

Why do we use spatial models?

Zambia HIV Estimates Technical Working Group

Adam Howes

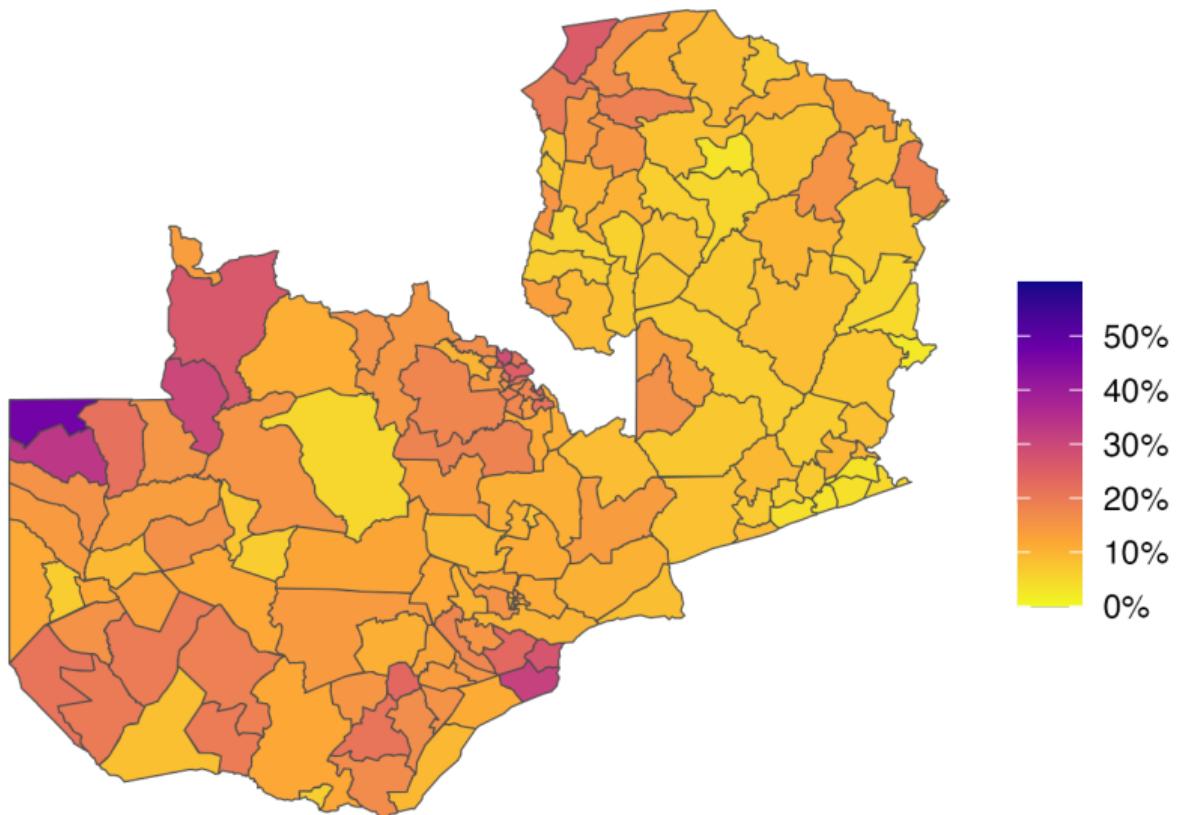
Imperial College London

August 2023

The 156 constituencies of Zambia

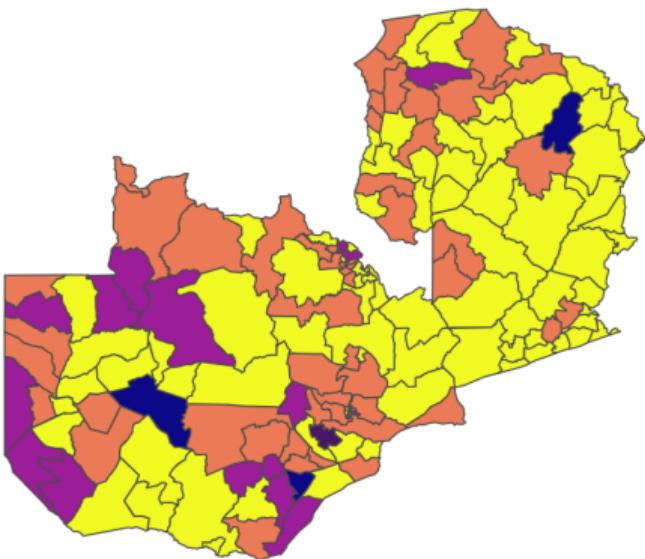


Underlying truth

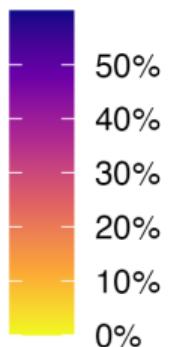
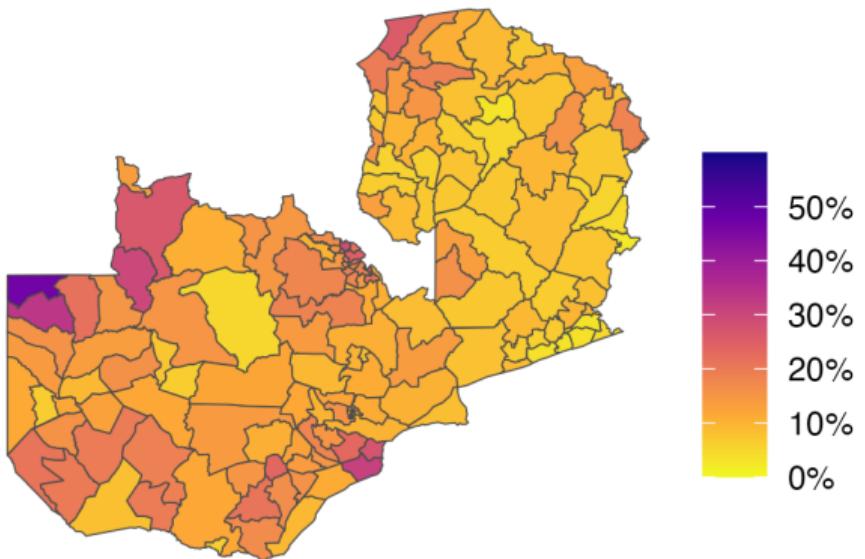


