Tutorial
Introduction to models and data: HIV in Harare

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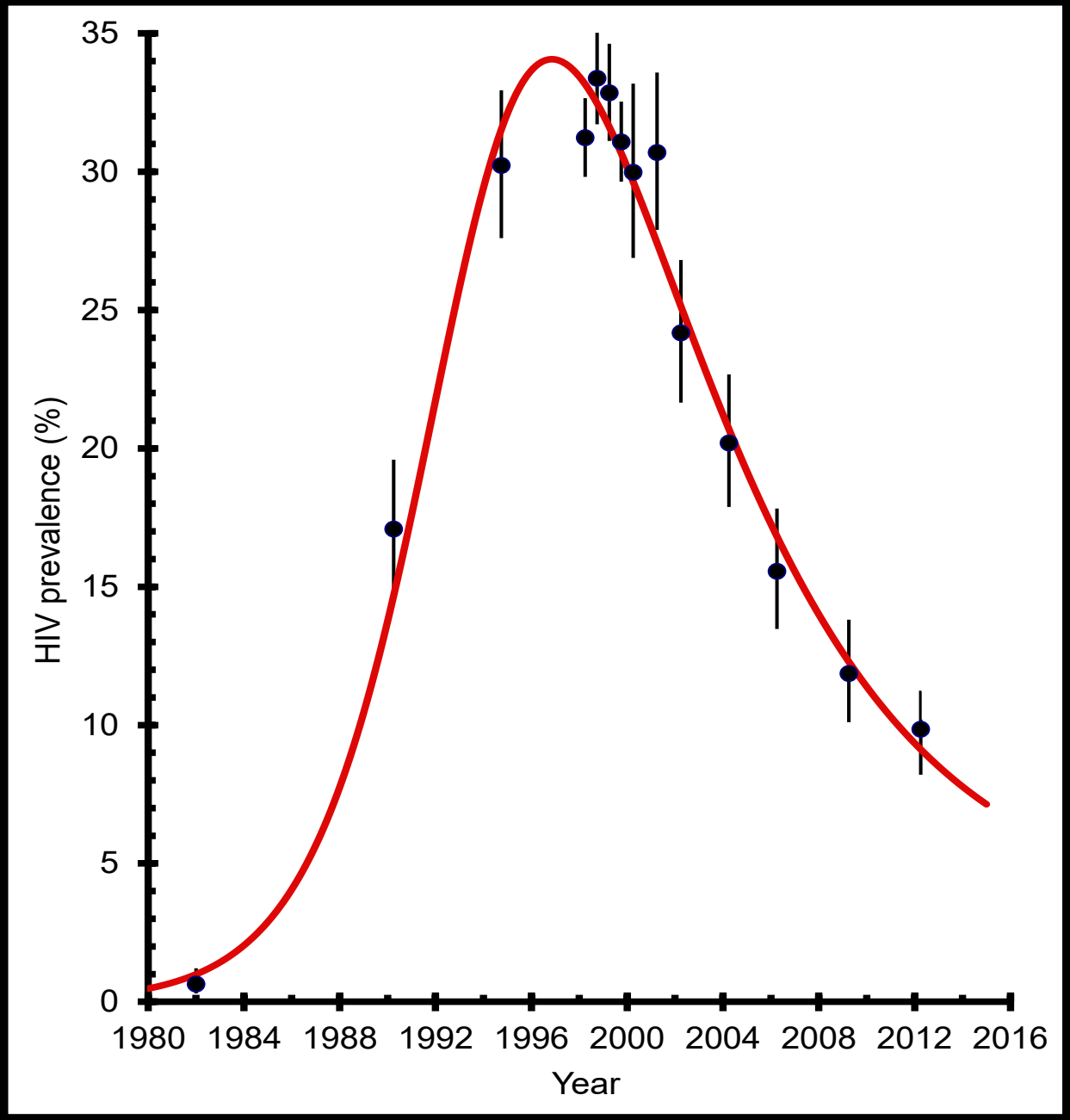
Based on content by John Hargrove and Brian Williams



