



# Feedback Rich Model Construction with Powersim Studio

International Conference of the System Dynamics Society

20 July 2017

Cambridge, MA

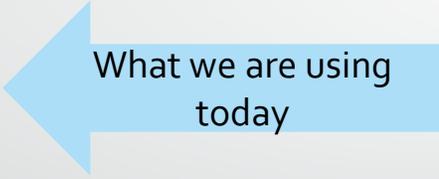
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# Powersim Studio: [www.powersim.com](http://www.powersim.com)

- Studio is a system dynamics modeling software from Powersim AS in Norway
- Studio 10 is the current version, initial versions began in 1988 (SimTek)
- Versions: [Modeling tools](#) | [Developer Suite](#) | [End-user tools](#) | [Academic tools](#)
  - Premium
  - Expert
  - Professional
  - Academic
  - Cockpit (free)
  - Express (free)
  - SDK and workstation for internet deployment
- Powersim AS has partnered with Forio and MAS consulting to provide easy to use PC to Web application generators



What we are using today



Plus a fully featured 30 day demonstration version.

# Studio features\*

Topic	Description	Pro	Exp	Pre
<b>Modeling</b> 	Stock-and-flow modeling, multiple diagrams for organizing your model	X	X	X
	Drag-and-drop variables into input/output objects to create user interfaces	X	X	X
	Automatic unit control, adding quality to your model	X	X	X
	Series Variables	X	X	X
	Function library with over 200 functions, e.g. delay and array functions	X	X	X
	Custom Functions		X	X
	Team collaboration			X

Topic	Description	Pro	Exp	Pre
<b>Features</b> 	Distribution to Studio Executive, Studio Cockpit and Studio Simulation Engine			X
	Number of elements for <u>Dynamic Ranges</u>	100	100	∞
	Risk Analysis, Optimization & Risk Management		X	X
	Password-protected models		X	X
	Monitor Performance			X
	Placeholders	X	X	X

\* We will look at the highlighted items with Studio.  
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Topic	Description	Pro	Exp	Pre
<b>Presentations</b> 	Distribution to Studio Executive, Studio Cockpit and Studio Simulation Engine			X
	Action buttons execute a set of actions, constituting a way to add user interface logic to simulations	X	X	X
	Save reference runs for comparison with your base scenario	X	X	X
	Provide texts for modeling constructs and user interface elements in multiple languages, achieving a multi-lingual model/simulation	X	X	X

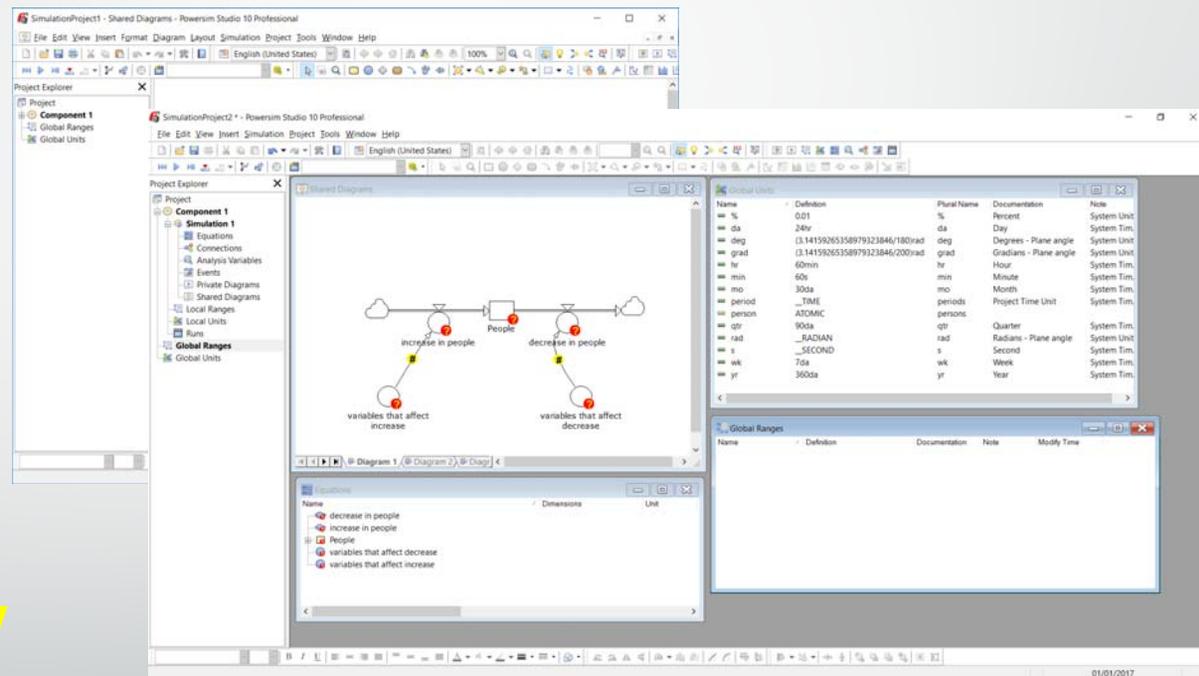
Topic	Description	Pro	Exp	Pre
<b>Connectivity</b> 	Connect to relational databases through Database Datasets			X
	Placeholders for datasets and data functions <sup>1</sup>	X	X	X
	Connect to Microsoft Excel spreadsheets through datasets, functions or drag-and-drop	X	X	X
	Connect to file databases through database functions <sup>2</sup>	X	X	X
	Connect to server databases through database functions <sup>3</sup>			X
	Connect to external data sources using scripts in Sidekick windows and Show Dialog actions	X	X	X

