Introduction to decomposition

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Objectives of the module

- Define decomposition

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- Motivate

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- Define decomposition
- Motivate
- Introduce variants

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- Practice

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- Resources

Decomposition

$$\mathbb{Z} = f(\theta)$$

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Example

$$f() = \int_0^{\omega} e^{-\int_o^x \mu(t)\mathrm{d}t}\mathrm{d}x$$

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$$\theta = [\mu]$$

$$\mathbb{Z} = e(0)$$

Decomposition

Say we have a difference between two outcomes:

$$\zeta = \mathbb{Z}' - \mathbb{Z} = f(\theta') - f(\theta)$$

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Property

$$\zeta = \sum \kappa_i$$

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It's due to differences in input parameters, θ

Property

$$\zeta = \sum \kappa_i$$

κ_i is the i^{th} "contribution" to ζ, attributable to differences between θ_i and θ_i'.

κ is on the scale of $\mathbb{Z}$

Motivation

"I believe [decomposition] is the key idea of all the methods founded in the core of demography. Decomposition theory is based on the simple principle of separating demographic measures into components that contribute to an understanding of the phenomena under study"

— Vladimir Canudas Romo (2003)

PLOS ONE

RESEARCH ARTICLE

Monitoring trends and differences in COVID-19 case-fatality rates using decomposition methods: Contributions of age structure and age-specific fatality

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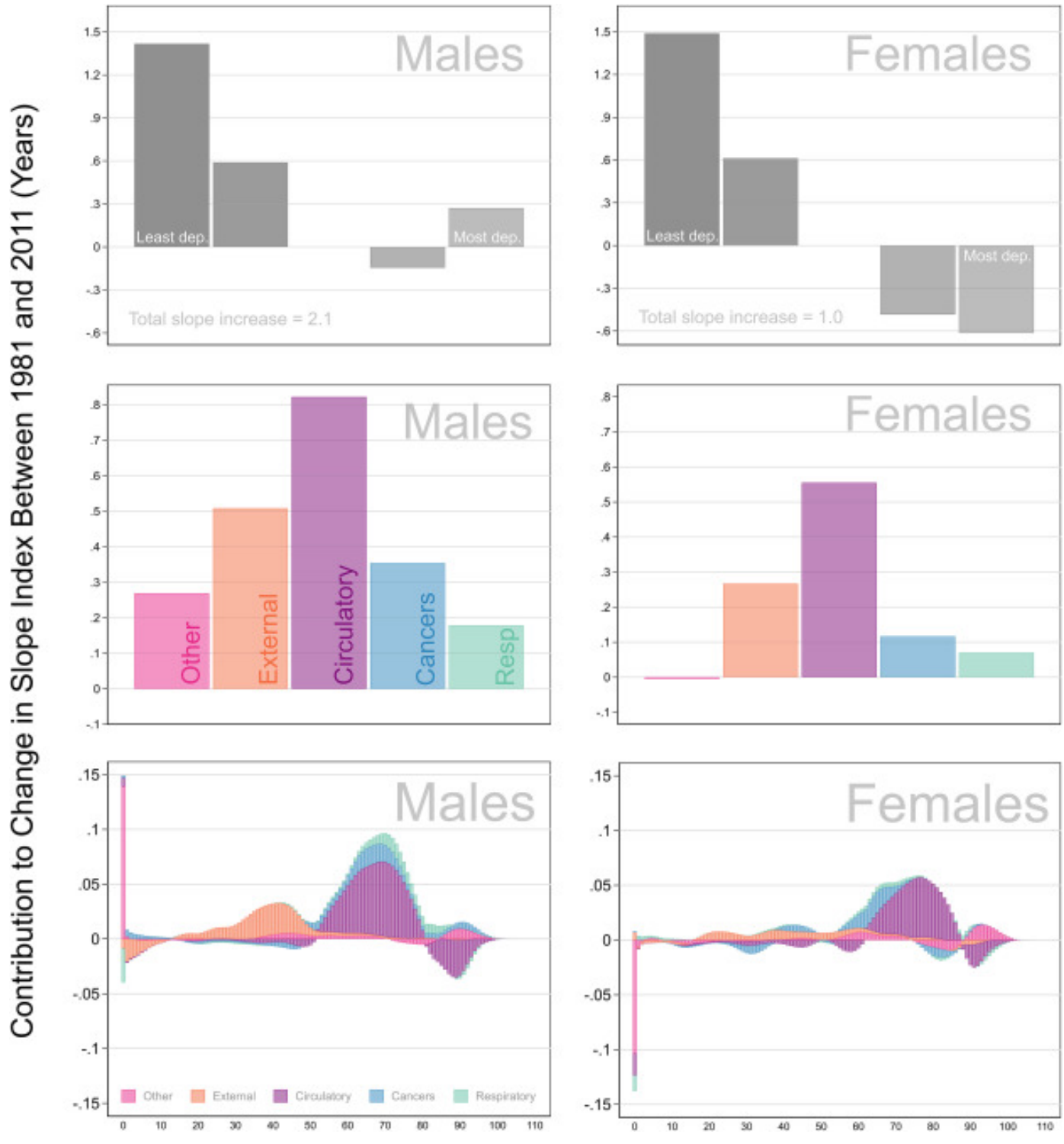
Abstract