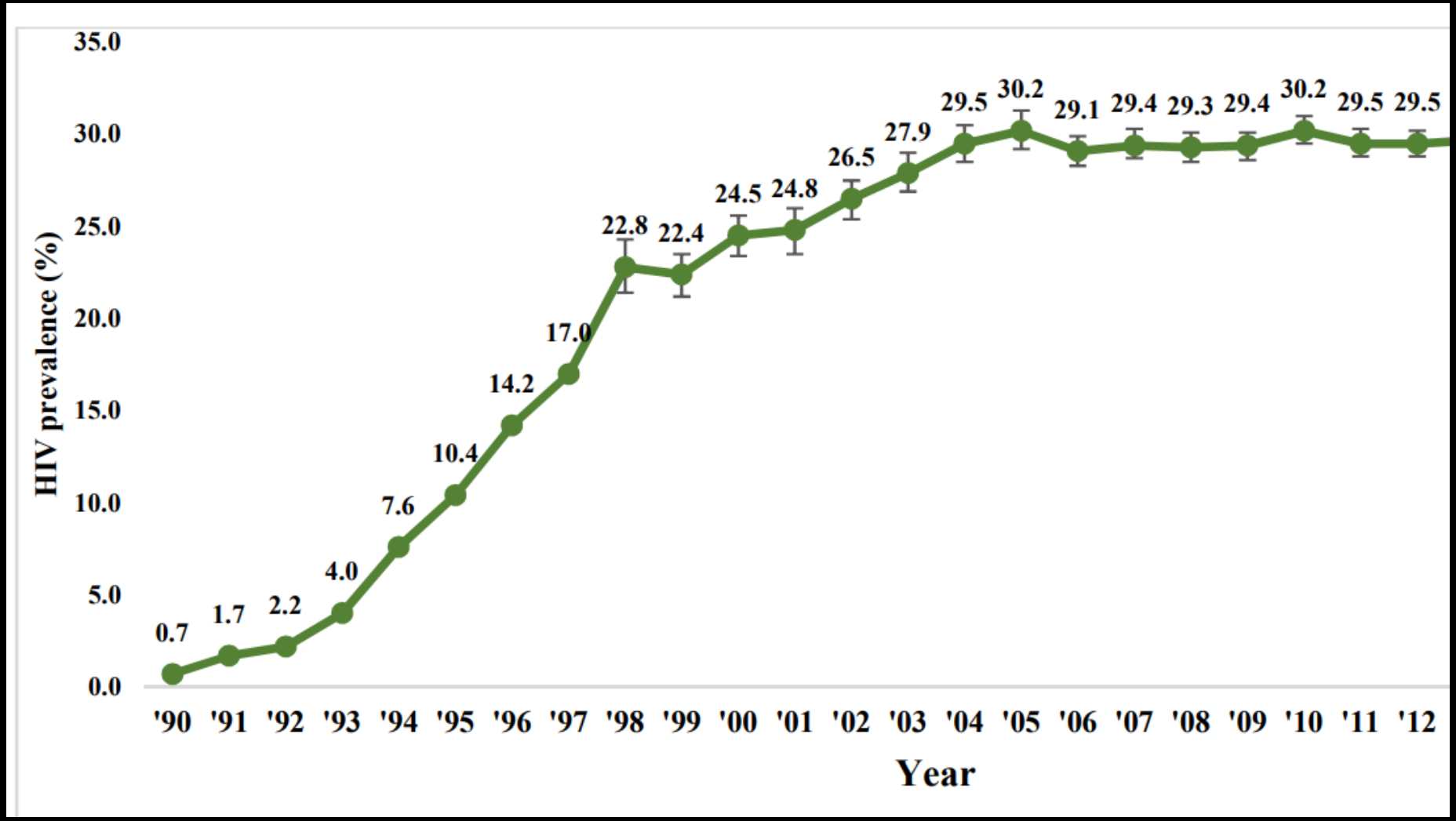
Harare, Zimbabwe

HIV prevalence

during 1980-2012

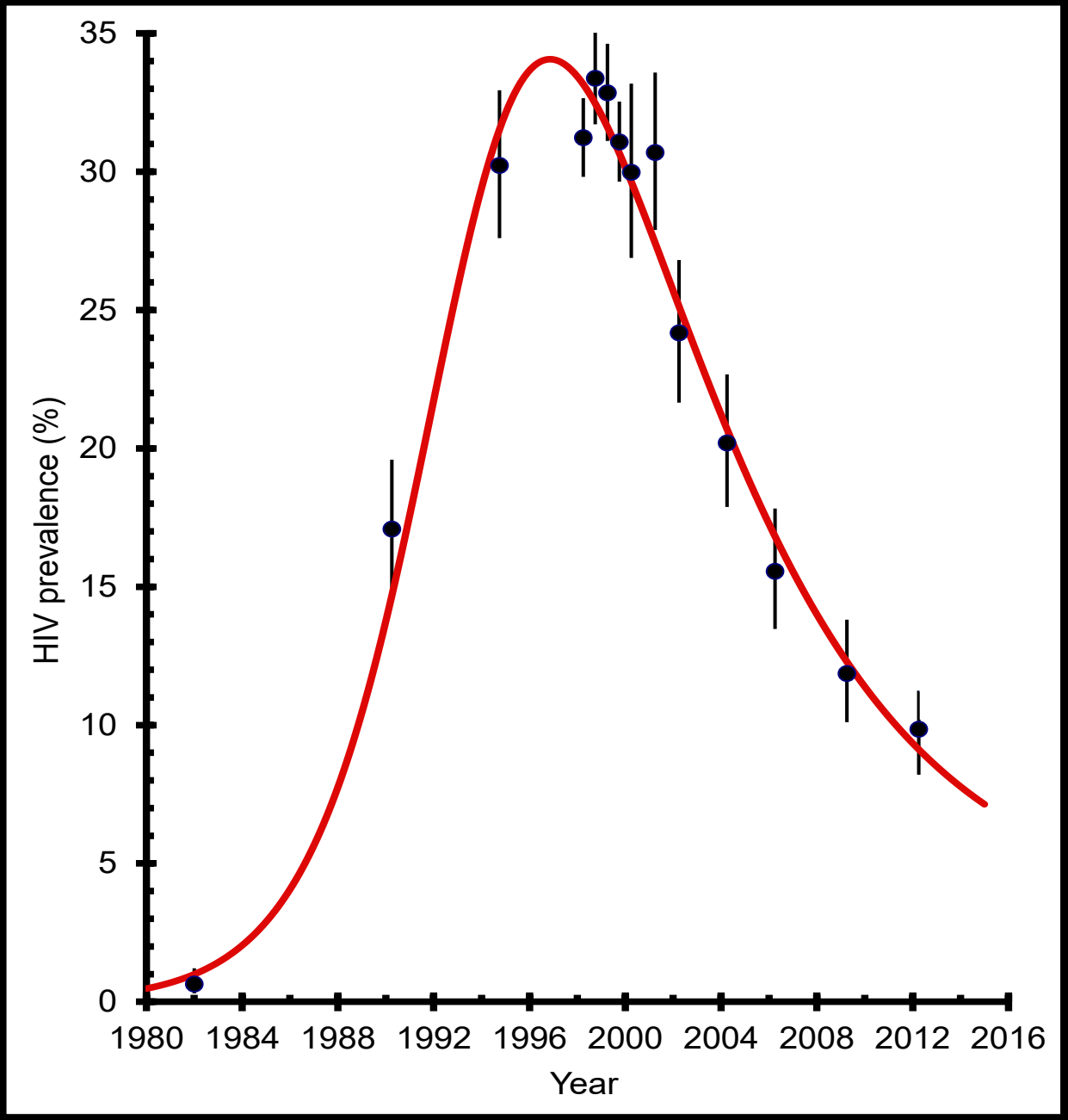
Pregnant women attending antenatal clinics

Hargrove et al. Epidemics 2011



South Africa

https://www.nicd.ac.za/wp-content/uploads/2021/11/Antenatal-survey-2019-report_FINAL_27April21.pdf