Topic	Description	Pro	Exp	Pre
<b>Technical features</b> 	Amount of memory allowed for variable values in bytes <sup>4</sup>	8M	2G	192G
	Elements allowed per array variable (in up to 6 dimensions) in millions <sup>5</sup>	0.01	0.5	10
	Maximum number of cores used in multi-core processing when running simulations	2	3	8
	Enable Active Content (VBFUNCTION, etc)		X	X

# Studio workspace and interactive development environment

- Windows compliant
- Customizable
- Multiple window enabled

Let's  
take a  
look



# First, let's build a model

- Population growth
  - INITIAL POPULATION = 1000 persons
  - Population = Integral of GROWTH RATE , initial value is INITIAL POPULATION
  - GROWTH RATE = 1.1 %/yr
  - Increasing population = INITIAL POPULATION \* GROWTH RATE
- How would one start such a model in Studio?
  - Use the blank workspace
  - Use the model building Wizard

SimulationProject1 - Shared Diagrams - Powersim Studio 10 Professional

File Edit View Insert Format Diagram Layout Simulation Project Tools Window Help

English (United States) 100%

Project Explorer

- Project
  - Component 1
    - Global Ranges
    - Global Units

**New Project Wizard**

**Welcome to the New Project Wizard**

This wizard will guide you through the fundamental steps of creating a new Powersim Studio project.

Press Next to continue to the next step.  
Press Finish to create your new project with current settings.  
Press Help to activate the context sensitive help window.

If you check the option below, this wizard will not appear the next time you use the 'New' command in the toolbar. You can turn the wizard on again in the Options dialog.

When you select 'New...' from the File menu or 'New project wizard' from the Task Assistant, this wizard will always appear, and the option will be disabled.