The population-level case-fatality rate (CFR) associated with COVID-19 varies substantially, both across countries at any given time and within countries over time. We analyze the contribution of two key determinants of the variation in the observed CFR: the age-structure of diagnosed infection cases and age-specific case-fatality rates. We use data on diagnosed COVID-19 cases and death counts attributable to COVID-19 by age for China, Germany, Italy, South Korea, Spain, the United States, and New York City. We calculate the CFR for


Contribution to Change in Slope Index Between 1981 and 2011 (Years)
Males
Least dep.
Most dep.
Total slope increase = 2.1
Females
Least dep.
Most dep.
Total slope increase = 1.0
Males
Other
External
Circulatory
Cancers
Resp
Females
Males
Other
External
Circulatory
Cancers
Respiratory
Females

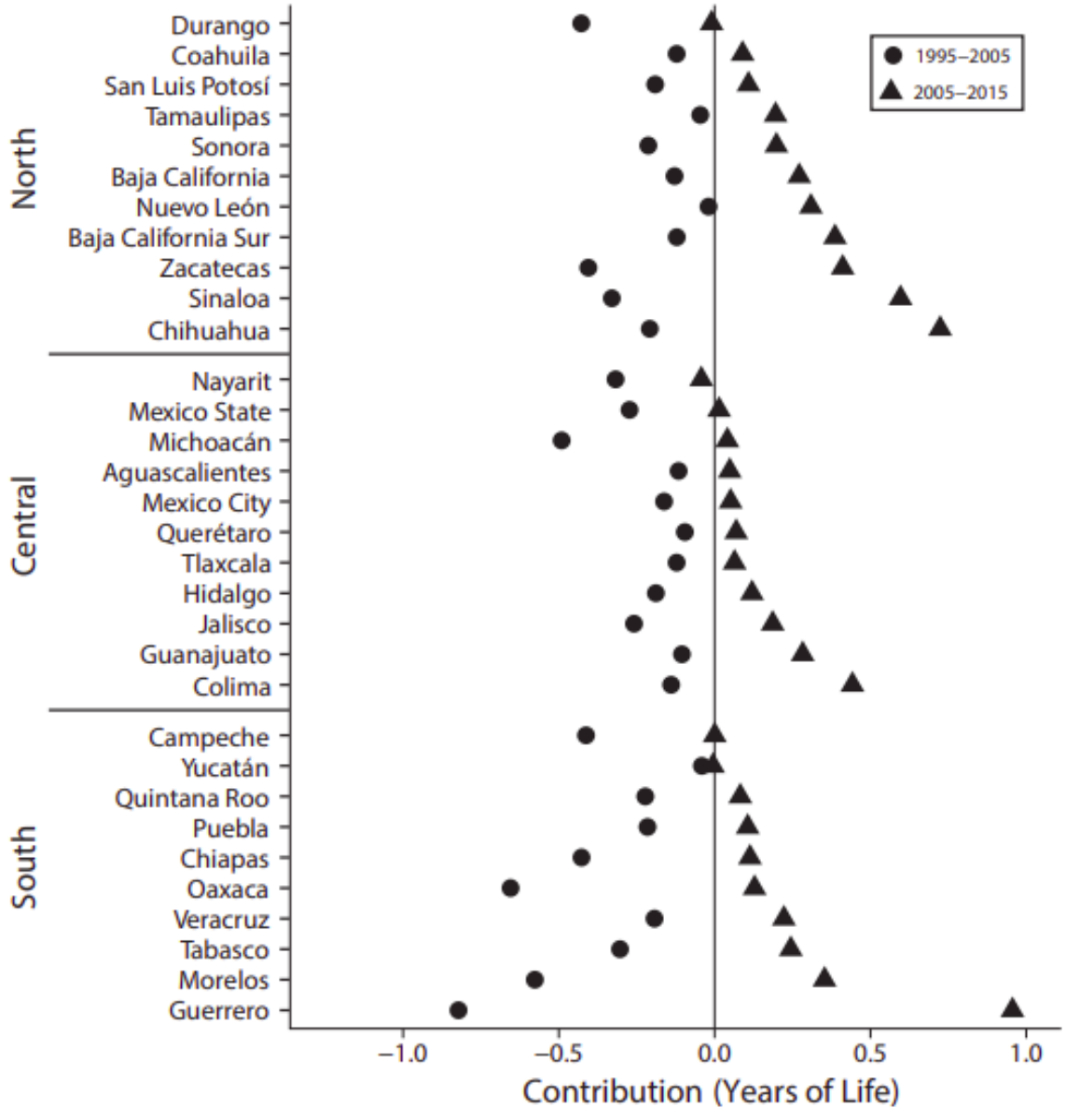
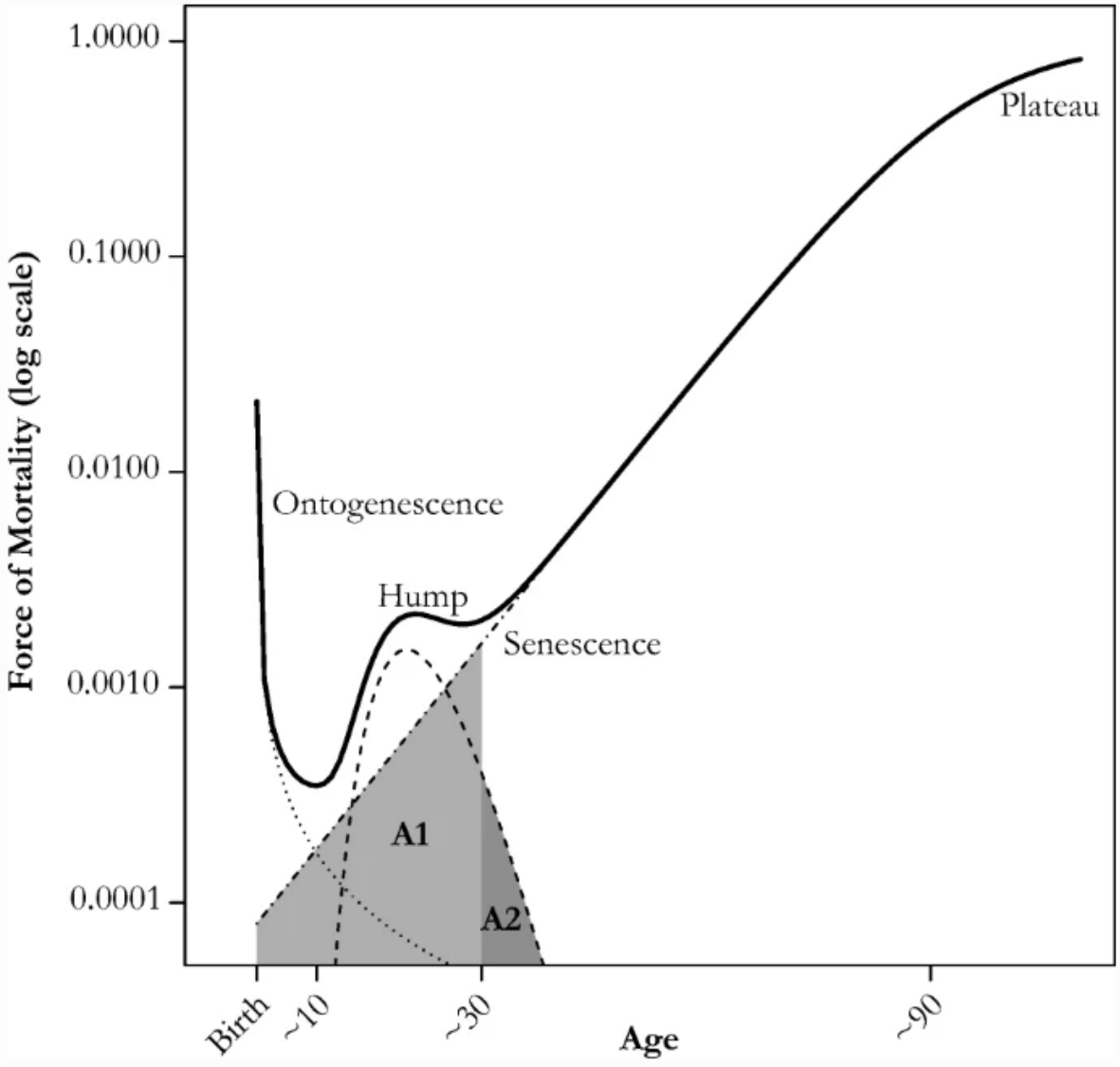

