An Initial Glimpse of AnyLogic & Emergence: Modifying an Existing Model

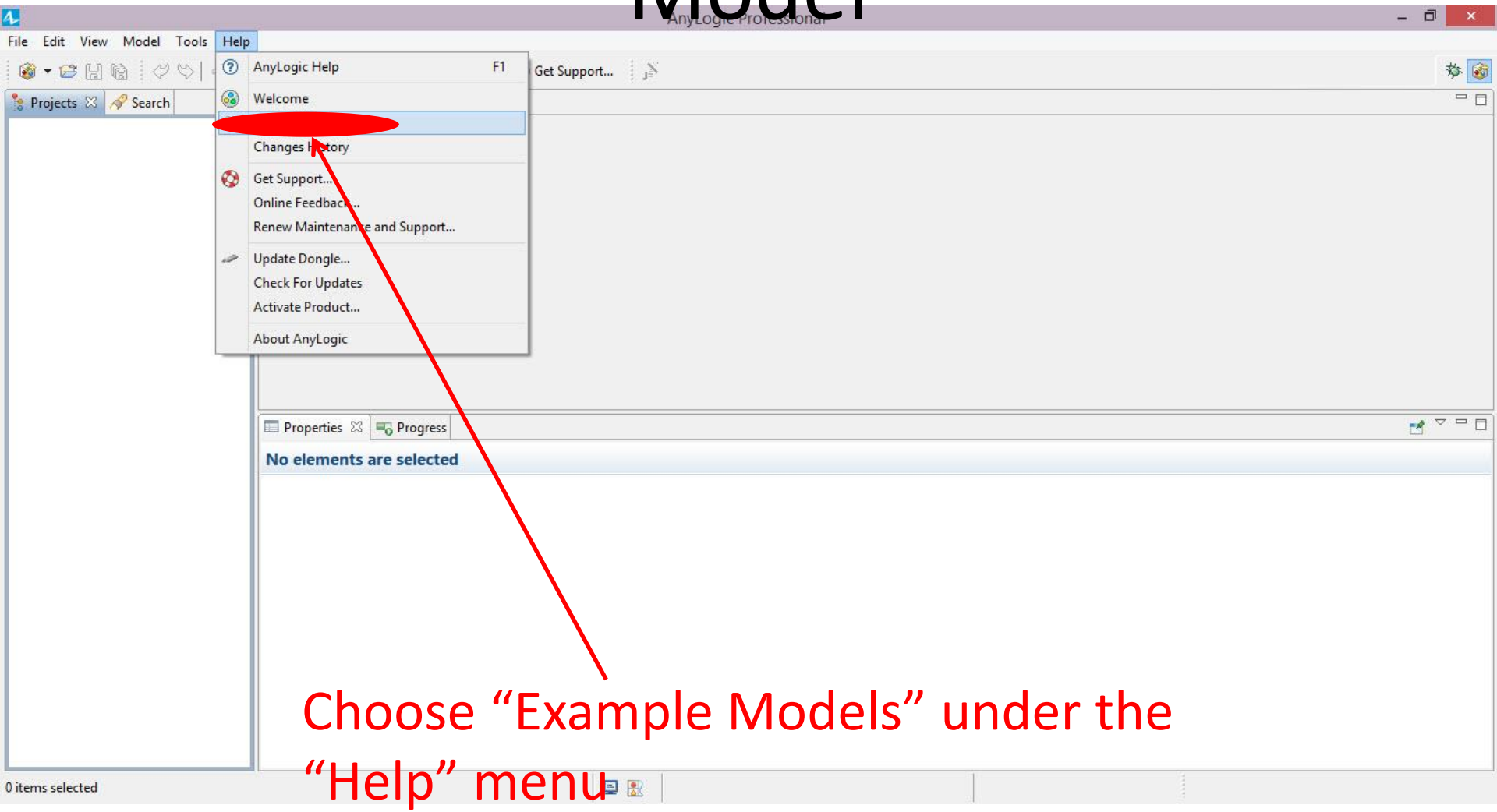
Nathaniel Osgood

Using Modeling to Prepare for Changing Healthcare Needs

Duke-NUS

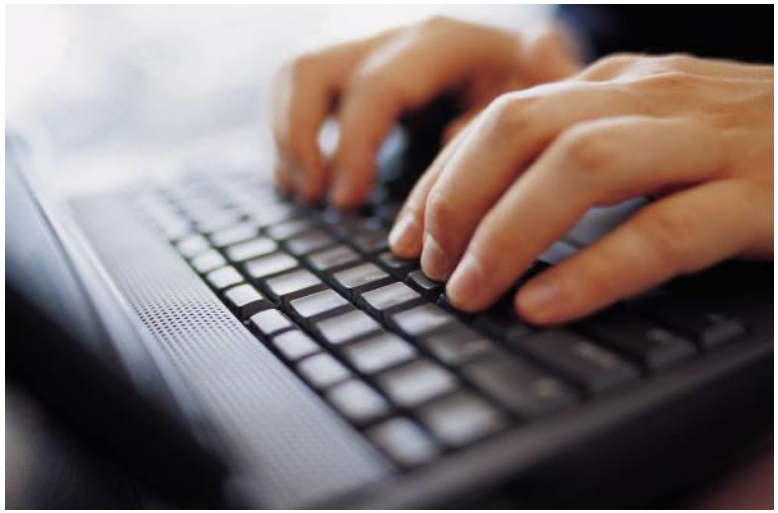
April 16, 2014

Opening an AnyLogic Example Model



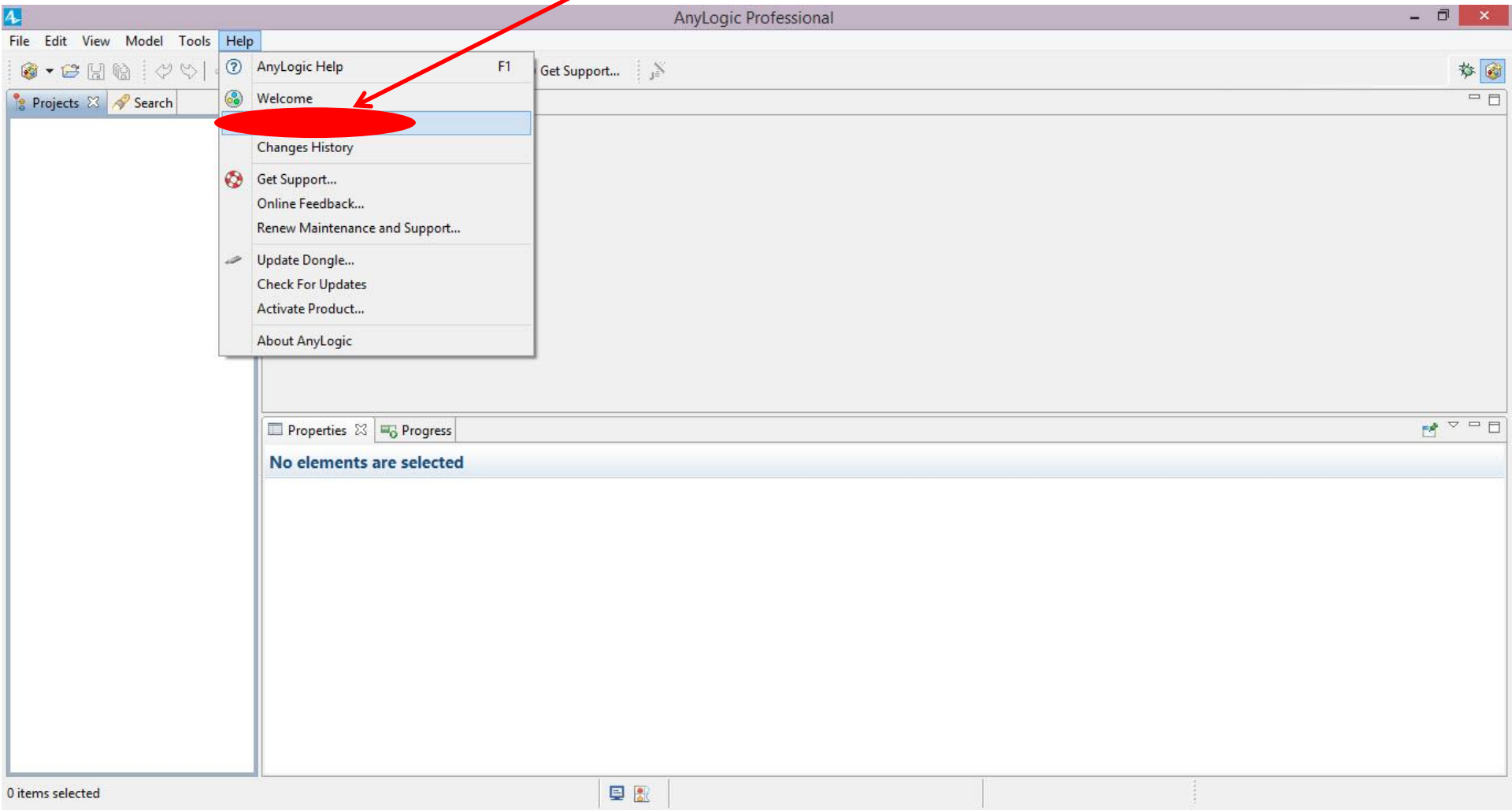
Choose “Example Models” under the “Help” menu

Hands on Model Use Ahead

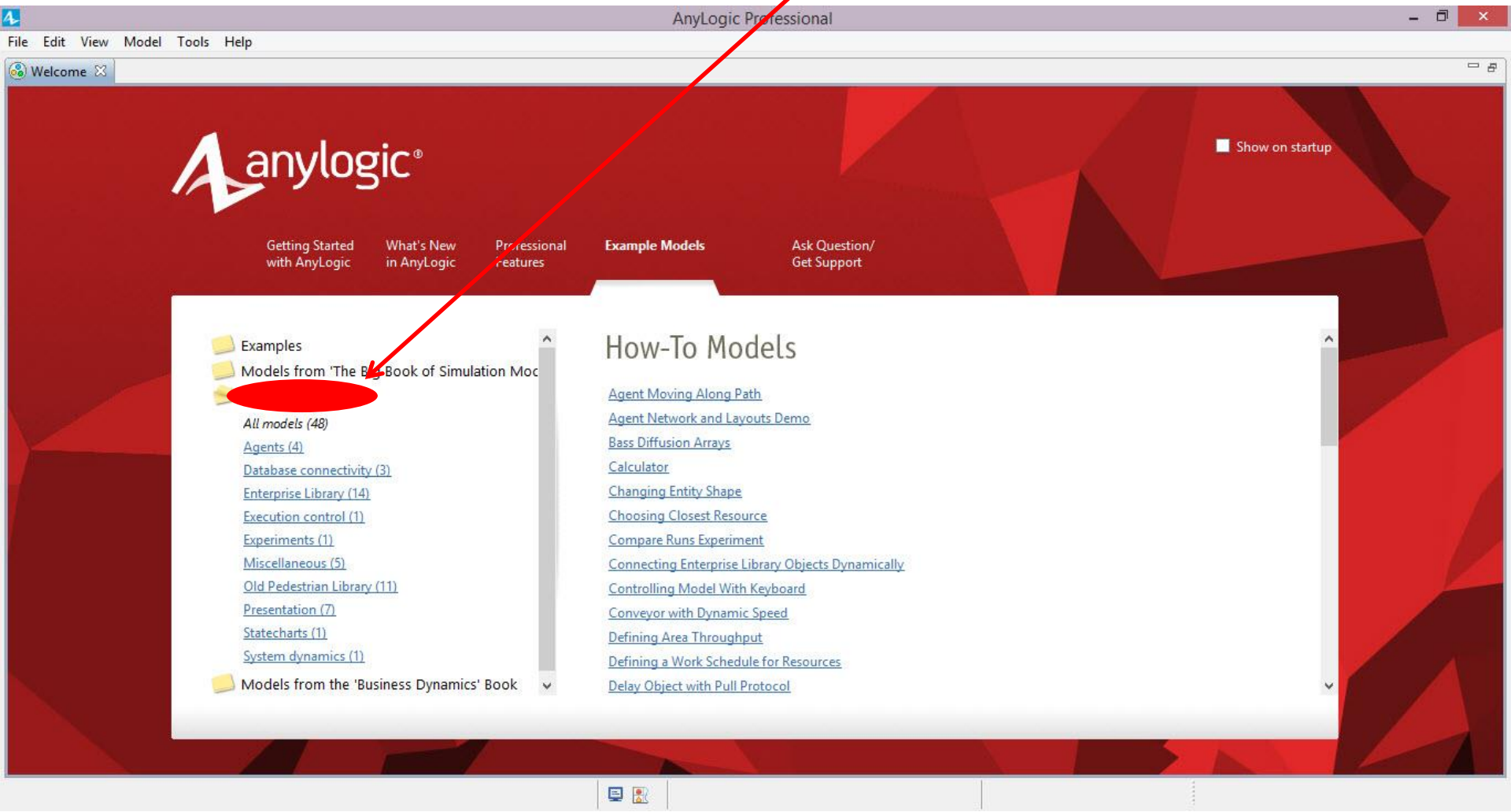


Load AnyLogic Example Model: SIR Agent Based.alp

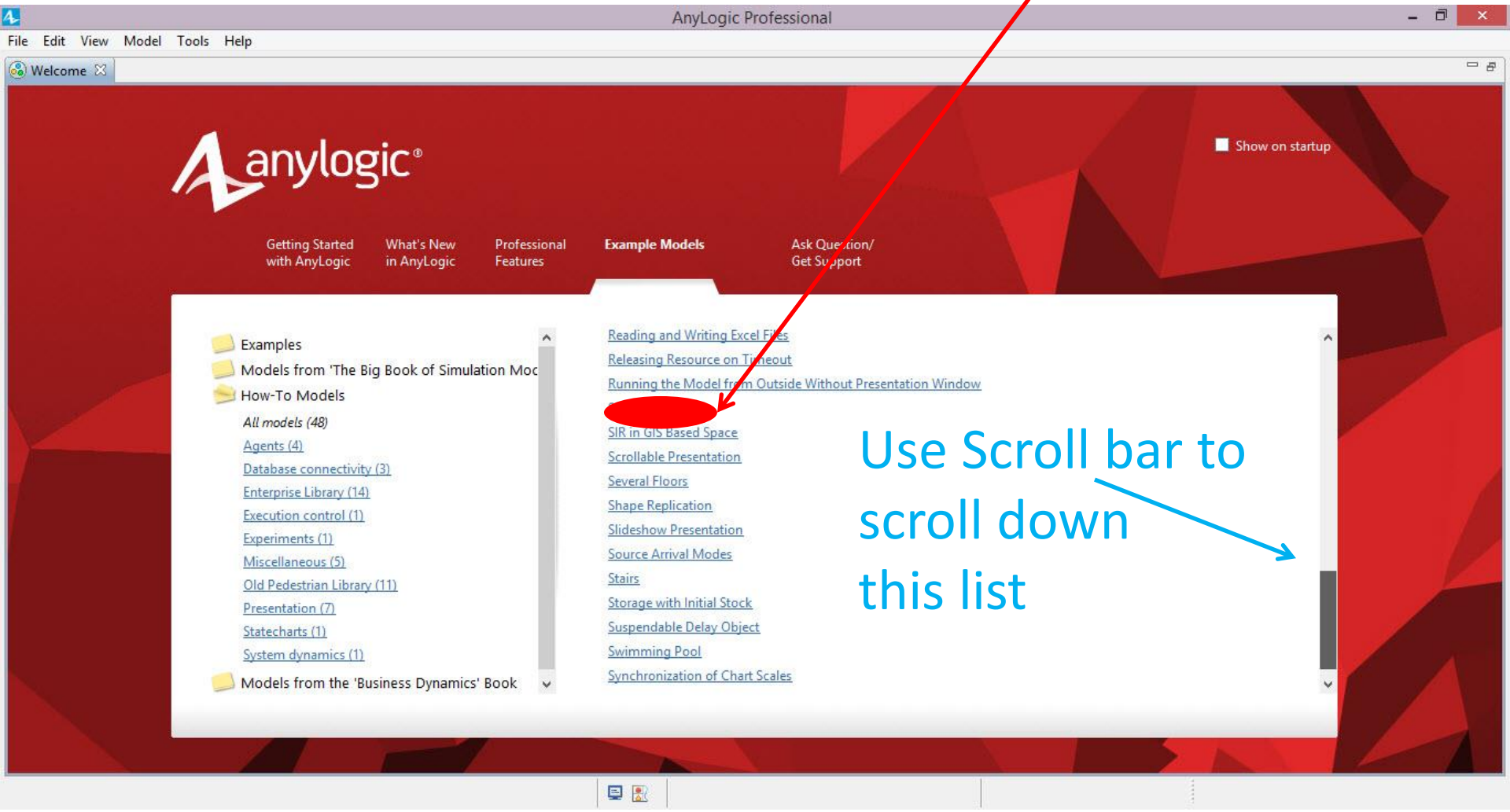
Request "Example Models" via Help Menu



Select “How-To Models”



