

A hazards approach to the biometric analysis of infant mortality

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Outline

- Bourgeois-Pichat (1951): Biometric analysis of IM (background).
- Hazard-based alternative.
- Theoretical considerations
- Real-world examples.

Bourgeois-Pichat and causes of death

- Two categories:
 - Endogenous: *inherited, delivery*, etc.
 - Exogenous: *accidental, infectious diseases*, etc.
- How to differentiate between the two categories without information of causes of death?

Bourgeois-Pichat's Biometric model.

The biometric model

Two postulates:

- ① Endogenous deaths only occur during the neonatal period (0–28 days).
- ② On a specific time scale, exogenous infant mortality is uniformly distributed.

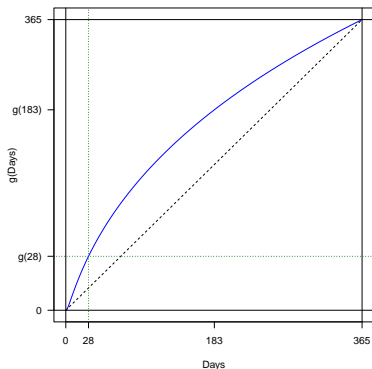
The log-cube transform

$$g(t) = C \log^3(t + 1), \quad 0 < t \leq 365.$$

where C is a normalizing constant:

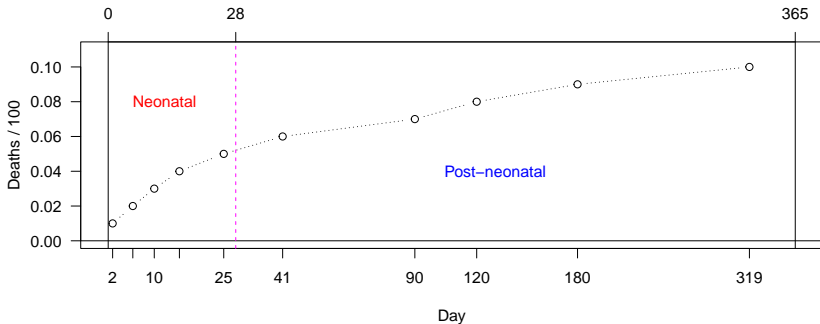
$$C = \frac{365}{\log^3(365 + 1)}$$

Note: C is not part of B-P's original definition.



Demonstration of the B-P plot

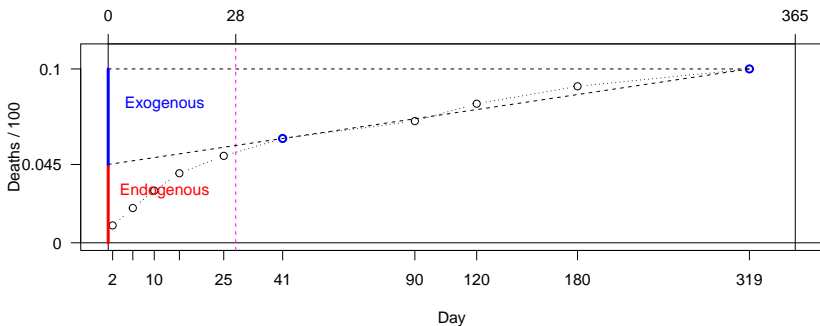
Assume 100 births, of which 90 survives infancy, ten death ages:
2, 6, 10, 15, 25, 41, 90, 120, 180, 319.



Calculation (no ties): $\frac{1}{100}, \frac{2}{100}, \frac{3}{100}, \dots, \frac{10}{100}$.