Survey of size 5

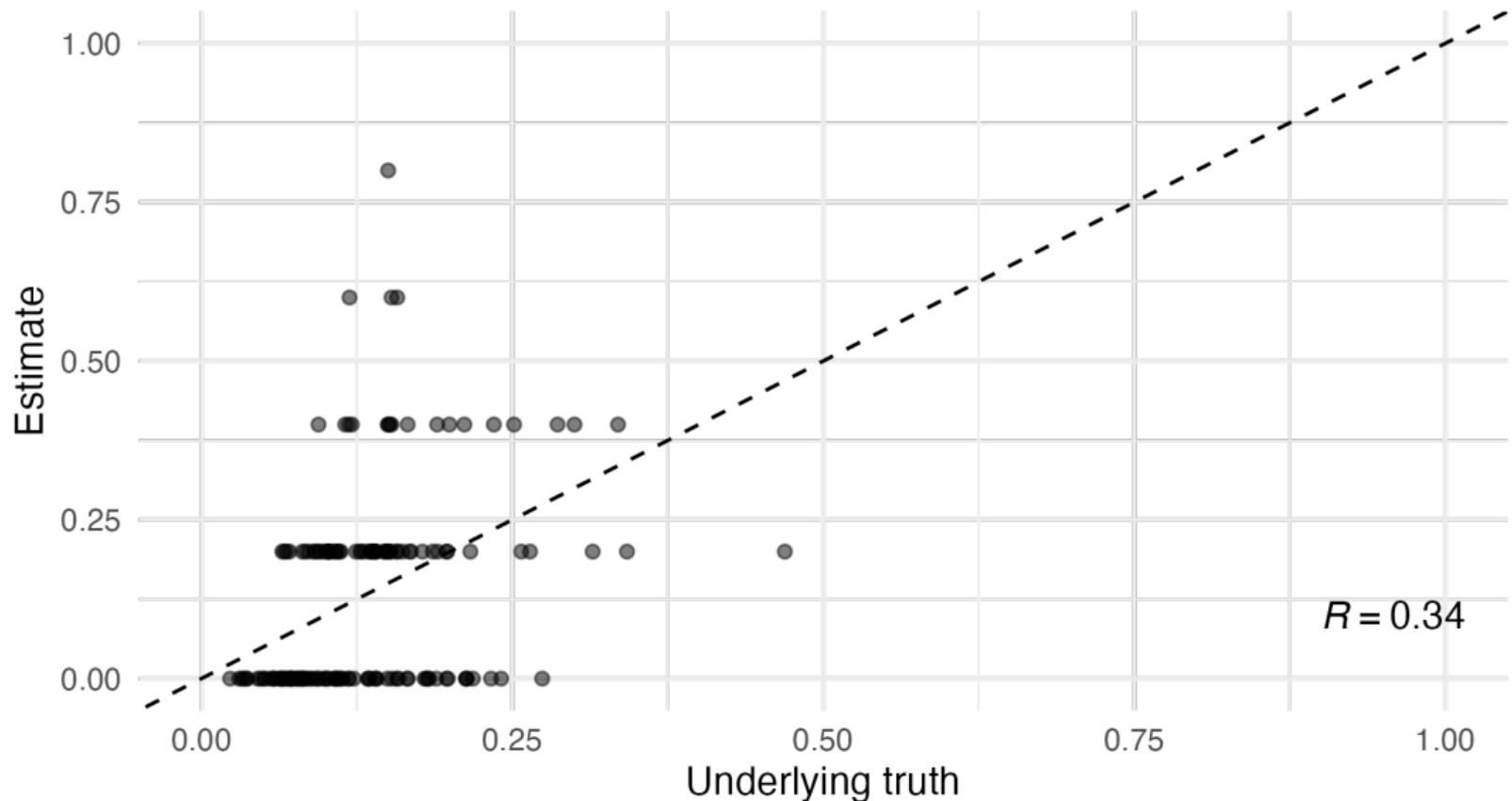
Direct estimates



Underlying truth

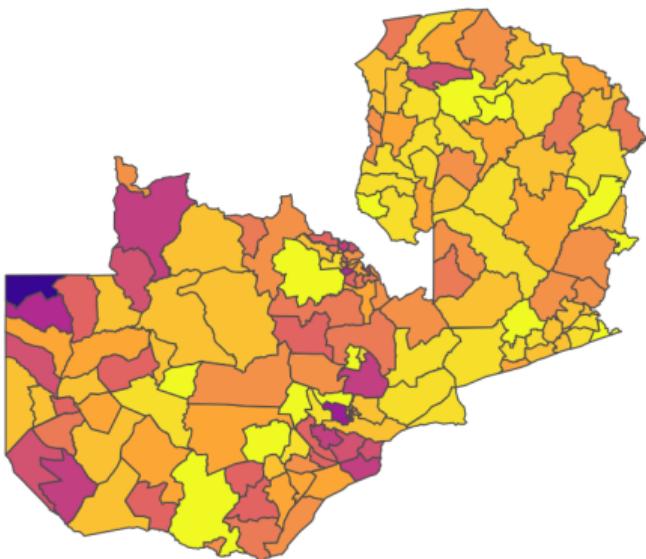


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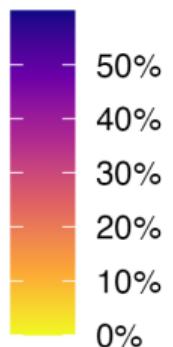
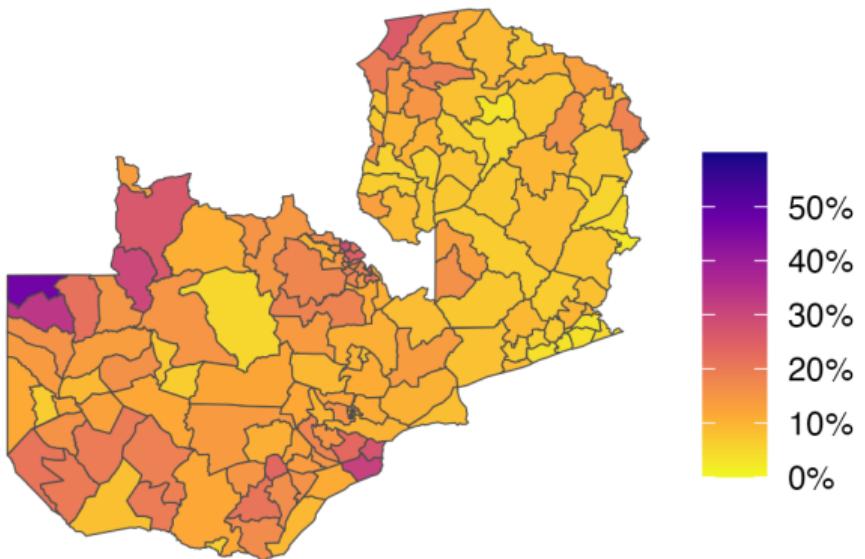