Scroll Down to & Click on “SIR Agent Based”

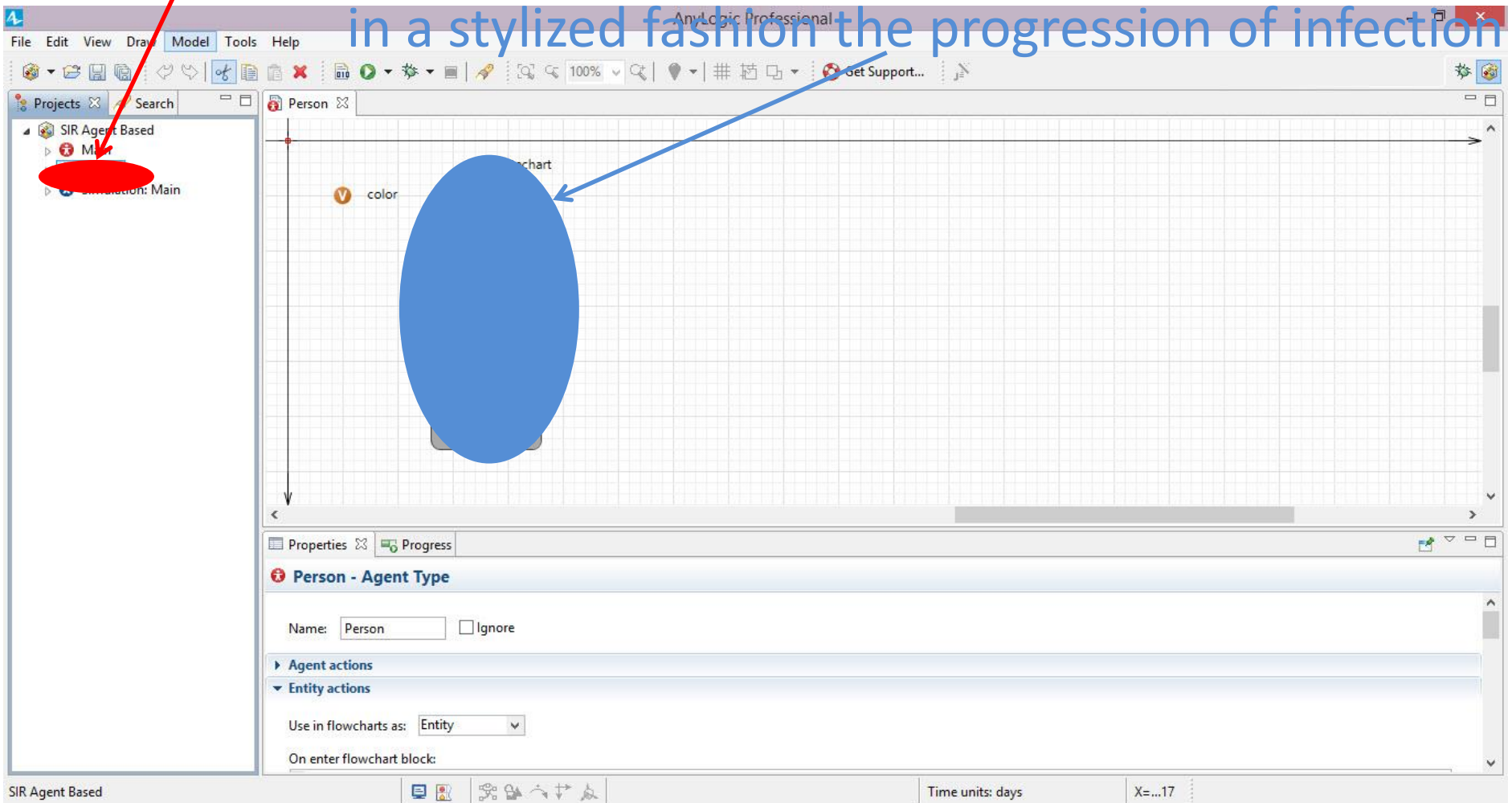


Model Focus: Spatial Spread of an Infectious Disease

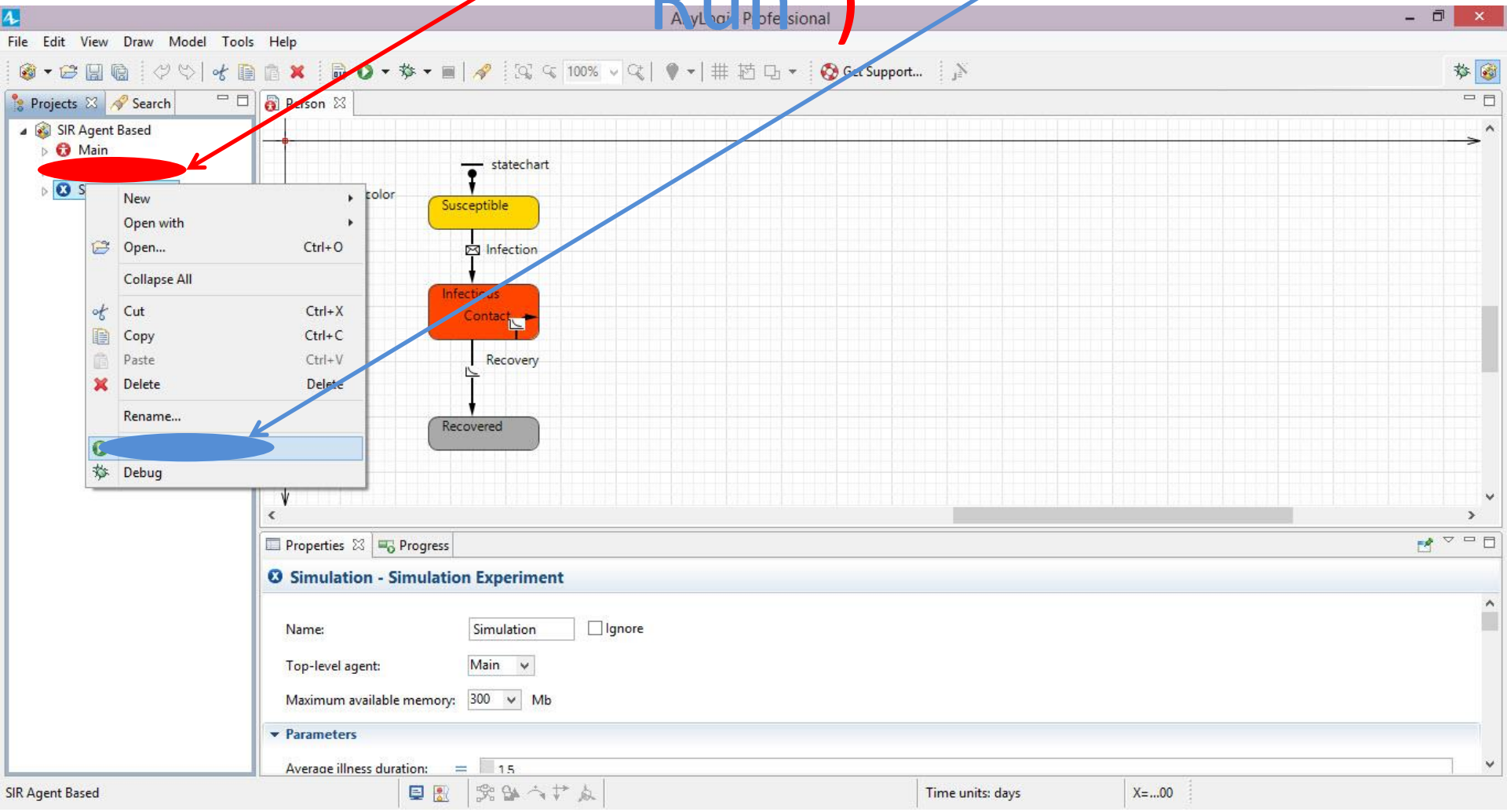
- This model simulates the spread of an infectious disease in a regular space
- The simulation starts with a single index infective case (towards lower right of space)
- Natural history of infection involves progression from Susceptible to Infected (& Infective) to Recovered
  - There is no waning of immunity in the original model
- If a given person is infective, the infection can spread from that person to their neighbours in the 4 cardinal directions ("North", "South", "East", "West") (i.e. Up, Down, Left, and Right)

Viewing the Model Structure

Double click on “Person” to see the associated state transition diagram. This diagram represents in a stylized fashion the progression of infection

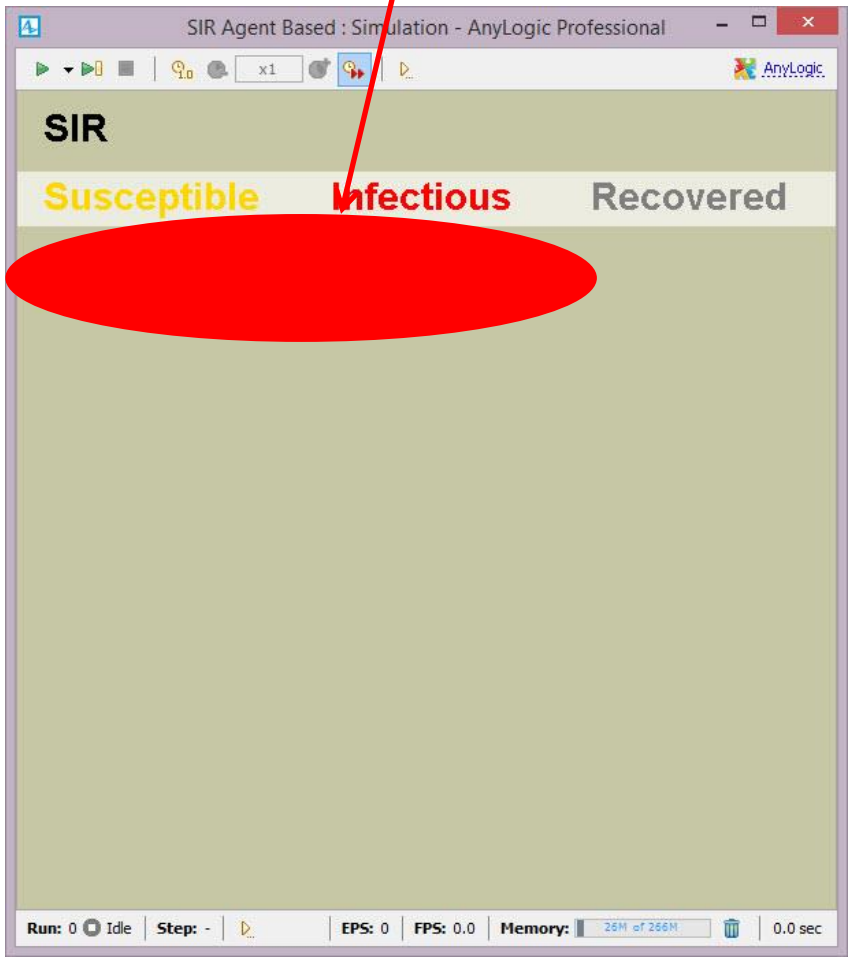


Run the Model (Right Click the Experiment “Simulation” & select “Run”)

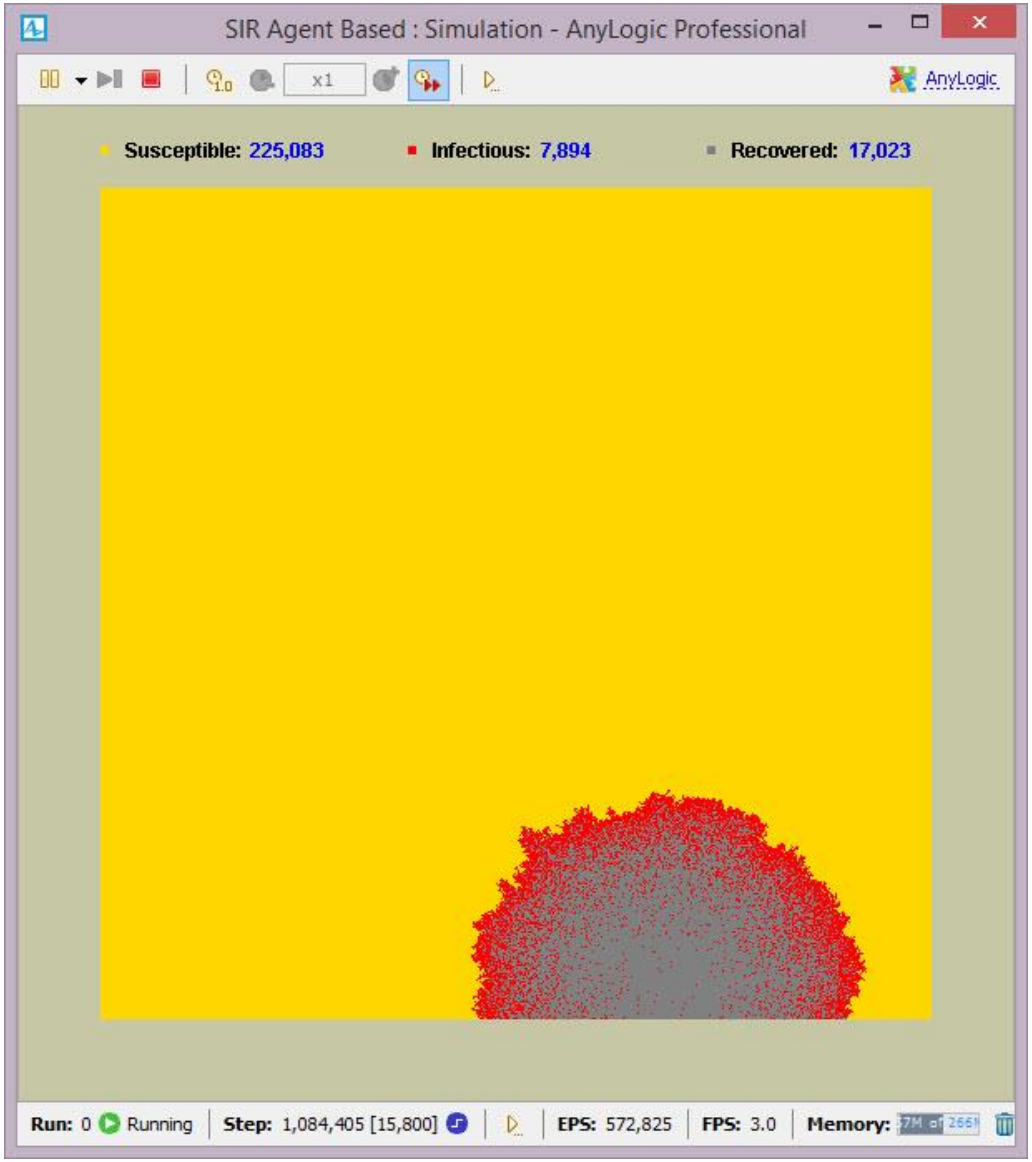


What do You Expect to See?

