

Decomposition - Class 3

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HYGIENE
& TROPICAL
MEDICINE



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

Quiz time!

Now we can decompose

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

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

Two main computational methods

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

Two main computational methods

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

- 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

→ 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
→ 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

[Am J Public Health](#). 2019 March; 109(3): 483–489.

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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

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Let's try to decompose lifespan variation by age

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

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

Hypertension

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RESEARCH ARTICLE

| Originally Published 11 February 2019 | 

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Nikkil Sudharsanan  and Pascal Geldsetzer | [AUTHOR INFO & AFFILIATIONS](#)

More examples






Contents lists available at [ScienceDirect](#)

Social Science & Medicine

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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} 














Environment International

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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

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



Mohsen Bayati¹ and Ali Kiadaliri^{2,3*}

scientific reports





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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}

There exist more decomposition methods, some of which decompose along different dimensions. Is there something you would like to decompose, but you can't with the three methods shown here? What would your ideal decomposition method look like?

-  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.