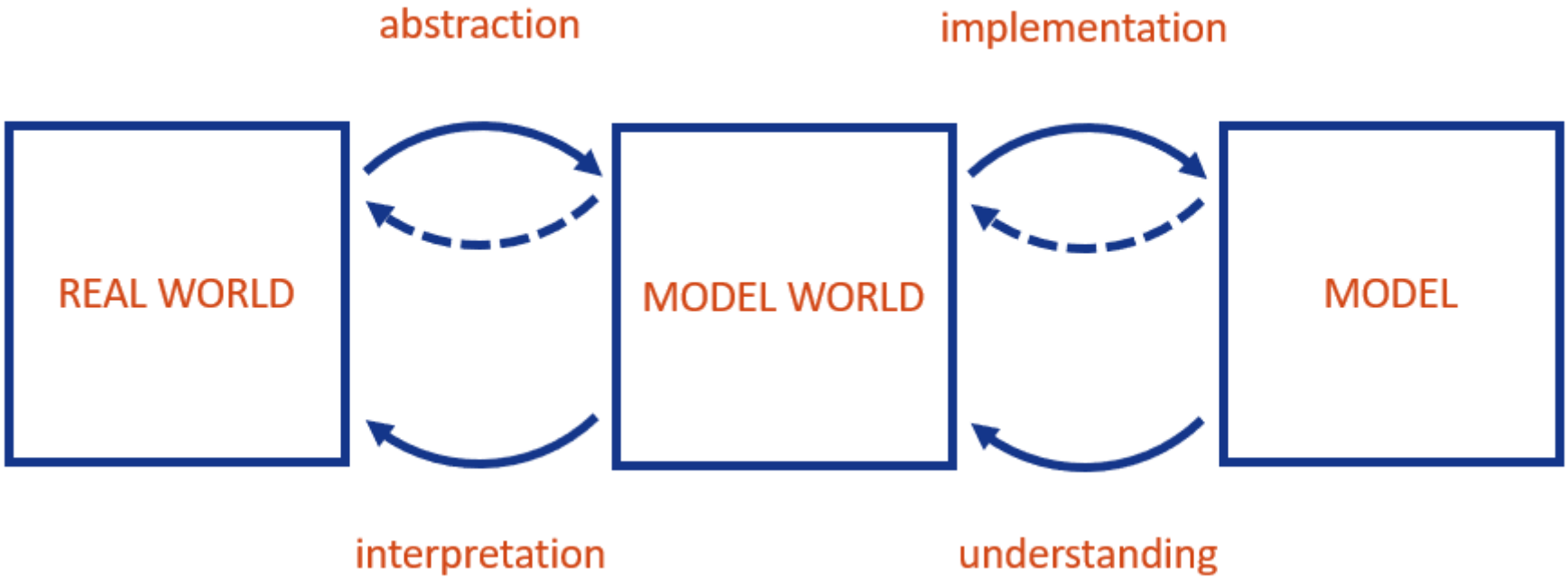


You are going to model this data!

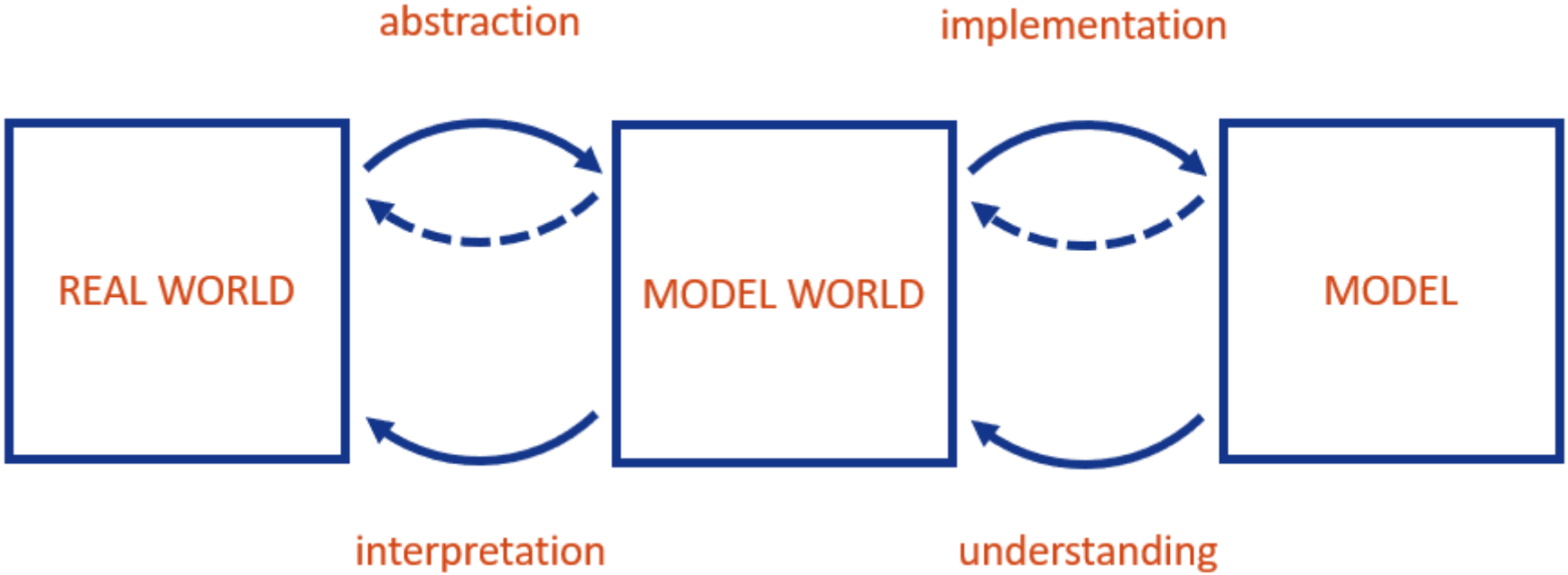
Outline

- Recap of two relevant methodological principles
- More background on the data and setting
- The goals of the exercise
- Discuss the first model that you will be fitting

… leave you to play


abstraction
implementation
REAL WORLD
MODEL WORLD
MODEL
interpretation
understanding

Model world: a (often simpler) representation of the real world



Model world: a (often simpler) representation of the real world

- Does not need to exactly capture every mechanism of the real world

complex ⟷ simple

- Difficult to:
  implement model,
  interpret results,
  obtain inputs, …
- May not be able to accurately answer