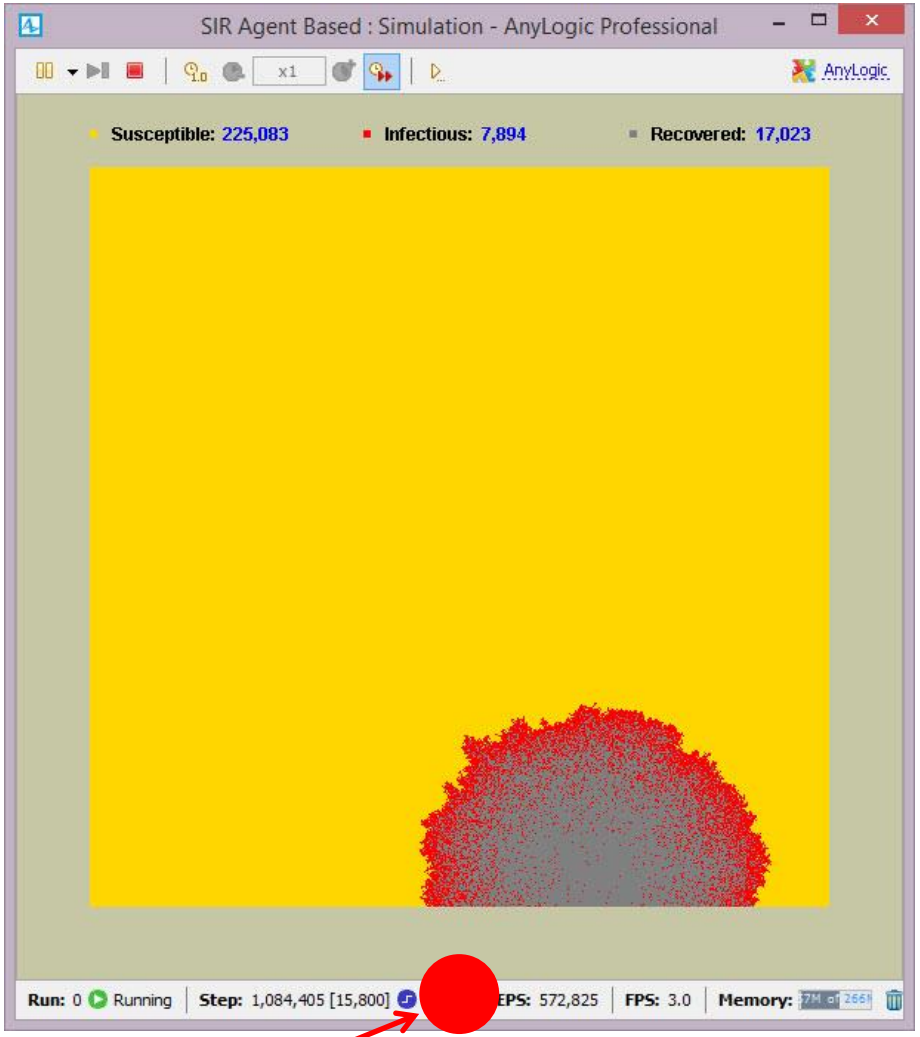
Press this button to start model execution



Example of Emergent Behaviour

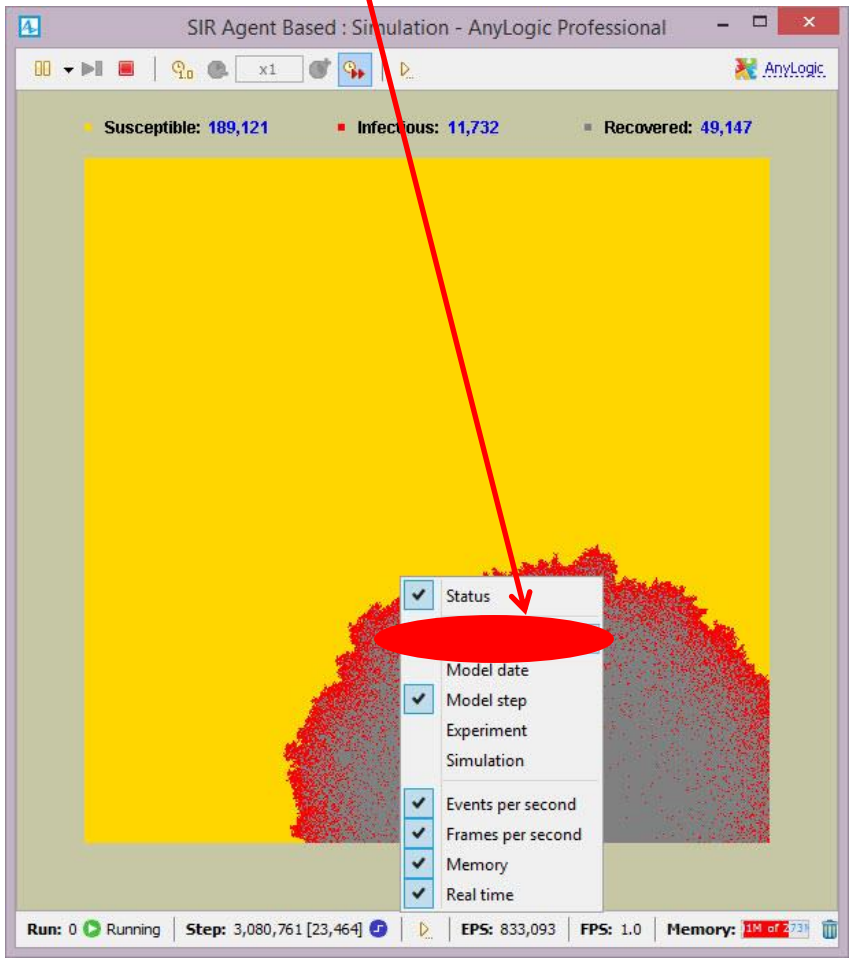


Make Sure Model Time is Visible

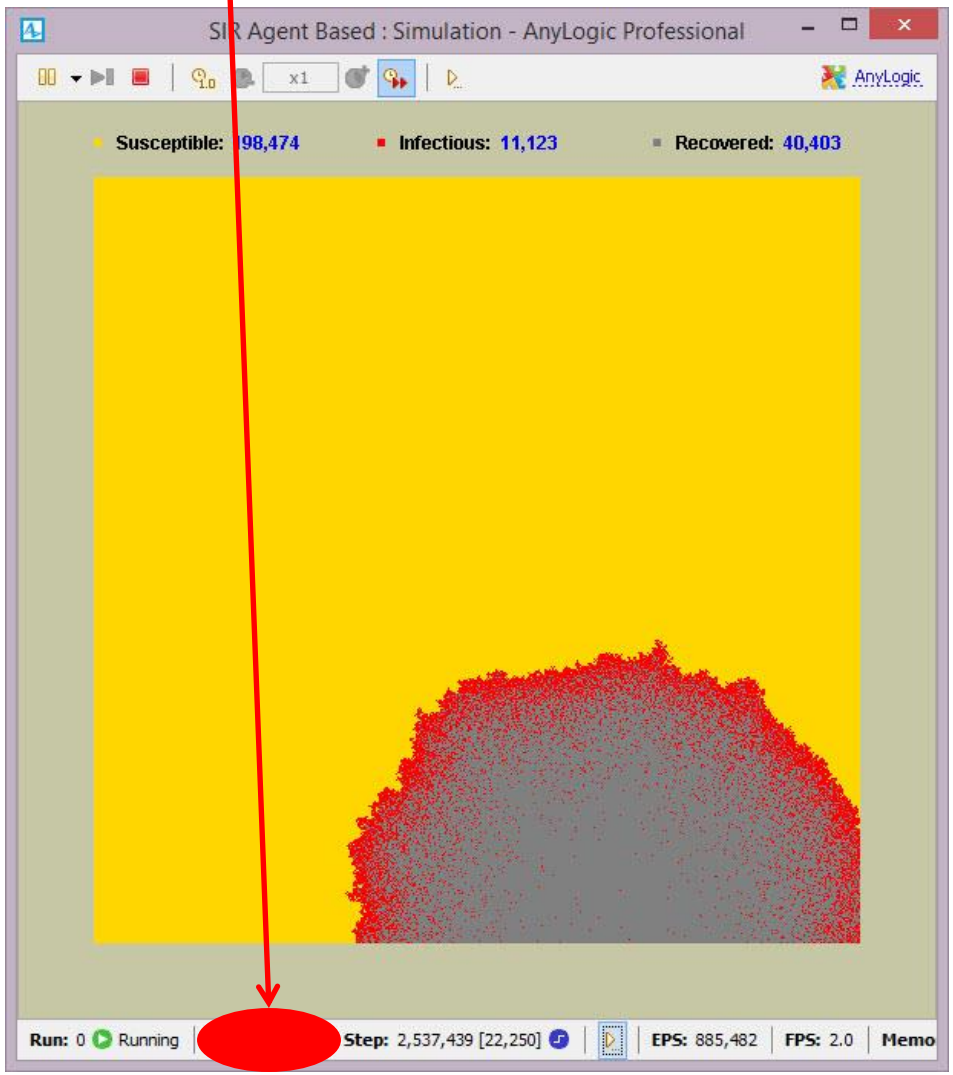


If no model time is visible on the bottom of the window, press this button to add a “model time” output

Select “Model Time” here (so a check mark appears)
(If a checkmark is already present, just click back on the output window)



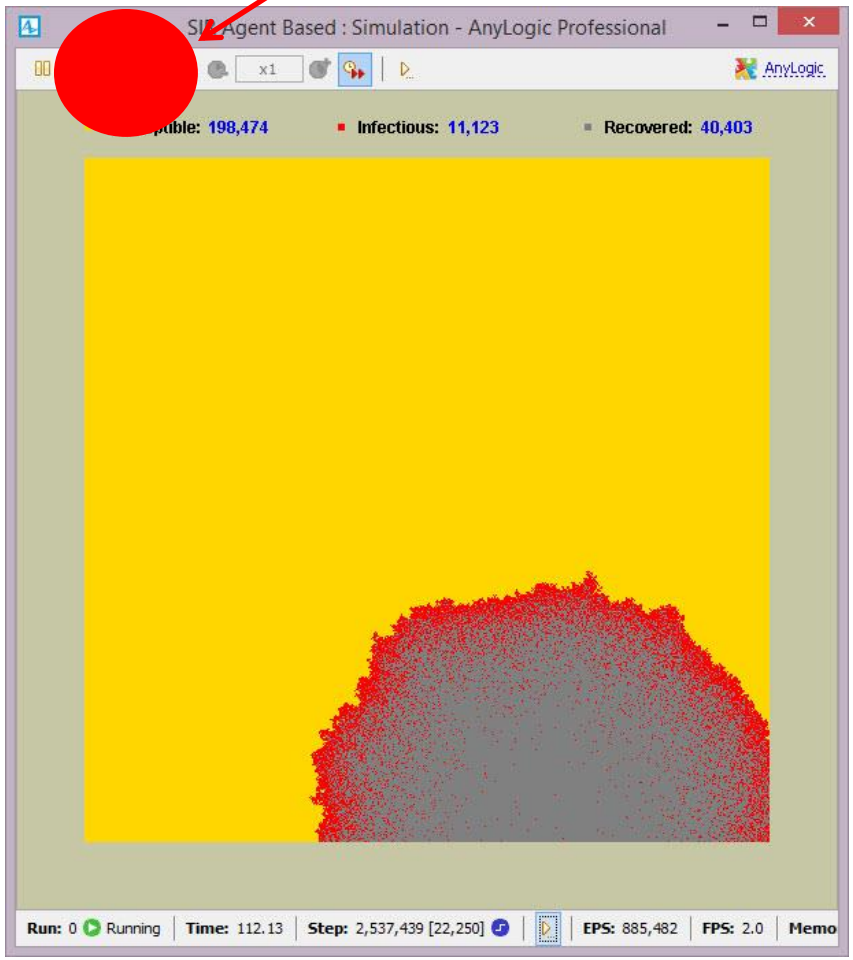
The Updated Window Should Include a Model Time Output