Survey of size 25

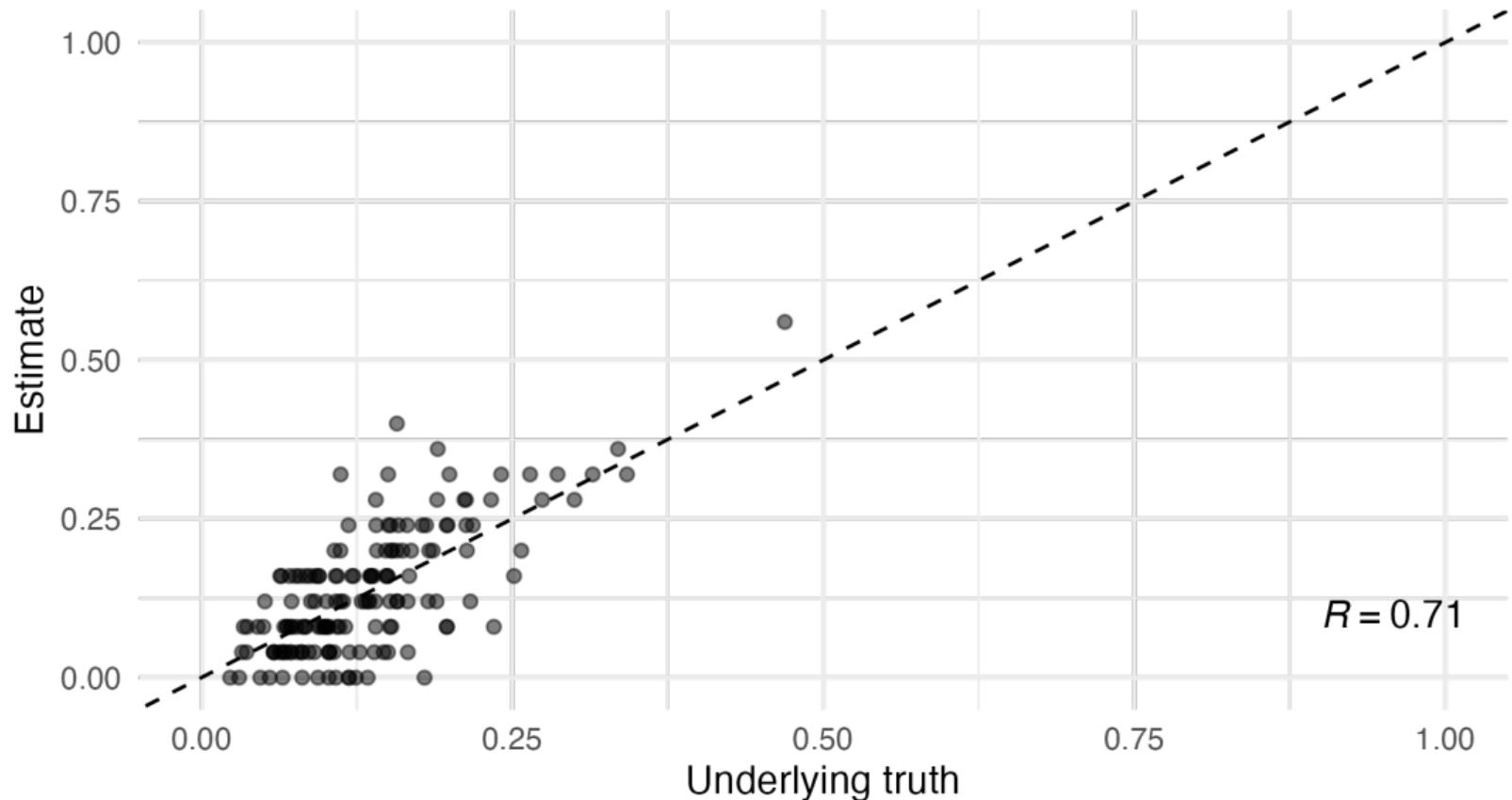
Direct estimates



Underlying truth

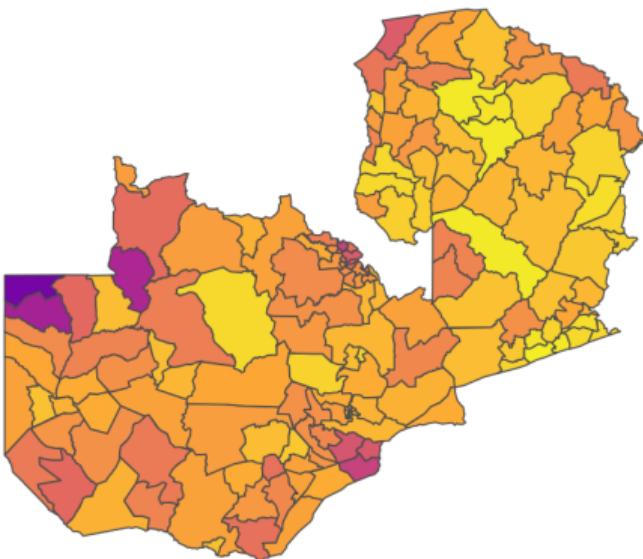


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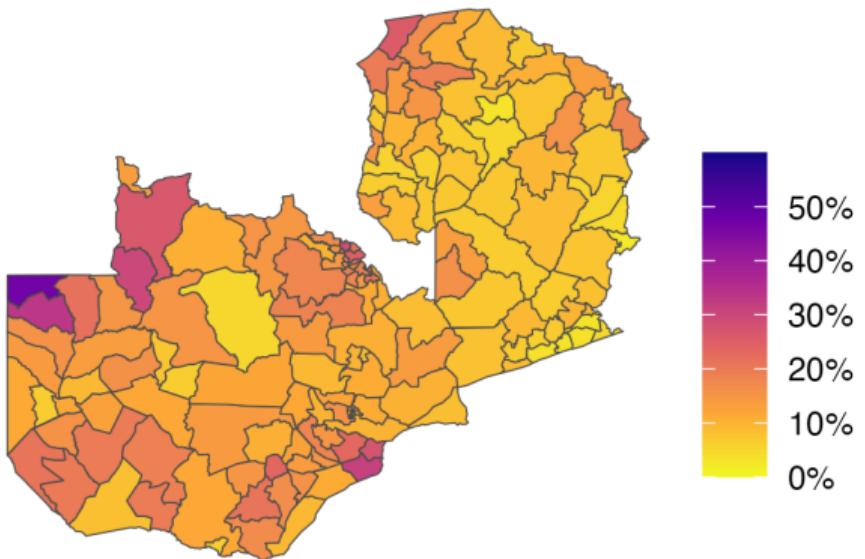


