<u>Evaluation of estimation methods of vaccine efficacy and waning using models</u>

The design of vaccination policy - which population subgroups should be prioritized for vaccination, is a booster needed and to whom, media management, and more - is a primary tool in the management of an epidemic. Throughout the COVID-19 crisis in Israel, the design of vaccination policy was based on model-based scenarios which in turn where based on statistical estimates of vaccine efficacy and the rate of vaccine waning. These statistical estimates, however, and the relation between them and model parameters may suffer from various baises and lead to inaccuracies. For example, if the vaccine provides partial immunity from infection in each interaction, then the estimates of vaccine efficacy will also be effected by the number of interactions of those vaccinated with those infected.

This project will study various biases by applying statistical estimates to synthetic data produced by a model in a way that will allow full control of the parameters that are estimated.

The project week will focus on the problem statement, derivation of a basic model and study of the linkage between the model parameters and vaccie efficacy estimates. It will combine elements of modelling, analysis and numerics that will be distributed between the group members.

Naturally, the project week will consider a limited problem. The research question, however, is of scientific interest and of primary practical interest.   We are concurrently a similar project in collaboration with statistical groups (Yair Goldberg, IE), modelling groups (Nir Gavish, Math) and with the Gertner institute of the ministry of Health. This project utilizes the detailed COVID-19 model which is used by the ministry of Health to study the epidemic dynamics in Israel, and considers the statistical schemes developed and used during the COVID-19 outbreak to asses the efficacy of vaccines in Israel and it's waning over time.

<u>Prerequisites:</u>
A first course in ODE and `Intro to applied Math' or a similar course.
At least part of the group will need a first course in Numerical analysis and some experience in programming.

To acquire the neccesary background in epidemic modeling, I will provide recorded lectures and and questions for self-study <u>before</u> the project week starts. These lecture are part of a week focused on epidemic modeling in the course 'Intro to applied Math'. The first day of the project week will be dedicated to the presentation of solutions to the relevant exercise by the group members, to the construction of additional background in the numerical solution of the arising systems and to reading of relevant literature.