Demonstration of the B-P plot II

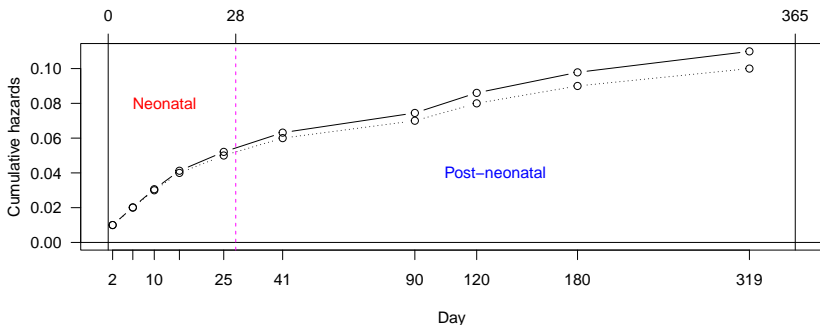
Assume 100 births, of which 90 survives infancy, ten death ages:
2, 6, 10, 15, 25, 41, 90, 120, 180, 319.



Calculation (no ties): $\frac{1}{100}, \frac{2}{100}, \frac{3}{100}, \dots, \frac{10}{100}$.

Explanation of the hazards plot

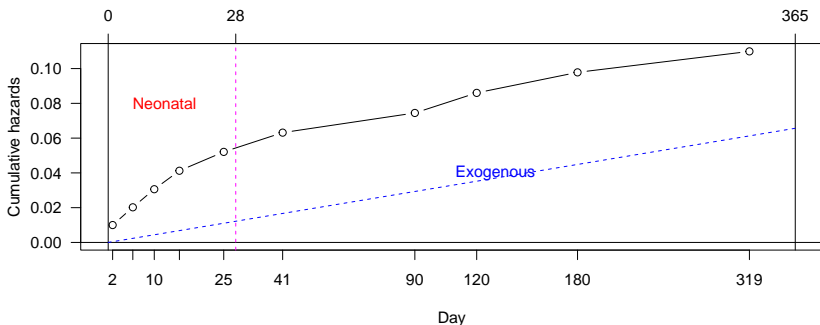
Assume 100 births, of which 90 survives infancy, ten death ages:
2, 6, 10, 15, 25, 41, 90, 120, 180, 319 (same as before).



Calculation (no ties): $\frac{1}{100}, \frac{2}{99}, \frac{3}{98}, \dots, \frac{10}{91}$.

Explanation of the hazards plot II

Assume 100 births, of which 90 survives infancy, ten death ages:
2, 6, 10, 15, 25, 41, 90, 120, 180, 319 (same as before).

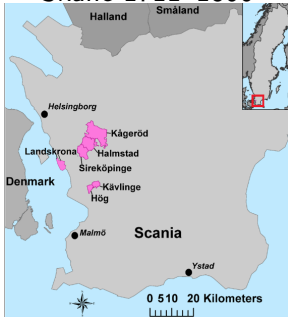


Earlier work

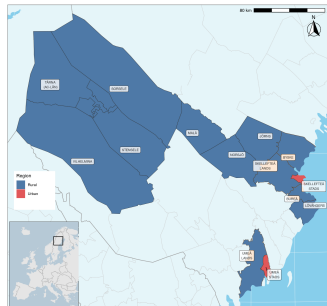
- Knodel & Kintner (1977)
- Wrigley (1977).
- Lynch, Greenhouse & Brändström (1998).
- Bengtsson (1999).
- Manfredini (2004).

