

Modelling Club: Week 1

Welcome to Modelling Club!

Modelling Club

Guided Meetings

- Sundays, 19:00—21:00
- Starting 5th February
- Presentation of materials and discussion
- Goal/task for next guided meeting

Check-in Meetings

- Wednesdays, 15:00—16:00
- Starting 8th February
- Answer questions, give updates on progress
- Receive help with goal for next guided meeting

Modelling Club

- Practice model-building in teams
 - Learn about modelling topics
 - Enjoy our modelling community
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- First practice models: new COVID-19 variant in Bangladesh

New COVID-19 Variants

- The virus that causes COVID-19 evolves - this is a natural behavior of viruses
- Viral evolution comes from genetic mutations happening all the time and these mutations could change the virus (making a variant)
- Possible changes include:
 - easier/more difficult to spread among people
 - cause less/more severe disease
 - less/more resistant to treatments
 - more/less similar to previous viruses (and if immune system can recognize)

New COVID-19 Variants

- Teams around the world are monitoring the genetic sequence of the virus
- If the teams find a variant that can spread more easily, evade immunity, and/or cause more severe disease, it is tracked
- Variant under monitoring: **BF.7**
 - sub-lineage of Omicron
 - believed to be more transmissible
 - has mutations that could affect disease

Practice Model

- Scenario: BF.7 subvariant in Bangladesh
- Main purpose: estimate number of cases, number of hospitalizations, number of deaths caused by BF.7

Practice Model

- Main purpose: estimate number of cases, number of hospitalizations, number of deaths caused by BF.7
- Possible key questions? What else might we be interested in knowing?

What do we know already?

-what data do we have?

How much time do we have to work on questions?

Will interventions have an impact?

-vaccination programs

-masking

-closing schools

-tele-health for cases or most vulnerable

Financial impact of virus with/without interventions?

How quickly will it spread?

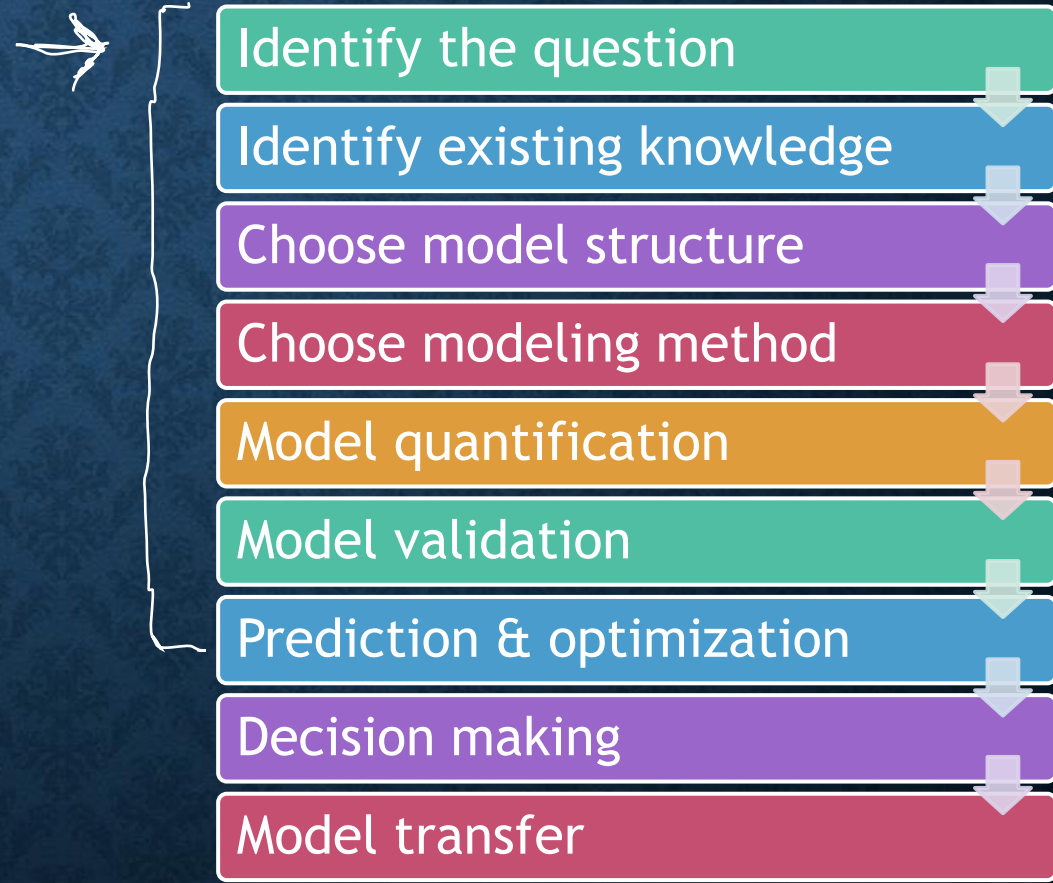
Which people impacted the most?

