**ANALISYS BEHAVIOURAL MODEL**

Immagine che contiene schizzo, Carattere, diagramma, Line art

Descrizione generata automaticamenteThe behavioural model is defined with the following structure:

Immagine che contiene testo, Carattere, ricevuta, bianco

Descrizione generata automaticamente

EQUILIBRIUM AND STABILITY

There are different final equilibrium value of the system depending on the values of the parameters. In particular, the four coefficients are combined, obtaining two reproduction rates . The formula of these coefficients is

I case:

First the nullclines lines are calculated and plotted. To do this, the system can be reduced to two equations assuming the mass conservation and that the following relation holds:

The first two equations are rewritten, rescaling also with , the humans population.

Immagine che contiene calligrafia, testo, Carattere, linea

Descrizione generata automaticamente

These two becomes:

![Immagine che contiene bianco, design

Descrizione generata automaticamente](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAAAYEAAACWCAMAAAAPI8SBAAAAAXNSR0IArs4c6QAAAARnQU1BAACxjwv8YQUAAAAGUExURf///wAAAFXC034AAAACdFJOU/8A5bcwSgAAAAlwSFlzAAAh1QAAIdUBBJy0nQAAAE9JREFUeF7twTEBAAAAwqD1T20LLyAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAgJsa4iwAAeOyKF0AAAAASUVORK5CYII=)Immagine che contiene calligrafia, testo, Carattere, linea

Descrizione generata automaticamente

The two nullclines can be calculated, imposing and .

The resulting equations are:

For the first nullcline

Immagine che contiene testo, linea, calligrafia, Carattere

Descrizione generata automaticamente

And for the second nullcline

Immagine che contiene calligrafia, Carattere, linea, testo

Descrizione generata automaticamente

The plots in matlab of this case for a certain set value of the parameter is

Immagine che contiene testo, diagramma, linea, schermata

Descrizione generata automaticamente

In this case the stability of the equilibrium can be computed using the Ruth- Hurwitz conditions.

The two conditions are used to express a relation that can be used with the coefficient to verify if the equilibrium is stable.

“QUALITATIVE” ANALYSIS

This system evolution is simulated varying the value of the four parameters in the following range:

* and between 0.1 and 0.99 (1/days)
* between 1/5 and 1/30 ] (1/days)

Some sensitivity plots are realised to analyse the value of the network at the variation of parameters. In particular, the four coefficients are combined, obtaining two reproduction rates .

The formula of these coefficients is

Immagine che contiene Policromia, schermata

Descrizione generata automaticamentePLOT presentations:

This first figure plots the max number of compliant and against compartments at the variation of the coefficients. The plot is realized extrapolating the value of a specific and varying the and value to calculate the proper value. With the same value of , as in this case the two figures are symmetric. **Is this an example of trans-critical behaviour?**

Another example done with the same methodology is the following figure showing the value at system equilibrium:

Immagine che contiene schermata, testo, Policromia, Diagramma

Descrizione generata automaticamente**The careless plot is a subcritical pitchfork?**

Finally, a bifurcation plot is realised, fixing also the value and varying the . Here are fixed while are selected several values of , to plot multiple lines at different . The first figure show the max value reached by each group varying the R1 parameter.

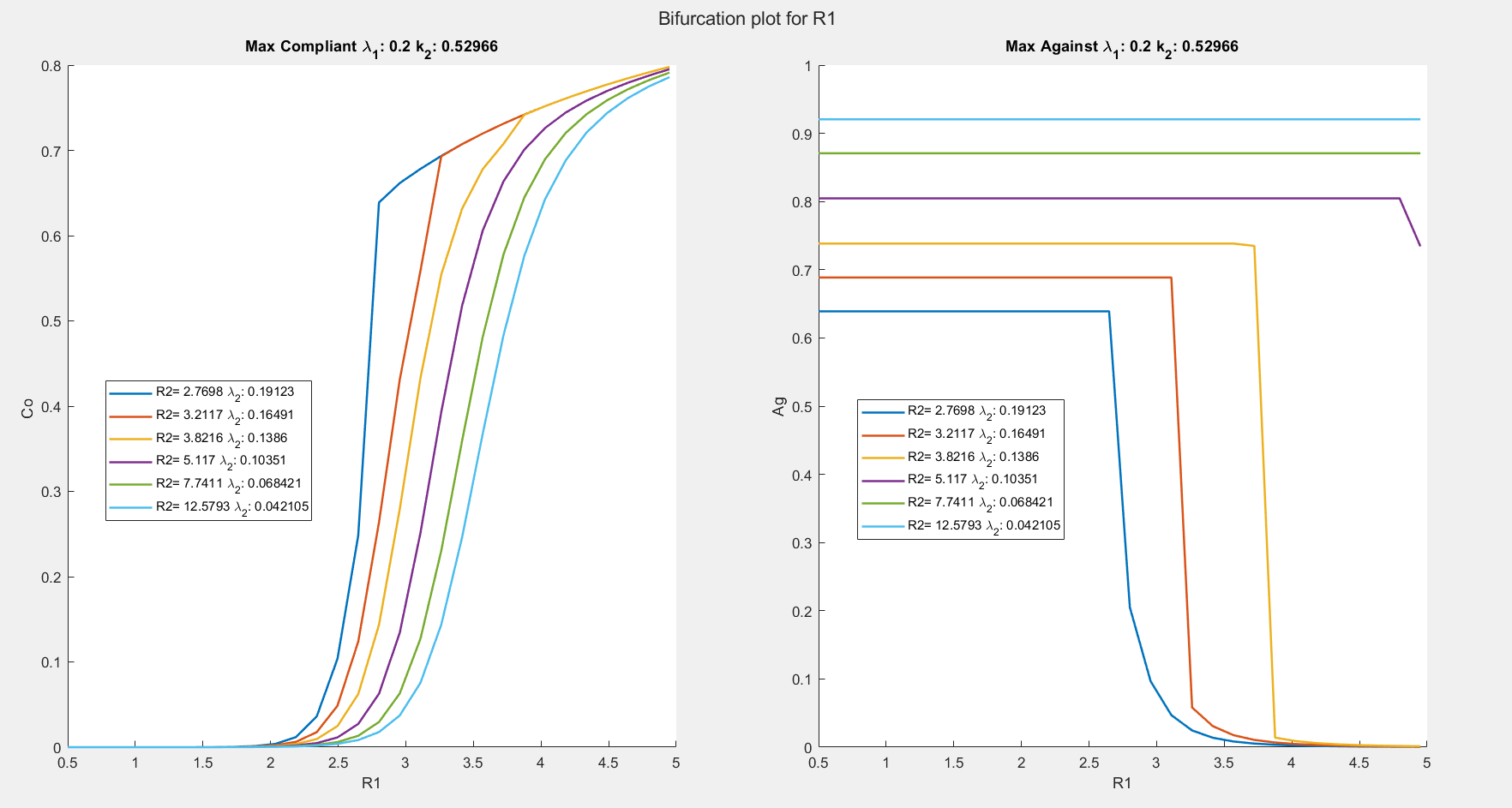


Immagine che contiene testo, diagramma, linea, schermata

Descrizione generata automaticamenteAnd in the final plot the value at equilibrium of the system realised with the same method.