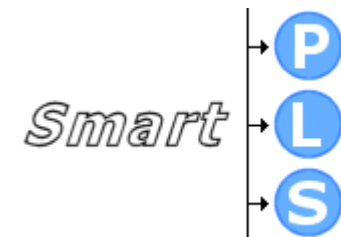




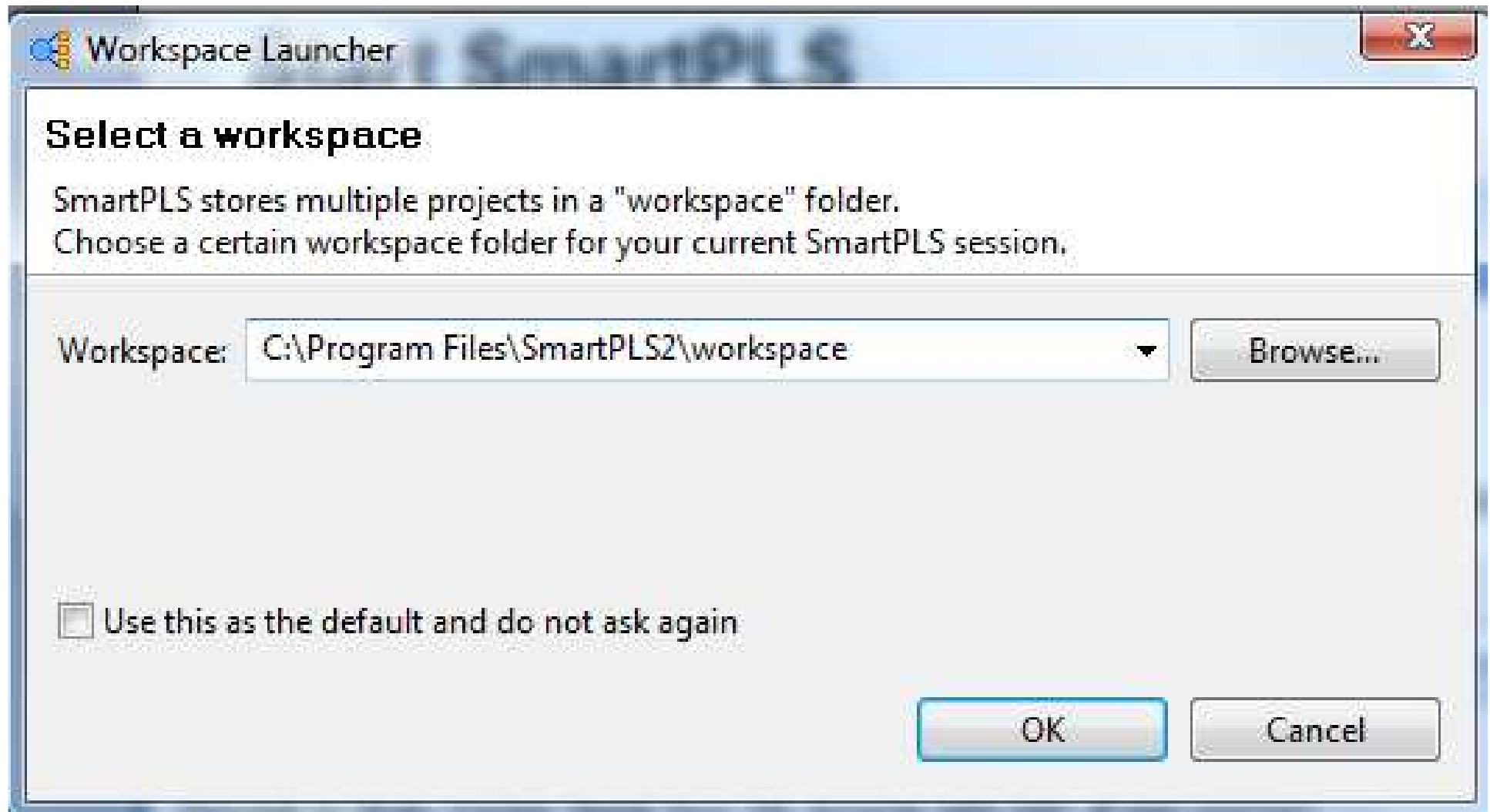
# Basic Path Modeling with SmartPLS

(register and obtain free SmartPLS software at <http://www.smartpls.de>)

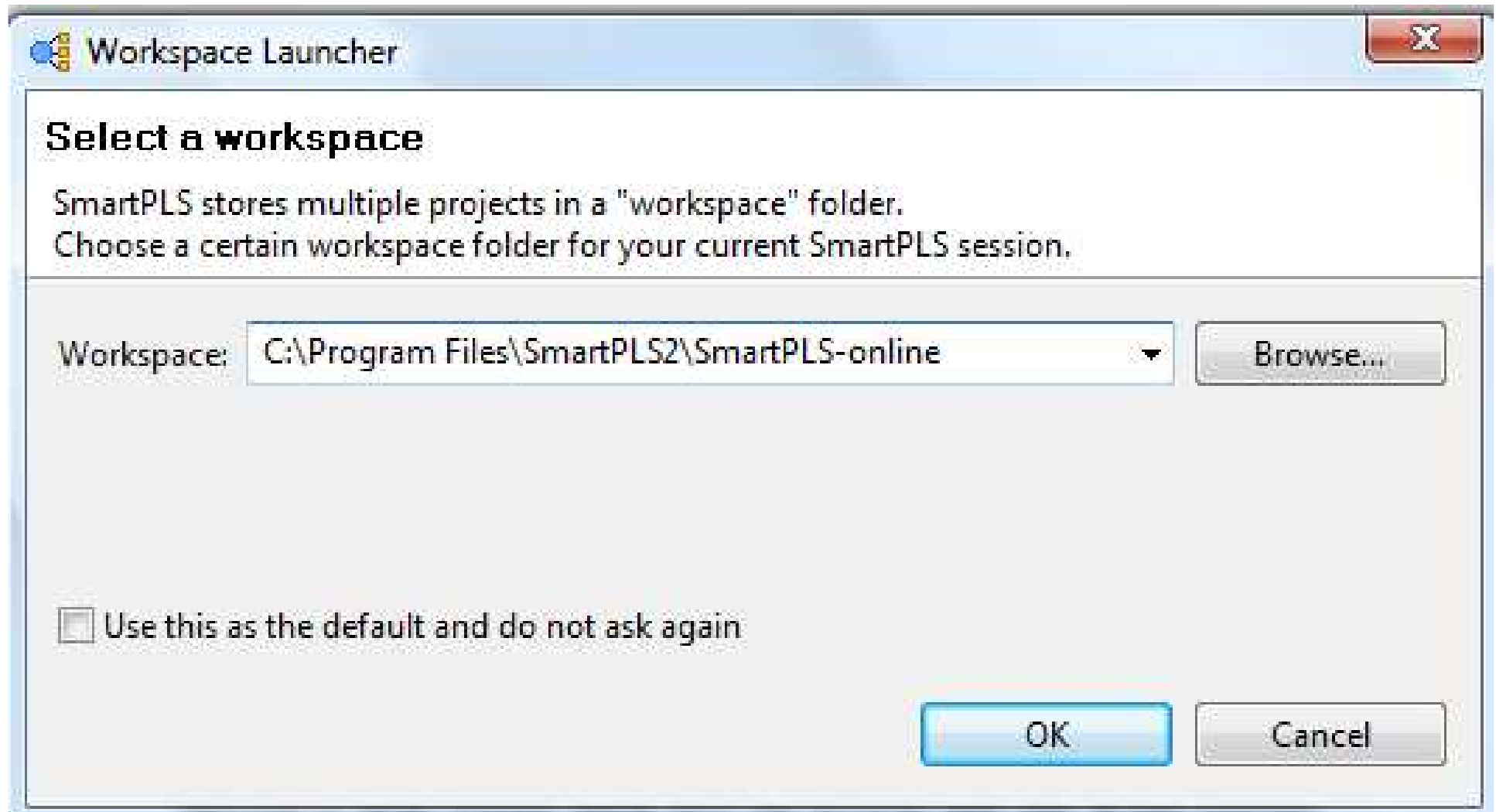
More information about SEM seminars at <http://www.PLS-SEMinars.com>