- Aim: find the simplest model that can adequately answer your question

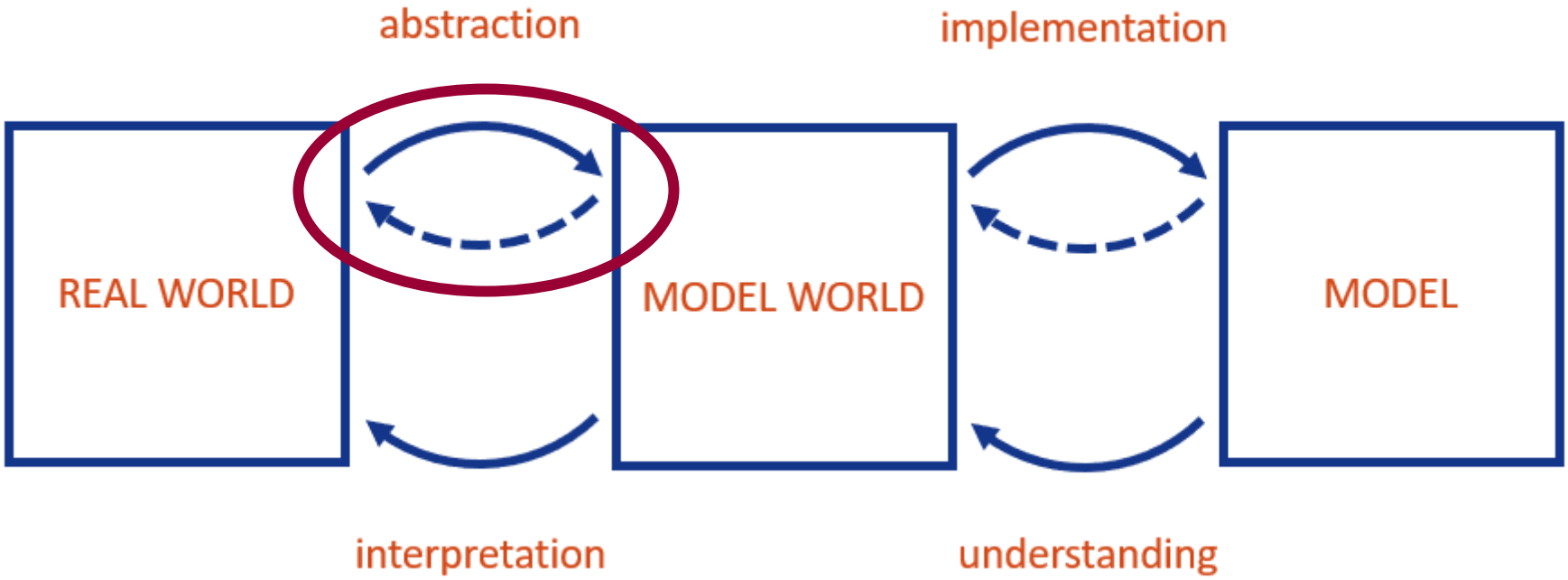
Want your model to ‘fit’ the data

- Outputs from your model should be consistent with available data

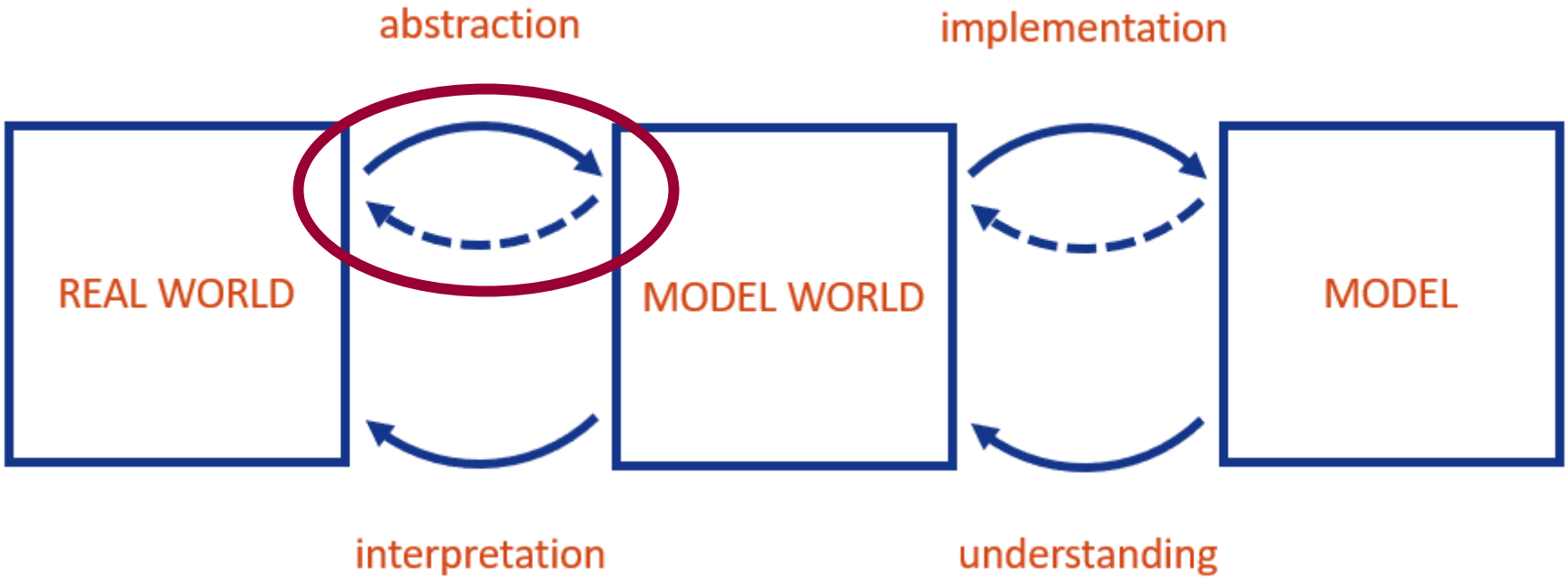
- E.g. HIV prevalence survey estimates should be ‘close’ to the modelled prevalence in the population at those times