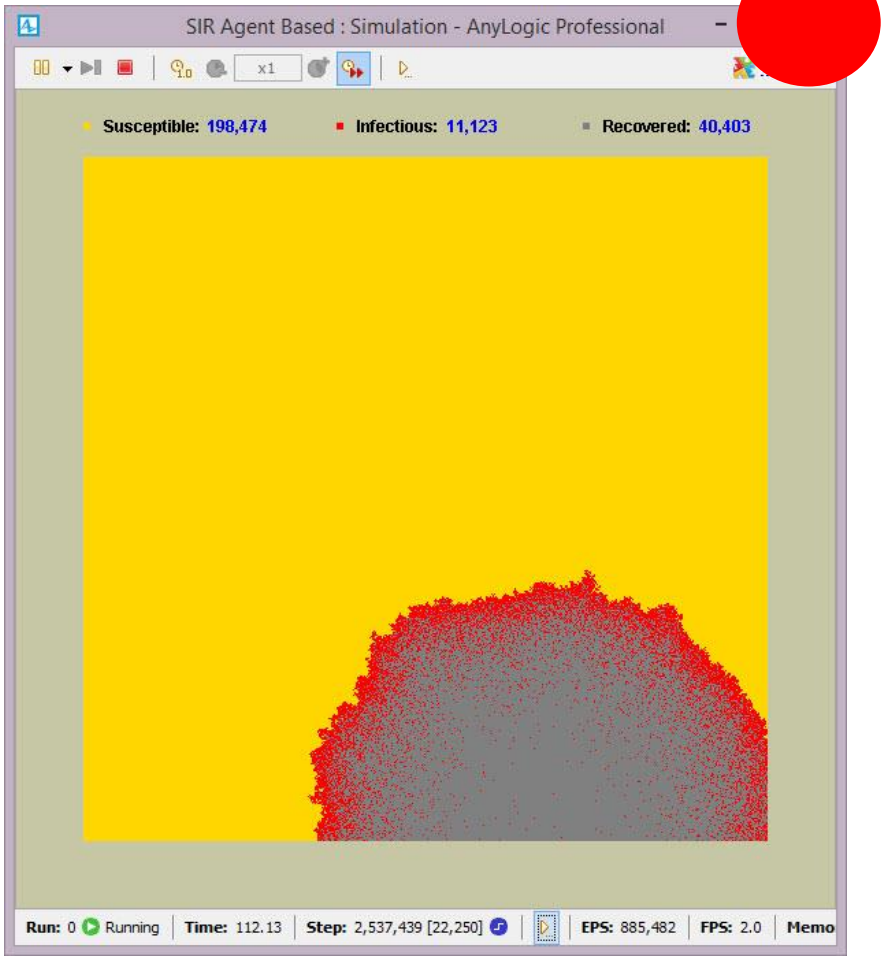
Stylized Measurement 1

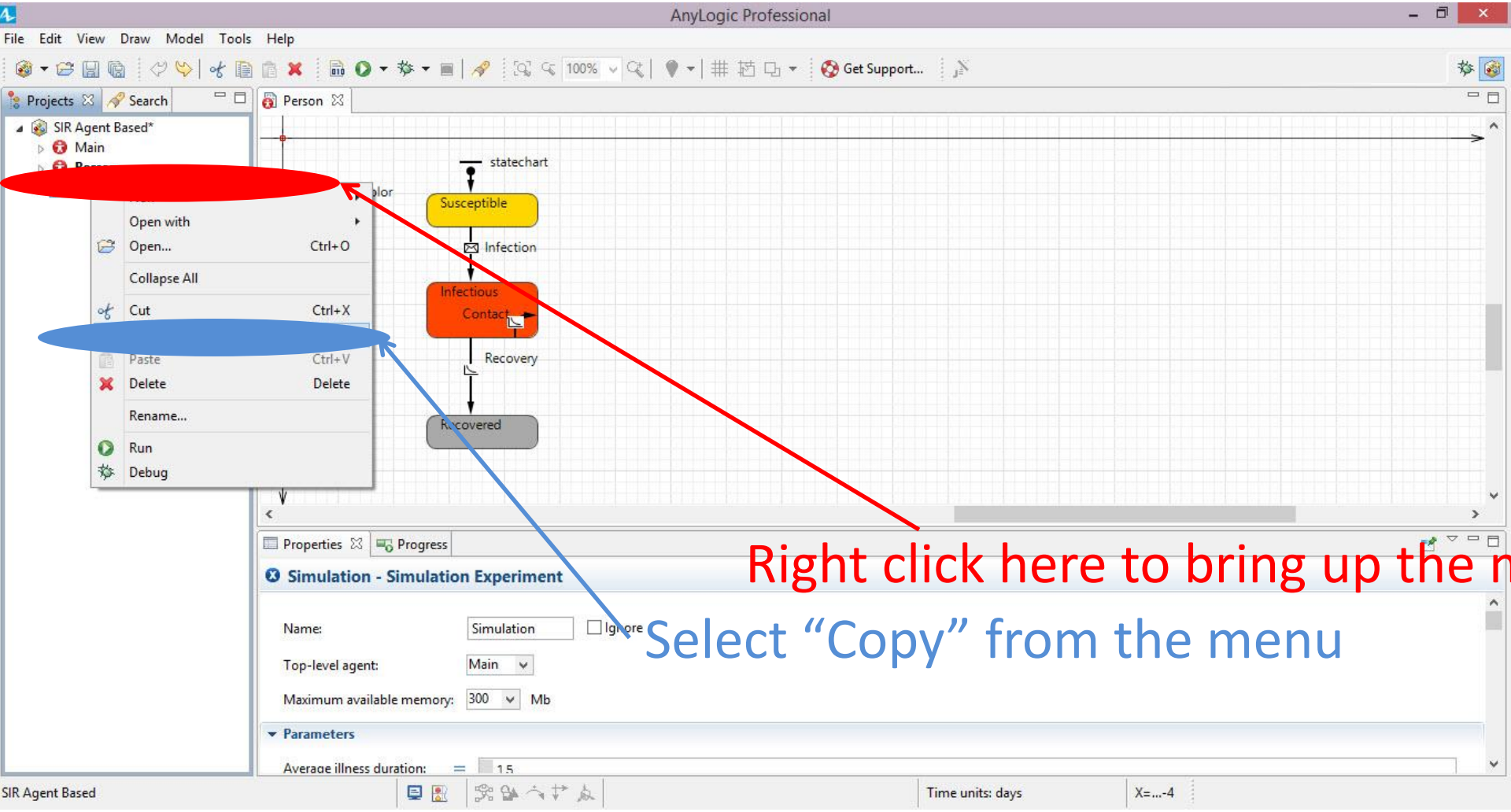
- How Long Does it Take for The Infection to Reach the Top or Left Boundaries?
- We'll compare this to the situation with other assumptions regarding the progression of the infection (as encoded by model "parameters")

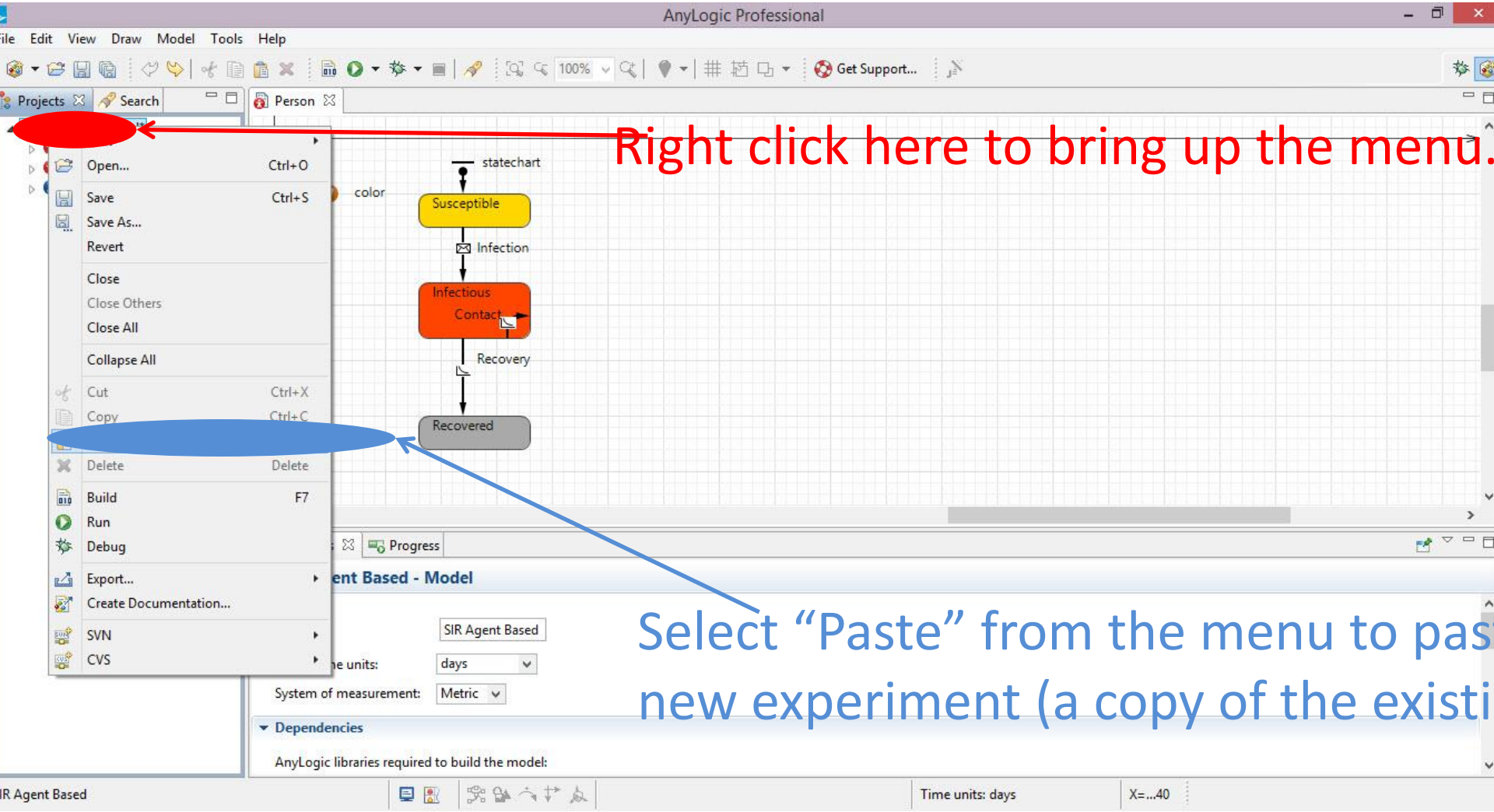
Press this button to stop model execution