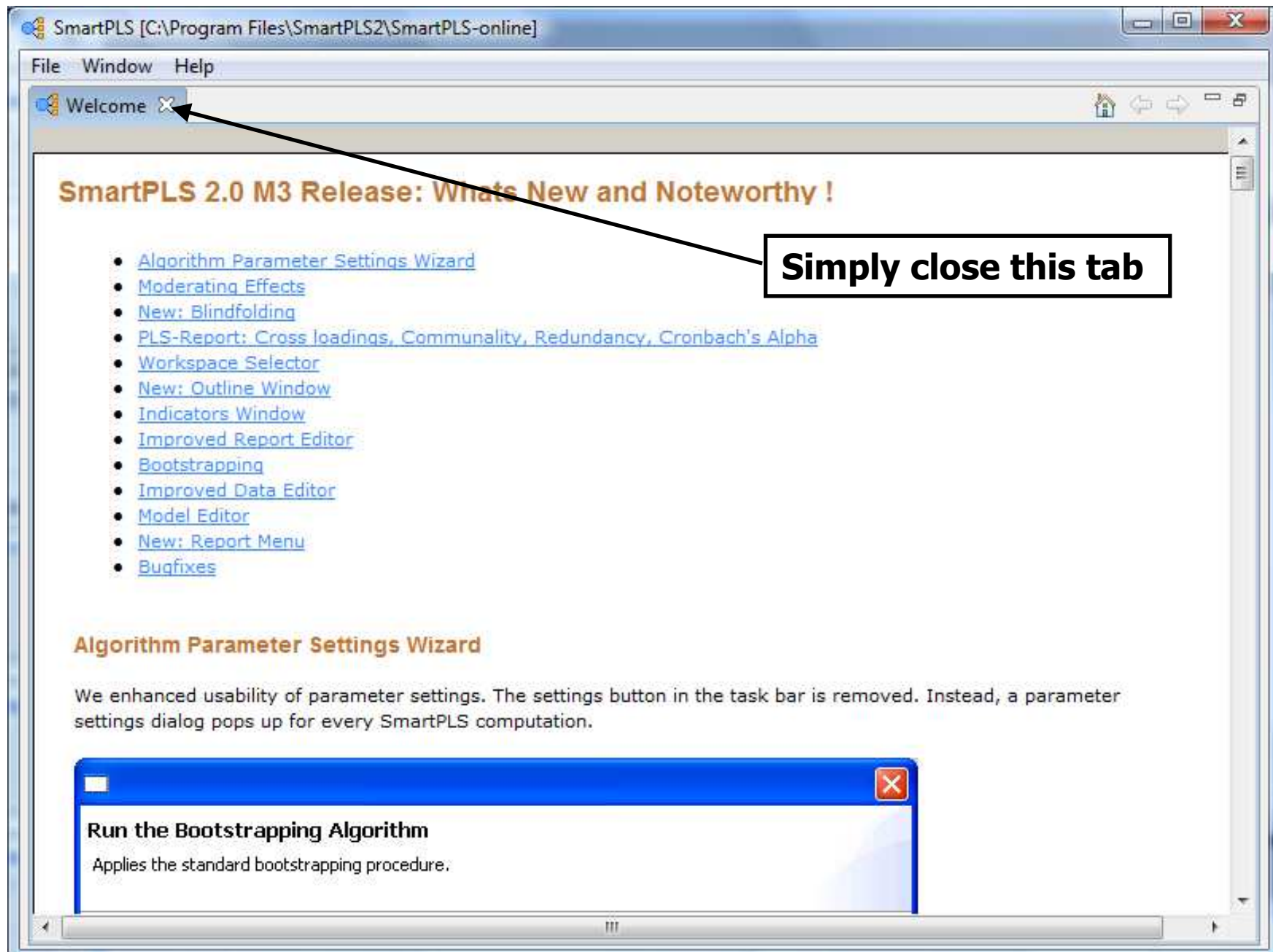
# Start SmartPLS



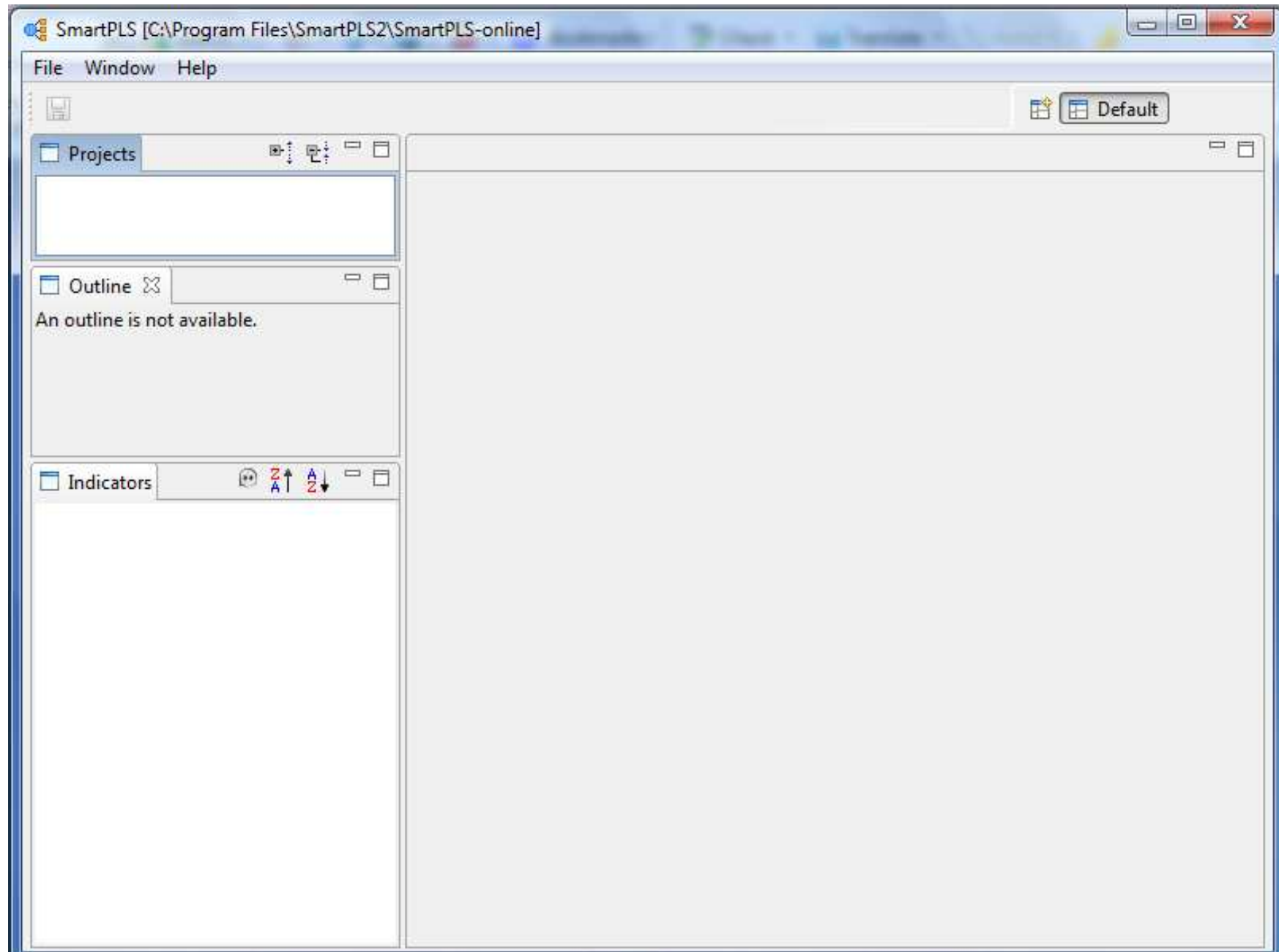
# Start SmartPLS



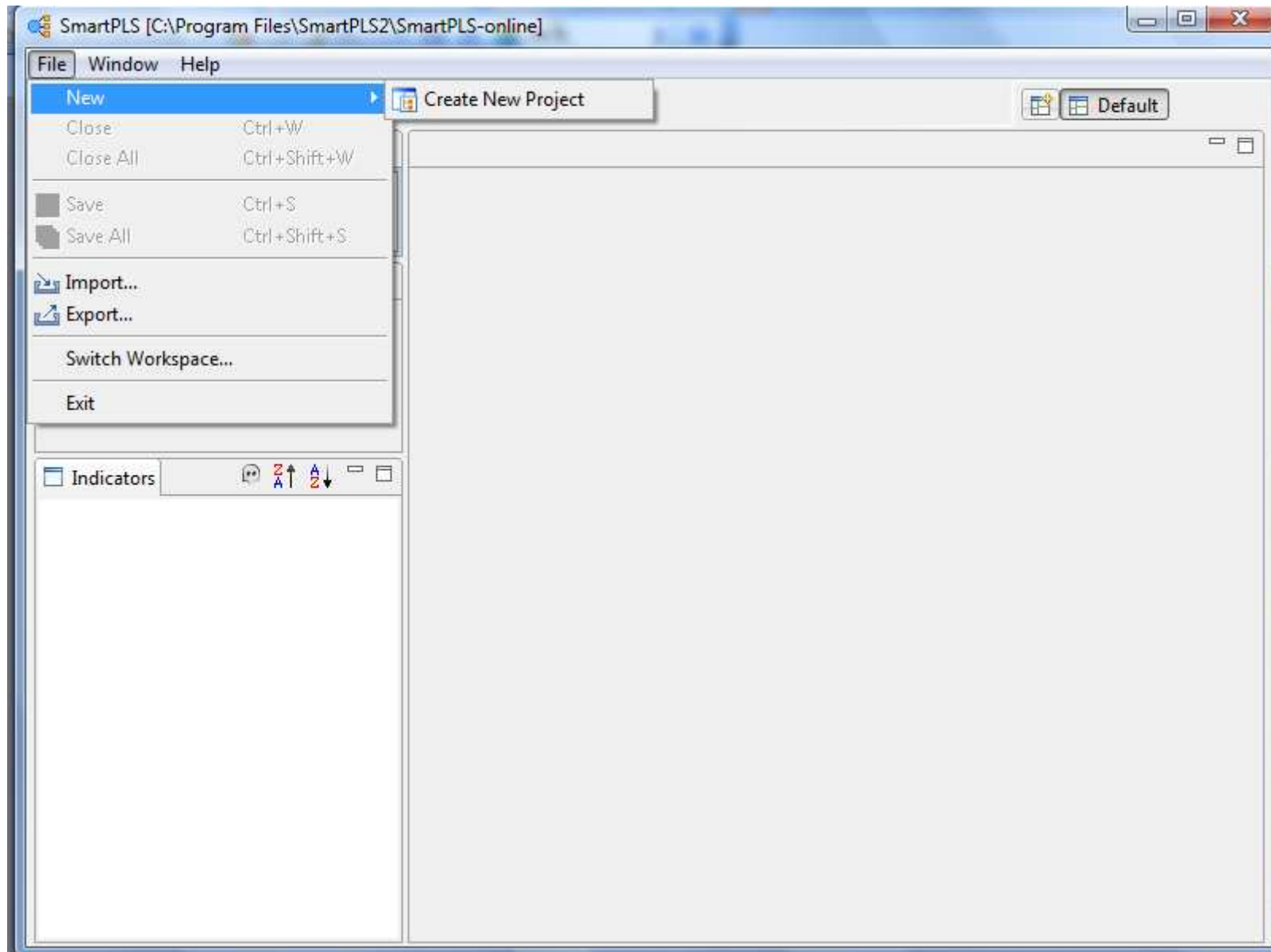
# Welcome Screen



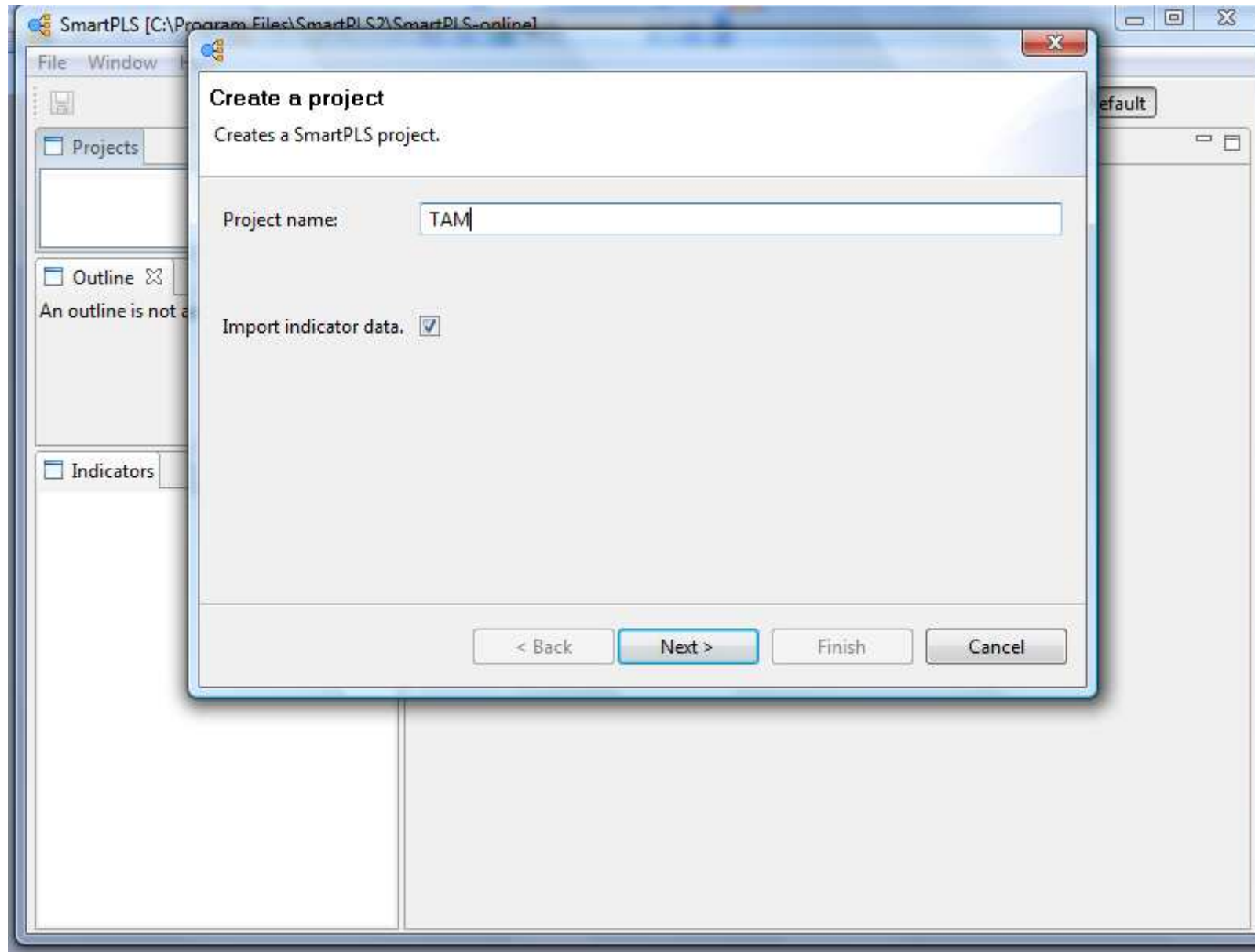