Survey of size 125

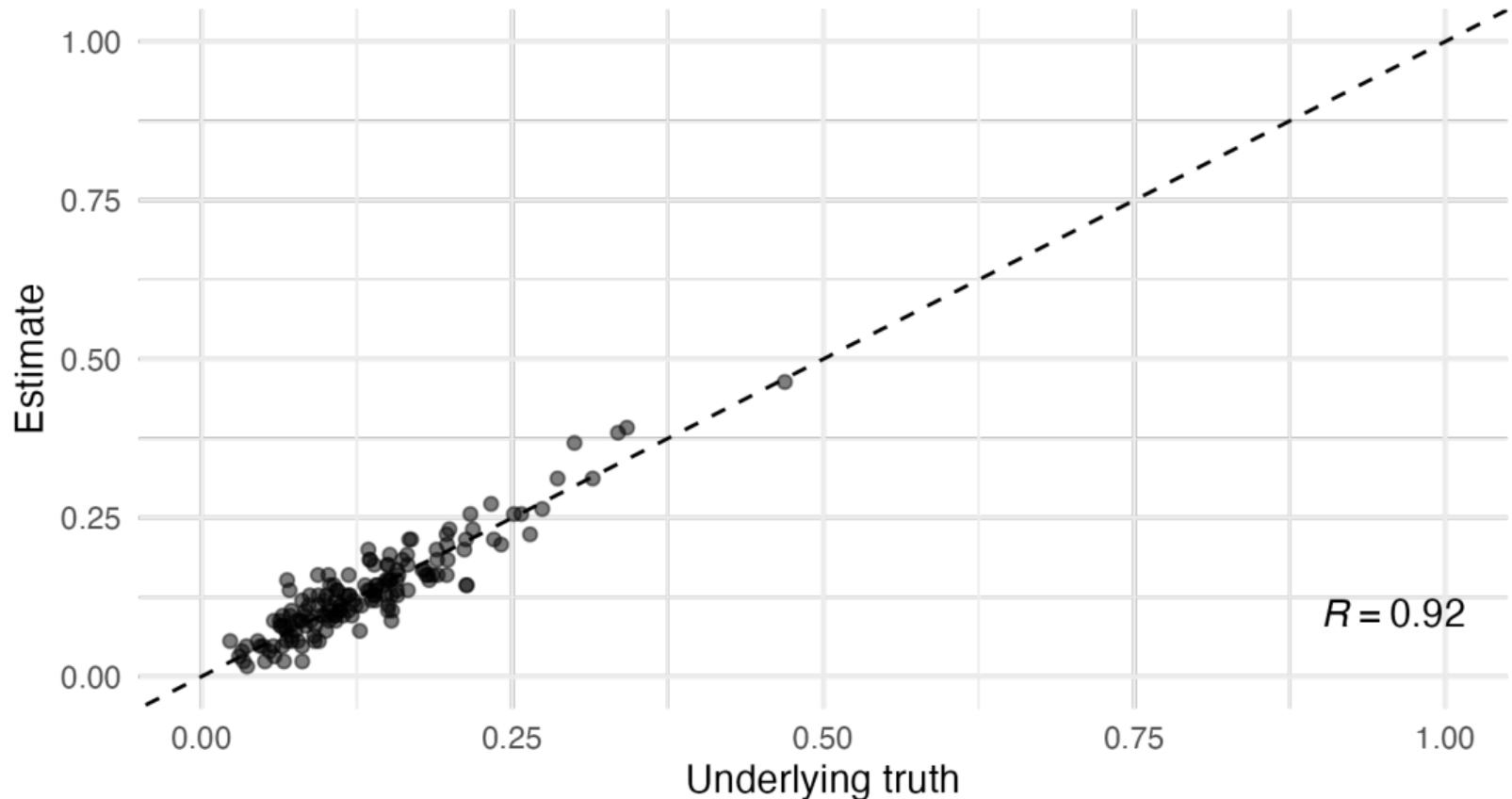
Direct estimates



Underlying truth



Survey of size 125





Under box A



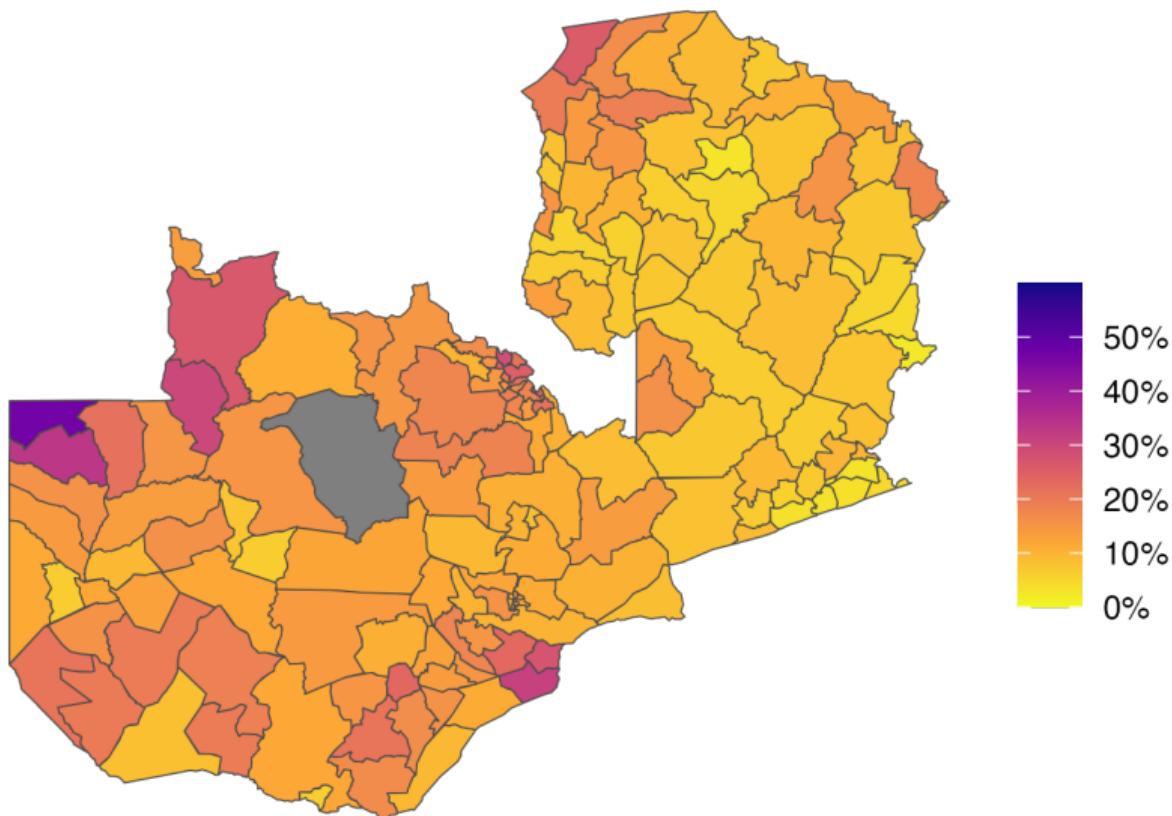
Under box B



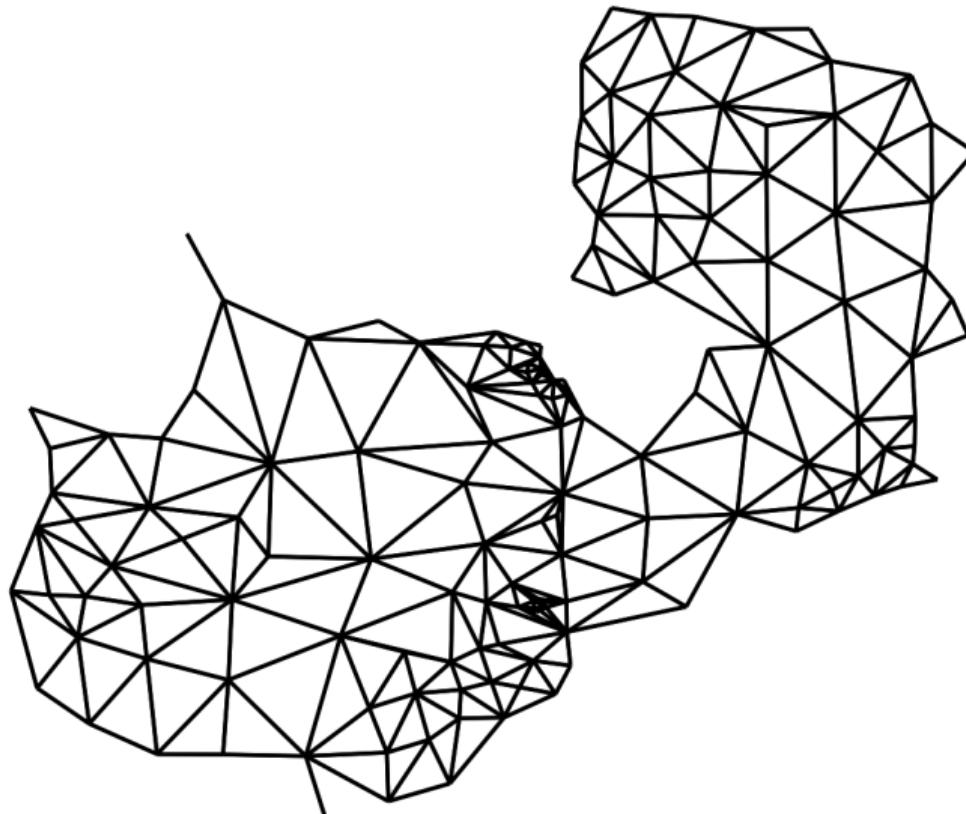