Don't show this wizard next time

< Back Next > Finish Cancel Help

Diagram 1 Diagram 2 Diagram 3

Creates a new simulation project with the New Project Wizard

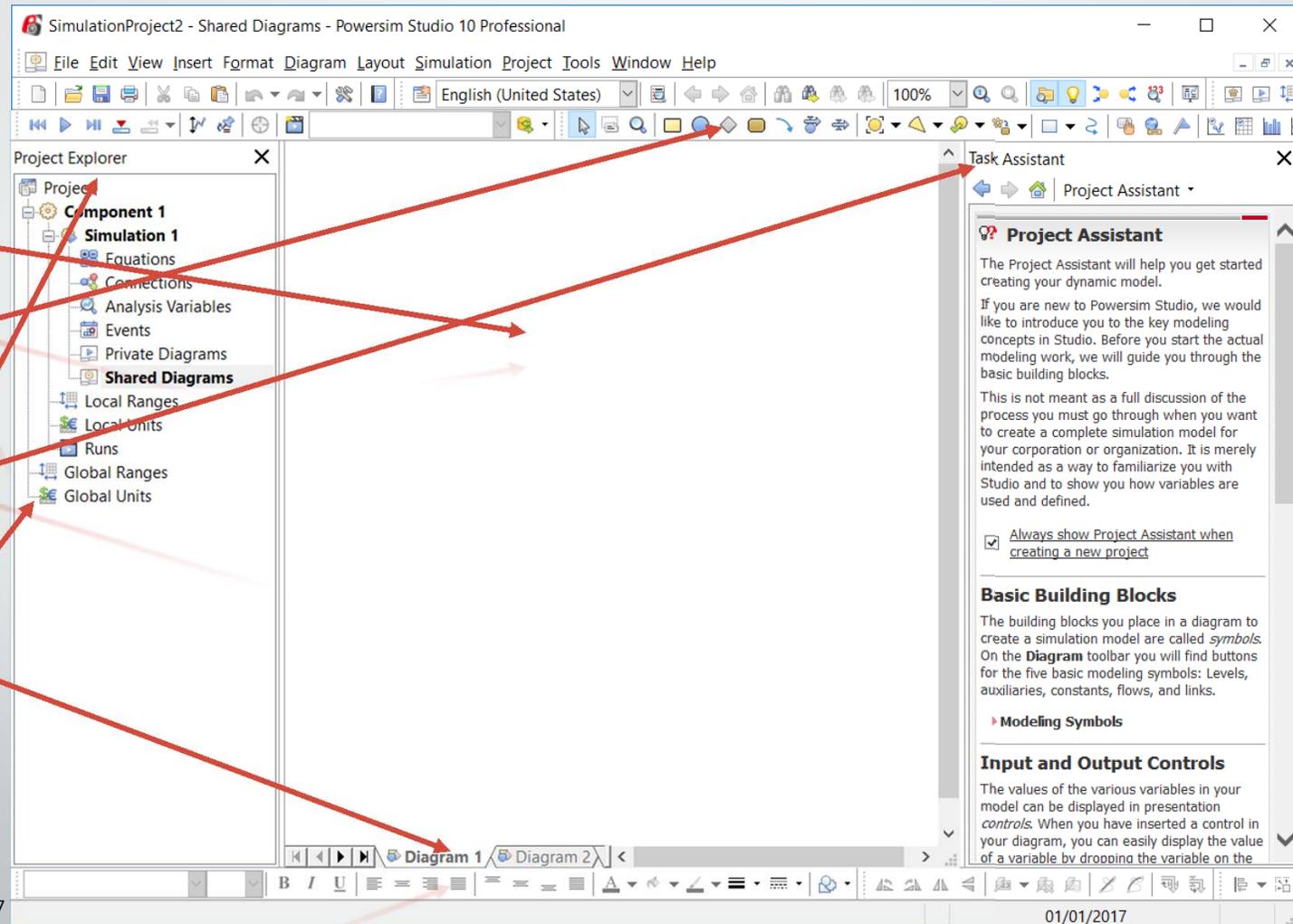
01/01/2017

# What does the Wizard help with?

- Wizard screens
  - Language – English, Spanish, French, etc.
  - Compatibility – older versions of Studio
  - Time Unit Consistency – a must
  - Calendar and Time Interval – specific to problem
  - Series variables
  - Time range of the simulation
- Other more detailed settings are under:
  - Simulation Settings
  - Project Settings

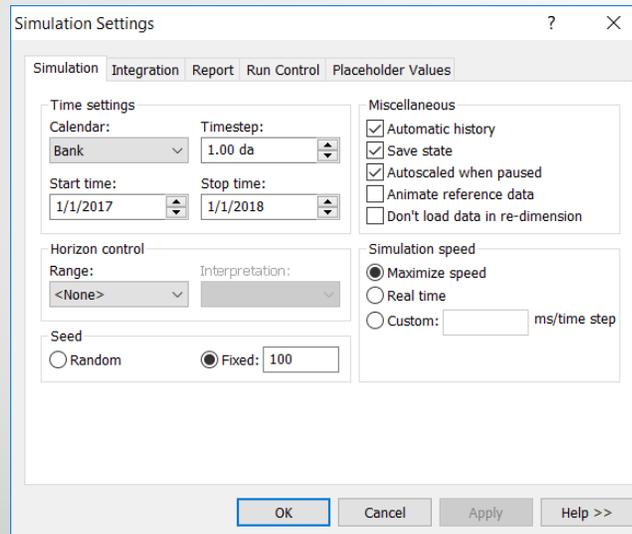
# After the Wizard

- Model worksheet
- Modeling Tools
- Project Explorer
- Task Assistant
- Global Settings
- Model Tabs