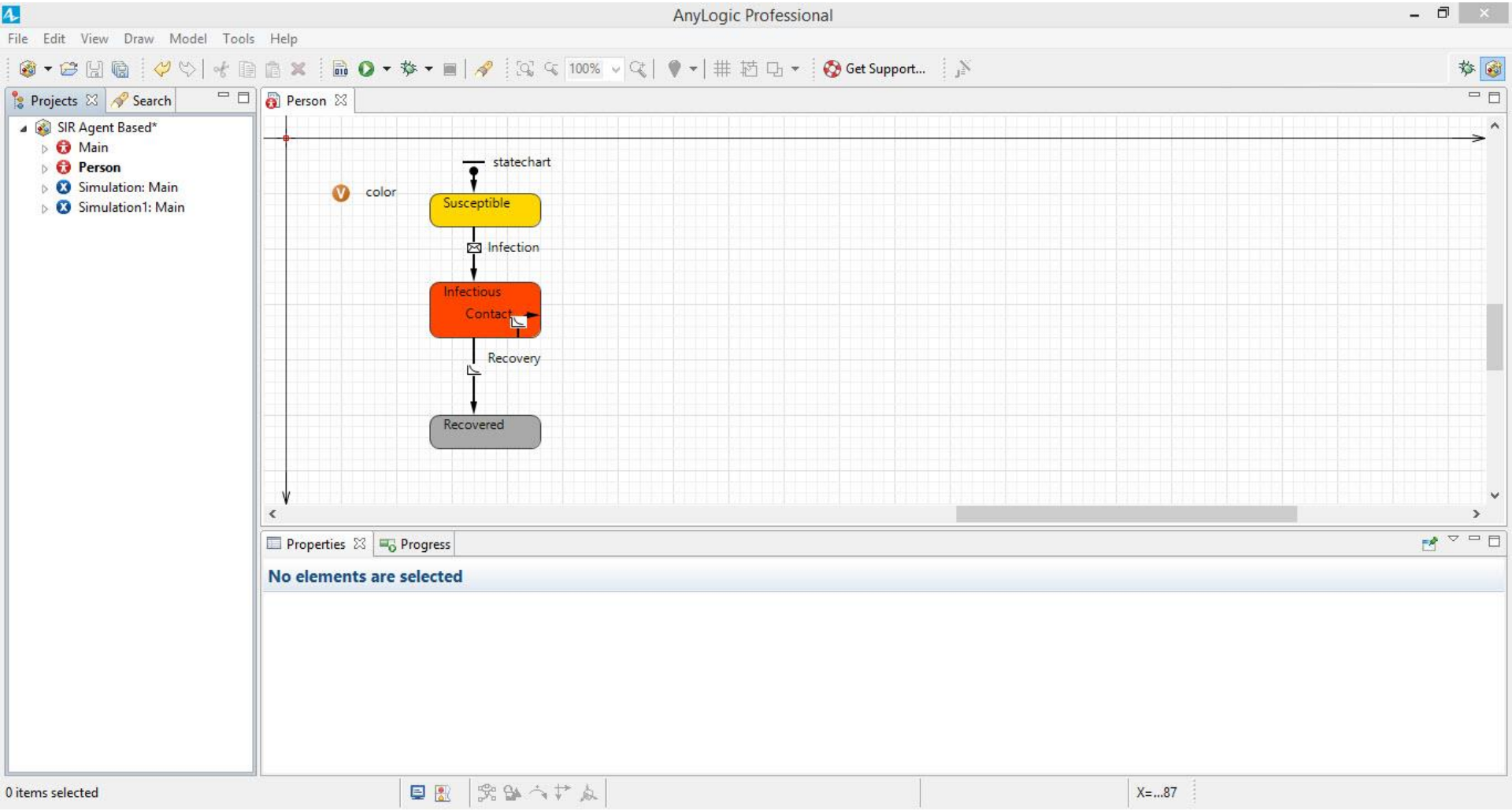
Close the window using this button



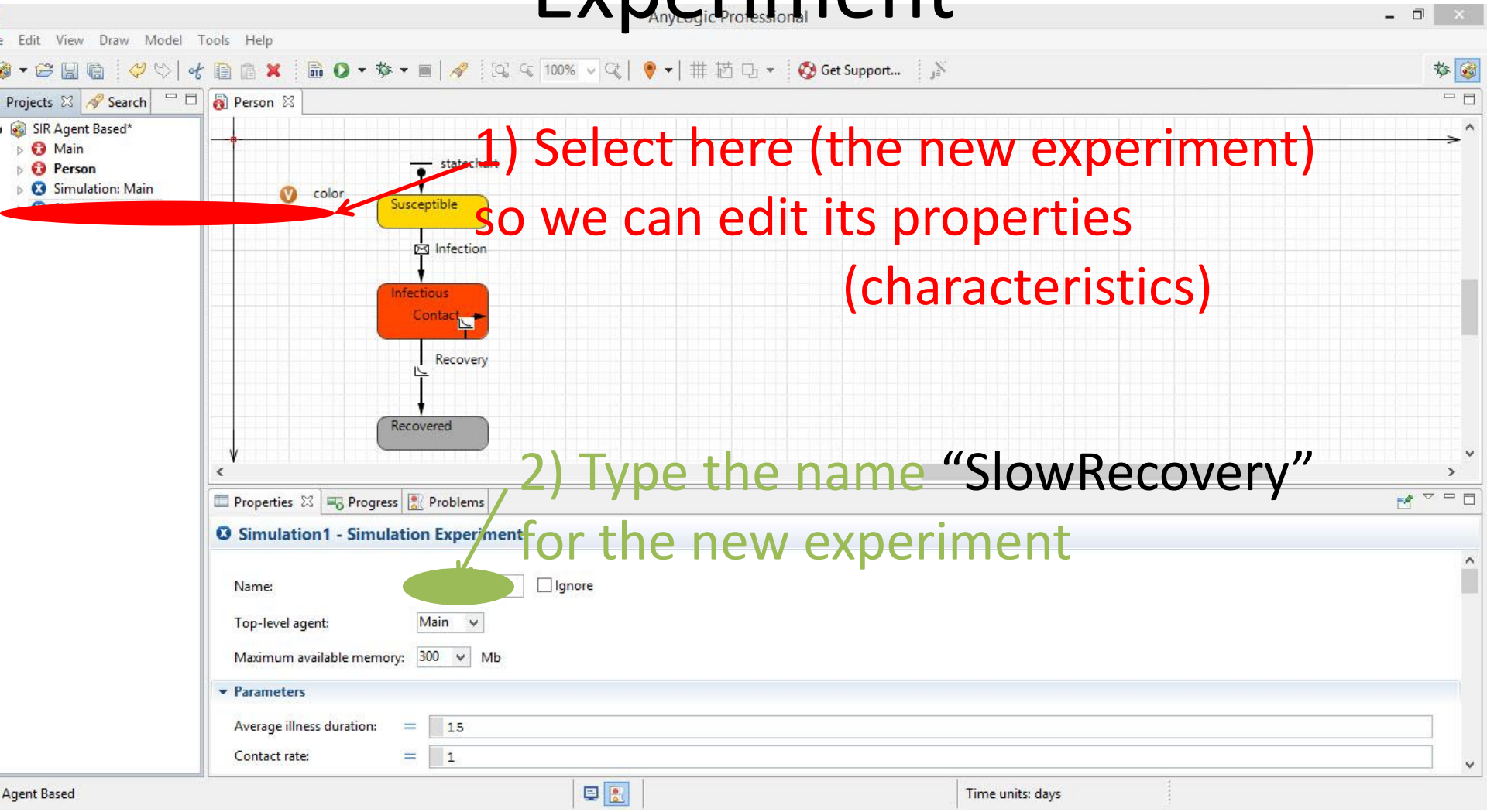

AnyLogic Professional
File Edit View Draw Model Tools Help
Get Support...
Projects
Search
SIR Agent Based*
Main
Person
statechart
Susceptible
Infection
Infectious
Contact
Recovery
Recovered
Open with
Open... Ctrl+O
Collapse All
Cut Ctrl+X
Paste Ctrl+V
Delete Delete
Rename...
Run
Debug
Properties
Progress
Simulation - Simulation Experiment
Name: Simulation
Ignore
Top-level agent: Main
Maximum available memory: 300 Mb
Parameters
Average illness duration: 15
Right click here to bring up the m
Select “Copy” from the menu
SIR Agent Based
Time units: days
X=...-4


AnyLogic Professional
File Edit View Draw Model Tools Help
Get Support...
Projects
Search
Person
Open... Ctrl+O
Save Ctrl+S
Save As...
Revert
Close
Close Others
Close All
Collapse All
Cut Ctrl+X
Copy Ctrl+C
Delete Delete
Build F7
Run
Debug
Export...
Create Documentation...
SVN
CVS
statechart
color
Susceptible
Infection
Infectious
Contact
Recovery
Recovered
Progress
ent Based - Model
SIR Agent Based
e units:
days
System of measurement:
Metric
Dependencies
AnyLogic libraries required to build the model:
IR Agent Based
Time units: days
X=...40
Right click here to bring up the menu.
Select “Paste” from the menu to pas
new experiment (a copy of the existi

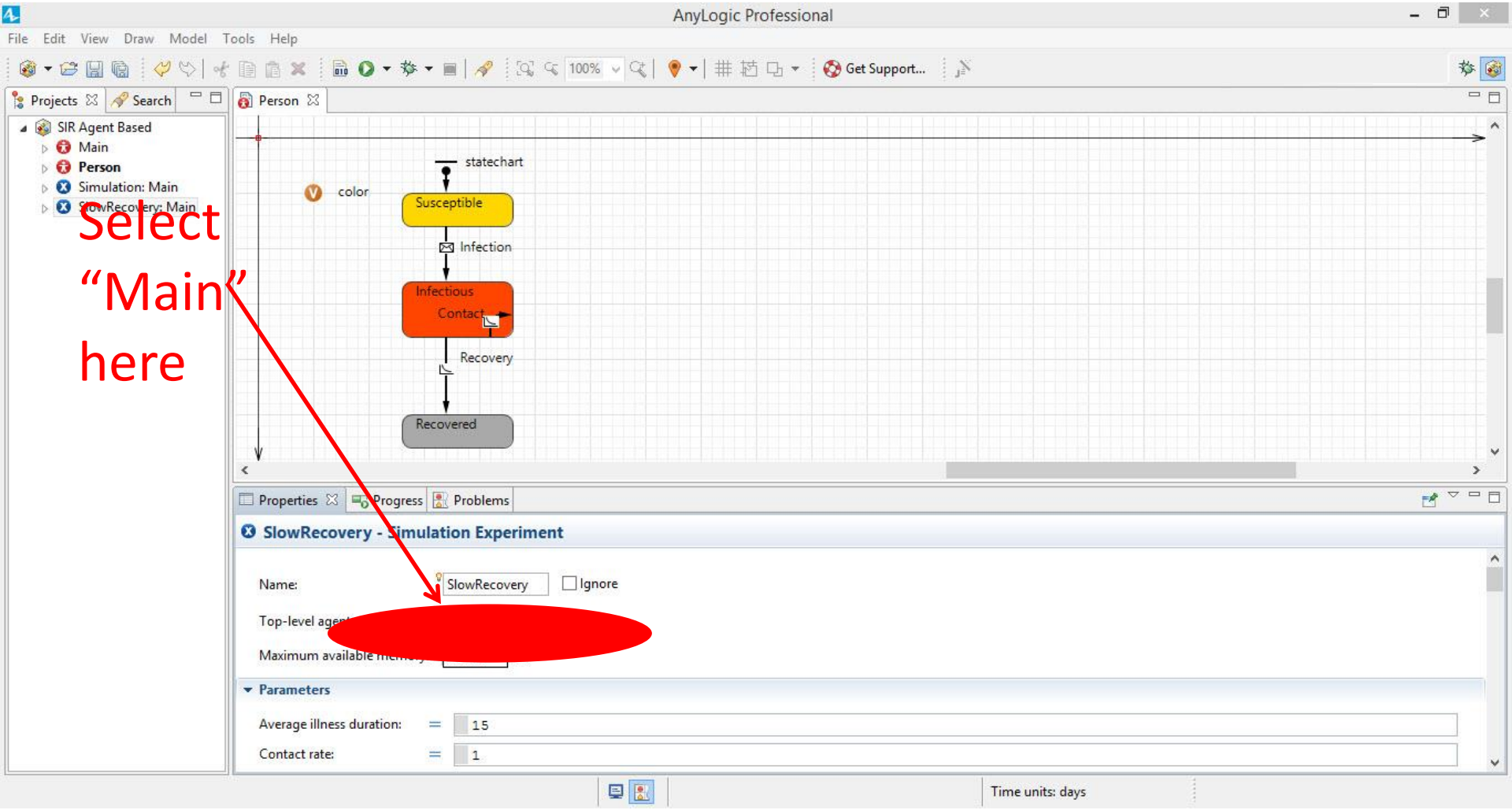
Your Screen Should Look as Follows



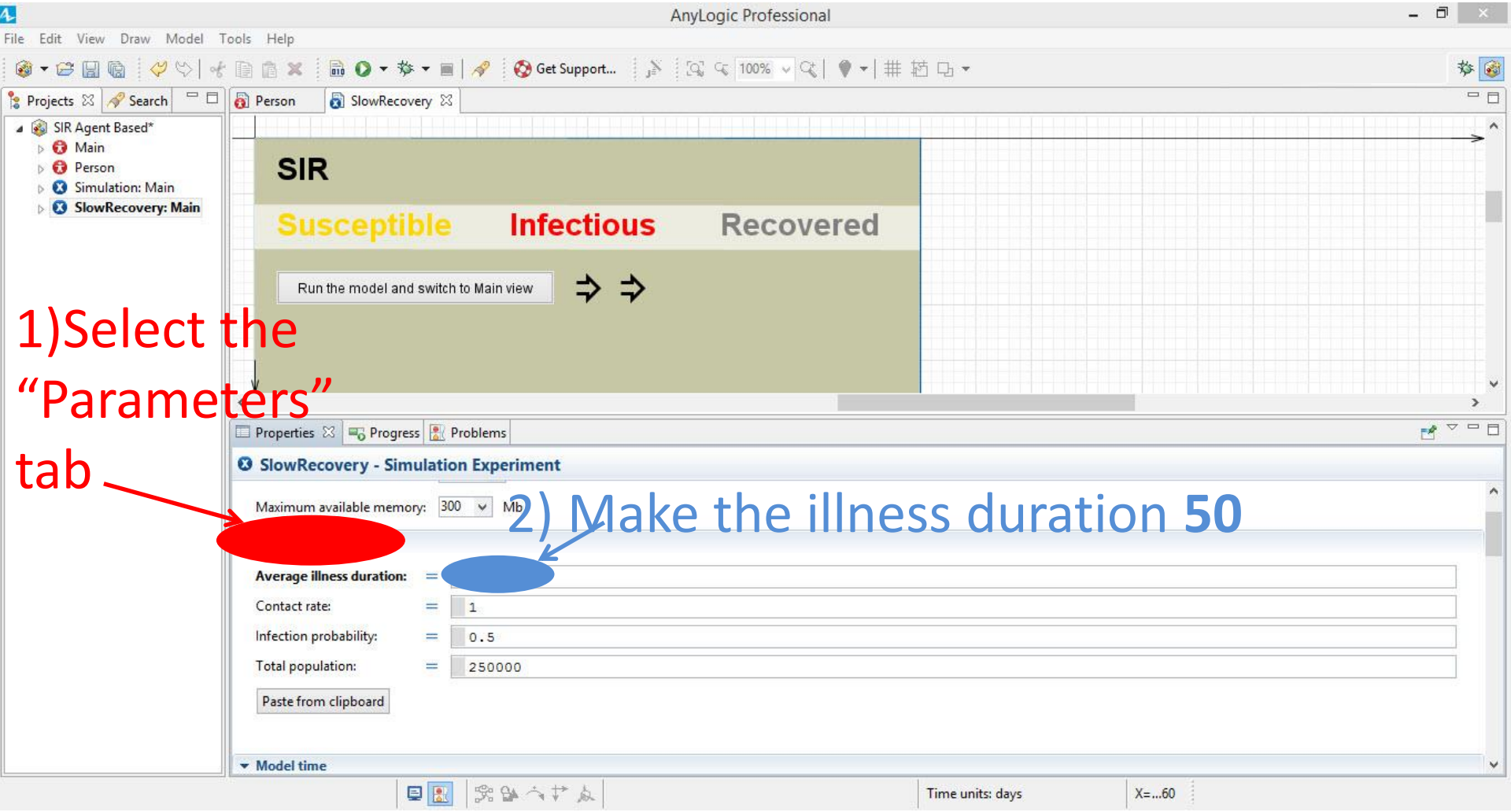
Changing the Name of the Experiment



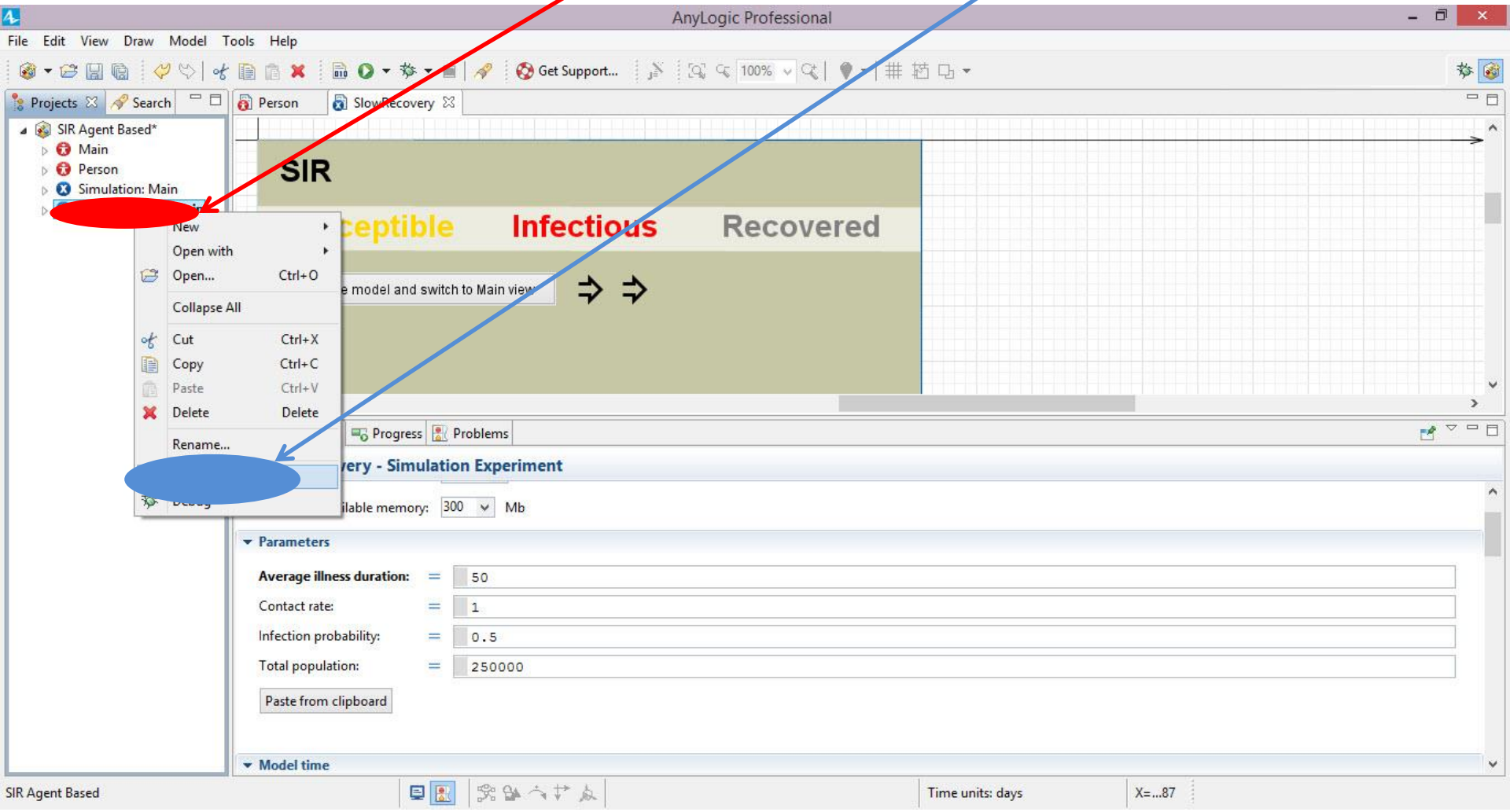
Selecting the Model Used for this Experiment



Altering Assumptions Regarding Infectiousness Duration (via Parameters)