Study areas

Skåne 1711–1800

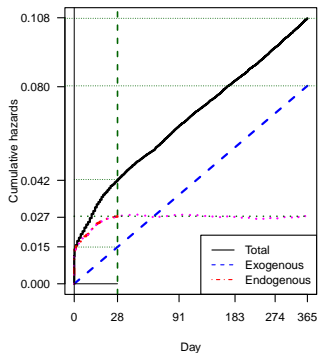


Västerbotten 1801–1950

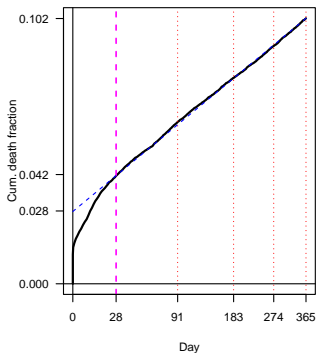


Västerbotten 1861-1890

Hazards method

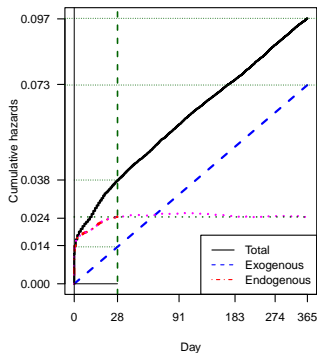


B-P method

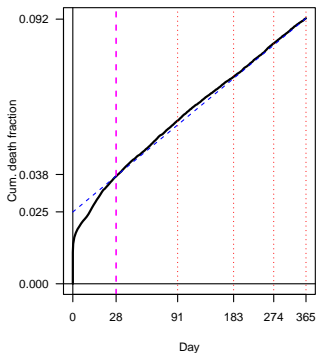


Västerbotten 1921–1950

Hazards method



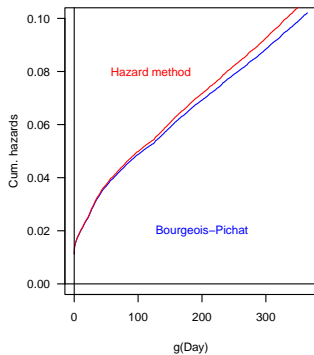
B-P method



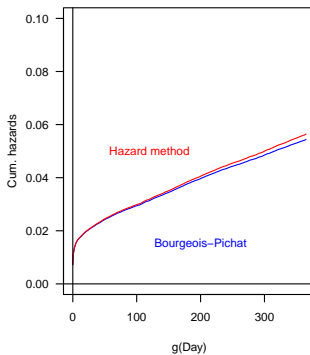
Comparison

Remove?

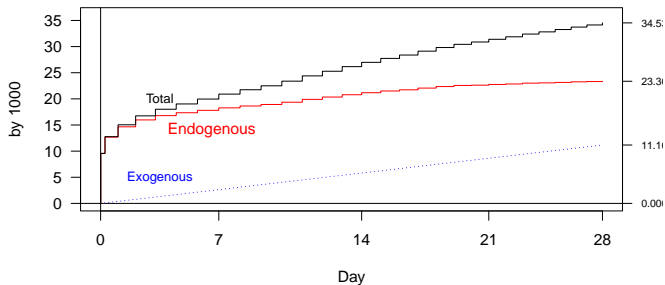
1861–1890



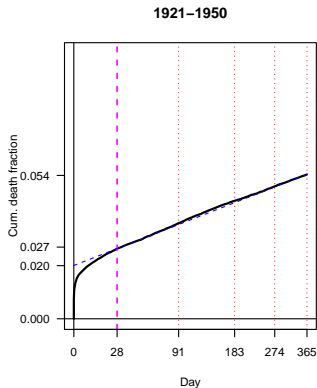
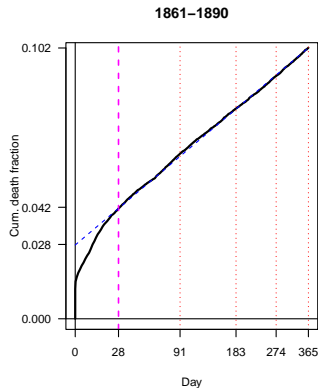
1921–1950



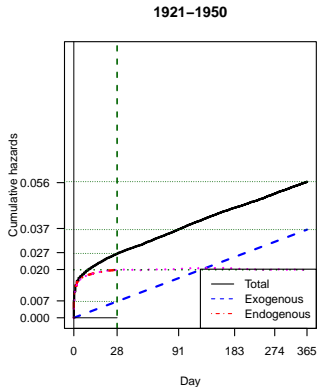
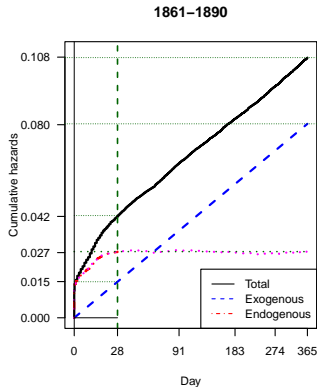
Cumulative hazards, neonatal mortality, Västerbotten 1861-1950