North
Durango
Coahuila
San Luis Potosí
Tamaulipas
Sonora
Baja California
Nuevo León
Baja California Sur
Zacatecas
Sinaloa
Chihuahua
Central
Nayarit
Mexico State
Michoacán
Aguascalientes
Mexico City
Querétaro
Tlaxcala
Hidalgo
Jalisco
Guanajuato
Colima
South
Campeche
Yucatán
Quintana Roo
Puebla
Chiapas
Oaxaca
Veracruz
Tabasco
Morelos
Guerrero
1995–2005
2005–2015
−1.0
−0.5
0.0
0.5
1.0
Contribution (Years of Life)

Fig. 1


1.0000
0.1000
0.0100
0.0010
0.0001
Force of Mortality (log scale)
Plateau
Ontogenescence
Hump
Senescence
A1
A2
Birth
~10
~30
~90
Age

More examples

- How much of a life expecancy gap is due to differences in young vs old mortality?

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- Which ages and parities account for differences in TFR?
- How much of a crude rate is due to differences is rates vs population structure?
- How much of an increase in disabled life expectancy is due to short vs long bouts of disability?

Motivation

- Understanding

Motivation

- Understanding
- Targetting interventions

Summary

- if you can calculate it you can decompose it

Summary

- if you can calculate it you can decompose it
- enrich measurement, monitoring, science, even activism

Bibliography

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