Generation intervals in space

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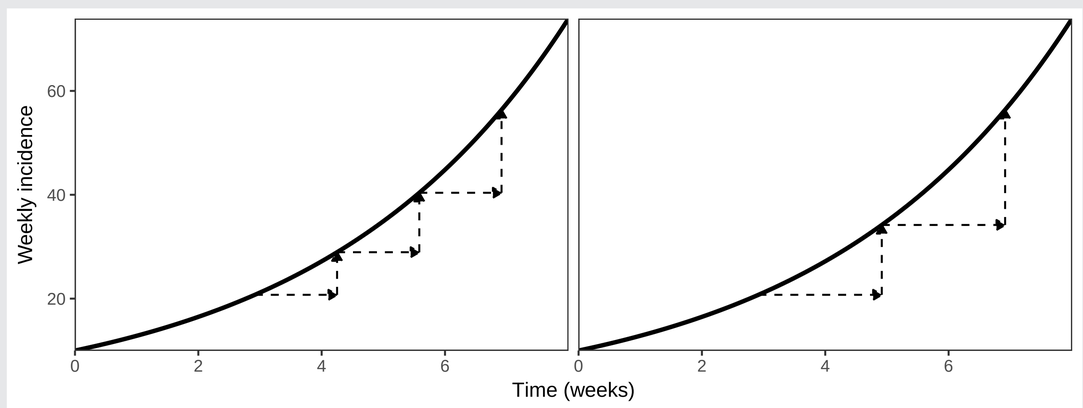
Introduction

- Generation interval (GI) measures time between when a person is infected and when that person infects another person
- GI distributions, $g(\tau)$, link speed, r, and strength, $\mathcal{R}$, of an epidemic [1]

$$1/\mathcal{R} = \int g(\tau)\exp(-r\tau)d\tau$$

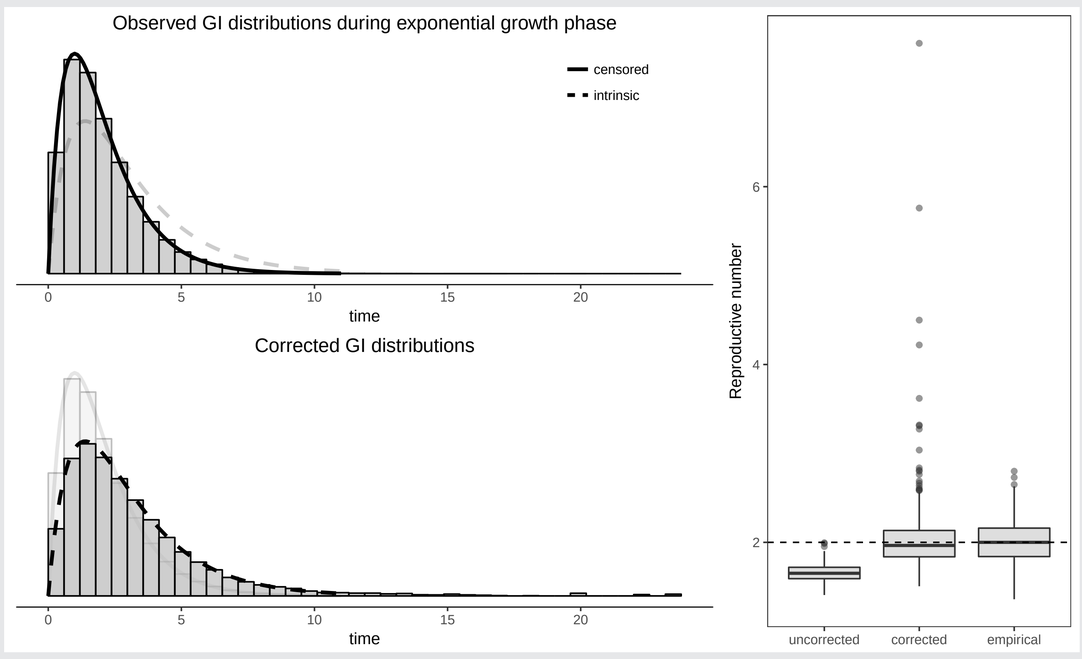
- Previous work showed that measuring GI through contact tracing data can introduce bias [2]
- Trapman *et al.* [3] demonstrated that network structure can affect $\mathcal{R}$ but it also has effect on GI distributions