Under box C



What is under this missing value?

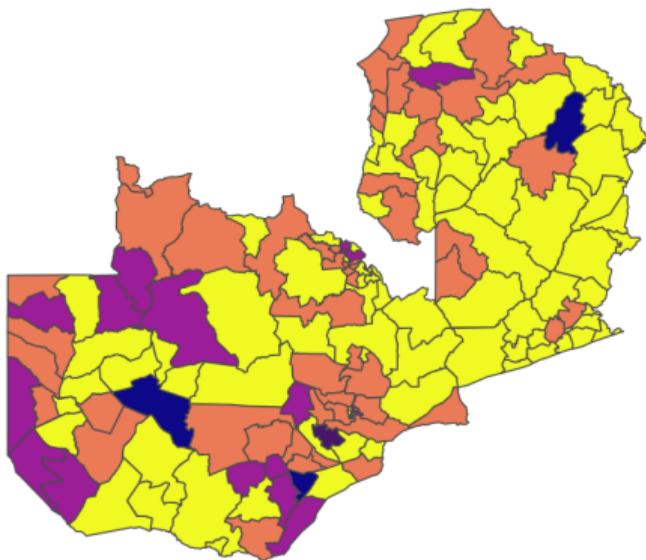


Borrow information from neighbouring constituencies

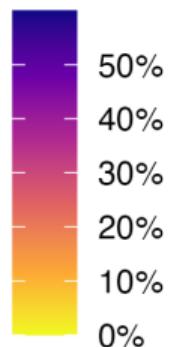
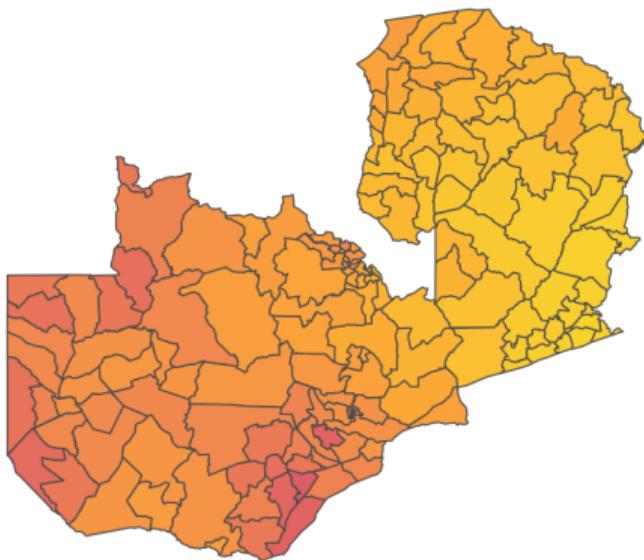