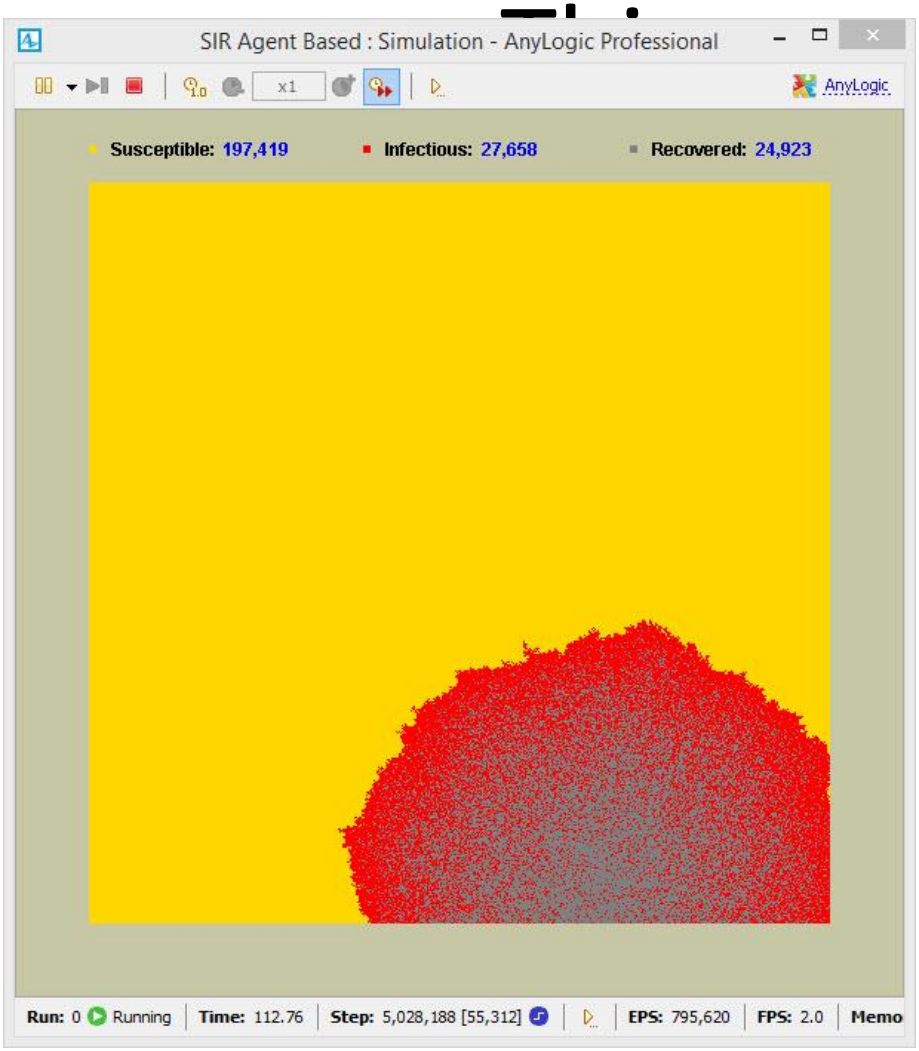


Run the Model (Right Click the Experiment “SlowRecovery” & select “Run”)



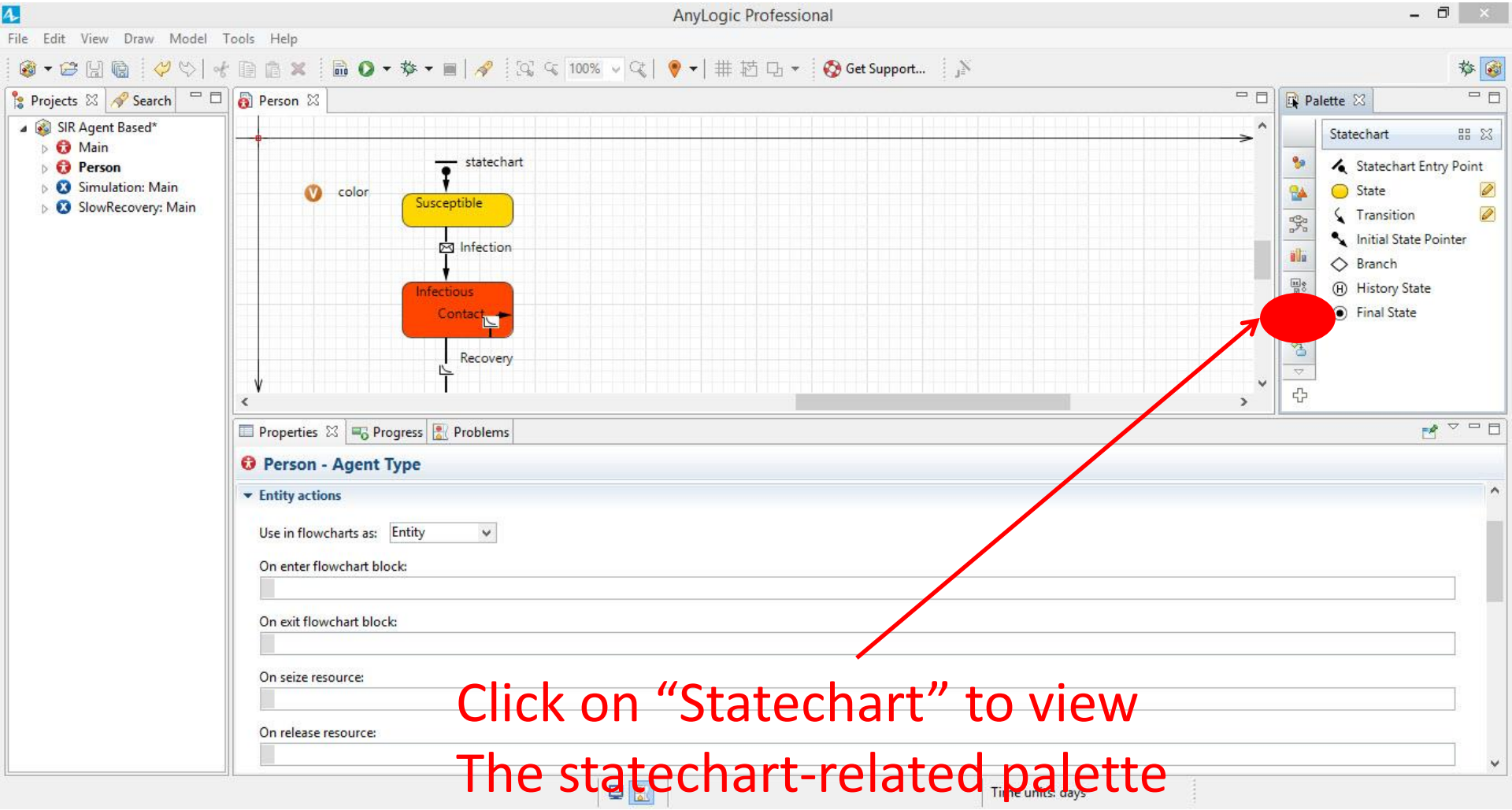
What do You Expect to See?

You Should See Something Like This

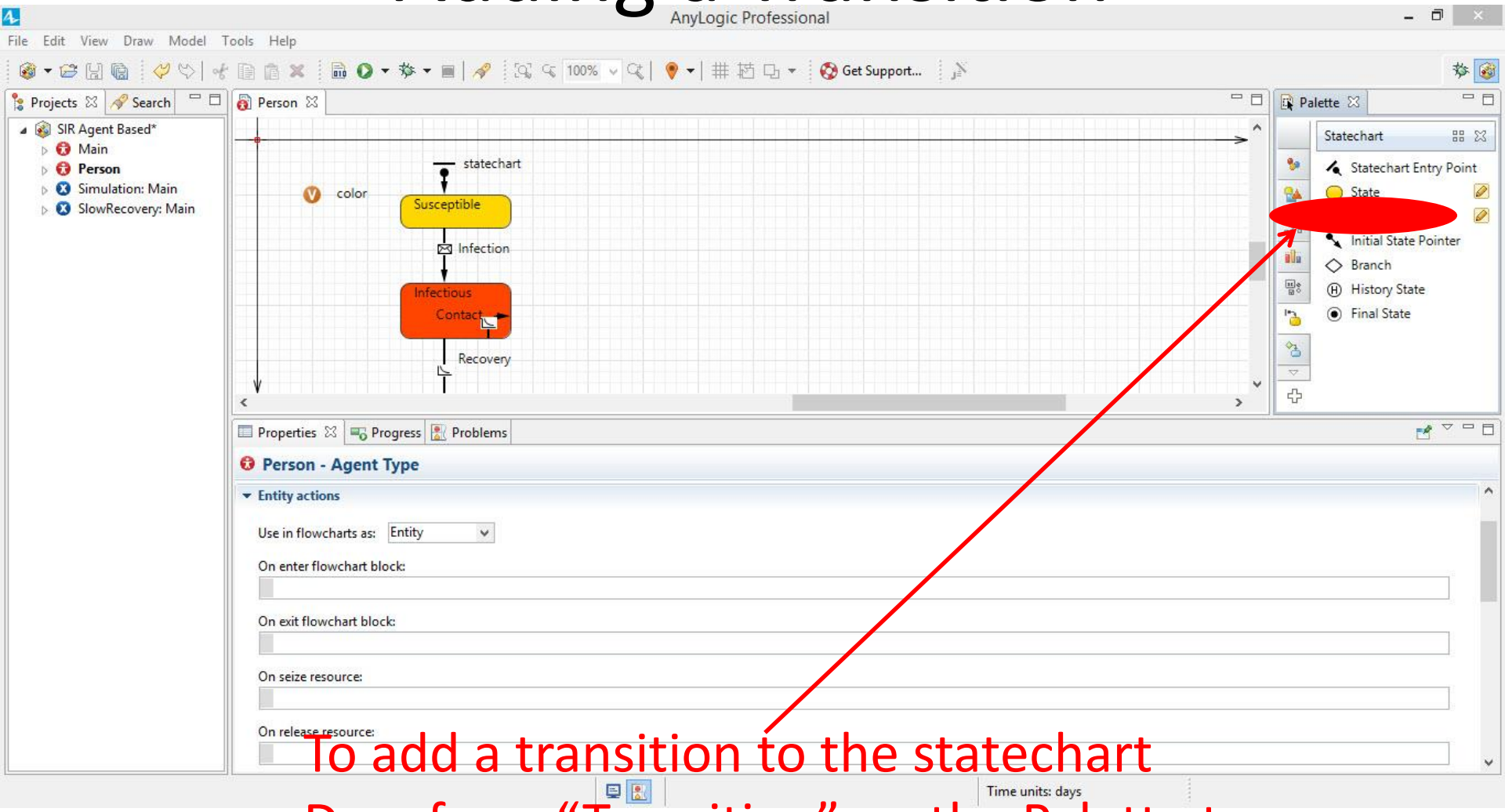


How quickly does the wave of infection take to reach the top border? How does this compare to the situation where we assumed a shorter period of infectiousness? Why?