-children, adults, elderly?

Review of Steps for Building a Model

Model Development

- Important to reflect on purpose of model & wider considerations
- 9-step process from Habbema *et al.*, 1996



Model Development

- Important to reflect on purpose of model & wider considerations
- 9-step process from Habbema et al., 1996
- We will focus on the first steps for our practice

Identify the question

Identify existing knowledge

Choose model structure

Choose modeling method

Model quantification

Model validation

Prediction & optimization

Identify the Question

Identify the question

- What is our key question? ◦
 - Inference versus prediction
- Estimate number of cases, hospitalizations, and deaths from BF.7 in Bangladesh

- more specific question

Identify Existing Knowledge

- What data are available?
 - What inputs do we know?

- • Demographic rates
- • Natural history parameters
- • Control options & impact

- Do other models exist? -many COVID-19 models exist

- { • Similar disease?
- Similar scenario?
- Distributions/values for parameters?

- from a published paper
- WHO posts parameter estimates
- estimate from your own data
- from a similar model

Identify the question

Identify existing knowledge

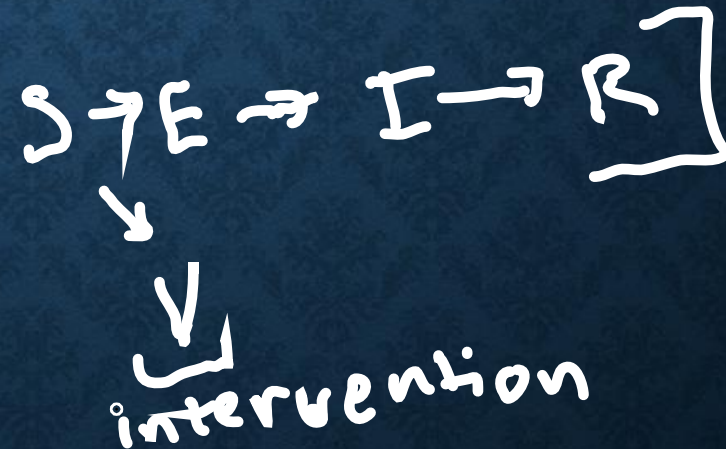
Choose Model Structure

- What compartments are important?
 - Infection categories **SEIR**
 - Population categories/subgroups **ages**
- “Models should be as simple as possible and no simpler.”
 - What compartments are necessary to answer our research question?
- What time period is important?
 - Births/deaths/migration less important for short-term questions**0-2 years**

Identify the question

Identify existing knowledge

Choose model structure



Choose Modeling Method

start →

- Deterministic?
 - every parameter has one value
 - run model one time
 - Describes average outcome
 - Uses average transition rates
- Stochastic?
 - Incorporate chance variation
 - Range of possible outcomes

→ {

- Combination?
 - Deterministic models can include stochastic elements and vice versa

- every parameter has multiple possible values
- run model many times

- some parameters have fixed (one) value, others have a range of possible values
- run model many times

Identify the question

Identify existing knowledge

Choose model structure

Choose modeling method

Model Quantification

- Specify your inputs
 - Range of possible values from review step
 - Make sure time units are correct!
- Estimate from data
 - Collect new data?
 - Statistical model
 - Parameter estimation