# Detailed settings

- Time
- Integration
- Reporting
- Run control
- Placeholders

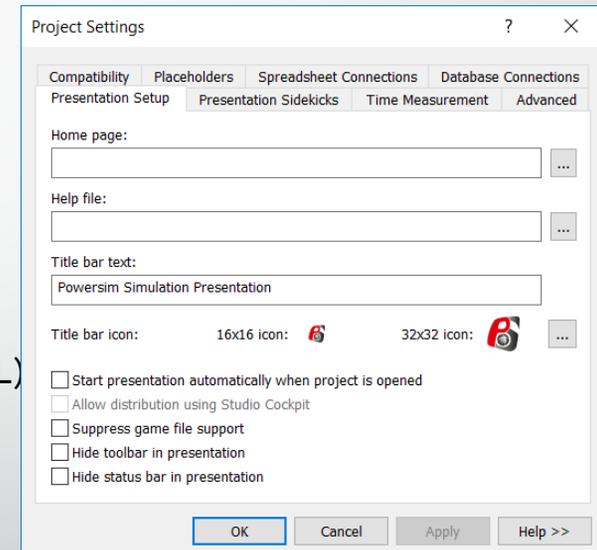


The Simulation Settings dialog box is divided into several tabs: Simulation, Integration, Report, Run Control, and Placeholder Values. The Simulation tab is active. It contains the following sections:

- Time settings:** Calendar (Bank), Timestep (1.00 da), Start time (1/1/2017), Stop time (1/1/2018).
- Horizon control:** Range (<None>), Interpretation (dropdown).
- Seed:** Random (unselected), Fixed (100).
- Miscellaneous:**  Automatic history,  Save state,  Autoscaled when paused,  Animate reference data,  Don't load data in re-dimension.
- Simulation speed:**  Maximize speed,  Real time,  Custom (ms/time step).

Buttons at the bottom: OK, Cancel, Apply, Help >>

- Compatibility
- Placeholders
- Spreadsheet
- Database
- Presentations
- Sidekicks (HTML)
- Time
- Advanced



The Project Settings dialog box has tabs for Compatibility, Placeholders, Spreadsheet Connections, and Database Connections. The Compatibility tab is active. It contains the following sections:

- Presentation Setup:** Home page (text field), Help file (text field).
- Title bar text:** Powersim Simulation Presentation (text field).
- Title bar icon:** 16x16 icon (red icon), 32x32 icon (red icon).
- Options:**  Start presentation automatically when project is opened,  Allow distribution using Studio Cockpit,  Suppress game file support,  Hide toolbar in presentation,  Hide status bar in presentation.

Buttons at the bottom: OK, Cancel, Apply, Help >>

# Commonly used features

The screenshot shows the Powersim Studio 10 Professional interface. The Project Explorer on the left lists the project structure: Project, Component 1, Simulation 1, Equations, Connections, Analysis Variables, Events, Private Diagrams, Shared Diagrams, Local Ranges, Local Units, Runs, Global Ranges, and Global Units. The main workspace shows a diagram with various modeling symbols. The Task Assistant on the right provides guidance for new users, including sections for Basic Building Blocks and Input and Output Controls. Red arrows point from the list of features to specific elements in the interface: Simulation objects (to the main workspace), Interface tools (to the top toolbar), Run controls (to the top toolbar), Dimension management (to the Global Ranges folder), and Unit management (to the Global Units folder).

- Simulation objects
- Interface tools
- Run controls
- Dimension management
- Unit management

