Episode 3.
Synthetic Extinct Generations and Combined GGB-SEG Methods

Module 3. Episodes

- Episode 1. Methods for Evaluating Coverage of Deaths of Women of Reproductive Age

- Episode 2. General 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

Goal

To provide a basic description of:

- The Synthetic Extinct Generations (SEG) Method for evaluating coverage of deaths using data from two censuses.

- The Combined SEG-GGB Method for evaluating coverage of deaths using data from two censuses.

- Evaluation and adjustment of pregnancy-related deaths.

Road Map

- Synthetic Extinct Generations (SEG) Method
  - Assumptions behind the SEG method.
  - Data requirements.
  - Logic behind the SEG method.
  - Interpretation.
  - Caveats and warnings.

Road Map (Con.)

- Combined GGB-SEG Method
  - Logic and interpretation.
  - Evaluation of adjustment of pregnancy related deaths.
- Recommendations.
- Learning assessment.

Assumptions

- Reporting of ages is reasonably accurate.

- The reporting of deaths and population does not vary with age.

- Deaths as reported have the same age pattern as did true deaths during the entire intercensal period.

- Invariant coverage of population across time.

- The population is little affected by migration.

Data Requirements

- Distribution of population by sex and 5-year age groups from two censuses (less than 15 years apart).

- Number of deaths by sex and 5-year age groups from one or two censuses.

- Number of pregnancy related deaths by 5-year age groups from one or two censuses.

Logic Behind the SEG Method

- SEG uses age-specific growth rates to adjust the observed age distribution of deaths to approximate the distribution in a stationary population.

- Recap from episode 2: A stable population has age-specific fertility and mortality rates that remain constant over time.

- A stationary population is a special case of a stable population that has a zero-growth rate, neither growing nor shrinking in size, and is equivalent to a life table population.

Logic Behind the SEG Method (Con.)

- The SEG method is based on the idea that in a stationary population the number of persons at a particular age at a point in time must equal the total number of deaths arising from this population from that time until the last survivor has died.

Logic Behind the SEG Method (Con.)

- Since everybody dies, the number of persons aged x alive today will be equal to the future deaths at ages x and above of those persons.

- Therefore, the current distribution of deaths at ages *x* and over can be adjusted by current population growth rates at ages *x* and over to equal future cohort deaths.

Logic Behind the SEG Method (Con.)

The population at age x ($\hat{P}(x)$) can be estimated from the period deaths and intercensal growth rates at all ages y above that age x:
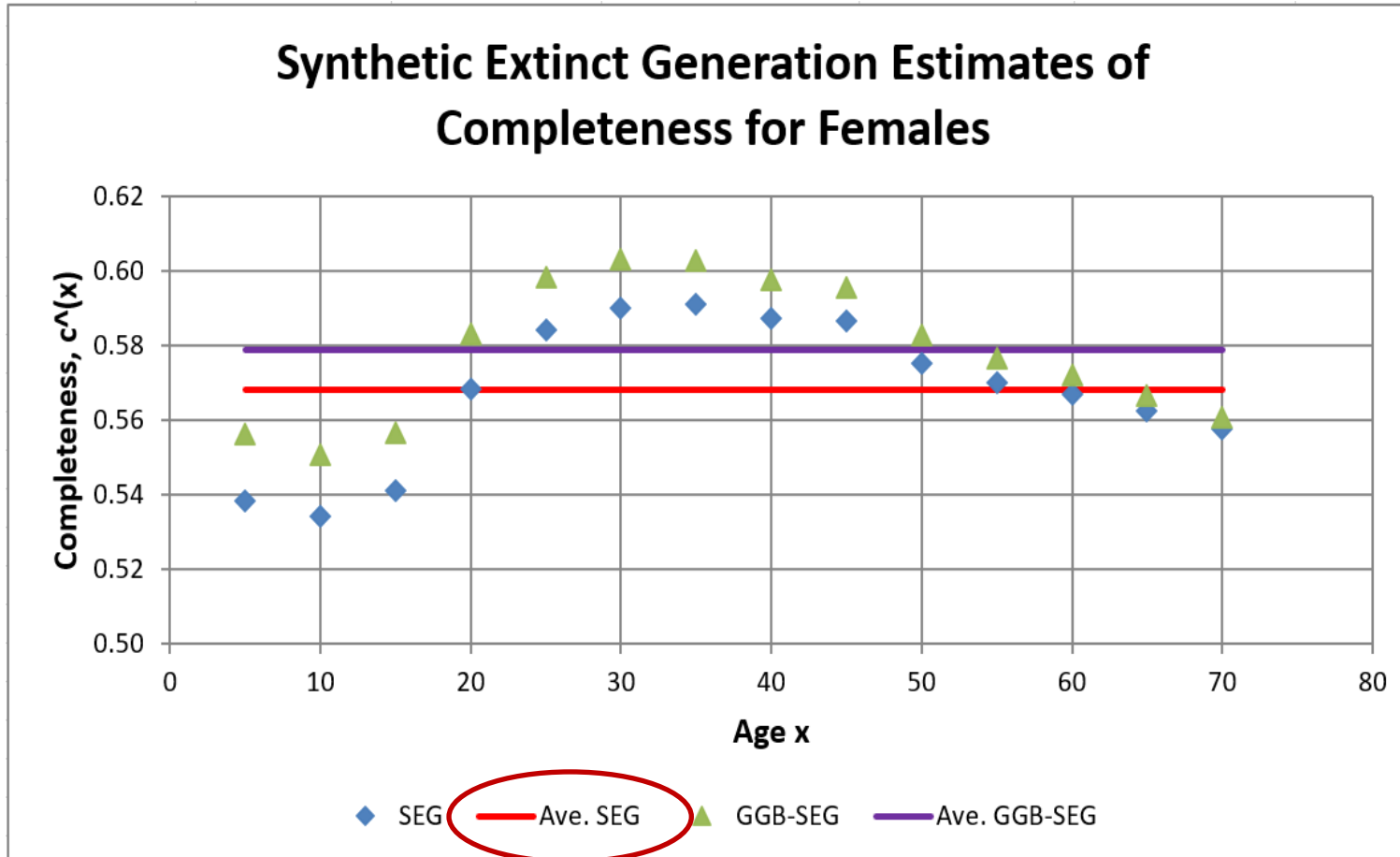
$$\hat{P}(x) = \int_{x}^{\omega} D^{obs}(y) e^{\int_{x}^{y} r(z)\,dz} \, dy$$

