


## Adding Input/Output Objects to Vensim PLE Models

Once you are comfortable building flow chart models and viewing basic graphs and tables in Vensim PLE, you will probably want to start refining your models. An easy way to do this is to incorporate input-output objects in your build window using the

Input/Output Object Button .

On the input side of things, slider bars allow you to build an interface for interactively exploring your model. They allow you to quickly change variable and parameter values. Slider bars become active in *SyntheSim* mode, so you will be able to immediately view the effect of changes you make.

Regarding output, custom graphs that you build in the Control Panel  can be fixed to your window. This removes the hassle of cycling through multiple windows to find your output. These permanent graphs will also respond instantly to changes in the model when *SyntheSim* is on.

This lesson covers the following aspects of adding Input/Output Objects:

- Slider Bars for constant-valued auxiliary variables
- Slider Bars to set the initial value of box variables
- Making a switch out of a Slider
- Adding custom graphs/tables to the build window

The examples in this lesson will relate to the sample model of disease spread covered in the tutorial. The model is reproduced here for your convenience:

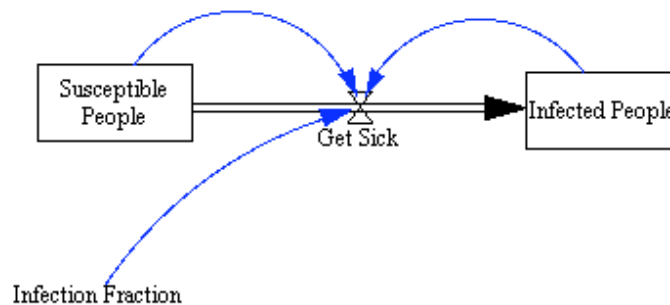



Figure 1: Flow-chart for the Spread of Disease

Set the parameters for the model in Figure 1 as follows:

- *Susceptible People* is initially 99
- *Infected People* is initially 1
- *Infection Fraction* = 0.0151
- $Get\ Sick = Susceptible\ People * Infected\ People * Infection\ Fraction$
- Model Settings: Initial Time = 1, Final Time = 10, TimeStep = 0.1, unit for time = days

## Slider Bars for Constant-Valued Auxiliary Variables

Consider the model in Figure 1. You have built the model, defined the input, run the model and examined the data. But suppose you want to try changing the infection fraction. By exploring the effect of this change, you hope to match your system with some real world data. This can easily be done by adding a slider bar.

**PROCEDURE:** Select the Input/Output Object button  from the toolbar. Click in the build window where you want to add the slider. A window like the one in Figure 2 will pop-up. Click on *Constant* and select the variable you wish to associate the slider with from the pop-up menu. Now enter the minimum, maximum, and increment value for the slider bar. Click *OK* to finish.

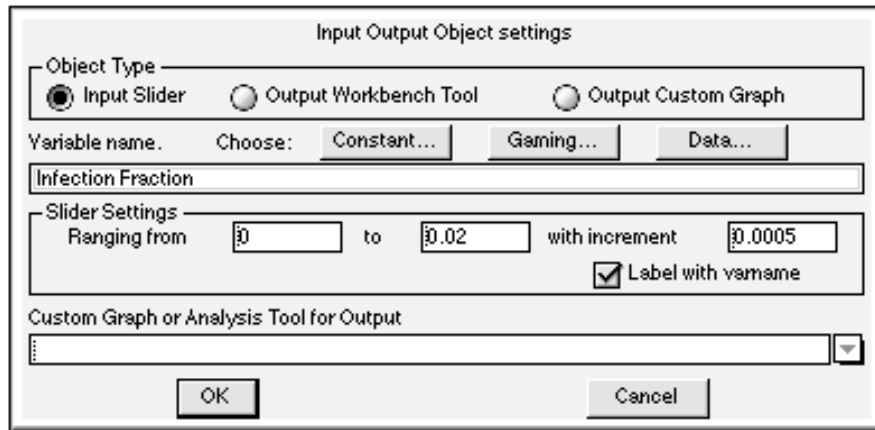
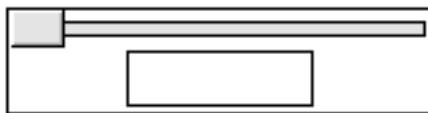


Figure 2: Input Output Object Settings Window

You should now see a new slider bar in your build window. The slider is currently inactive, and will remain so until *SyntheSim* mode is entered.




Infection Fraction

Inactive




Infection Fraction

Active (*SyntheSim*)

**PROCEDURE:** To operate a slider bar, click and drag the slider. The variable value will change by the increment you specified when creating the slider. You may also manually enter a value in the middle text box. Values entered this way may exceed the normal range for the slider. Settings for a slider can be changed later by clicking on that slider while the Input/Output Object button  is selected.

### Slider Bars to Set the Initial Value of a Box Variable

In addition to controlling the Infection Fraction, it would be nice to be able to vary the initial value of Susceptible People. Since Vensim PLE likes to associate sliders with constant auxiliary variables, you have to 'trick' it a little bit. Create an auxiliary variable to store the initial value for the box variable, set the box variable's initial value equal to that auxiliary, and create a slider to control the auxiliary variable.

