NATURAM PRIMUM COGNOSCERE RERUM

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Workshop on Decomposition Methods

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Kitagawa and Vaupel & Canudas-Romo Decomposition

Crude Death Rate (Direct S)

Table 3: Comparison of Standardized CDR

	Standard as JPN	Standard as KOR
Korea	12.7	5.9
Japan	11.1	5.3

Note: Results are multiplied by 1000

Crude Death Rate (Indirect S)

Table 7: CDR comparison, Korea vs Japan

	Korea	Japan
CDR	5.9	11.1
Indirect Standardized CDR	5.6	11.9

Note: Results are multiplied by 1000

CDR

$$CDR_{JPN} - CDR_{KOR} =$$

$$\sum_x \Delta m_x \bar{c}_x + \sum_x \bar{m}_x \Delta c_x$$

Direct component

$$\Delta m_x = m_{x,JPN} - m_{x,KOR}$$

Direct component

$$\overline{c}_x = \frac{c_{x,JPN} + c_{x,KOR}}{2}$$

Indirect component

$$\Delta c_x = c_{x,JPN} - c_{x,KOR}$$

Indirect component

$$\overline{m}_x = \frac{m_{x,JPN} + m_{x,KOR}}{2}$$

CDR decomposition

Table 1: CDR decomposition (Kitagawa)

CDR in Japan	11.08
CDR in Korea	5.94
Difference	5.14
Direct component	-1.11
Indirect component	6.26
Total estimated difference	5.14

Note: Results are multiplied by 1000

Population growth rates

$$\bar{r}(t) = \int_0^{\omega} r(x,t)c(x,t)\,dx$$

Sex-gap in growth rate

$$\Delta\bar{r}(t) = \bar{r}_M(t) - \bar{r}_F(t)$$

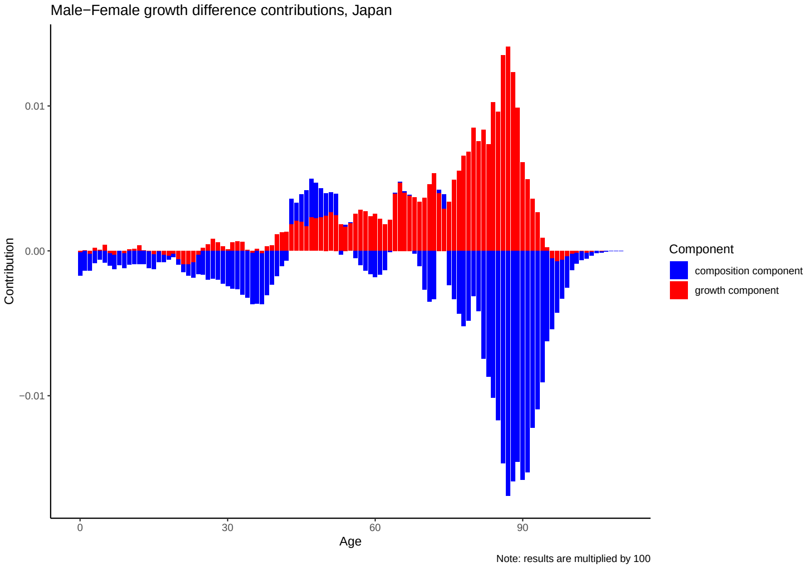
Sex-gap in growth rate

Table 2: Growth Difference between Male and Female, Japan

	Japan
Growth of Male Population 2010-2020	-0.22
Growth of Female Population 2010-2020	-0.18
Observed difference	-0.04
Direct Component	0.24
Indirect Component	-0.28
Estimated Difference	-0.04

Note: Results are multiplied by 1000

Sex-gap in growth rate



BREAK

DEMOGRAPHIC RESEARCH
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Decomposing demographic change into direct vs. compositional components

BY » James W. Vaupel, » Vladimir Canudas-Romo

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Abstract

We present and prove a formula for decomposing change in a population average into two components. One component captures the effect of direct change in the characteristic of interest, and the other captures the effect of compositional change. The decomposition is applied to time derivatives of averages over age and over subpopulations.