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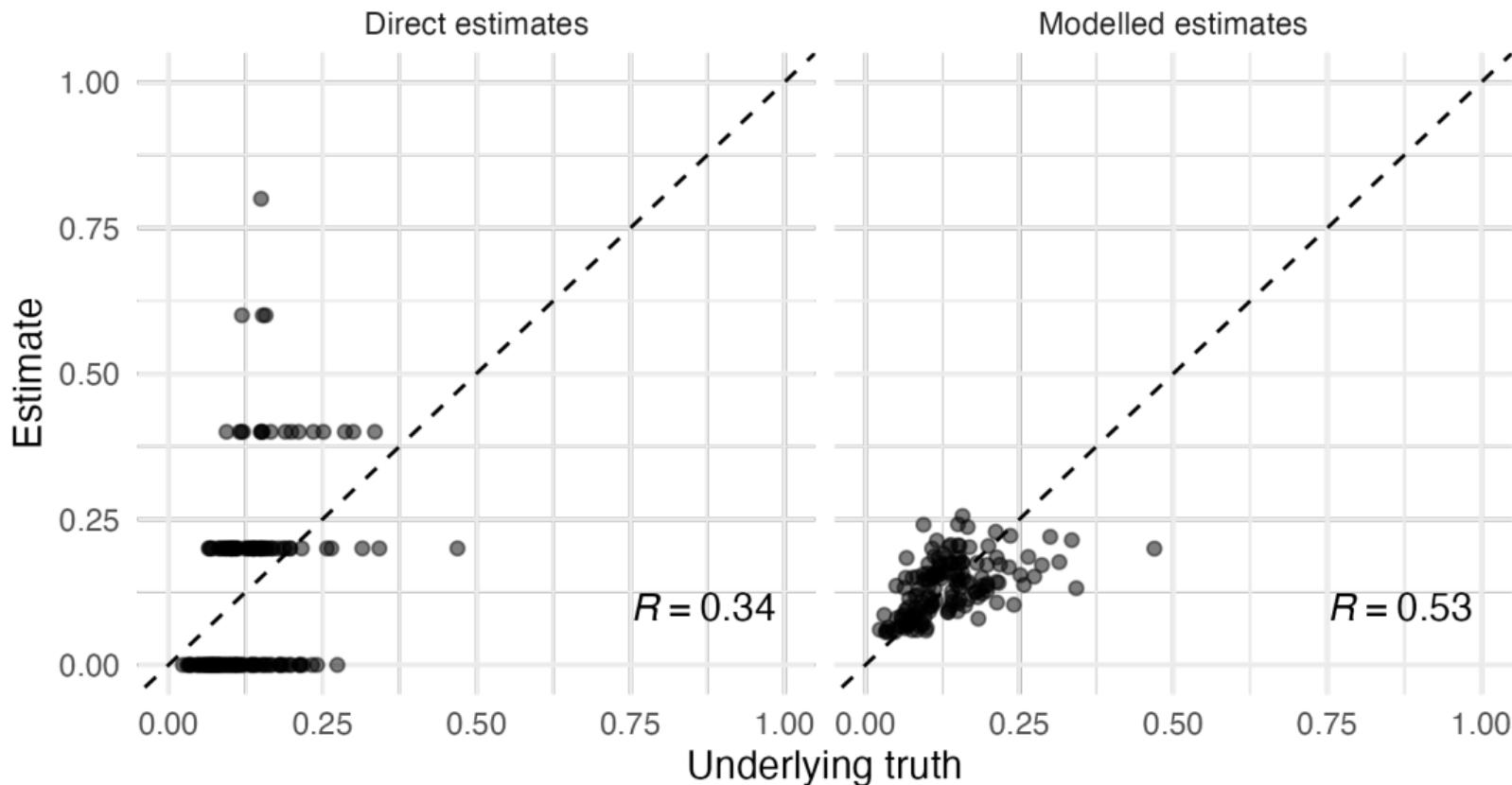
Direct estimates



