

README: A Simple Planning Problem for COVID-19 Lockdown, Testing and Tracing^{*}

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Abstract

This file contains a description of the implementation of the code and the order in which the files must be run to replicate the results in the main paper. For more details refer to the Online Appendix.

^{*}First draft, March 23, 2020. We thank Tom Phelan who shared his code of our problem using a similar version of the finite difference method, substantially improving the speed on our earlier method of computation.

A Implementation with and without TTQ of the code

The user studying the planning problem without the TTQ protocol must run the files provided choosing the maximum of the testing-tracing rate $T_{max} = 0$. In order to implement the code with the TTQ protocol, the user must choose $T_{max} = 1$ as well as $\tau = 1$ and $\kappa = 0$ in accordance to the assumptions required for the implementability of the problem described above. Furthermore, the accuracy of the solution increases as the number of grid points increase and as the number of iteration increase (or equivalently the tolerance to stop the iterations). To obtain accurate solutions even when the initial conditions are close to the boundary (i.e. $X_0 = 0.01$ and $S_0 = 0.97$), for the benchmark case we ran the code with 300 grid points for S (i.e. N_S in the code) and $k \times 300$ grid points for X where $k = 5$ (i.e. N_X in the code). For higher values of vsI (i.e. $vsI=50$), we use $N_S=400$ grid points for S and $N_X = 5 \times 400 = 3250$ grid points for X . For $vsI=70$, we use $N_S=650$ grid points for S and $N_X = 5 \times 650 = 3250$ grid points for X . To replicate the figures and table in the paper the user should use the following files:

- “Table1.m” for Table 1. The file uses as input “SolvePlanningProblem” and “SolvePlanningProblem_q”. The parameters for each of the rows of the table are created in the matrix “parameters” inline 35-55. The user can choose to run only certain rows of the table by modifying the vector “selector” inline 61. For example, if the user wants to run only row 1 and 16 of Table 1, the user should specify “selector = [1,16]” .
- “Figure1A.m” and “Figure1B.m” replicate each of the panels in Figure 1.
 - “SimplePlanningProblem.m” and “SimplePlanningProblem_tau1.m” create the underlying files for the figures.
- “Figure2.m” replicates Figure 2 in the paper.
 - “SimplePlanningProblem_TTQ.m” and “SimplePlanningProblem_TTQ_zeta1.m” create the underlying files for the figures.

We ran “Table1.m” in an iMac Pro (2017) with processor 2.3 GHz 18-Core Intel Xeon W and memory 256 GB 2666 MHz DDR4. It takes several days of this computer using Matlab ‘9.8.0.1323502 (R2020a)’ to run this code. In order to run alternative parameterizations to those in Table 1, the user could manually change the parameters of file “SimplePlanningProblem.m”, which solves the planning problem with and without TTQ. The file “SimplePlanningProblem_Figures_NoTTQ.m” plots the main figures in ? without TTQ and takes as an input the .mat file created in “SimplePlanningProblem.m.” The file “SimplePlanningProblem_Figures_TTQ.m” plots the figures with the TTQ protocol. Note that all the .mat files required are provided in the replication package.

B Implementation of Quadratic Lockdown Costs

Relative to the benchmark case, the code is very similar. The only changes in the code are the first order conditions for L in the right-hand side of the HBJ equation and the period return of the value function. The file “SimplePlanningProblem_quadratic.m” solves the planning problem without TTQ, this file should be run first and must be implemented choosing the maximum of the testing-tracing rate $T_{max} = 0$. To replicate the figures in the Appendix the user should use the following files:

- “FigureE1.m” replicates Figure E1 in the Appendix.
 - “SimplePlanningProblem.m” and “SimplePlanningProblem_tau1.m” create the underlying files for the figures.
- “FigureE2A.m” and “FigureE2B” replicate each of the panels in Figure E2 in the Appendix.
 - “SimplePlanningProblem_quadratic.m” and “SimplePlanningProblem_quadratic_tau1.m” create the underlying files for the figures.

For alternative parameterizations, the user should run the file “SimplePlanningProblem_quadratic.m” and to plot figures “SimplePlanningProblem_Figures_NoTTQ.m”. Note that all the .mat files required are provided in the replication package. To create all .mat files and figures all together run “All_Figures.m”.