- Not aligned → model world is not adequately describing your real world

Want your model to ‘fit’ the data



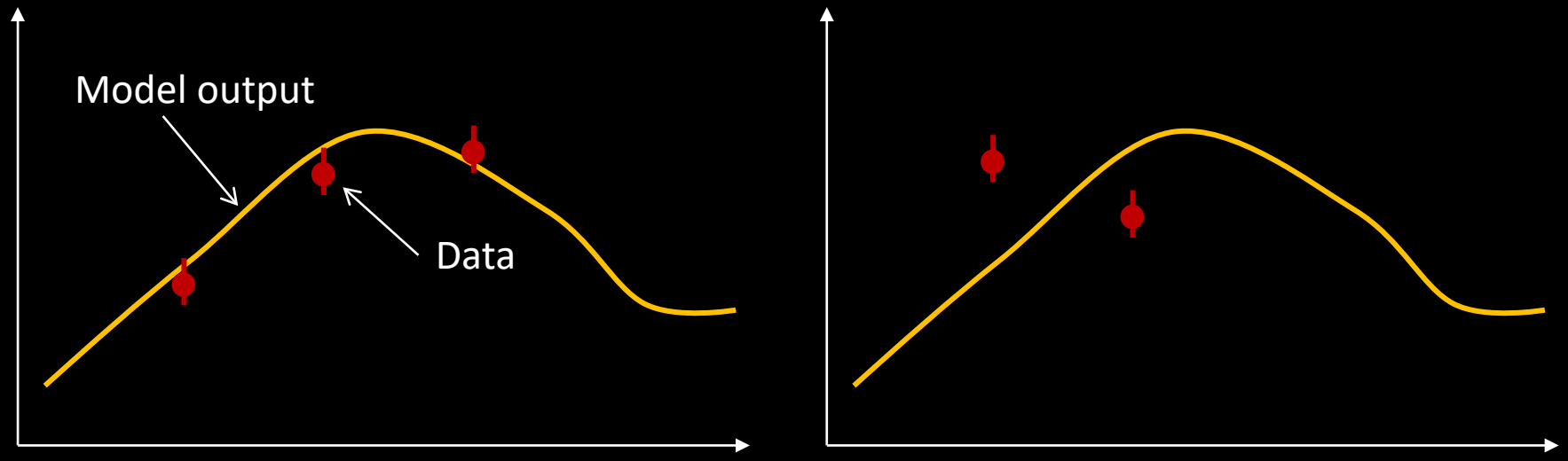
Want your model to ‘fit’ the data

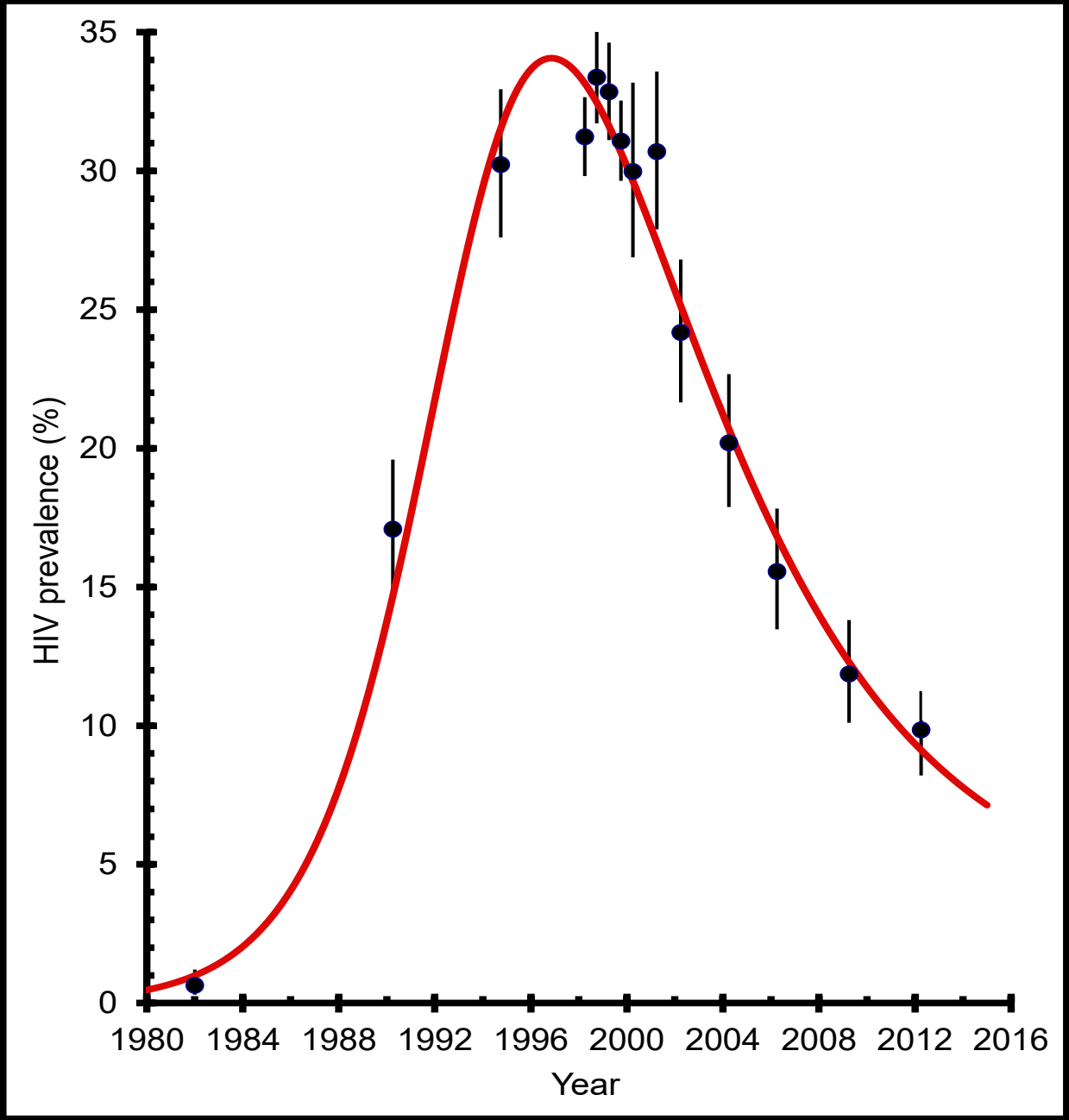


- If there is misfit, this could be caused by an incorrect structure of model or incorrect inputs

Want your model to ‘fit’ the data

- Various methods for trying to ensure or check whether your model fits the data
- Today, we will be checking ‘by eye’





You are going to model this data!