Linking r and $\mathcal{R}$



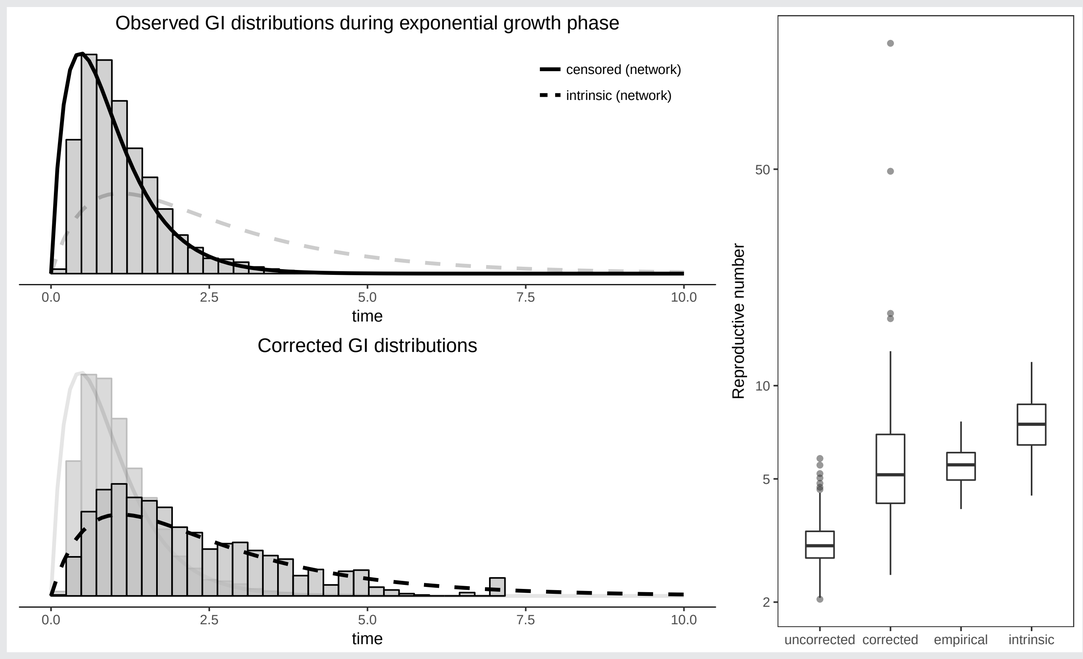
Longer generation interval requires higher $\mathcal{R}$ given fixed exponential growth rate r.

Temporal correction on a homogeneous network



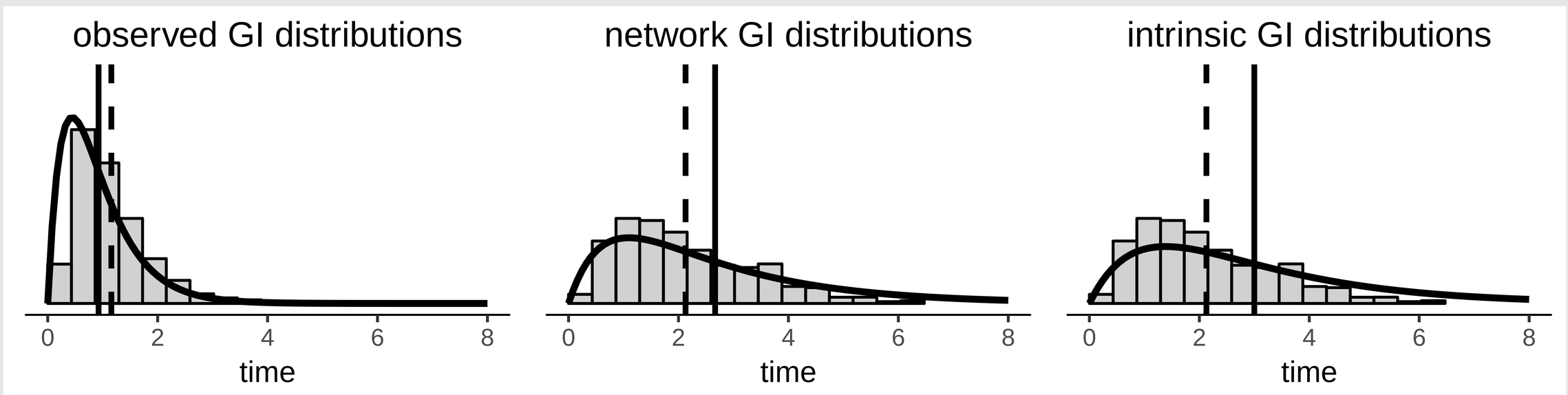
- During the exponential growth phase, the observed GI distributions is proportional to $g(\tau)\exp(-r\tau)$.
- By weighting observed distribution by $exp(r\tau)$, intrinsic GI distribution can be recovered

Temporal correction on an empirical network



- Something about network/spatial effect
- $\mathcal{R}$ estimate based on corrected GI distributions matches empirical $\mathcal{R}$. Meanwhile, using intrinsic GI distributions and observed GI distributions can over/underestimate $\mathcal{R}$.

Spatial effect on generation intervals distribution



Summary

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Bibliography

[1] Jacco Wallinga and Marc Lipsitch. How generation intervals shape the relationship between growth rates and reproductive numbers. *Proceedings of the Royal Society of London B: Biological Sciences*, 274(1609):599–604, 2007.

[2] David Champredon and Jonathan Dushoff. Intrinsic and realized generation intervals in infectious-disease transmission. In *Proc. R. Soc. B*, volume 282, page 20152026. The Royal Society, 2015.

[3] Pieter Trapman, Frank Ball, Jean-Stéphane Dhersin, Viet Chi Tran, Jacco Wallinga, and Tom Britton. Inferring r0 in emerging epidemicsthe effect of common population structure is small. *Journal of the Royal Society Interface*, 13(121):20160288, 2016.