Decomposition - Class 4

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Horiuchi decomposition

- Computational decomposition methods
- Horiuchi decomposition can decompose pretty much any function by its covariates (as long as it's differentiable)

Quiz time!

Life expectancy: shifting vs compression

Decomposes differences in life expectancy in

- changes in the modal age at death (shifting)
- changes in the shape/variability (compression)

Proposed by Marie-Pier Bergeron-Boucher, Marcus Ebeling and Vladimir Canudas-Romo (2015)

Change in life expectancy can be expressed as

$$\Delta e = \Delta\beta + \Delta M$$

or

$$\dot{e}_{0,t} = \underbrace{-\dot{\beta}_t \int_0^{\omega} l_{a,t} \int_0^{a} f_{\beta}(\mu_{x,t}) d_x d_a}_{\Delta\beta} +$$

$$\underbrace{\dot{M}_t \int_0^{\omega} l_{a,t} \int_0^{a} f_{M}(\mu_{x,t}) d_x d_a}_{\Delta M}$$

Life expectancy: shifting vs compression

Based on mortality models re-parametrised to show the modal age at death

- Gompertz model ($\Delta e_0 = \Delta M + \Delta\beta$)
- Gompertz-Makeham model ($\Delta e_0 = \Delta M + \Delta\beta + \Delta C$)
- Siler model ($\Delta e_0 = \Delta M + \Delta\alpha + \Delta b + \Delta c + \Delta\beta$)

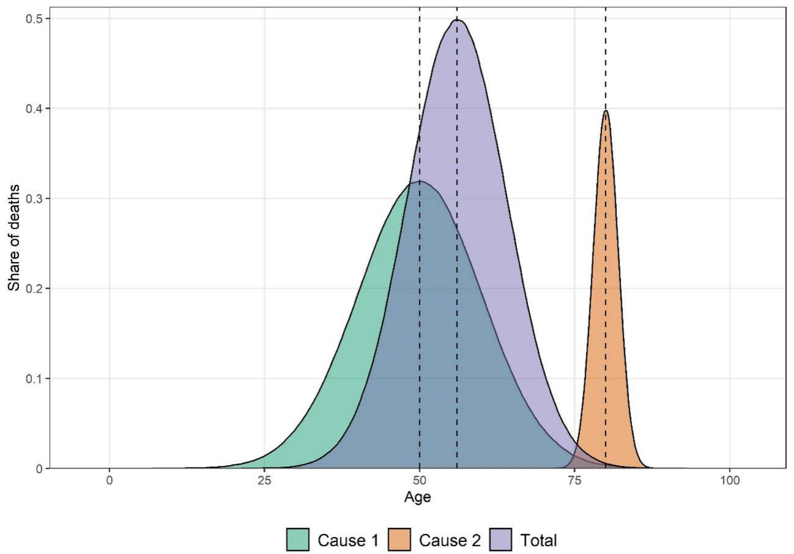
IPM decomposition

Decomposes lifespan variation (variance and coefficient of variation squared) by causes of death and

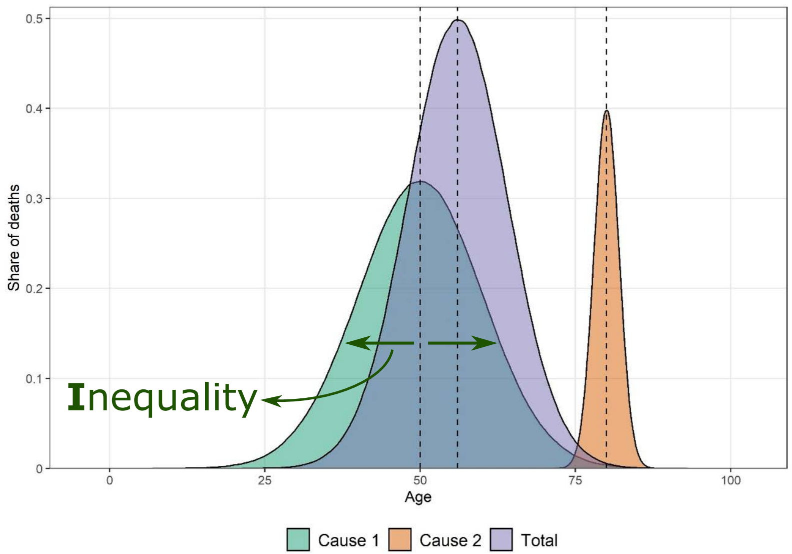
- **I**nequality: within-cause lifespan variation
- **P**roportion: cause-specific weight
- **M**ean: difference between population-mean and cause-specific mean