**PROCEDURE:** First, add a new auxiliary variable and name it *Initial Value of Susceptible People*. Add a connector from this auxiliary variable to *Susceptible People*. Next, open the equations window of *Susceptible People*. (Click on the box variable while the equations button  is selected). Set its initial value equal to *Initial Value of Susceptible People*. Now open the equations window for *Initial Value of Susceptible People* and specify a value. Click *OK*. Now create a slider for your auxiliary variable as described in the previous section.

Although slightly indirect, this method offers great interactive control of the initial values of box variables.

### Making Switches Out of Sliders

Another creative use of sliders involves restricting them to a value of either 0 or 1, effectively turning them into On/Off switches. Sliders implemented this way can be particularly effective at turning rates on and off. Turn a slider into a switch by simply setting its range from 0 to 1 with increment 1.

Suppose you wanted to be able to turn the rate *Get Sick* on and off in your model (This would probably make more sense in a model with multiple rates, but it works for an example). Follow the procedure below to create a switch as seen in Figure 3. As abbreviations, let  $k$  = *Infection Fraction*,  $S$  = *Susceptible People*,  $I$  = *Infected People* and  $o$  = *Get Sick On/Off*.

**PROCEDURE:** Add an auxiliary variable to your model called *Get Sick On/Off*. Set the value of *Get Sick On/Off*. Connect this new auxiliary variable to the rate *Get Sick*. Change the formula for *Get Sick* to  $GS = S * I * k * o$  where  $o$  represents the value of *Get Sick On/Off*. Add a slider associated with *Get Sick On/Off*. Let the slider range from 0 to 1 with increment 1. In this example, 1 means on and 0 indicates Off for *Get Sick On/Off*.


When *Get Sick On/Off* = 0, the formula for *Get Sick* evaluates to 0:

$$GS = S * I * k * 0 = 0.$$

When *Get Sick On/Off* = 1, the formula for *Get Sick* is normal:

$$GS = S * I * k * 1 = S * I * k.$$

In this fashion, you can easily turn certain rates on and off without having to deconstruct your model. The implementation may seem a bit cumbersome at first, but the payoff can be well worth the effort.

**NOTICE:** When using switches, only use the slider added with the Input/Output Object button . The slider on the flow-chart that appears when *SyntheSim* is activated is not as easily restricted to 0 and 1. Use only the permanent slider to avoid confusion.

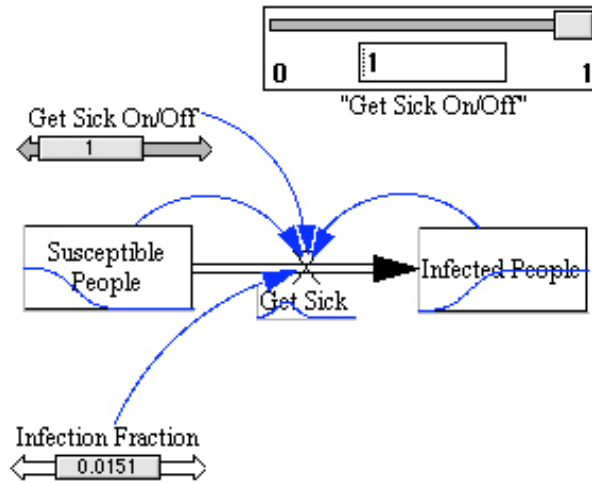


Figure 3: Implementation of a Switch

### Adding Custom Graphs and Tables to the Build Window

Adding custom graphs and tables to the build window is pretty simple. Create the custom graph or table using the control panel, then follow these steps:

**PROCEDURE:** Select the Input/Output Object button and click in the build window where you want to add the graph. Set the object type to *Output Custom Graph*. Bring up a list of the custom graphs and tables available by clicking on the arrow at the right of the lower text box. Then select the graph you wish to add and click *OK*.

The procedure for adding custom tables is analogous.

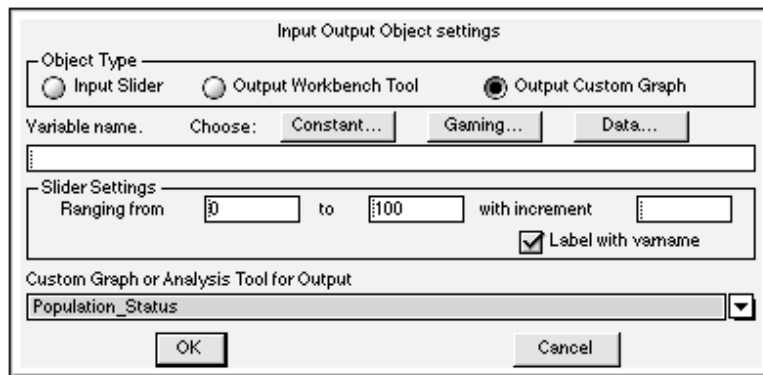


Figure 4: Adding a Permanent Graph