# Main Window



# Create New Project



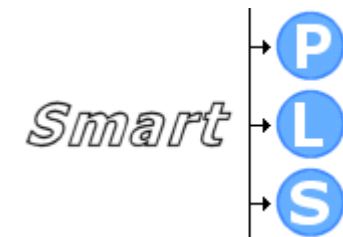
# Create TAM Project



# Technology Acceptance Model (TAM)

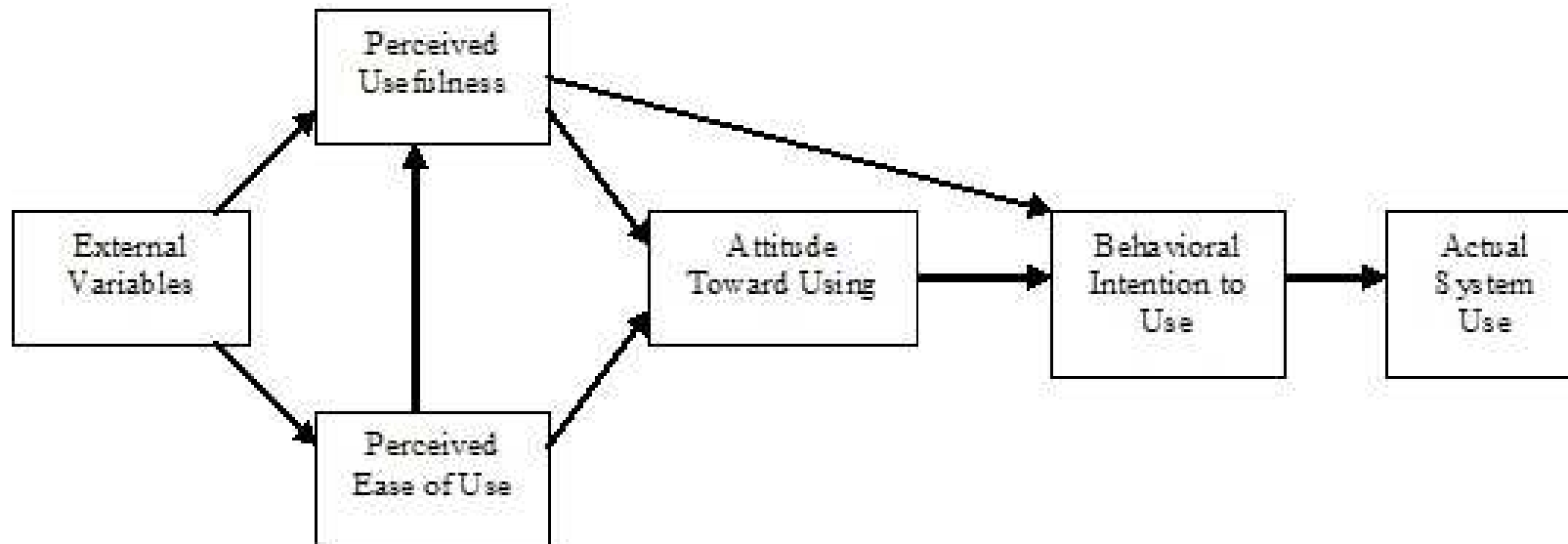


- Predicts Users':
  - Intentions to use technology
  - Intentions predict usage
- Belief Constructs and Attitudes
  - Perceived usefulness
  - Perceived ease of use
  - Attitude towards using