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# Variable definition

- Feature rich definition

- Define
  - Functions
- Document
- Scale
- Design
- Advanced

Stock Variable Properties

Definition Documentation Advanced Scale Value Line Fill Symbol

Type:  Unit:   
Real person  Start-up

Dimensions:  Series type: None

Definition

100<<persons>>

= 100 persons

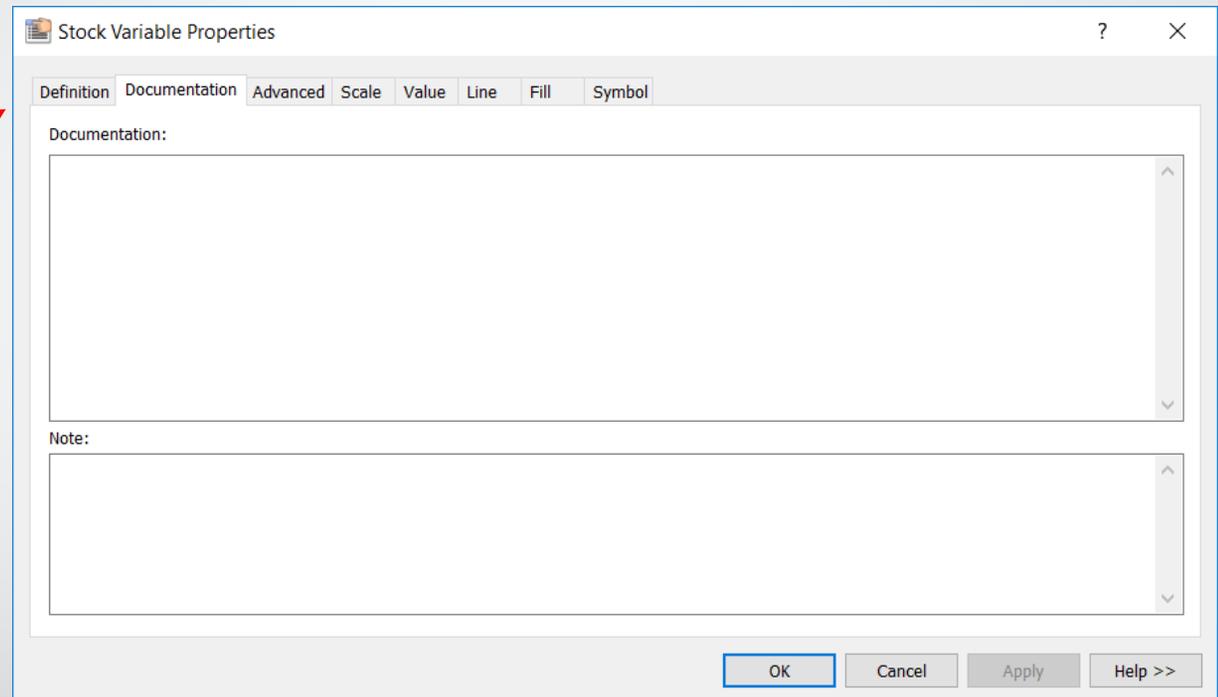
1 Linked variables  
 2 All variables  
 3 Ranges  
 4 Units  
 5 Functions

OK Cancel Apply Help >>

# Variable definition

- Feature rich definition

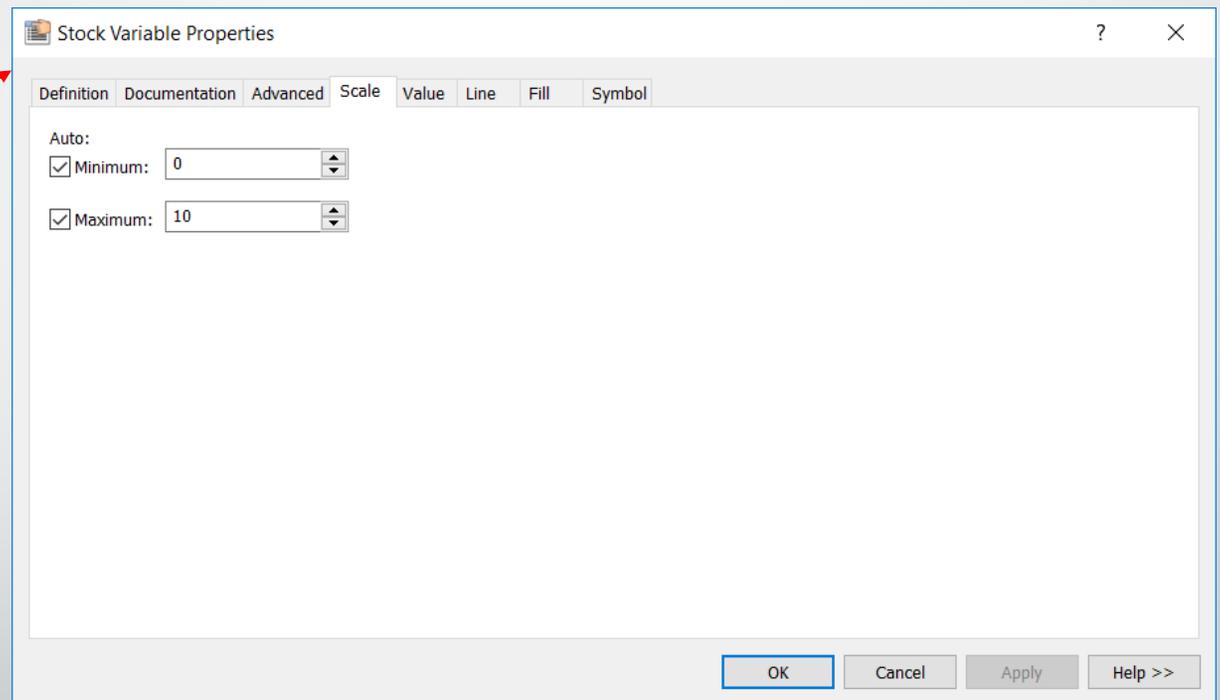
- Define
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# Variable definition