Modelled estimates

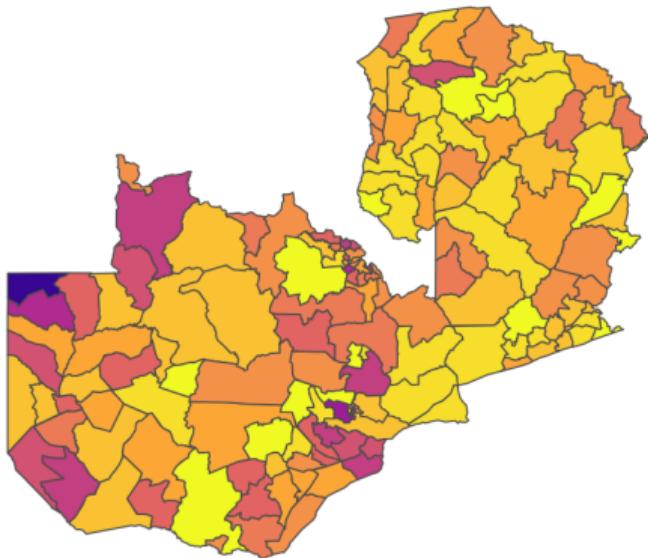


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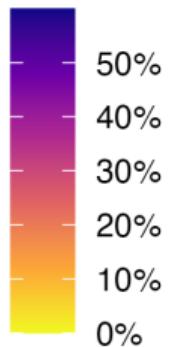
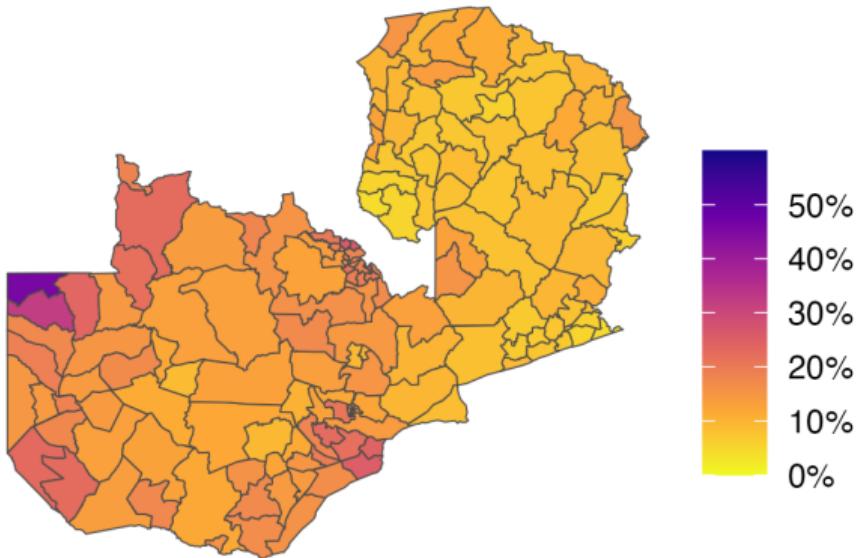


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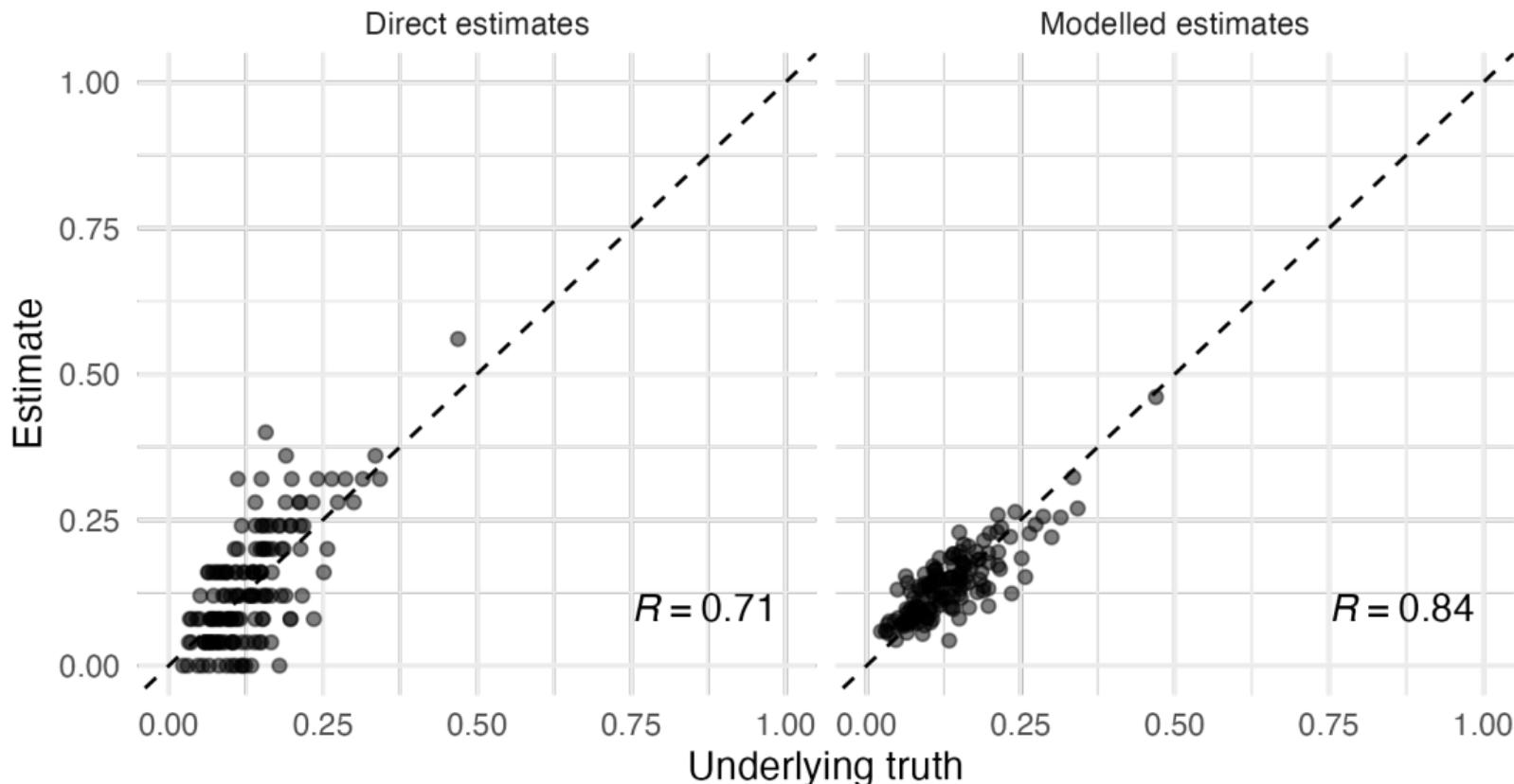
Direct estimates