Vaupel & Canudas-Romo Decomposition

$$\bar{v}(t) = \frac{\int_0^{\omega} v(x,t)w(x,t)dx}{\int_0^{\omega} w(x,t)dx}$$

Derivatives

$$\dot{v}(x,t) = \frac{\partial}{\partial t} v(x,t)$$

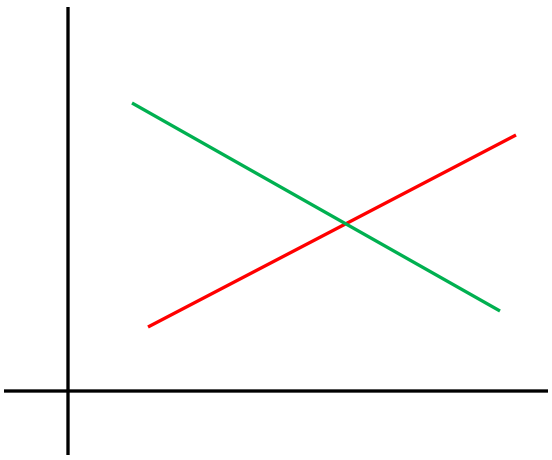
Relative derivatives

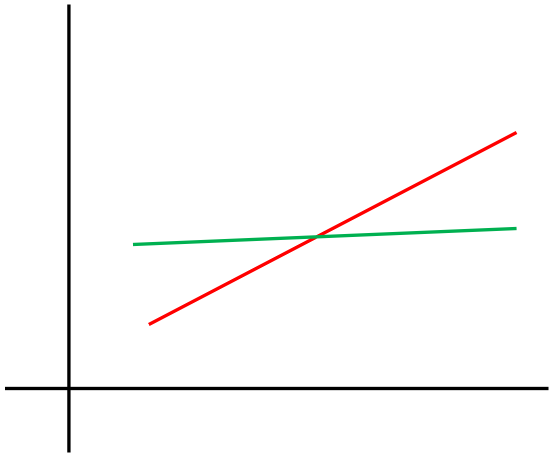
$$\acute{w}(x,t) = \frac{\frac{\partial}{\partial t} w(x,t)}{w(x,t)}$$

VCR decomposition

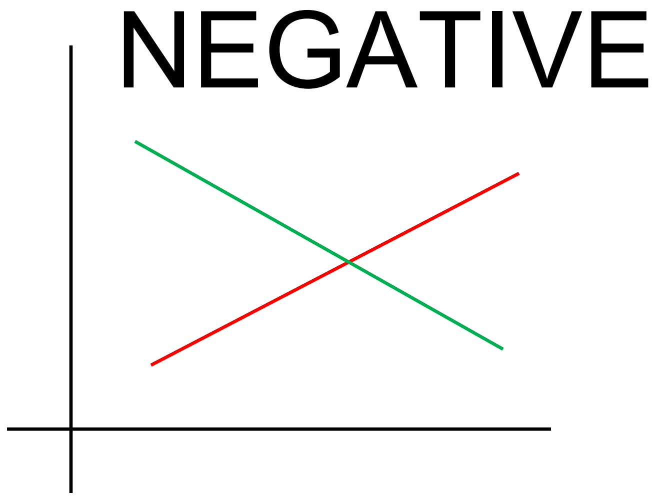
$$\dot{\bar{v}} = \bar{\dot{v}} + Cov(v, \acute{w})$$

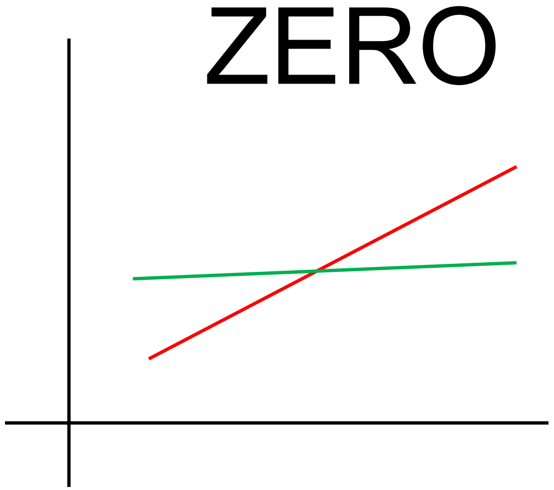
CO-variance





CO-variance





Crude Death Rate

$$\dot{\bar{m}} = \bar{\dot{m}} + Cov(m, r)$$

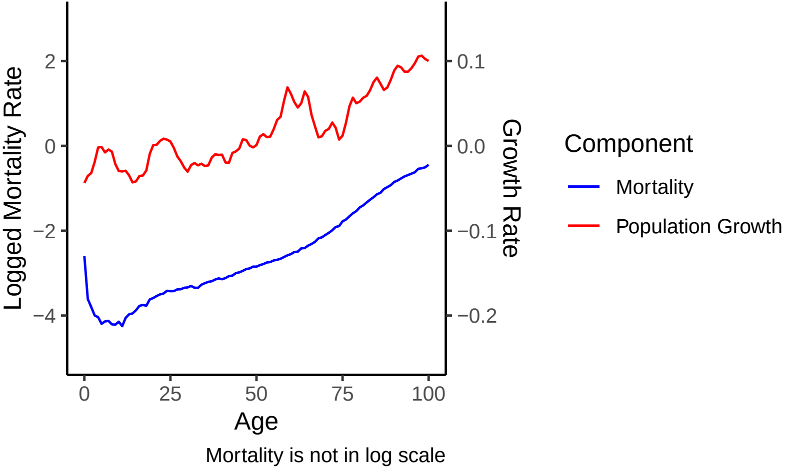
CDR

Table 3: CDR decomposition (VCR)