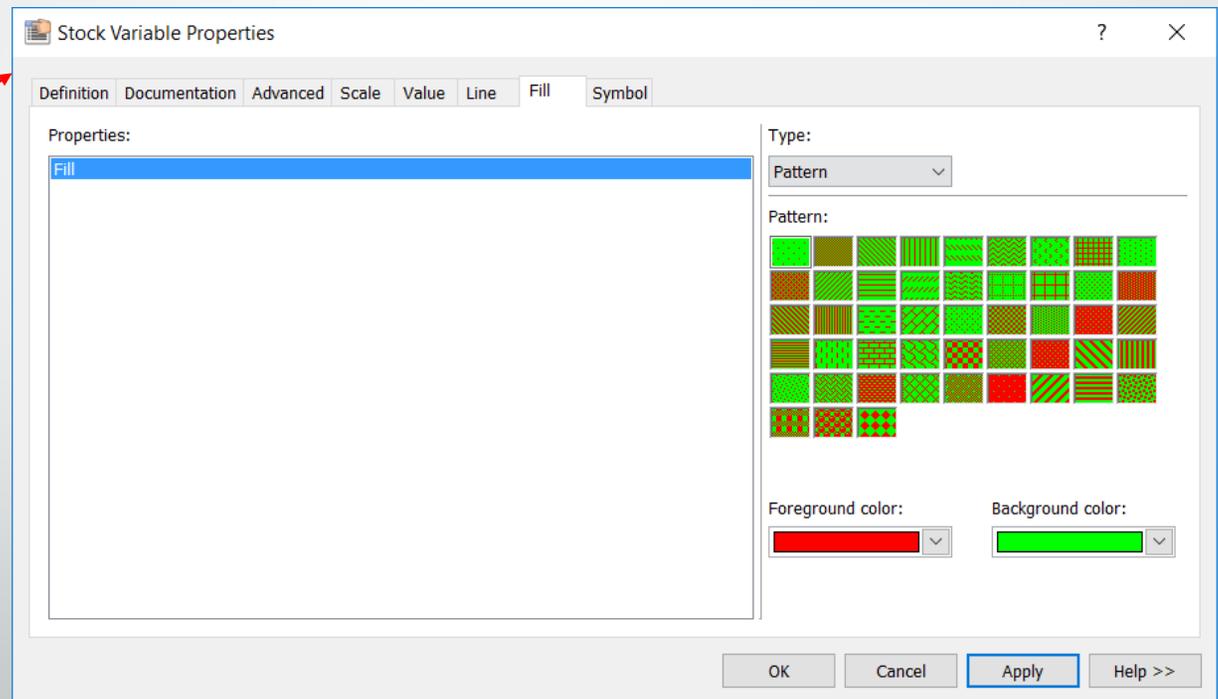
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# Variable definition

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# Variable definition

- Feature rich definition
  - Define
    - Functions
  - Document
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  - Advanced →

Stock Variable Properties

Definition Documentation **Advanced** Scale Value Line Fill Symbol

**Characteristics**  
Variable type: **Level**  
 Permanent (Keep value between simulations.)  
 Reservoir (Cannot be depleted below zero.)

