Person-years lost from Covid

BFDW, Day 2, Lecture 3

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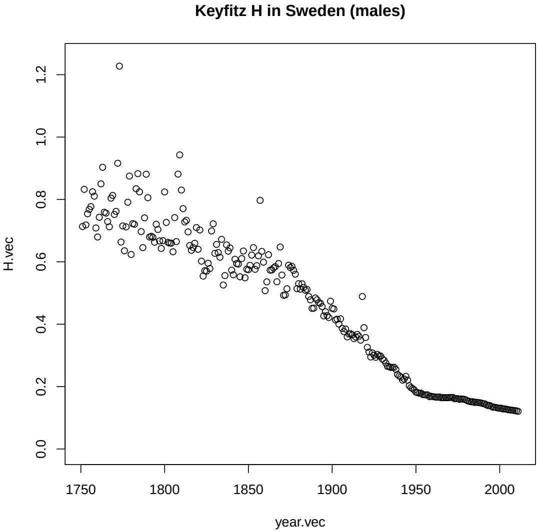
Our plan

- Life expectancy criticisms
- Remaining person years lost as an alternative
- Mathematics of lost lives and lost life
- Elegance $\neq$ relevance?

Technical problem: $\mathcal{H}$ is not constant



Populations with different base mortality will see different changes

Substantive problem: isn't e_0 a "misleading indicator"?

> *In the context of epidemic mortality, life expectancy at birth is a misleading indicator, because it implicitly assumes the epidemic is experienced each year over and over again as a person gets older.*

– Goldstein and Lee (2000)

e_0 as "standardization"

Life expectancy is reciprocal of standardized mortality, with period survivorship as standard.

$$\frac{\int h(a)\ell(a)\, da}{\int \ell(a)\, da}$$

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Life expectancy is reciprocal of standardized mortality, with period survivorship as standard.

$$\frac{\int h(a)\ell(a)\,da}{\int \ell(a)\,da} = \frac{1}{e_0}$$

So with different life tables, we'll have different standard pop $\ell(x)$.

Loss of person years

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Proportion of remaining life lost

Our equation (3) from "cheatsheet"

$$\frac{\Delta\theta_0}{\theta_0} \approx -\frac{\mathcal{H}}{A_0}\delta,$$

where θ_0 is the number of remaining person-years in the population before the crisis.

Set up

Assume a stationary population and proportional crisis

- Person-years remaining before crisis

$$\int N(a)e(a)\,da = \int B\ell(a)e(a)\,da$$

- Person-years lost

$$\int D(a)e(a)\,da = \int B\ell(a)\delta h(a)e(a)\,da$$

Combining, proportion of remaining person years of life:

$$\frac{\Delta\theta_0}{\theta_0} = \frac{\text{PY lost}}{\text{PY remaining}} = -\delta\frac{\int \ell(a)h(a)e(a)\,da}{\int \ell(a)e(a)\,da}$$

Evaluating

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Dividing top and bottom by e_0 gives

$$\frac{\Delta\theta_0}{\theta_0} = \frac{\text{PY lost}}{\text{PY remaining}} = -\delta \frac{\mathcal{H}}{A_0}$$

An example

Say $\delta = 1/2$, $H = 0.15$, $A_0 = 40$
Then,

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Why so small, when mortality increased by so much?

$$\frac{\text{PY Lost}}{\text{PY Remaining}} = \frac{D_{crisis} \cdot \bar{e}(\text{dying})}{N \cdot \bar{e}(\text{living})}$$

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$$\frac{\text{PY Lost}}{\text{PY Remaining}} = \frac{D_{crisis} \cdot \bar{e}(\text{dying})}{N \cdot \bar{e}(\text{living})} \approx CDR_{crisis} \cdot \frac{10}{40}$$

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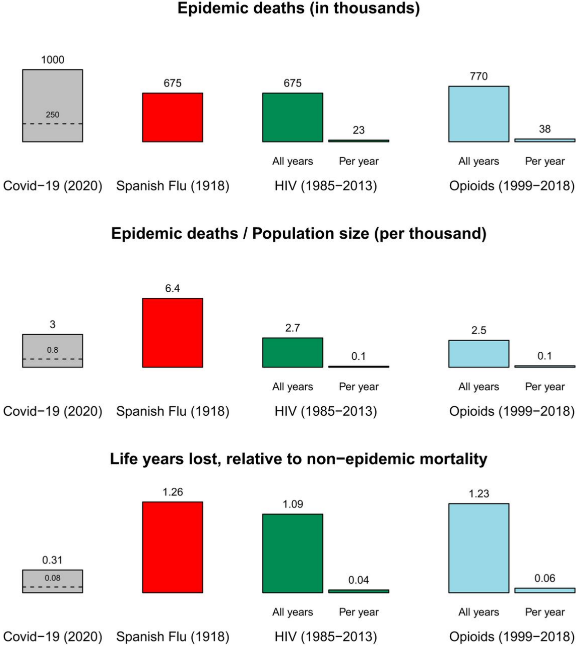
So we have $1/4$ of a per-capita death rate ..., a very small number. (Mostly, because the base rate of mortality is already small.)

Comparing to baseline (Goldstein and Lee, 2020)



Breakout Exercises

Our usual A, B, C (but spiced up with some controversy?)

A Calculate person years in population

B Calculate person years lost

C Compare to our approximation

Discussion

Your questions first

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Your questions first

- About how many person years were lost per person in the US from Covid in 2020? Multiple years, multiple weeks, ...
- Who's right: Ilya or Josh? (Or neither?)
- How do we think about effect on cohort life expectancy?
- Why did Spanish Flu, HIV, and Opioids result in a larger loss of remaining life?
- Should we adjust for age structure?

Concluding common threads

- Each measure (CDR, e_0, PYR) tried to accomplish something
- Formal analysis simplified and identified key properties – and potential problems.
- New problems, new formulations
  Results discovered 100 years ago are still important today.

A concluding quote

Formal demography
"is nothing more than clear analytic thinking about a demographic problem, with hard-edged concepts, typically distilled into mathematical expressions."

– Ron Lee (2014),