Modelled estimates

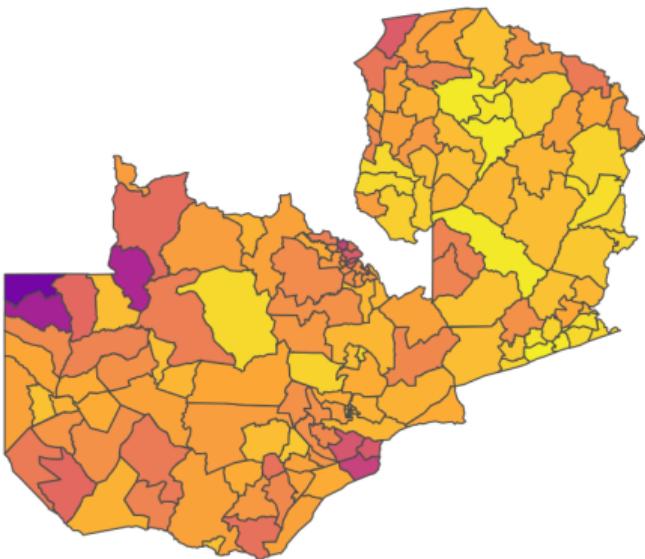


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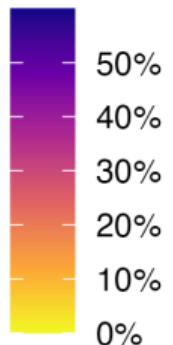
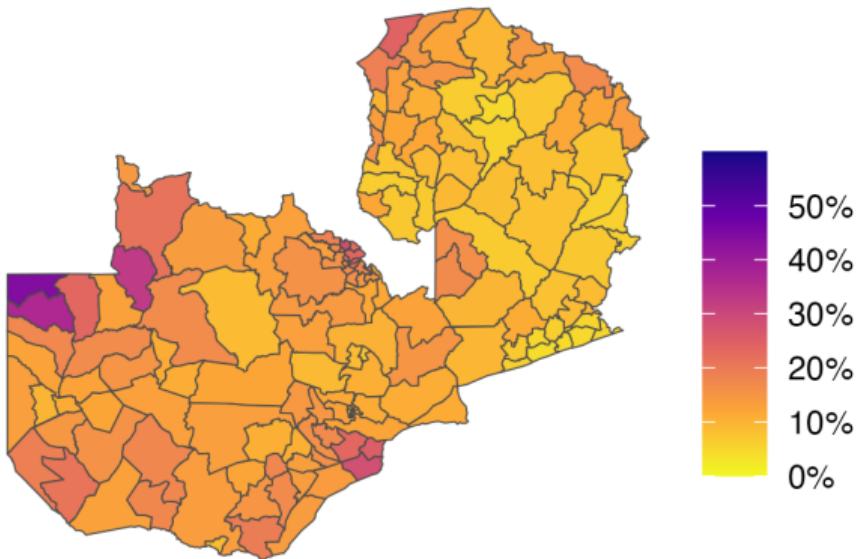


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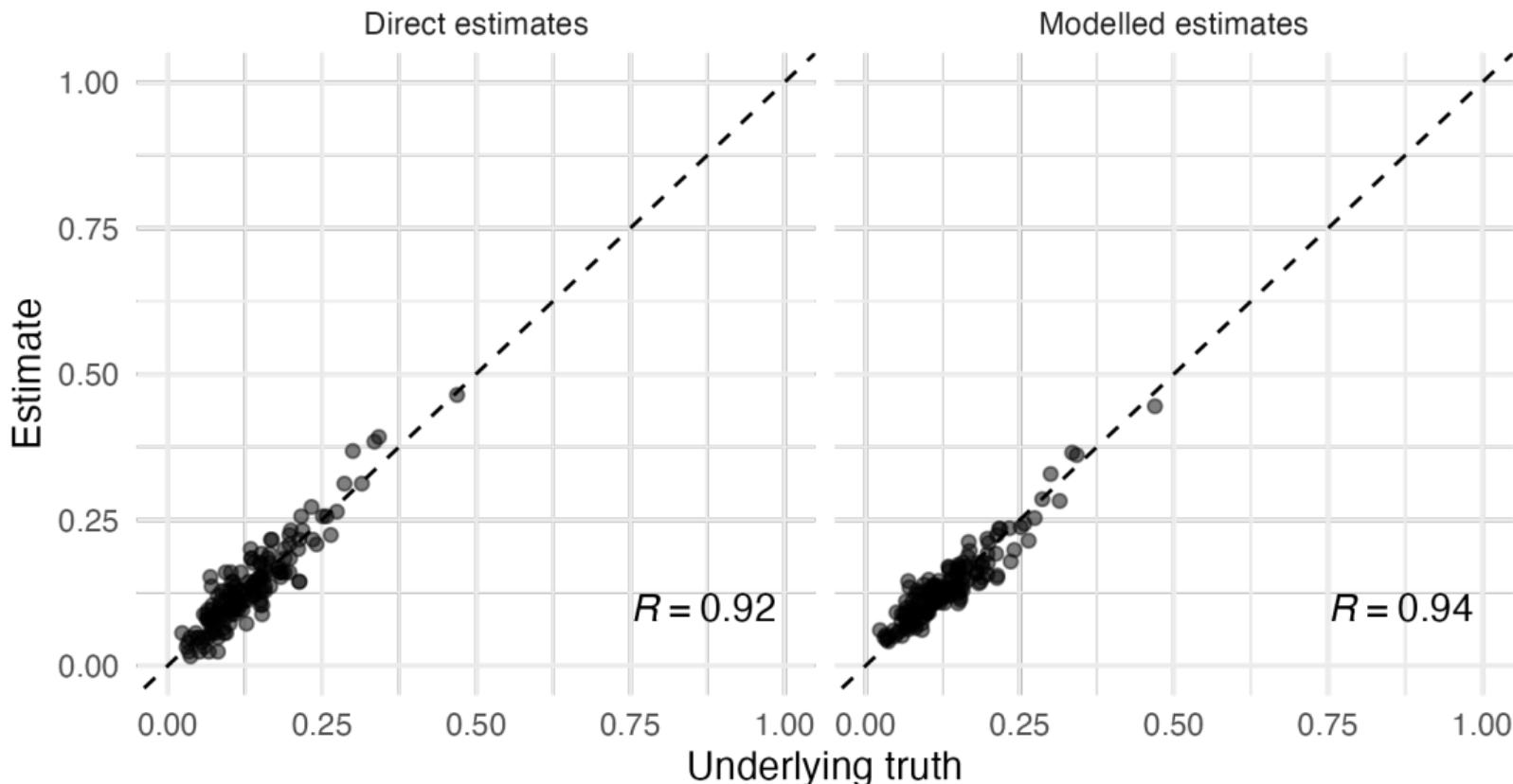
Direct estimates



Modelled estimates



Survey of size 125



Takeaways

- Small samples give noisy estimates that we probably shouldn't trust
- Nearby things are often similar but not always
- Spatial smoothing can help by borrowing information

Thanks for listening!

- For more information about the spatial models we use:
 - Online book of Moraga (2019)
 - Papers of Besag, York, and Mollié (1991) and Simpson et al. (2017)



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Disease Analysis

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London



MACHINE LEARNING
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References I

- Besag, Julian, Jeremy York, and Annie Mollié. 1991. "Bayesian image restoration, with two applications in spatial statistics." *Annals of the Institute of Statistical Mathematics* 43 (1): 1–20.
- Moraga, Paula. 2019. *Geospatial Health Data: Modeling and Visualization with r-INLA and Shiny*. CRC Press.
- Simpson, Daniel, Håvard Rue, Andrea Riebler, Thiago G Martins, and Sigrunn H Sørbye. 2017. "Penalising Model Component Complexity: A Principled, Practical Approach to Constructing Priors." *Statistical Science* 32 (1): 1–28.