-choosing the exact values for your parameters and inputs

Identify the question

Identify existing knowledge

Choose model structure

Choose modeling method

Model quantification

Model Validation

- Compare model results with real data
 - Ideally with independent datasets
 - Is the behavior you model consistent with reality?
 - Model fitting
- Share with other experts

Identify the question

Identify existing knowledge

Choose model structure

Choose modeling method

Model quantification

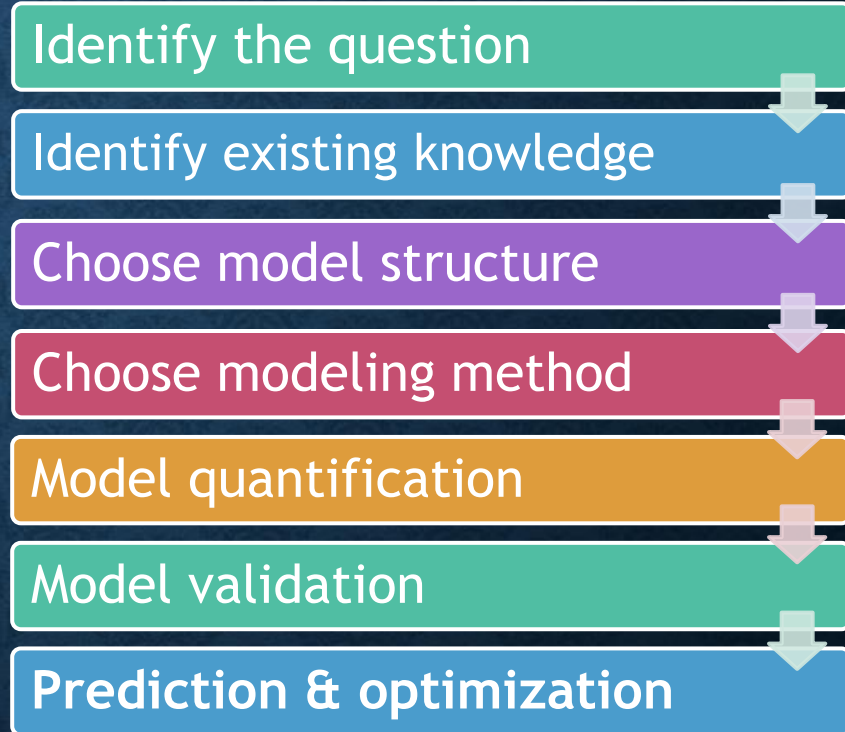
Model validation

- do the results make sense?
- compare to real data
- show to others

Prediction & Optimization

- Run your model and make predictions
- Sensitivity analysis
 - Imagine that assumptions are flawed
 - Test boundaries of the model
 - “Try to break the model”
- Report any model limitations

-are there any situations where the model doesn't work?
-testing extreme values for parameters



Communicating About Models

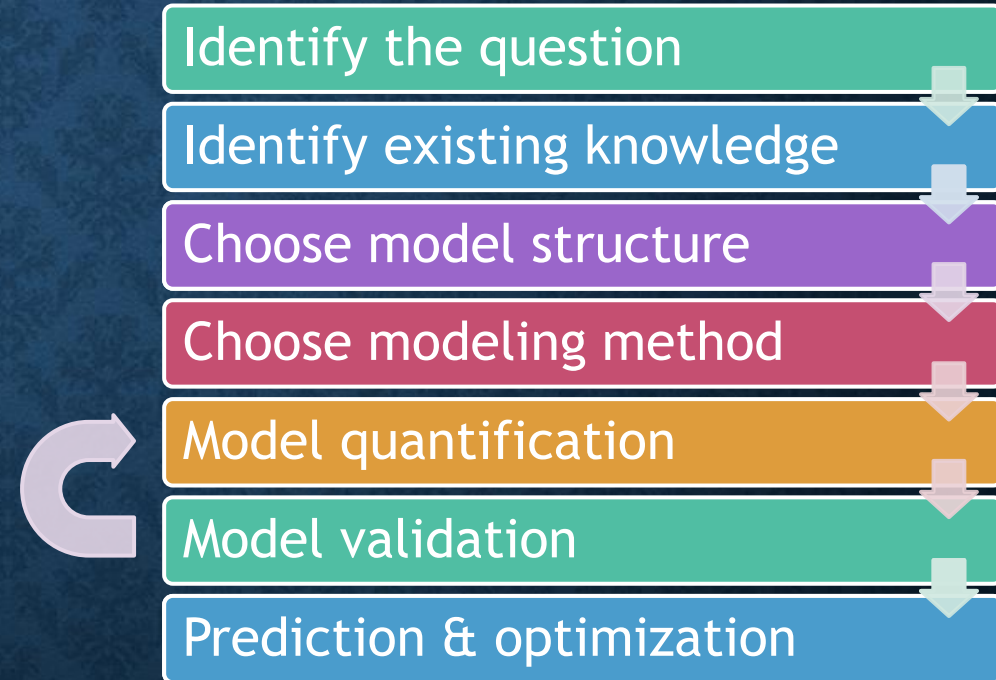
- Practice sharing model and its results
 - Make sure the model can be explained to broad audiences
 - Be able to explain model limitations



