Decomposition - Class 3

Serena Vigezzi and José Manuel Aburto

Arriaga decomposition

- Method to decompose life expectancy by age
- Extendable to causes of death

Quiz time!

Kitagawa and Arriaga decomposition

Now we can decompose

- Any crude rate
- Life expectancy by age and causes of death

Kitagawa and Arriaga decomposition

Now we can decompose

- Any crude rate
- Life expectancy by age and causes of death

What about everything else?

Analytical vs computational methods

- **Analytical** methods can only be applied to the specific measures for which they were developed
- They give a mathematically exact decomposition

- **Computational** methods harness modern computational power to decompose a wider range of measures
- They rely on modern computational power

Computational methods

Two main computational methods

- Linear integral decomposition method [Horiuchi et al., 2008]
- Stepwise replacement method [Andreev et al., 2002]

Computational methods

Two main computational methods

- **Linear integral decomposition method** [Horiuchi et al., 2008]
- Stepwise replacement method [Andreev et al., 2002]

Shiro Horiuchi

- Japanese demographer, worked at UN and various US universities
- Mortality, interested in overall patterns of ageing
- Mostly low-mortality countries and some bio-demography
- *A decomposition method based on a model of continuous change*, 2008 (with John R. Wilmoth and Scott D. Pletcher)

Horiuchi decomposition (Linear integral decomposition method)

Decompose a difference in a function with n covariates (e.g. ages)
Total difference is the sum of covariate-specific changes:

$$y(t_2) - y(t_1) = \sum_{i=1}^{n} c_i$$

Horiuchi decomposition (Linear integral decomposition method)

$$c_i = \int_{x_i(t_1)}^{x_i(t_2)} \frac{\delta}{\delta x_i(t)} y(t) dx_i(t)$$

Where

- i is the specific covariate
- t_1 and t_2 are two periods or populations
- $\frac{\delta}{\delta x_i(t)} y(t)$ is the derivative of function y with respect to its covariate x_i (how much y changes, given an infinitesimal change in x_i)

Horiuchi decomposition (Linear integral decomposition method)

The contributions of covariates to the change in function y are additive, even when the function itself is not additive with respect to the covariates

$\rightarrow$ It can be applied to a wide range of functions

Horiuchi decomposition (Linear integral decomposition method)

Three main limitations/assumptions:

- The dependent variable is a differentiable function of the covariates
  $\rightarrow$ only condition for applicability
- The population is treated as homogeneous (doesn't mean it actually is)
- The values of the covariates change continuously and proportionally to each other

An example

Am J Public Health. 2019 March; 109(3): 483–489.
Published online 2019 March. doi: 10.2105/AJPH.2018.304878

PMCID: PMC6366518
PMID: 30676788

Journal Article

Upsurge of Homicides and Its Impact on Life Expectancy and Life Span Inequality in Mexico, 2005–2015

José Manuel Aburto, MSc✉ and Hiram Beltrán-Sánchez, PhD

Let's try to decompose lifespan variation by age

An example

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An example

Let's try to decompose lifespan variation by age and cause

Group work

How could you use the Horiuchi method in your own research?

More examples

Hypertension

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Nikkil Sudharsanan and Pascal Geldsetzer | AUTHOR INFO & AFFILIATIONS

More examples

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

Internal migration, health selection, and the salmon bias: A register-based study of Finland

Eugenio Paglino [a,b,*], Irma T. Elo [c], Pekka Martikainen [a,b,d]

More examples

Environment International
Volume 193, November 2024, 109050

Full length article

The reciprocal relation between rising longevity and temperature-related mortality risk in older people, Spain 1980–2018

Simon J LLOYD [a], Erich STRIESSNIG [b], José Manuel ABURTO [c], Hicham ACHEBAK [d], Shakoor HAJAT [e], Raya MUTTARAK [f], Marcos QUIJAL-ZAMORANO [a], Constanza VIELMA [a], Joan BALLESTER [a]

More examples

Bayati and Kiadaliri *Archives of Public Health* (2023) 81:126
https://doi.org/10.1186/s13690-023-01141-z

Archives of Public Health

RESEARCH Open Access

Contributions of avoidable mortality to the sex gap in life expectancy and life disparity in Iran

Mohsen Bayati[1] and Ali Kiadaliri[2,3*]

More examples

scientific reports

OPEN

Evaluation of age-specific causes of death in the context of the Italian longevity transition

Andrea Nigri[1,2], José Manuel Aburto[3,4,5], Ugofilippo Basellini[6]✉ & Marco Bonetti[2,7]

REFERENCES I

- Andreev, E. M., Shkolnikov, V. M., and Begun, A. Z. (2002).
  Algorithm for decomposition of differences between aggregate demographic measures and its application to life expectancies, healthy life expectancies, parity-progression ratios and total fertility rates.
  Demographic Research, 7:499–522.
- Horiuchi, S., Wilmoth, J. R., and Pletcher, S. D. (2008).
  A decomposition method based on a model of continuous change.
  Demography, 45(4):785–801.