Adding a Transition



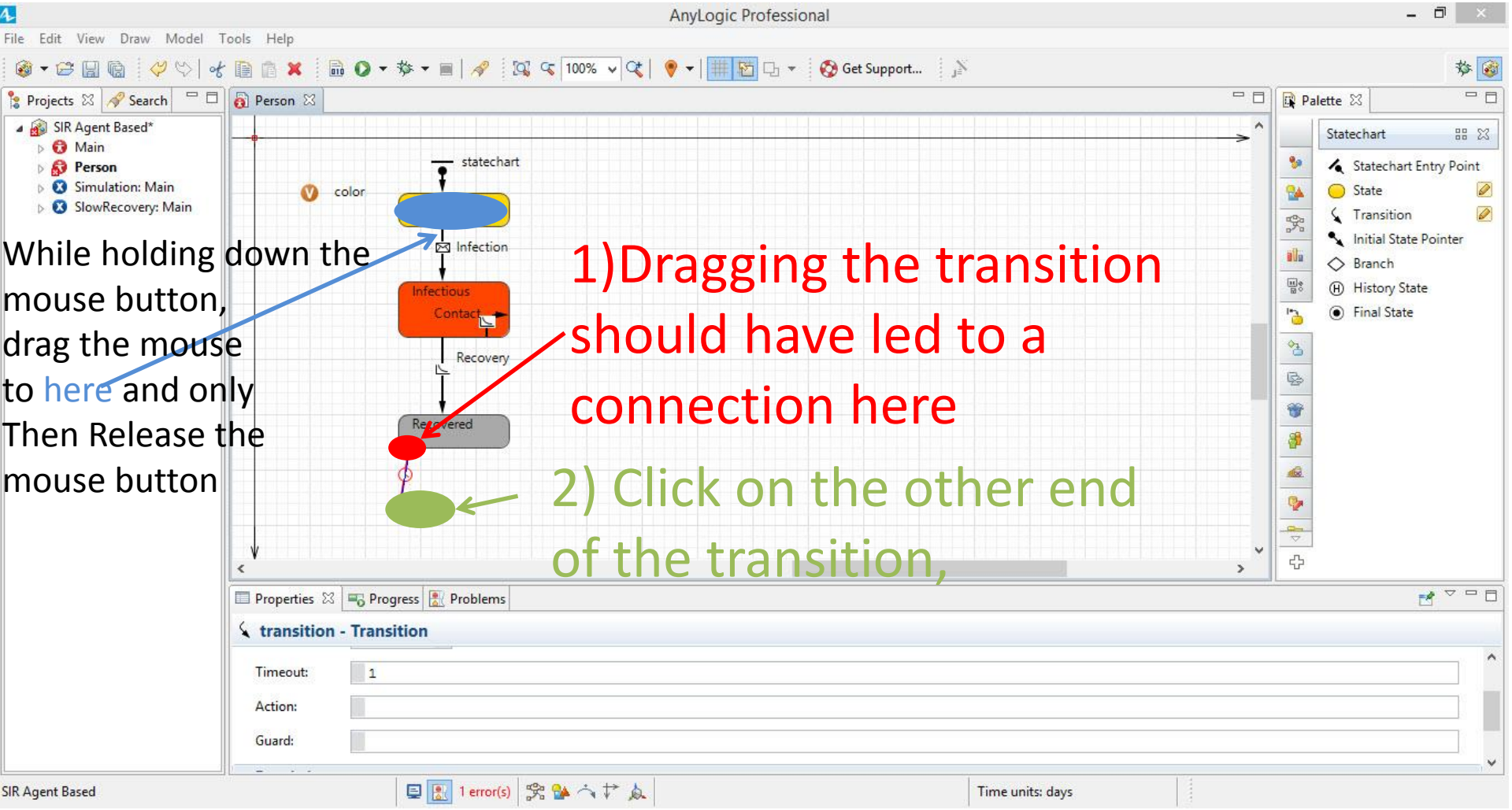
Adding a Transition



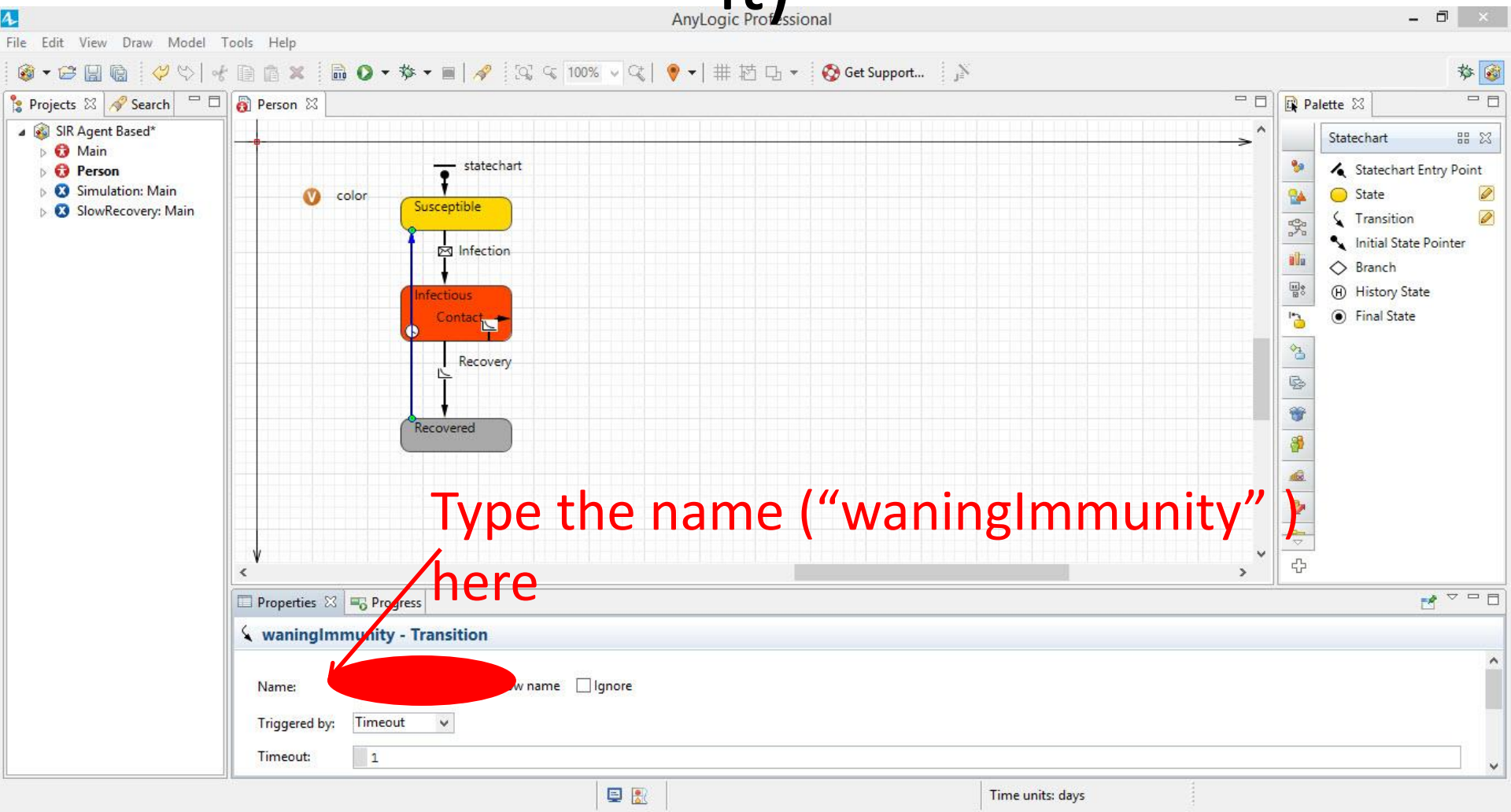
To add a transition to the statechart

Drag from “Transition” on the Palette to the “Recovered” state

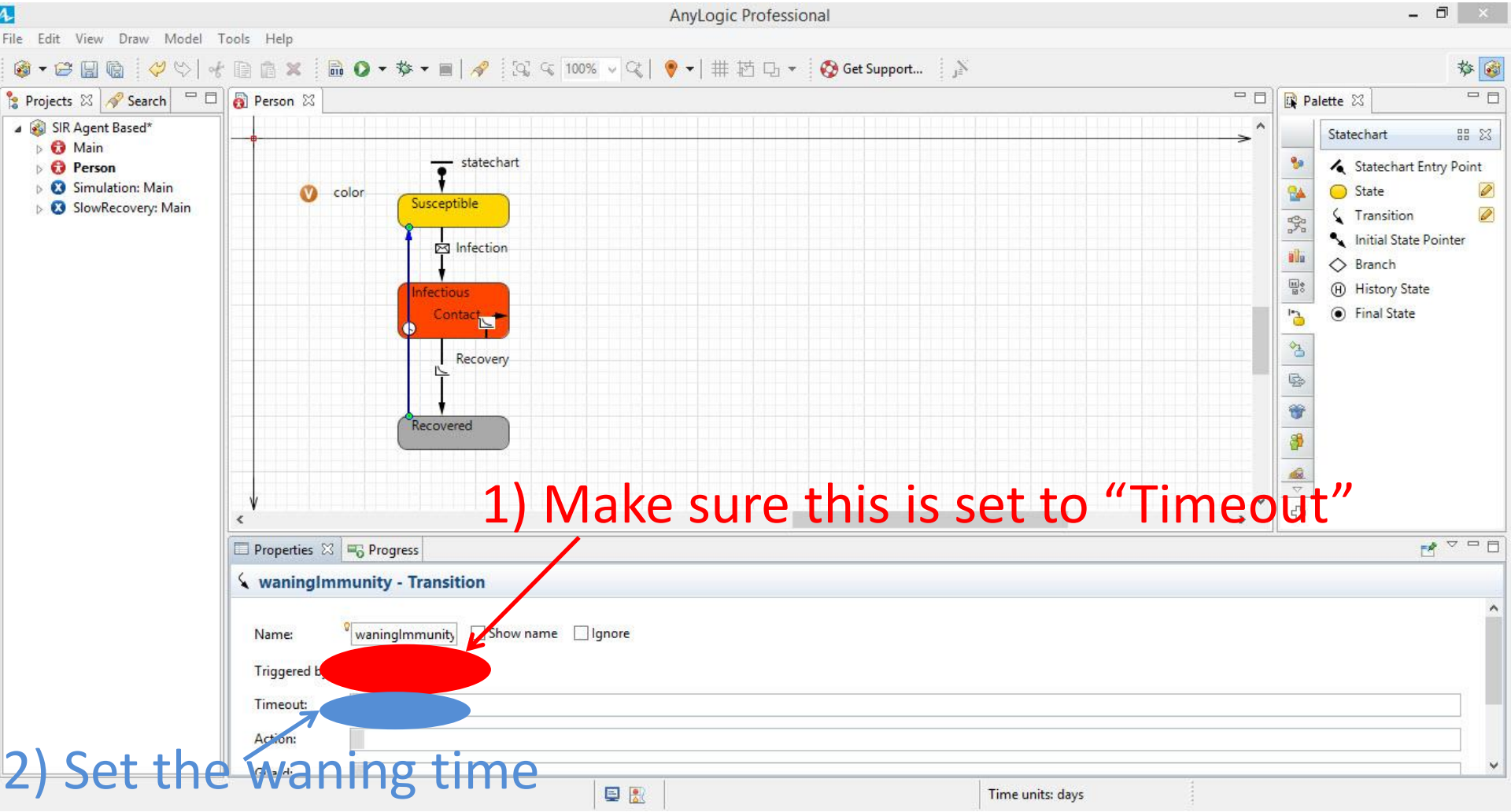
Connecting the Two States



Give the Transition a Name (Make sure it is selected by clicking on it)



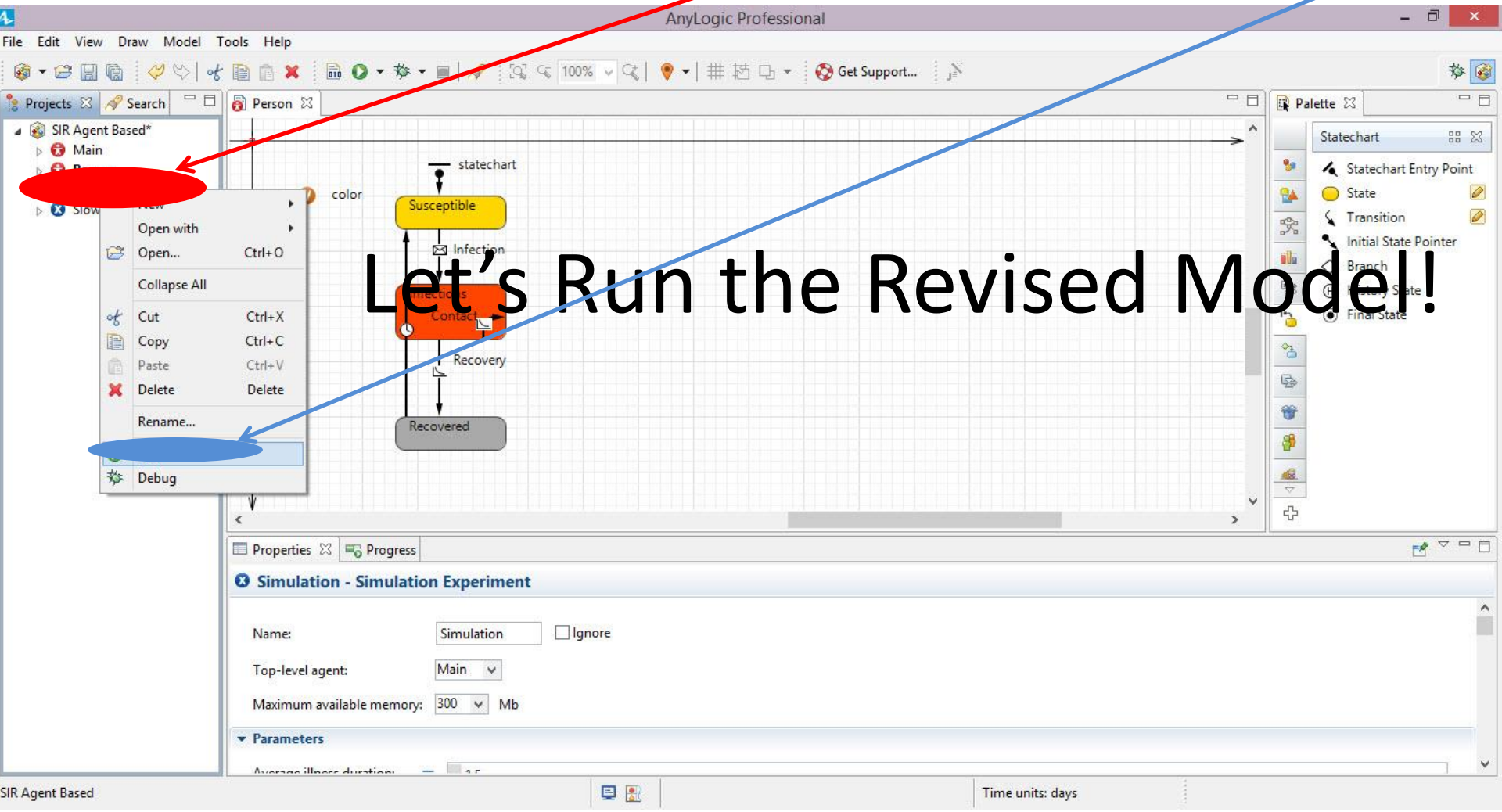
Setting the Duration Until Immunity Wanes



2) Set the waning time To 100

What do You Expect to See?

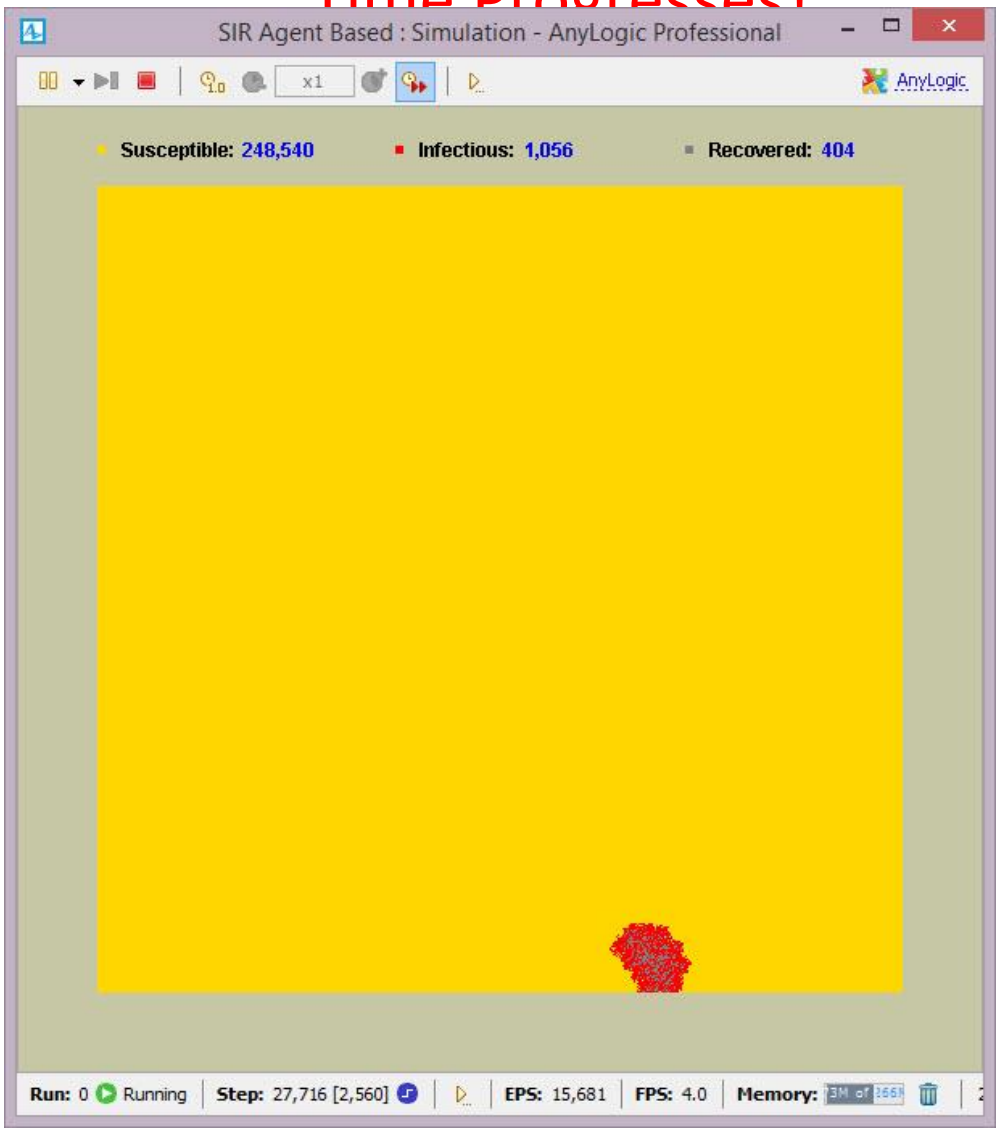
Run the original experiment ("Simulation") with the newly changed model by right clicking on "Simulation" & selecting **Run**