**Integration order of controlled flows**  
 Use order from Simulation Setting  
 First order  
 Zero order  
 Zero order immediate  
Settings are only available for

**Connection**  
Transfer: **none**  
 Keep definition in component copy

**Monitored flows**  
 Continuous inflows  
 Continuous outflows  
 Zero order inflows  
 Zero order outflows  
 Zero order immediate inflow:  
 Zero order immediate outflow:

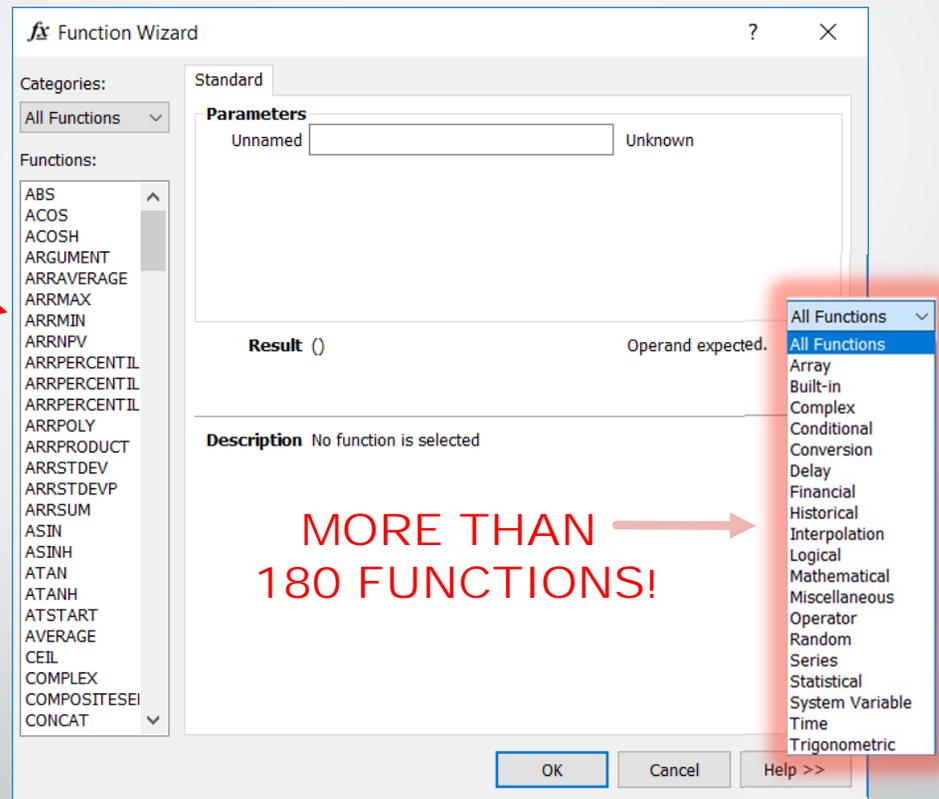
**Creation and last modification**  
Created: 6/26/2017 2:39:06 PM  
Modified: 6/26/2017 2:39:40 PM

OK Cancel **Apply** Help >>

# Variable definition

- Feature rich definition

- Define
  - Functions
- Document
- Scale
- Design
- Advanced



# Context sensitive Help

supply price schedule Variable Properties

Definition Documentation Advanced Scale Value Line Fill Symbol

Type: Real Unit: shirt

Dimensions:

Definition

GRAPH (Price, 0<<USD/shirt>>, 5<<USD/shirt>>, {0, 0, 40, 57, 68, 77, 8

PRICE CHANGE DELAY

Help

## GRAPH - Linear Graph with Horizontal Asymptotes

Syntax

GRAPH (X, X1, DX, Y(N) )

Description

The GRAPH function returns tabulated values (referred to as grid points or fixed points) for given input values. If the input value does not correspond to any of the tabulated values, GRAPH computes a value based on interpolation and/or extrapolation.

X is the input value that you want GRAPH to find a matching output value for. X1 is the first point of the graph, and DX is the increment between the fix points of the curve. Y is an array containing N fix points.

If X lies between the fix points of the tabulated graph, the output value of GRAPH is computed by linear interpolation. An imaginary line is drawn between the two fix points enclosing the input value, and the value of the function is found where the input value crosses this line.

If X is less than X or larger than  $X1+(N-1)*DX$  (thus lying beyond the range of the fix points given), the output value is computed by horizontal extrapolation. GRAPH uses horizontal asymptotes, where the value at the first and last fix point is continued along a horizontal line at each end of the graph.

The behavior of the GRAPH function is shown below.

The behavior of the GRAPH function (for equations, [see example](#)).