Epidemics 3 (2011) 88–94

Contents lists available at ScienceDirect

Epidemics

journal homepage: www.elsevier.com/locate/epidemics

Declining HIV prevalence and incidence in perinatal women in Harare, Zimbabwe ☆

John W. Hargrove [a,c,1], Jean H. Humphrey [a,e,*], Agnes Mahomva [b,2], Brian G. Williams [c], Henry Chidawanyika [a], Kuda Mutasa [a], Edmore Marinda [a,3], Michael T. Mbizvo [f], Kusum J. Nathoo [d], Peter J. Iliff [a,d], Owen Mugurungi [b]
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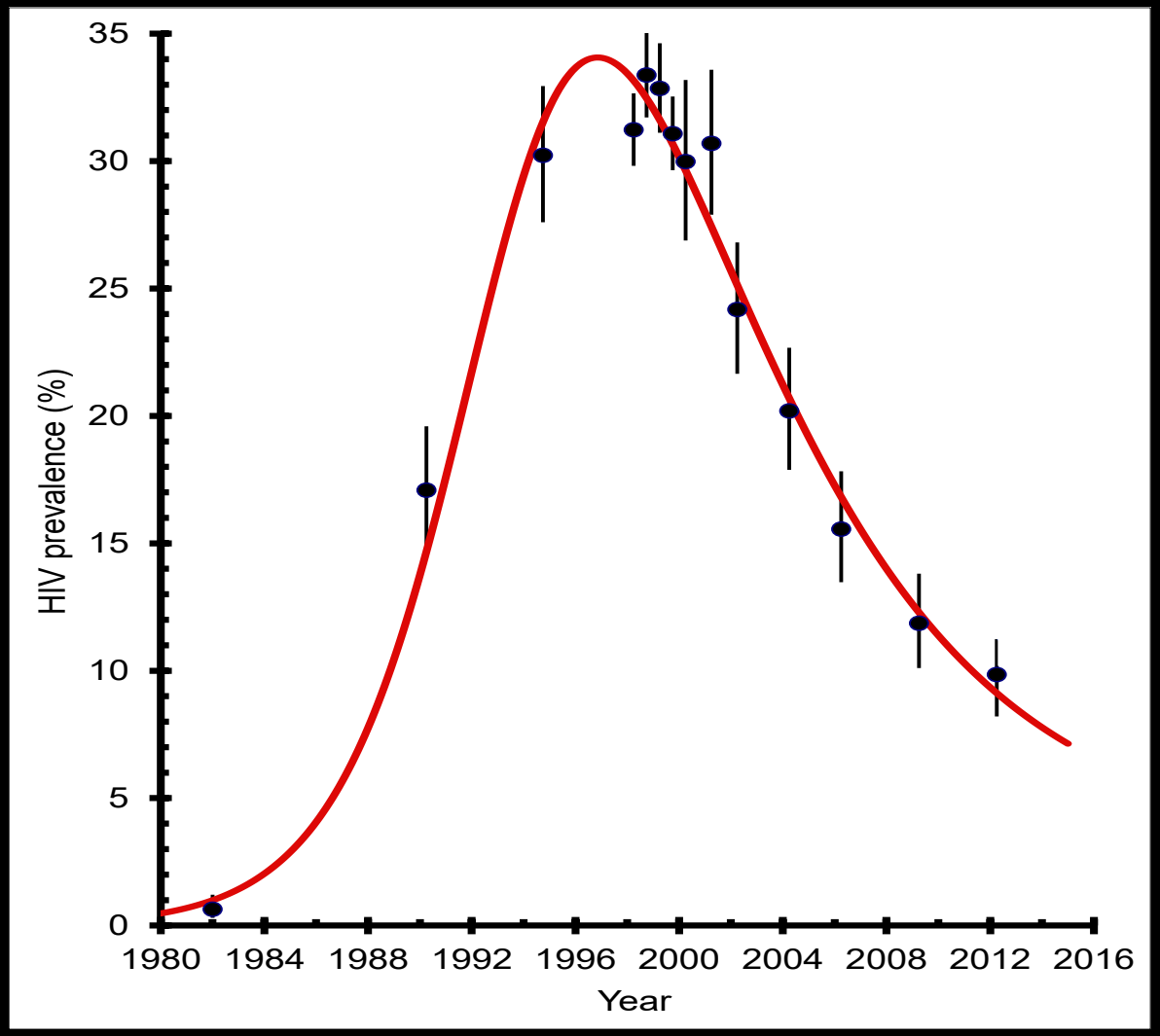
[d] *Department of Paediatrics, University of Zimbabwe*
[e] *Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA*
[f] *WHO, Geneva, Switzerland*

