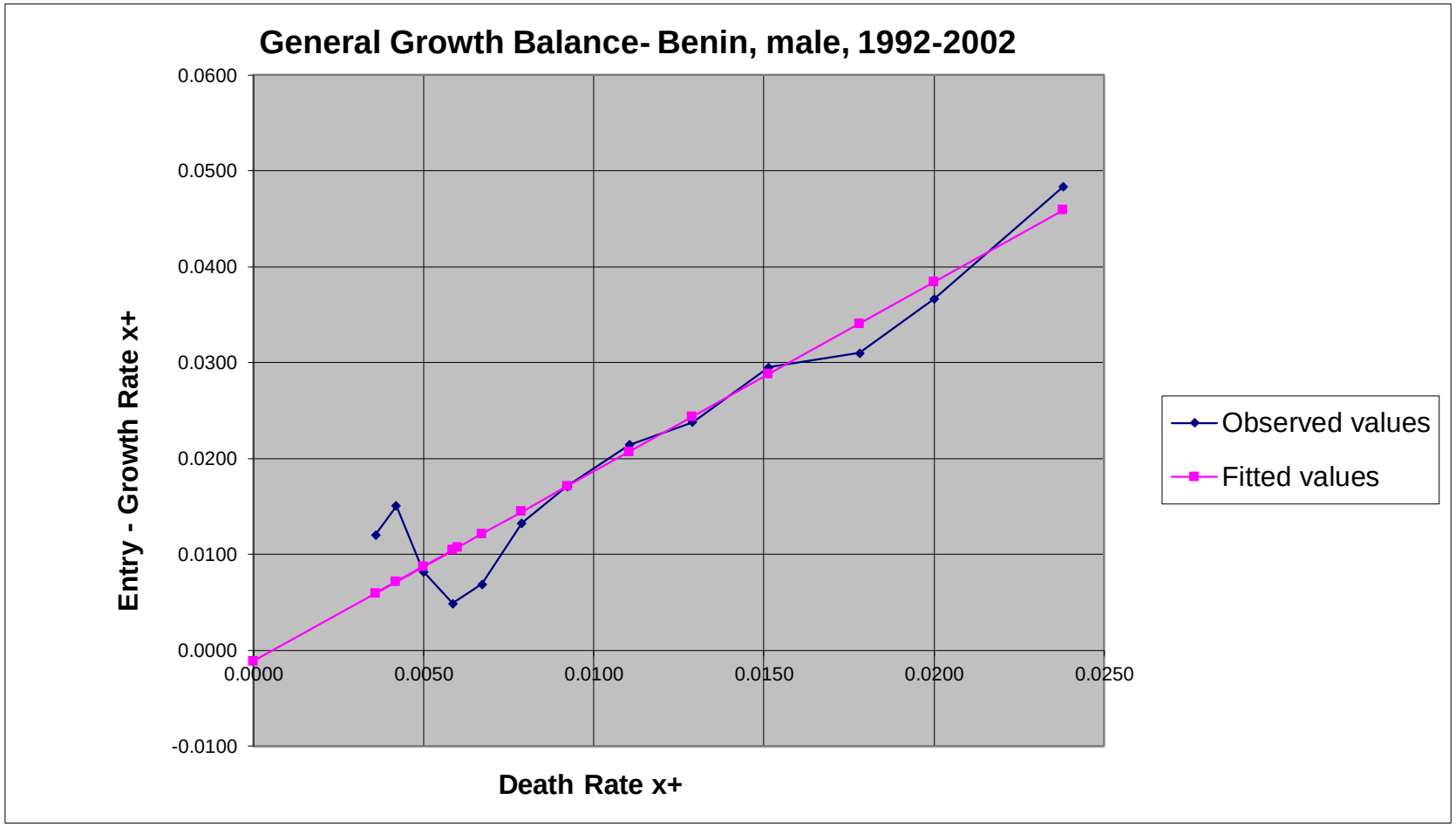
Interpretation: When Things Go Wrong



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Adjustment of Mortality Rates for Incompleteness of Reporting

- Adjusted age-specific death rates:

$$ {}_5ASDR_x^{GGB} = {}_5ASDR_x \frac{\sqrt{k1 * k2}}{c} $$

- Adjusted pregnancy-related deaths:

$$ PRDeaths^{GGB} = PRDeaths * \frac{1}{c} $$

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Checks and Validation

- Run the analysis by sex and compare the completeness of population records. Results should be similar within a range.
- Compare the results with SEG method estimates (in next episode).
- Compare your results with other available indicators of mortality for your country.

Caveats and Warnings

- If completeness of death recordings appears to be less than 60% then uncertainty is large and should be considered when interpreting results.
- Be aware that applying this method for estimation of sub-national geographic areas requires the incorporation of internal migration to the analysis. This estimation demands age and sex specific domestic migration tabulations.

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Caveats and Reminders

- Be aware of retirement migration to rural areas as well as age exaggeration patterns when deciding the age range to fit the straight line.
- If you have only data from one census, you should use the Brass Growth Balance Method. The use of survey data to replace the second census data is not recommended.

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Growth Balance Methods: Data Needs

Source of population data	Source of death data	Methodology used
Single census	Single census	Brass Growth Balance Method
Two censuses up to 15 years apart	First census	General Growth Balance Method, death rates from first census applied to intercensal population
	Second census	Same, but death rates from second census
	Both censuses	Same, but averaged death rates used

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Learning Assessment

- True or False

The GGB method is based on the assumption of a stable population.

- True or False

The advantage of the GGB method is that it incorporates observed growth rates from two censuses to estimate relative completeness of population records and completeness of intercensal death records.

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Learning Assessment

- FALSE

The GGB method is based on the assumption of a stable population.

- TRUE

The advantage of the GGB method is that it incorporates observed growth rates from two censuses to estimate relative completeness of population records and completeness of intercensal death records.

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