Introduction to projects

Project work

We will be provided with a description of a vector-borne disease affecting a village in Sub-Saharan Africa.

Our task is to consider intervention strategies that could reduce transmission and disease burden in the village.

We need to simulate the impact of different interventions to generate evidence that could help the disease control program decide which strategy to adopt.

The considered interventions are as follow:

- ✓ Host-targeted intervention (focused on protecting or treating people)
- ✓ Vector-targeted intervention (focused on reducing mosquitoes)

The disease control program would like us to present quantitative evidence showing the effect of these interventions when used alone and when combined.

Project Tasks

1. Simulate the dynamics of the base model of the vector-borne disease over 365 days without interventions and calculate the prevalence of the disease in the population at the end of the simulation period.
2. Update the model structure with the updated information: Write the flow diagram of the updated model structure to include the updated model structure and the proposed interventions.
3. Obtain the model parameters of the updated model described in the narrative.
4. Write the equations of the updated model structure: Translate the flow diagram into a system of differential equations.
5. Update the code: Modify the R code to include the updated model structure.

Project Tasks

6. Quantify intervention impact: Run simulations for each intervention and in combination and then calculate infections averted compared to the baseline at the end of the simulation period. What is your interpretation of the results.
7. Cost-effectiveness: Calculate the cost per case averted for each intervention and in combination. Which scenario gives you better value of money? What is your interpretation of the results?
8. Optional question: If you want to go further with your project, you could either do model fitting or parameter sensitivity (or both). The groups that are interested in this please reach out to us directly for further instruction on the tasks.
9. Present your results on the final day of the course.

Presentations

20 min presentation – (14 minutes presentation) + 6 minutes question

Key information to include (with visuals):

- Brief description of the model(s) including the interventions and the assumptions i.e. flow diagrams, equations, submit code on Github.
- Model parameters.
- Epidemiological output(s).
- Costs and Cost effectiveness output(s).
- Discussion of results.
- Recommendation.

Recap of our SIS-SI vector – example of project description

At the start of the rains in a village of one thousand people, about five mosquitoes buzz around each person. Ten villagers are already infectious with a vector borne disease, and about two percent of the mosquitoes carry the parasite. In humans, the average infection period is about twenty-five days, after which individuals become susceptible immediately.

Mosquitoes live only around ten days, bite humans at a rate of 0.3 bites per day, host seeking at rate of 0.01, and a bite has an infectivity of 0.03. Once a mosquito is infected, it stays infectious until they die. Records suggest that the transmission rate from infectious humans to mosquitoes at a rate of 0.5.

Simulate the dynamic of the model for 365 days. What is the population in each compartment at the end of the simulation period.

We now have look at scenarios where we have the following interventions in the model:

- reduce biting rate by forty percent,
- treatment reduces the average human infectious period from twenty-five to ten days,
- that would combine both interventions

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