John Hargrove and Brian Williams

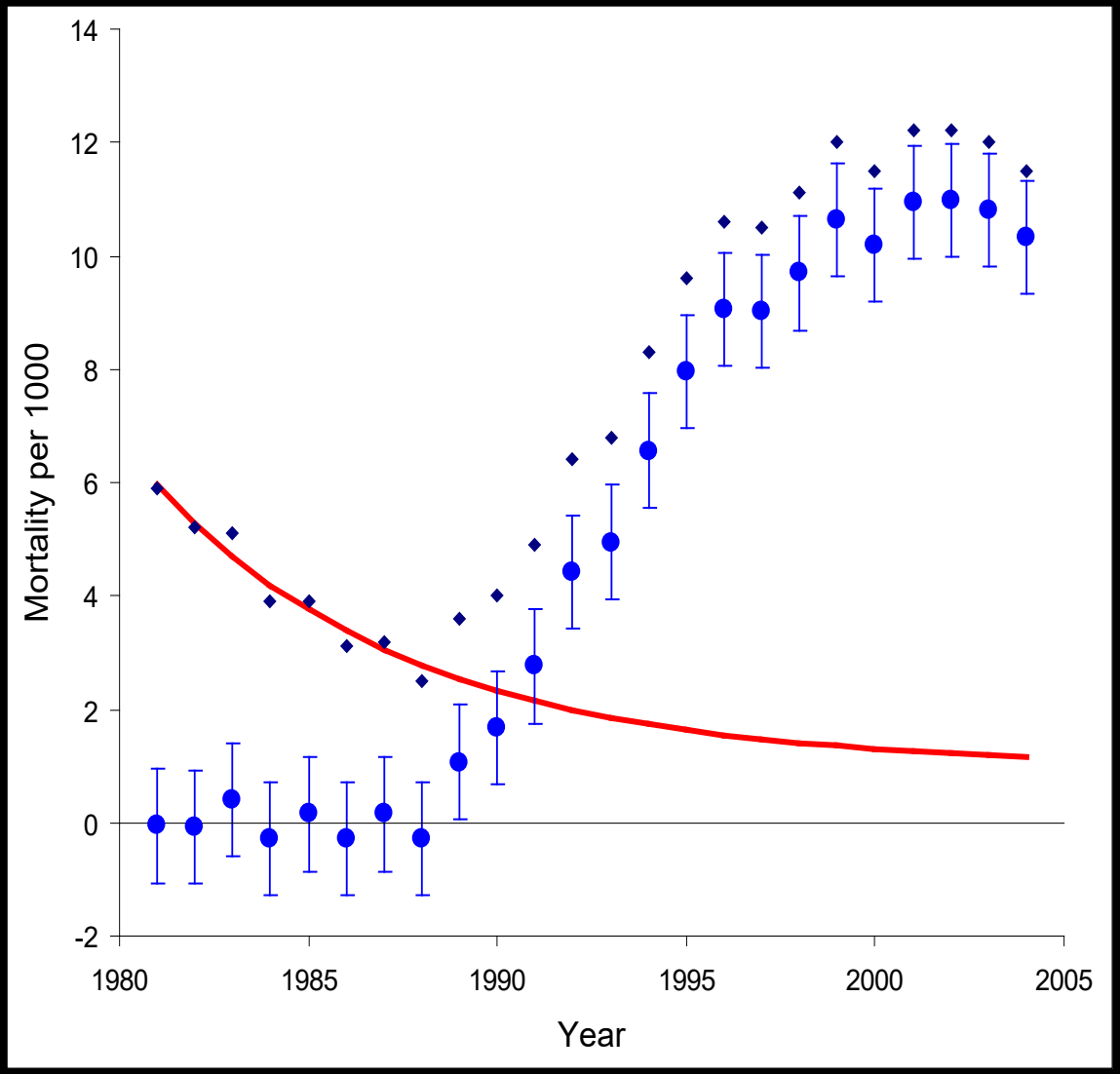
The data: Prevalence



Surveys of pregnant women attending nine antenatal clinics in different years

n = 22 684

The data: disease-related mortality



Total mortality from records provided by the City of Harare

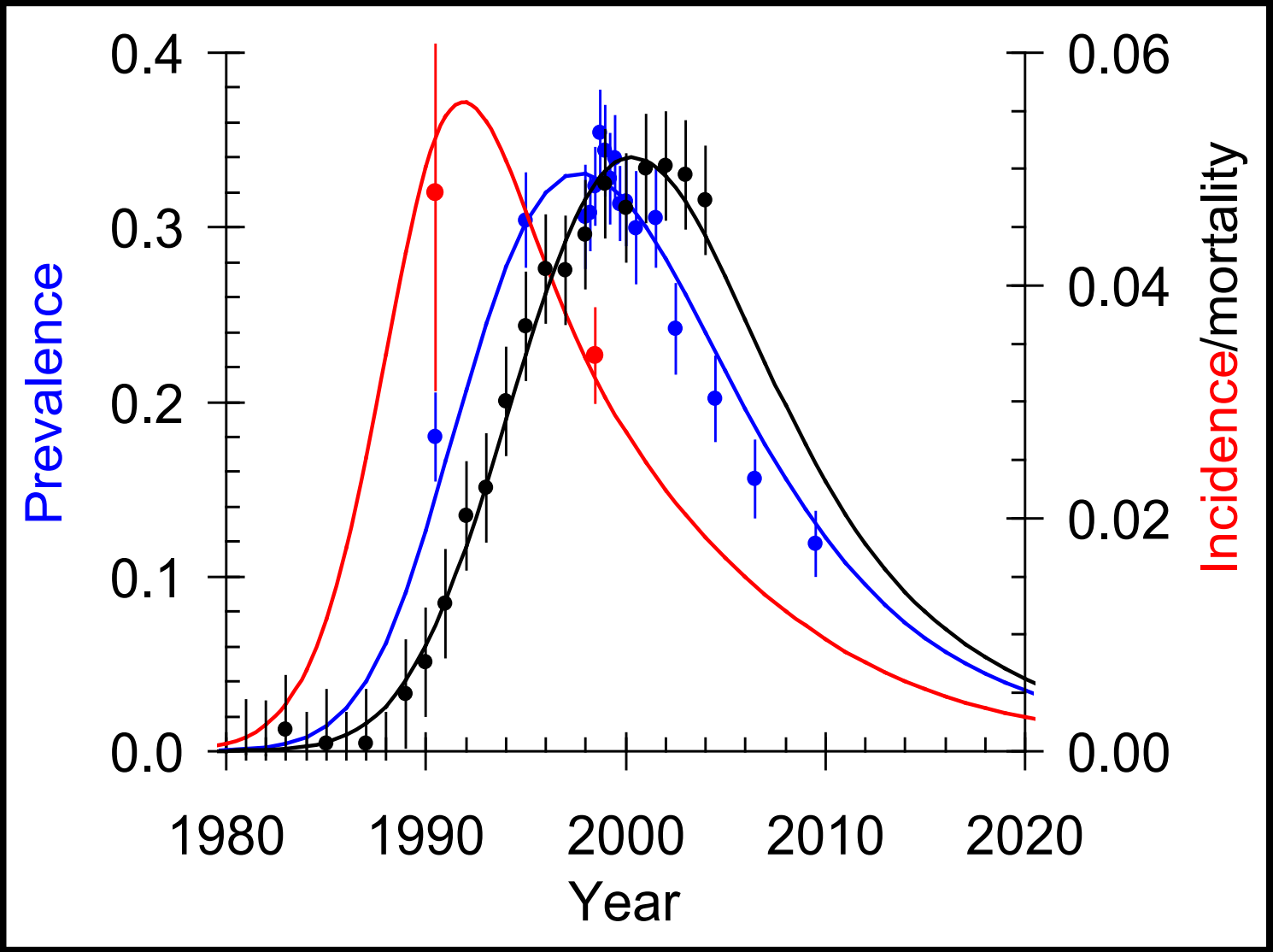
From 1980 to before the HIV epidemic: declining mortality

Extracted trends for disease-related mortality

The data: incidence

- Two estimates from two cohort studies of pregnant women (conducted in 1991 and 1993)

The data – can we find a model?