The ratio of the population age x, to the number of entries (or birthdays) at age x from the census population counts ($B(x)$) estimates the completeness of death recording relative to census coverage:

$$\hat{c}(x) = \frac{\hat{P}(x)}{B(x)}$$

Female Deaths: Vietnam 1999 to 2009

SEG Method

Average completeness (ages 5+ to 75+) = 0.5682

Interpretation

- The SEG estimate of completeness of death reporting is 57%.
- The assumptions of the method have not been met.
  - Age specific estimates of completeness of death reporting are not aligned in a horizontal line.

Errors Due to Differential Coverage

- Differential coverage of the two censuses can make the SEG estimates incorrect.

- In this case, the plot of c^(x) will not be constant but have an upward or downward tendency.

# Violation of Method Assumption: Invariant Coverage of Population Across Time

The combined GGB-SEG uses the information on relative completeness of the two censuses from GGB to adjust one of the censuses and get revised growth rates for SEG.

- Steps:

    1. Estimate change in census coverage using GGB.

    2. Adjusting the census data for the estimated coverage change.

    3. Apply the SEG method.

Female Deaths: Vietnam 1999 to 2009

Synthetic Extinct Generation Estimates of Completeness for Females
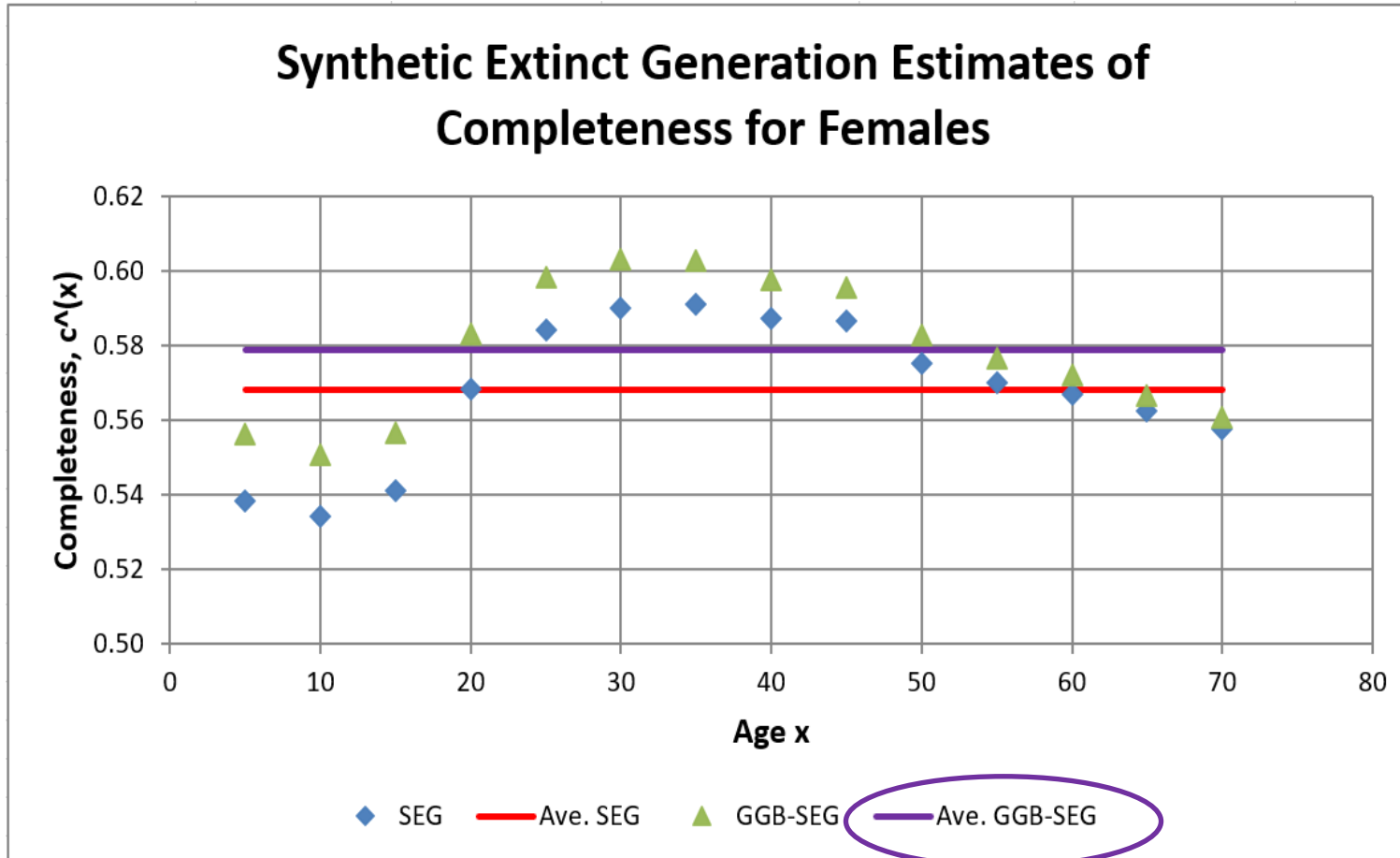
Combined GGB-SEG Method