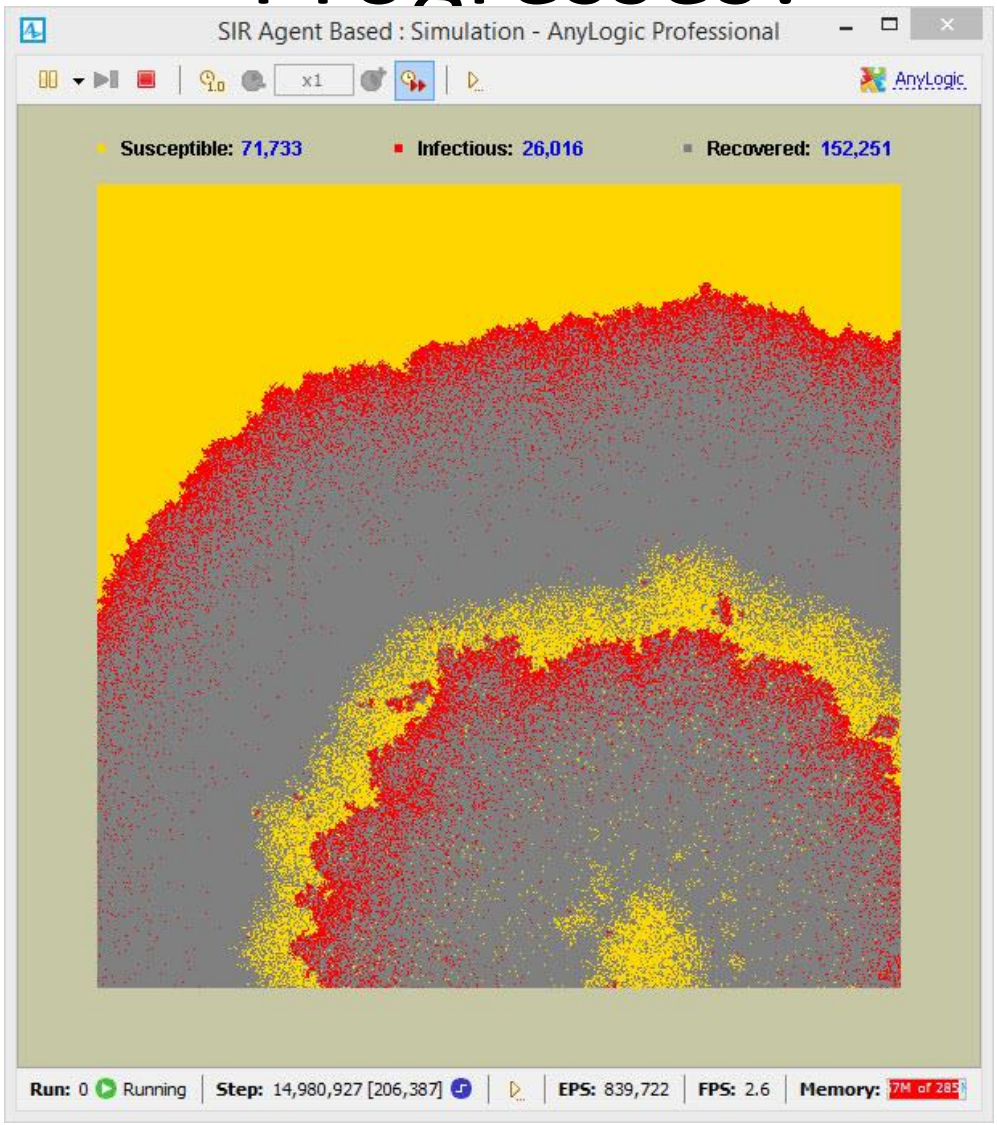
Let's Run the Revised Model!

After Starting the Model, You Should See Something Like This.

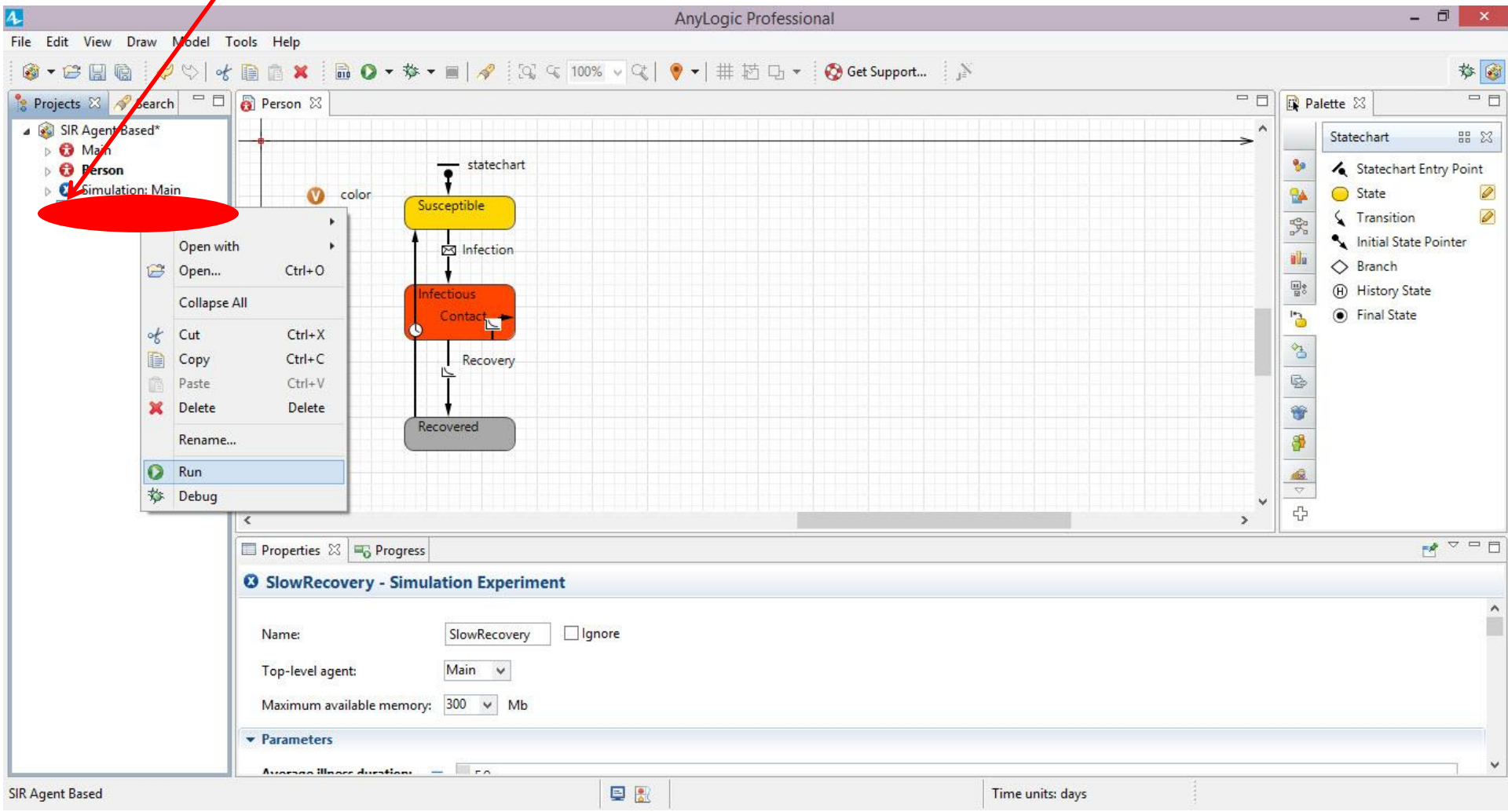
What Happens as Time Progresses?



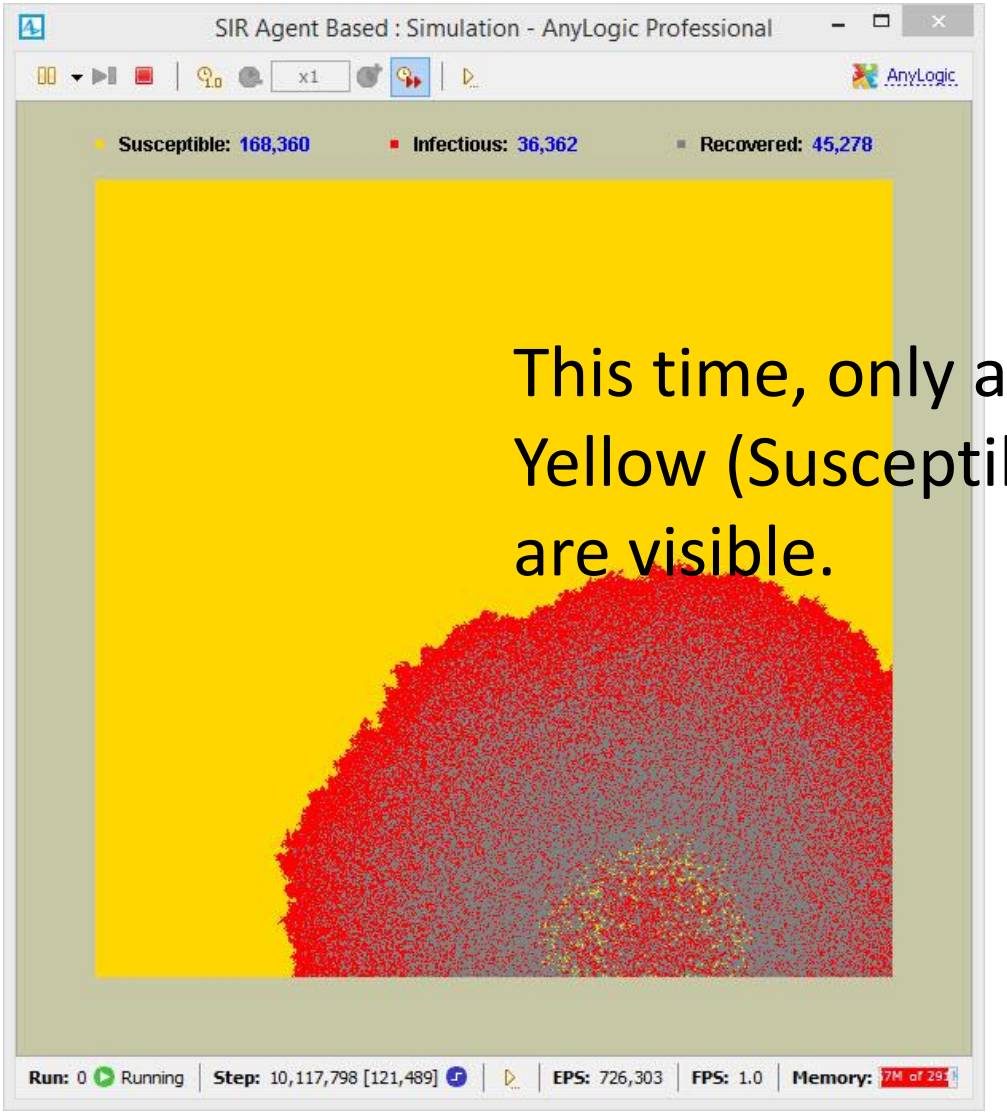
What Happens as Time Progresses?



Use the Run Button & run the “SlowRecovery” Experiment

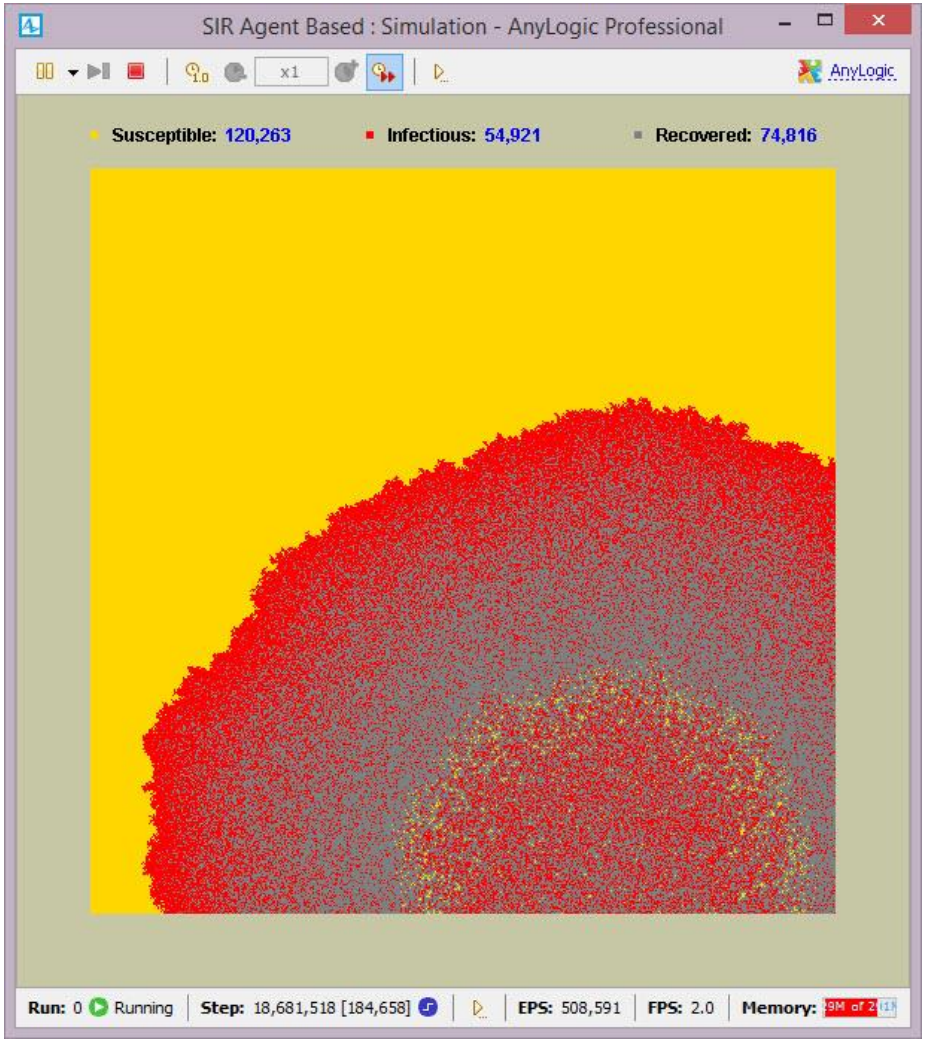


Slow Recovery Results



This time, only a few scattered Yellow (Susceptible) individuals are visible.

As Time Progresses, Little Internal Structure – Why?



Stylized Measurement 2

- How Long Does it Take for The Infection to Reach the Top or Left Boundaries?
- How does this compare with the earlier experiment with a shorter duration of immunity?
- Bonus question: What would an aggregate (random mixing) model have predicted?

Observations

- A brief & informal glimpse of AnyLogic's user interface for building, modifying & running models
- Take-Home Points
  - Much of a model can be described graphically
  - Running a structurally simple model can lead to complex *emergent* patterns over time & space
  - Modifying the model quantitative assumptions (described by parameters) can significantly change results
  - Modifying the model structure can qualitatively change model behavior

What do You Expect to See?