# Technology Acceptance Model (TAM) Looks Like

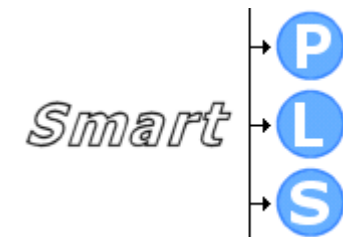


*Smart* P  
L  
S

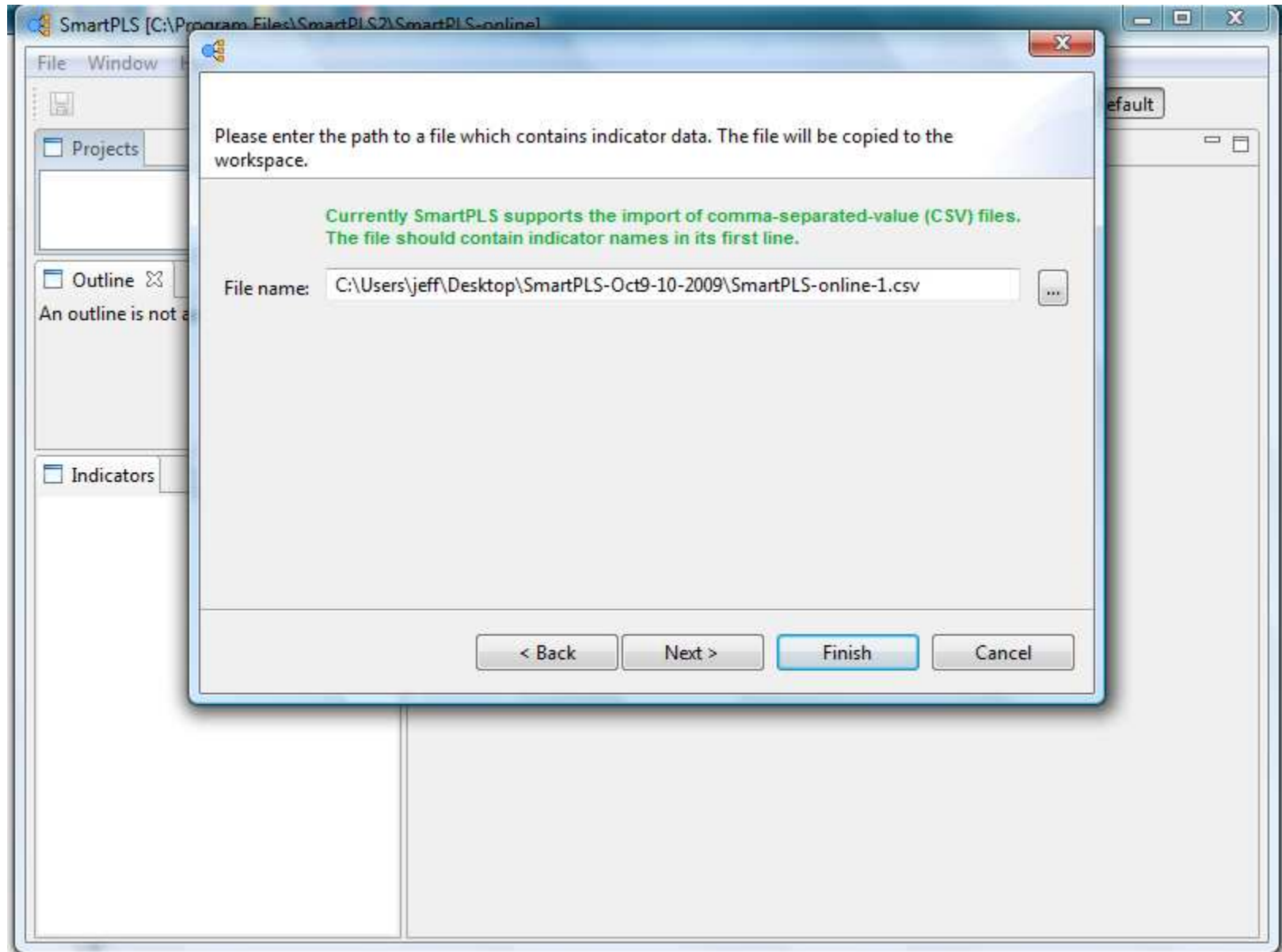
# Saudi Arabia Project Data



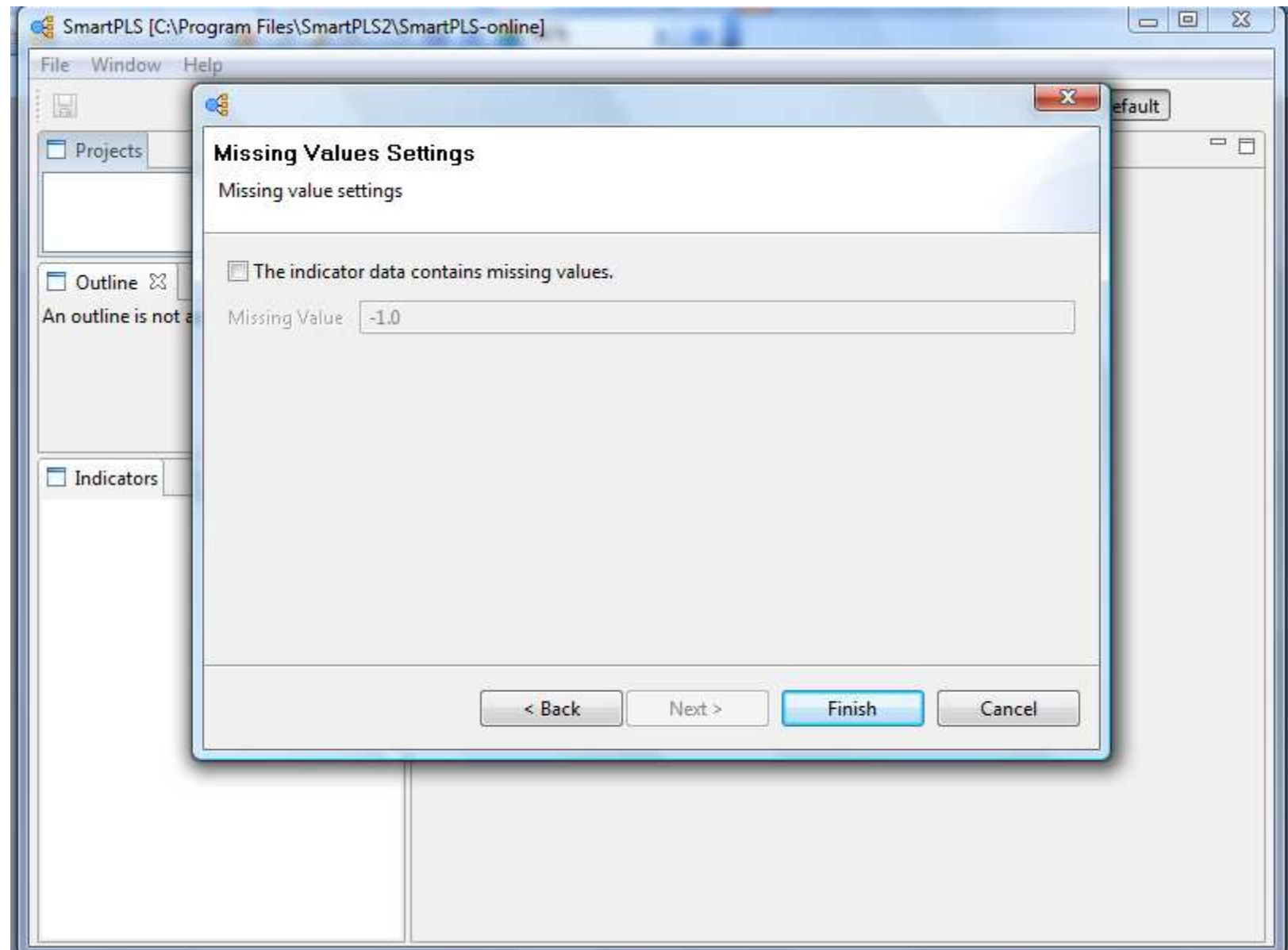
- Comprehensive study of technology usage in Saudi Arabia
  - 1,190 completed surveys - white-collar workers
