Parameters:

- **In model (COVID_vac) part:**
  - "num_group": number of groups in the simulation, the 3 and 7 groups cases are used in the code. (If want to try 7 groups, then parameter "inter_rate", "group_size", "init_infect_percent", "vac", "freq", "freq_vac", "w" also need to be changed correspondingly;
  - "p_trans", "p_trans_vac": these represent the probability of transmission of the disease for non_vac group and vaccinated group;
  - "lamb_exp_inf", "lamb_inf_sym", "lamb_sym": are the distribution parameters. User can turn these parameters to simulate a different disease distribution. (The default parameters are adapted from the original covid test problem);
  - "n": number of days you want to simulate.
  - "asymp_rate" & "asymp_rate_vac": probability of a patient is asymptomatic for non_vac and vac group.
  - "vac": if one only wants to do vaccination but no test, can use this to assign each group an initial vaccination percentage for demo_model and demo_problem code. (e.g. (0.8, 0.3, 0) means 80% of people from group 1 are being vaccinated, 30% of people from group 2 are being vaccinated, and group 3 people are not vaccinated);
  - "freq": if one only wants to do testing but no vaccination, can use this to assign each group an initial testing frequency for demo_model and demo_problem code. (e.g. (1/7, 1/7, 1/7) means for the all 3 groups, people are being tested once a week. (Can also be understand as a person is being tested with a probability 1/7 each day).

- "freq_vac": decision variable in the vaccination_testing combined problem. (e.g. (f1, f2, f3, v1, v2, v3) means for 3 groups case, there are v1% of group 1 is being vaccinated, and they are being tested with a probability f1 each day). One can turn this parameter to assign different value for demo_model & demo_problem code.
- "w": the protection weight for each group. For the subproblem 1, where we do not consider protecting any group, just let w be the default value ((1,1,1) for 3 groups case). If one wants to protect some groups, can assign the corresponding w a larger value.

- **In problem (CovidMinInfectVac)**:
  - "initial_solution": an initial solution for solver to start. Usually we want a solution that is not close to the optimal solution, so we set them to be all 0 at first;
  - "budget": maximum number of replications for a solver to take. If budget is too low, a solver may fail to find the optimal solution. Larger budget may take longer time for solver to run;
  - "vaccine_cap": total number of vaccines over the period. The number of people being vaccinated from all groups cannot exceed this limit. In our problem, we assume people are being vaccinated at the beginning at the period, which means all the vaccination process are done before the simulation begins and people are divided into non_vac and vac groups at the beginning;
  - "testing_cap": total number of COVID test kits available for each day. The number of people being tested from all groups each day cannot exceed this

limit. We set the capacity to be 5000. (testing capacity may not be set too large compared to the population size);

- “pen_coef”: the penalty coefficient if the solver find some solution that violate the constraint (i.e. exceed any of the above capacity). Our problem has linear constraints. Generally, we set this parameter to be large to ensure our solution does not exceed the capacity constraints.