Proposed by Iñaki Permanyer and myself in 2024

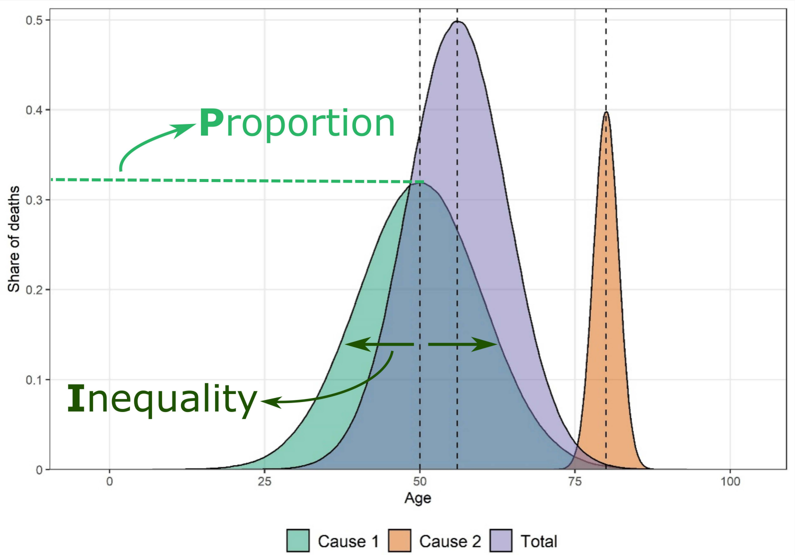
IPM decomposition



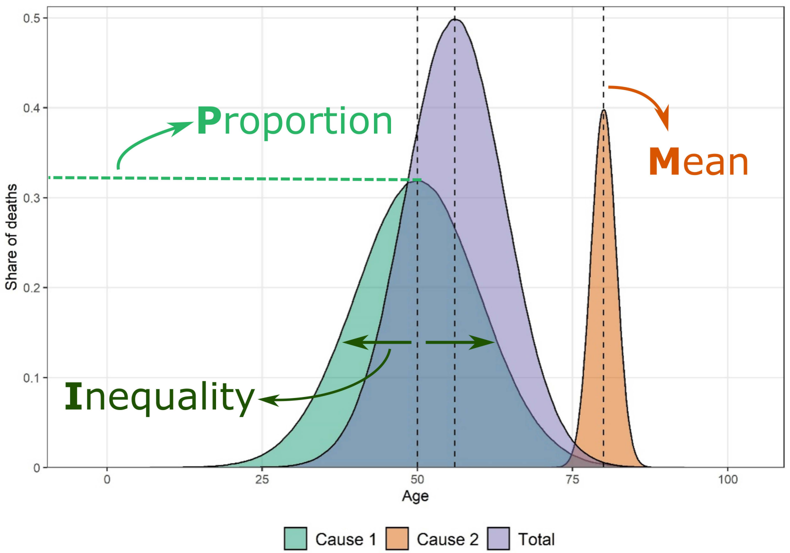
IPM decomposition



IPM decomposition



IPM decomposition



IPM decomposition

Dynamic decomposition

- Cause and dimension-specific contributions to change/difference in variation

Static decomposition

- Cause and dimension-specific contributions to variation in one population

Decomposition in fertility and migration

Some of the previous methods can be widely applied

- Kitagawa decomposition
- Horiuchi decomposition

I don't know of many methods specifically for fertility or migration measures (possibly because they are not my area of expertise)

Proximate determinants of fertility

Models TFR through five dimensions

- Marriage index C_m
- Contraception index C_c
- Postpartum infertility index C_i
- Abortion index C_a
- Total fecundity rate TF

Proposed by John Bongaarts in 1978, later extended to age-specific (1983) and revised (2015)

Proximate determinants of fertility

Simple formula

$$TFR = C_m C_c C_i C_a TF$$

Each index has its own formula

More of a model than a decomposition

Tempo vs quantum of TFR

What would be the TFR if there were no tempo changes?

- Proposed by Bongaarts and Grifftih Feeney in 1998
- Not really a decomposition method in their proposal

Tempo vs quantum of TFR

$$TFR'_i = TFR_i(1 - r_i)$$

Where

- i is a specific parity
- TFR_i is the classical parity-specific TFR
- r_i is the change in parity-specific mean age at birth in a given year

Could it be interpreted as tempo and quantum contribution to TFR?

Migration-specific decomposition methods

Do you know any?

Population change

Population change

$$\Delta P = B - D + I - E$$

References

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