  - Multiple industries and companies
  - Government (public sector) and Private (corporations)
  - Captured numerous user acceptance constructs
  - Target technology was use of “desktop computers for any work-related purpose”



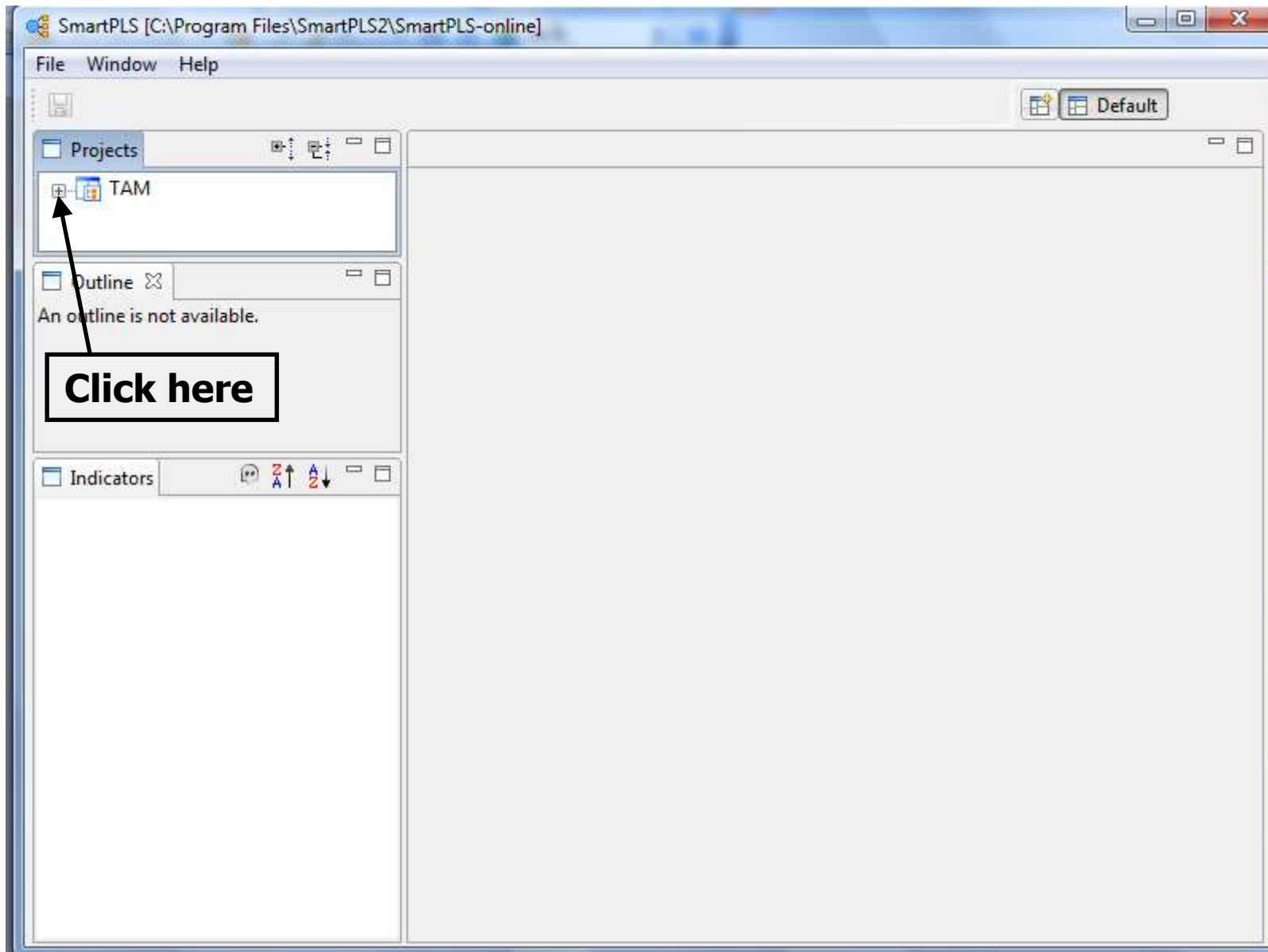
# Import Model Indicator Data (.csv)