Average completeness (ages 5+ to 75+) = 0.579

Adjusting Mortality Rates for Incompleteness of Reporting

- Adjusted Age-Specific Death Rates:

$$_5ASDR_x{}^{GGB-SEG} = \frac{Intercensal \ _5ASDR_x}{Average \ \hat{c}\ (x) over \ selected \ age \ range}$$

- Adjusted Pregnancy-Related Deaths:

$$PRDeaths^{GGB-SEG} = PRDeaths * \frac{1}{Average \ \hat{c}\ (x)}$$

Assumptions on Pregnancy-Related and Maternal Deaths

The application of adjustment factors assumes the same under-reporting rate for:

- All women deaths.

- Deaths of women in reproductive ages.

- Pregnancy-related and maternal deaths.

Proportion of Pregnancy-Related and Maternal Mortality of All Female Deaths

From Module 1 we know that:

- Pregnancy related deaths are a subset of deaths of women in reproductive age.

- It is important to assess the proportion of pregnancy-related or maternal deaths in relation to all deaths of women in reproductive age.

- For example, check the DHS reports for the closest survey year to the second census or the intercensal reference date.

Proportion of Pregnancy-Related and Maternal Mortality of All Female Deaths (Con.)

From Module 1 we know that:

- Maternal deaths are a subset of pregnancy related deaths.

Generally, you should consider the following:

- Make sure comparisons are consistent. For example, you must not compare maternal mortality with pregnancy related mortality.

- By definition, the proportion of pregnancy-related deaths is always higher than the proportion of maternal deaths.

Recommendations on GGB and SEG Methods

- GGB and SEG methods do not rely on the assumption that the population is demographically stable. These methods use observed growth rates between two censuses.

- Combining GGB and SEG methodologies is considered the most robust approach because these methods are differently affected by data errors.

- In countries where net migration is substantial, using estimations for both methods for ages 35 and over is recommended.

Summary: Data Requirements and Assumptions

Method	Data Requirements		Assumptions
	Age-Sex distribution of population and deaths from <u>one</u> census only	Age-Sex distribution of population from <u>two</u> censuses, with deaths from one or both	
Brass Growth Balance	X		-Stable population. -Population little affected by migration. -Recording of deaths and of the population is proportionately constant by age.
General Growth Balance (GGB)		X	-Population little affected by migration. -Recording of deaths and of the population is proportionately constant by age.
Synthetic Extinct Generation (SEG)		X	-Population little affected by migration. -No change in coverage of the two censuses. -Recording of deaths and of the population is proportionately constant by age.
Combined GGB-SEG (GGB-SEG)		X	-Population little affected by migration. -Recording of deaths and of the population is proportionately constant by age.

Learning Assessment

- True or False

The SEG method is based on the assumption that at some point in the future all members of a population die.

- True or False

The advantage of the SEG method is that it is easier to interpret because results should line up in a straight horizontal line around the value of the adjustment factor.

Learning Assessment

- TRUE

The SEG method is based on the assumption that at some point in the future all members of a population die.

- TRUE

The advantage of the SEG method is that it is easier to interpret because results should line up in a straight horizontal line around the value of the adjustment factor.