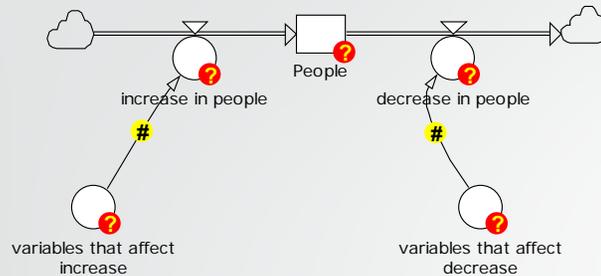
Parameters

X	
Description	The input value for which a output value is to be found or computed
Value	Any value
Unit	Any unit

1. Select Help
2. Click on Function (in blue)
3. See Help

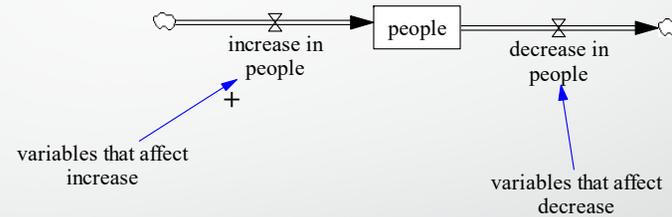
# Build stage: 3 tools - design

This is what you would see building a model by just placing objects on the screen. Studio has only one definition window => immediate feedback!

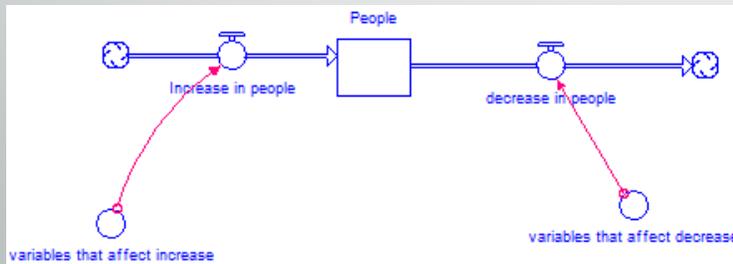


← Powersim Studio

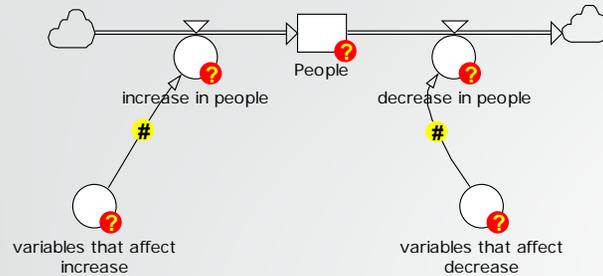
Ventana Vensim →



← ISEE Systems iThink – Map



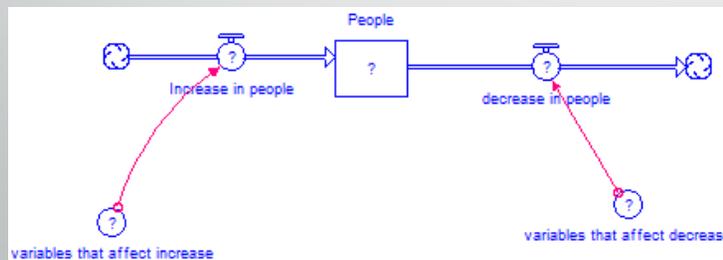
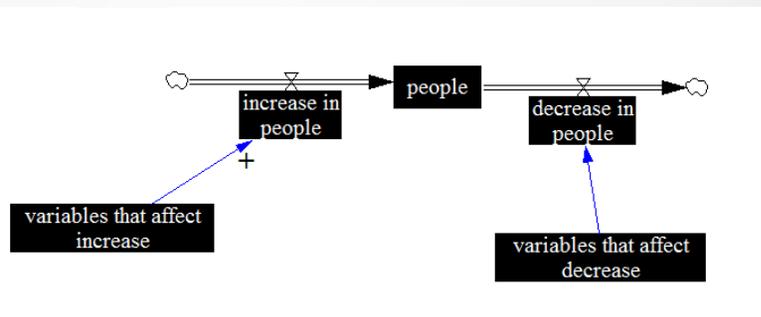
# Definition stage: 3 tools - definition



Ventana Vensim



← Powersim Studio



← iSee Systems iThink – Model view

Our recommendation: define as you go, take advantage of all the power of Studio

# Conclusion

- Powersim Studio
  - Most powerful tool on the market – Why?
    - Unit handling
    - Model size
    - Array handling
    - Collaboration
    - Ease of use: excellent context sensitive help
    - Functionality
    - Custom functions: internal (VBScript) and external (C++)

Thank You  
[www.mindseyecomputing.com](http://www.mindseyecomputing.com)

# Further Information



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