	Korea
CDR in 2010	4.54
CDR in 2020	5.42
CDR annualized difference	0.09
Direct component	-0.16
Compositional component	0.25
Total estimated difference	0.09

Note: Results are multiplied by 1000

Covariance(m,r)



GFR decomposition

$$\dot{\bar{f}} = \bar{\dot{f}} + Cov(f_x, r_f)$$

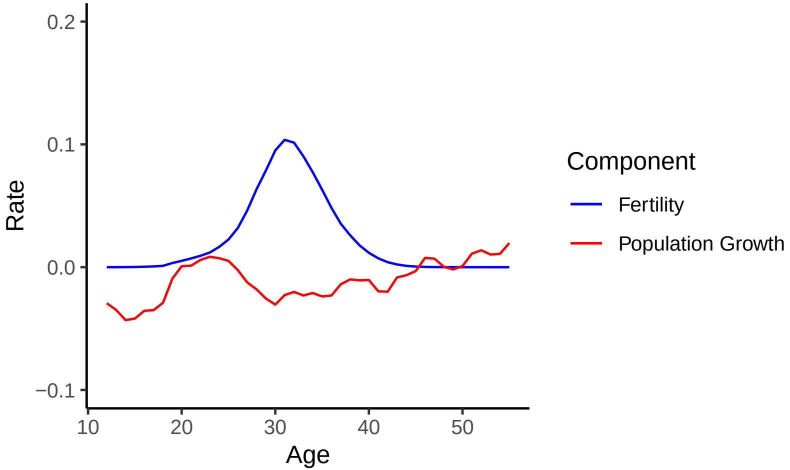
GFR decomposition

Table 4: GFR decomposition (VCR)

	Korea
GFR in 2010	28.24
GFR in 2020	18.06
GFR annualized difference	-1.01
Direct component	-0.79
Compositional component	-0.20
Total estimated difference	-0.99

Note: Results are multiplied by 1000

Covariance(f,r)



Mean Age of the Population (MAP)

$$\bar{a} = \frac{\int_0^{\omega} aP(a,t)da}{\int_0^{\omega} P(a,t)da}$$

Only covariance

$$\dot{a} = Cov(a, r)$$

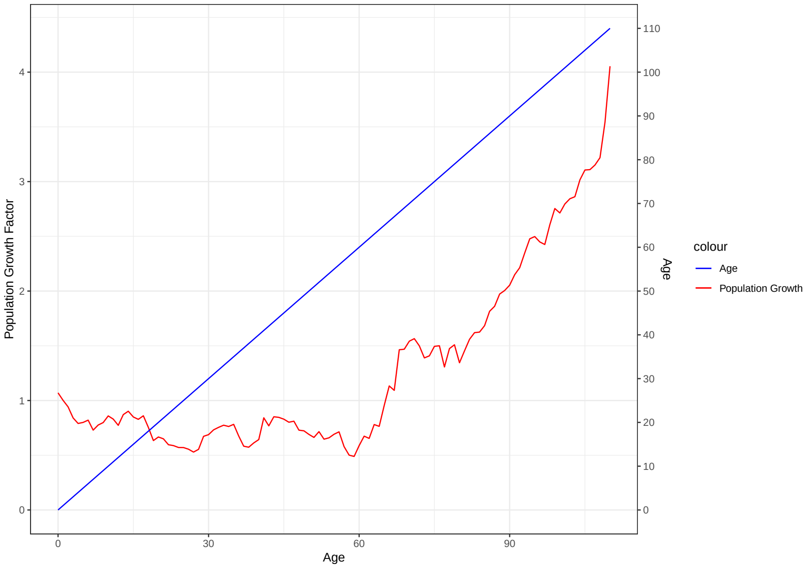
MAP decomposition

Table 5: MAP decomposition (VCR)

	Korea
MAP for Korea	43.14
MAP for Japan	48.72
Difference in MAP	5.58
Estimated Difference	5.52

Note: Results are multiplied by 1000

Covariance(a,r)



Relative derivatives estimation

$$\acute{v}(x,t) = \frac{\frac{\partial}{\partial t} v(x,t)}{v(x,t)}$$

Relative derivatives estimation

$$\acute{v}(x,t) = \frac{\partial}{\partial t} \ln[v(x,t)]$$

Relative derivatives estimation (Step 1)

$$\acute{v}(x,t) \approx$$

$$\ln\left[\frac{v(x,t+h)}{v(x,t)}\right]/h$$

Mid point estimation (Step 2)

$$v\left(x, t + \frac{h}{2}\right) \approx$$

$$[v(x,t)v(x,t+h)]^{\frac{1}{2}}$$

Derivatives estimation (Step 3)

$$\dot{v}\,(x,t) = \acute{v}(x,t)v\left(x, t + \frac{h}{2}\right)$$

Assignment 2

Select one of the measures in the examples of this section and apply to a different population from HMD or HFD.

Submit ONE page: one Figure (or Table) and a brief paragraph describing the results that you find.