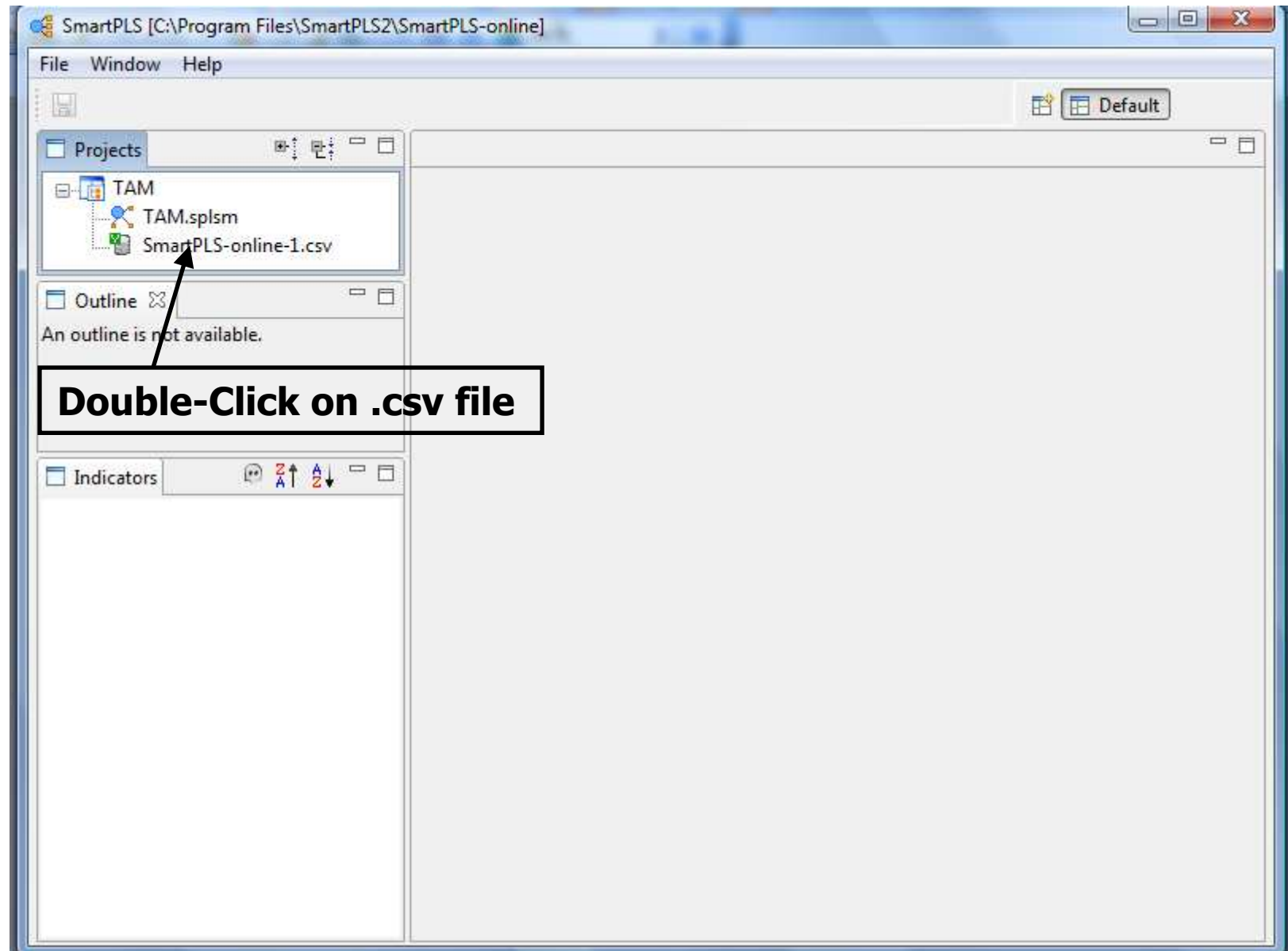
# Missing Values



# Main Window



# Open Data File



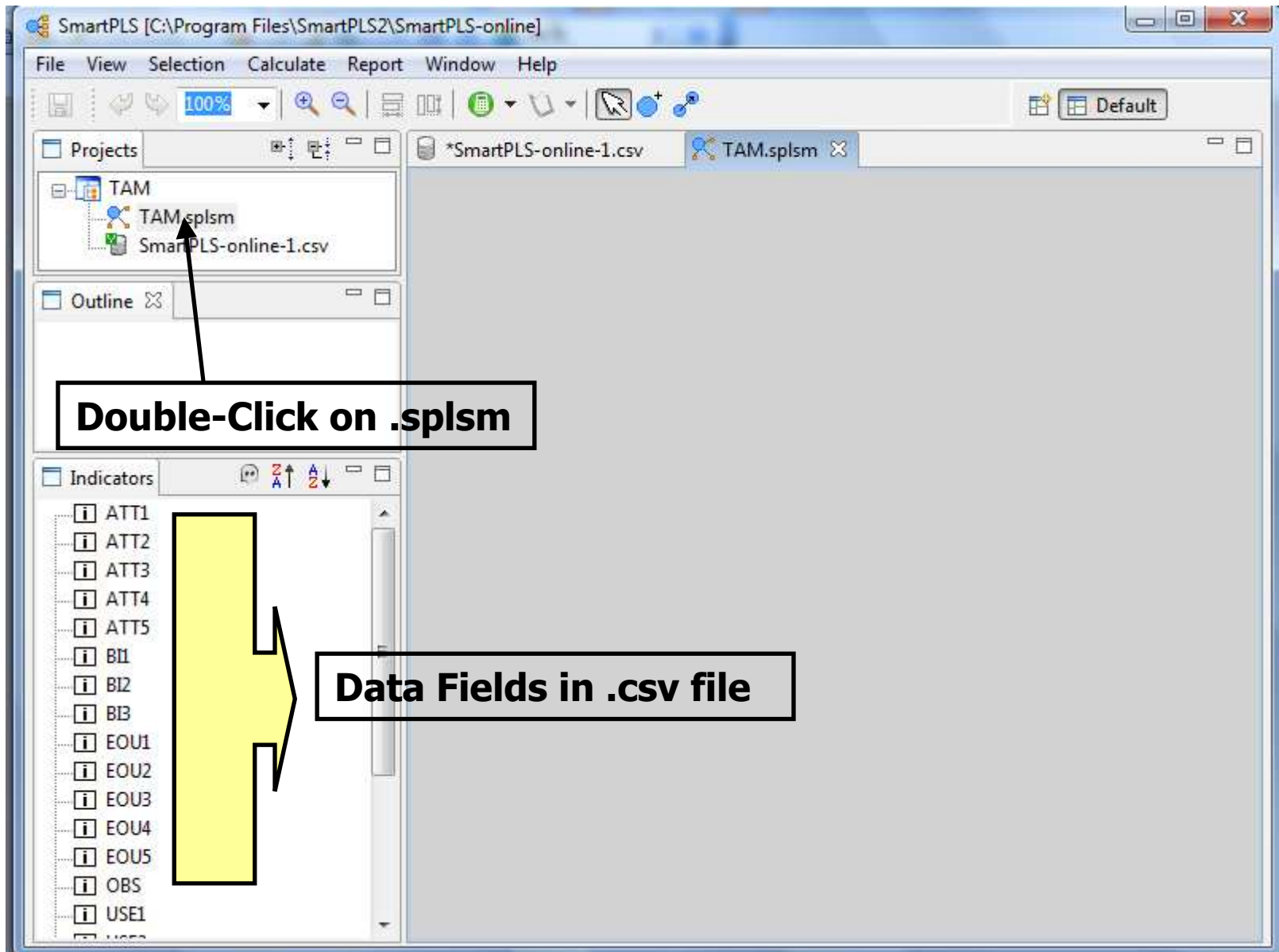
# Data File Contents

The screenshot shows the SmartPLS software interface. The main window displays the contents of a CSV file named \*SmartPLS-online-1.csv\*. The file contains 8 rows of data with 9 columns: OBS, USEF1, USEF2, USEF3, USEF4, USEF5, EOU1, EOU2, and EOU3. The data is as follows:

OBS	USEF1	USEF2	USEF3	USEF4	USEF5	EOU1	EOU2	EOU3
1	7	6	6	5	6	6	6	6