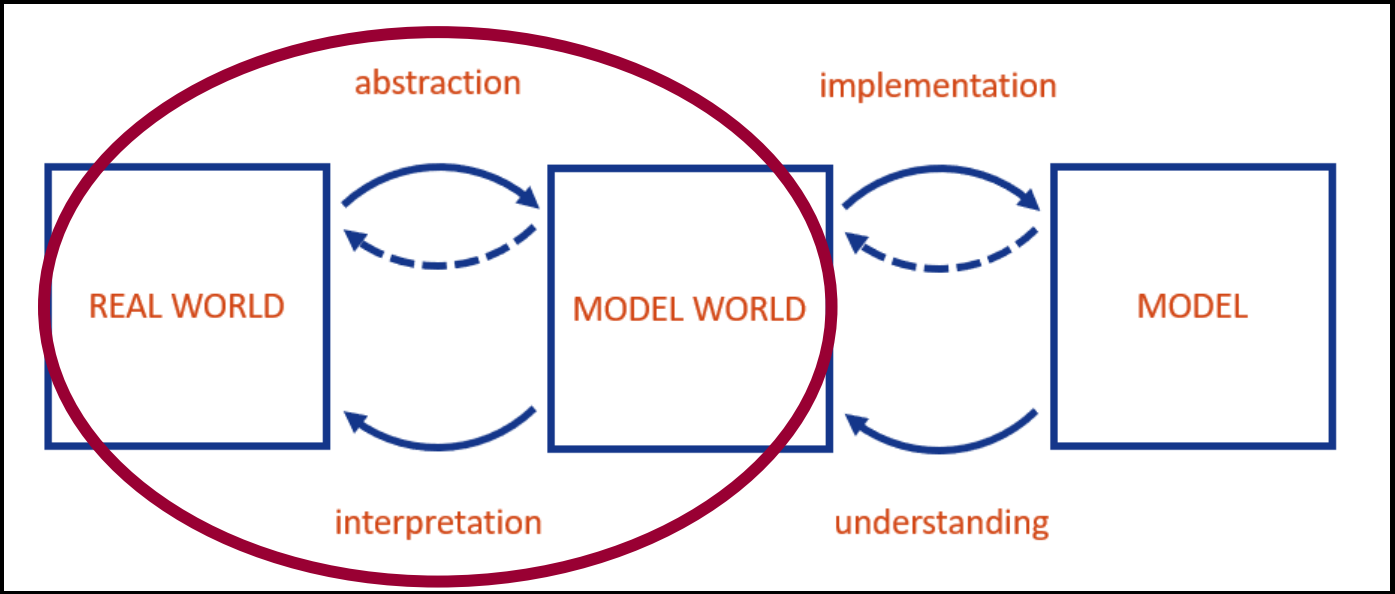


What you will be doing…

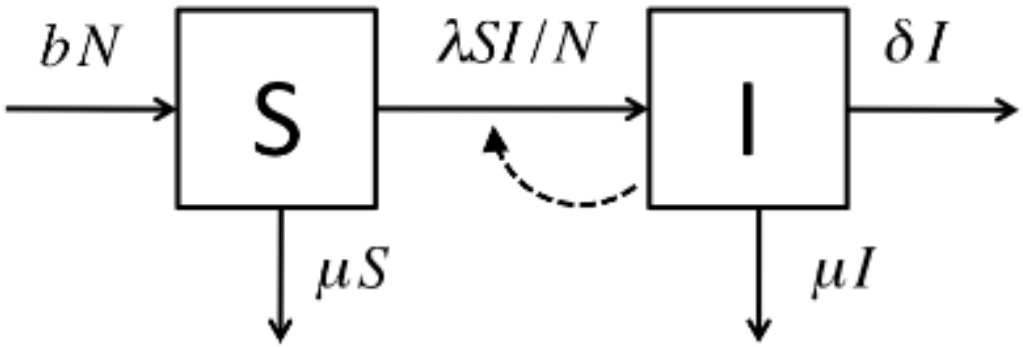
- You will start with the simplest possible model, with the smallest number of parameters
- You will not be surprised to find that you do not get a good fit the data
- You should try to reflect on why
- Then try a slightly more complex model (adding one feature)
- Reassess

What you will be doing…

- Use prevalence data, checking the fit ‘by eye’
- Shiny app (by Carl Pearson and Juliet Pulliam) – you do not need to the do the model implementation!



The first model



$N = S + I$

$b =$ *per capita* birth rate

$\lambda =$ effective contact rate

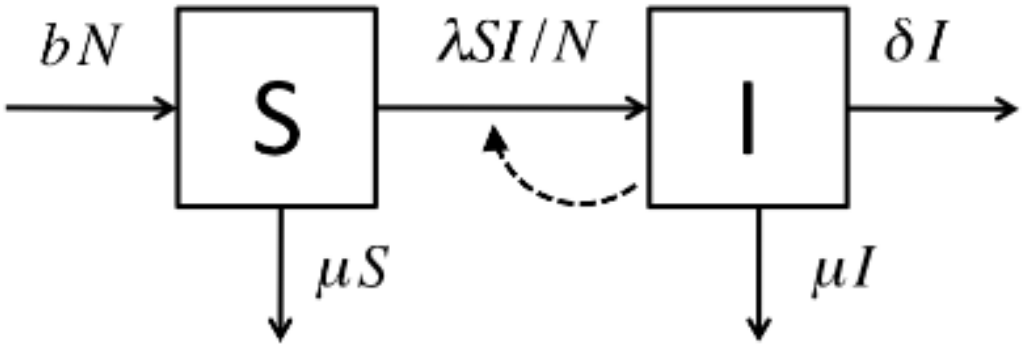
$\delta =$ disease induced mortality hazard

$\mu =$ *per* capita background mortality rate

The basic model

The first model

- Understand the model
- Try out different values for the inputs
- Compare model outputs to data points



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The basic model

Instructions

- Groups of <4 people
- Think about what it all means, answer the questions, and discuss
- When done with Harare, try the other two datasets (South Africa, Uganda)
- Can also look at the model code

```
ICI3D::hivTutorial()
```

You should have already done this:

```
remotes::install_github('ICI3D/ici3d-pkg')
```

Introduction to modelling changes in HIV prevalence and incidence in Harare, Zimbabwe

Attribution: J. Hargrove, B. Williams, R. Kassanjee

Clinic on the Meaningful Modeling of Epidemiological Data

For further information please contact figshare@ici3d.org.