Västerbotten, Bourgeois-Pichat's method

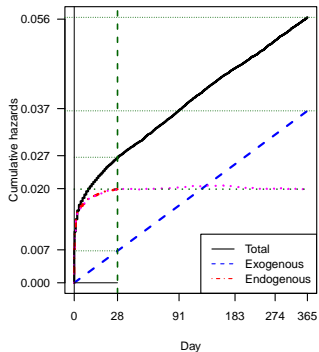


Västerbotten, hazards method

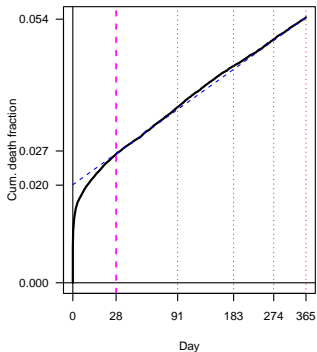


Västerbotten 1921–1950

Hazards method

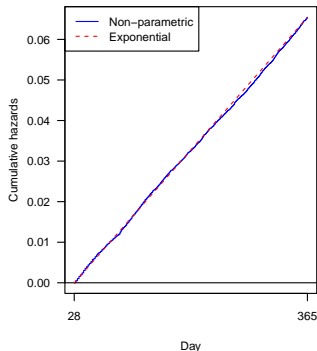


B-P method

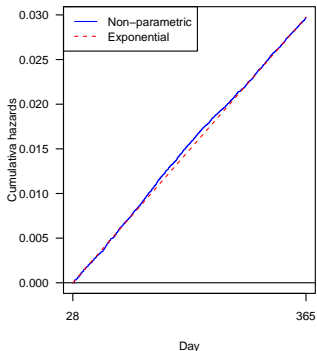


Exponential fits to post-neonatal data, Västerbotten

1861–1890

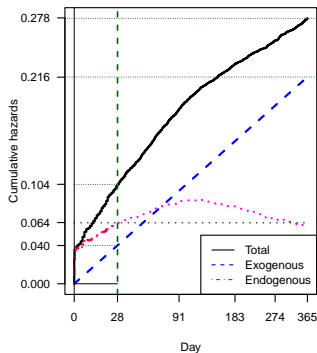


1921–1950

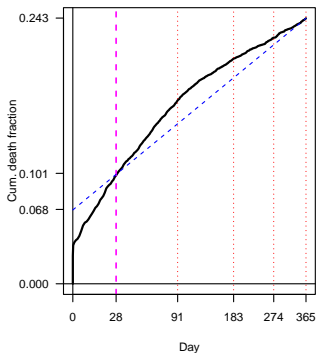


Scania 1711–1800

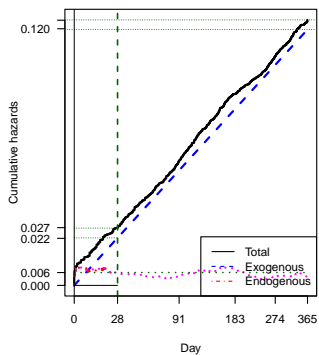
Hazards method



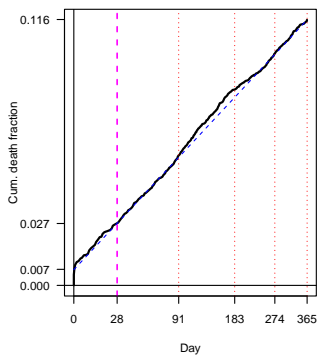
B-P method



Hazards method



B-P method



Conclusions

- Good