Model Development is Non-Linear

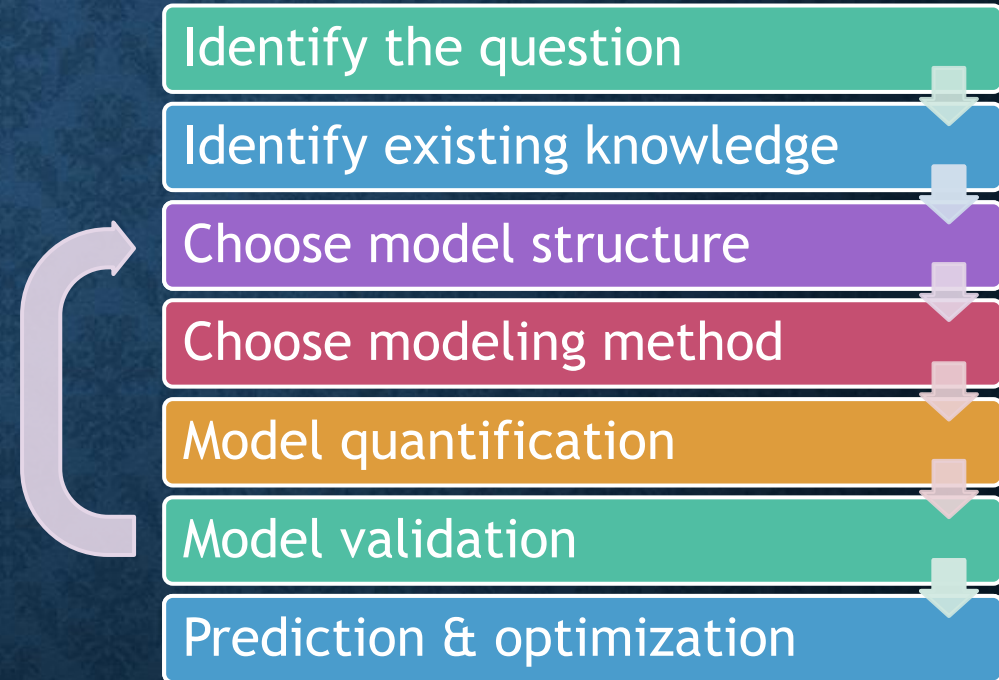
- Iterative process!

- often need to make adjustments to model (change parameters, add to the structure)
- if some results don't make sense, we can always adjust the model to fix it
- experts can give suggestions



Model Development is Non-Linear

- Iterative process!



Modelling Teams

Modelling Teams

- Building a model is complicated! Most models are built by working in a team
- Many tasks and decisions for each step
- Working in a team helps spread these responsibilities - team members can take different roles to help complete the tasks and make decisions

Modelling Teams

- Many tasks and decisions for each step
 - Gathering information about the disease
 - Finding data about the population
 - Researching options for model structure/method

- Coding

- model code

- model results & visualization

- Presenting and explaining the model

SEIR + other pieces
→ tables, plots

Tasks for Next Guided Session

- Think about a specific key questions related to our main purpose
- Consider the different roles for a modelling team and how you could contribute

Next Guided Session

- discuss ideas for key questions
- choose top 2 or 3 questions
- form teams