2	7	7	7	6	7	7	5	6
3	7	7	7	7	7	6	6	6
4	7	7	7	6	7	7	7	5
5	7	7	7	7	7	7	7	7
6	7	7	7	7	7	7	7	7
7	7	7	7	7	7	7	5	7
8	7	7	7	7	7	7	7	7

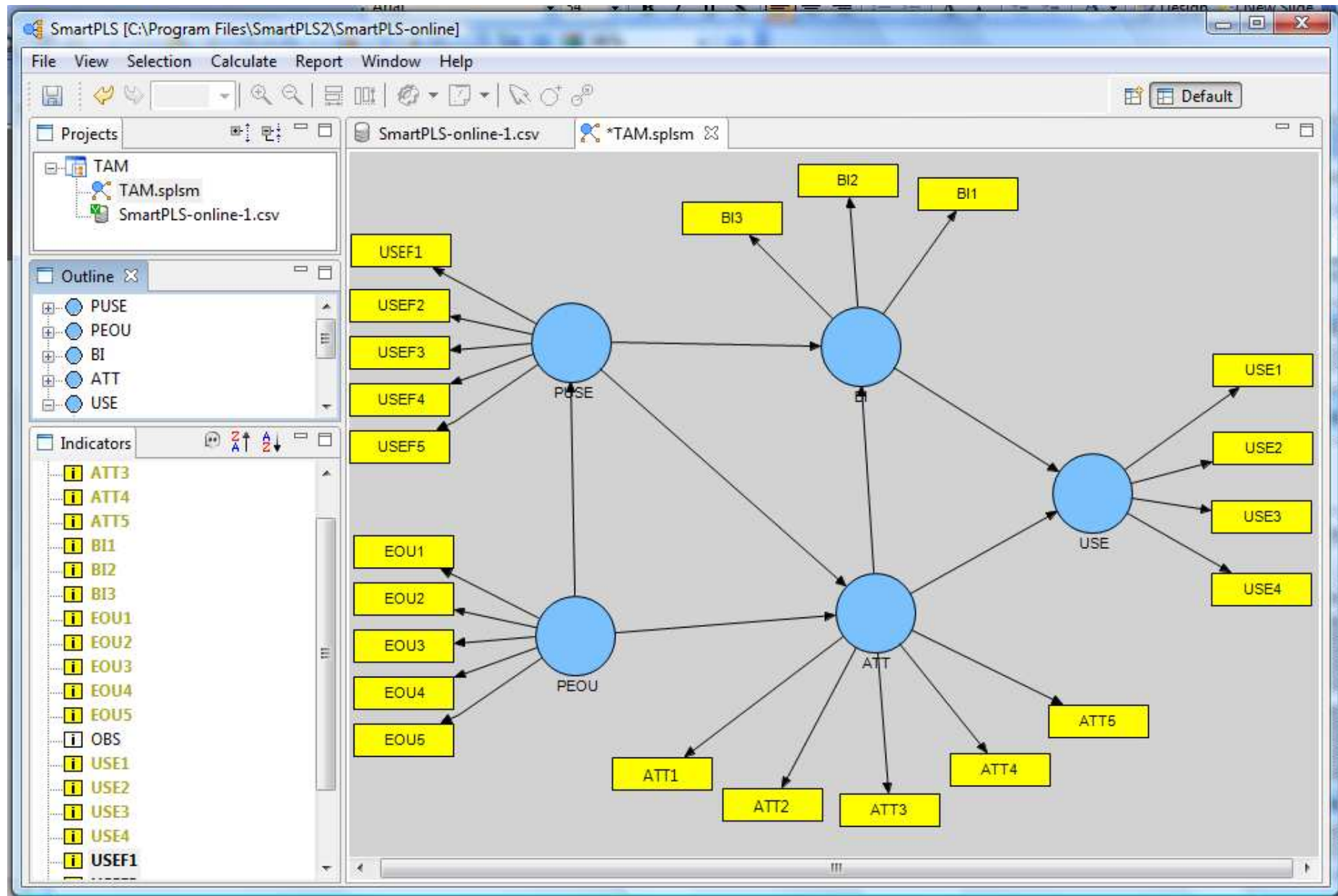
The interface also includes a 'Choose delimiter' section with options: Comma, Semicolon, Space, and Tabulator. A 'Validate' button is present. The 'Missing Values' section has a checkbox for 'The indicator data contains missing values.' and a 'Missing Value' input field.

# Open Drawing Window (.splsm)





# TAM Model

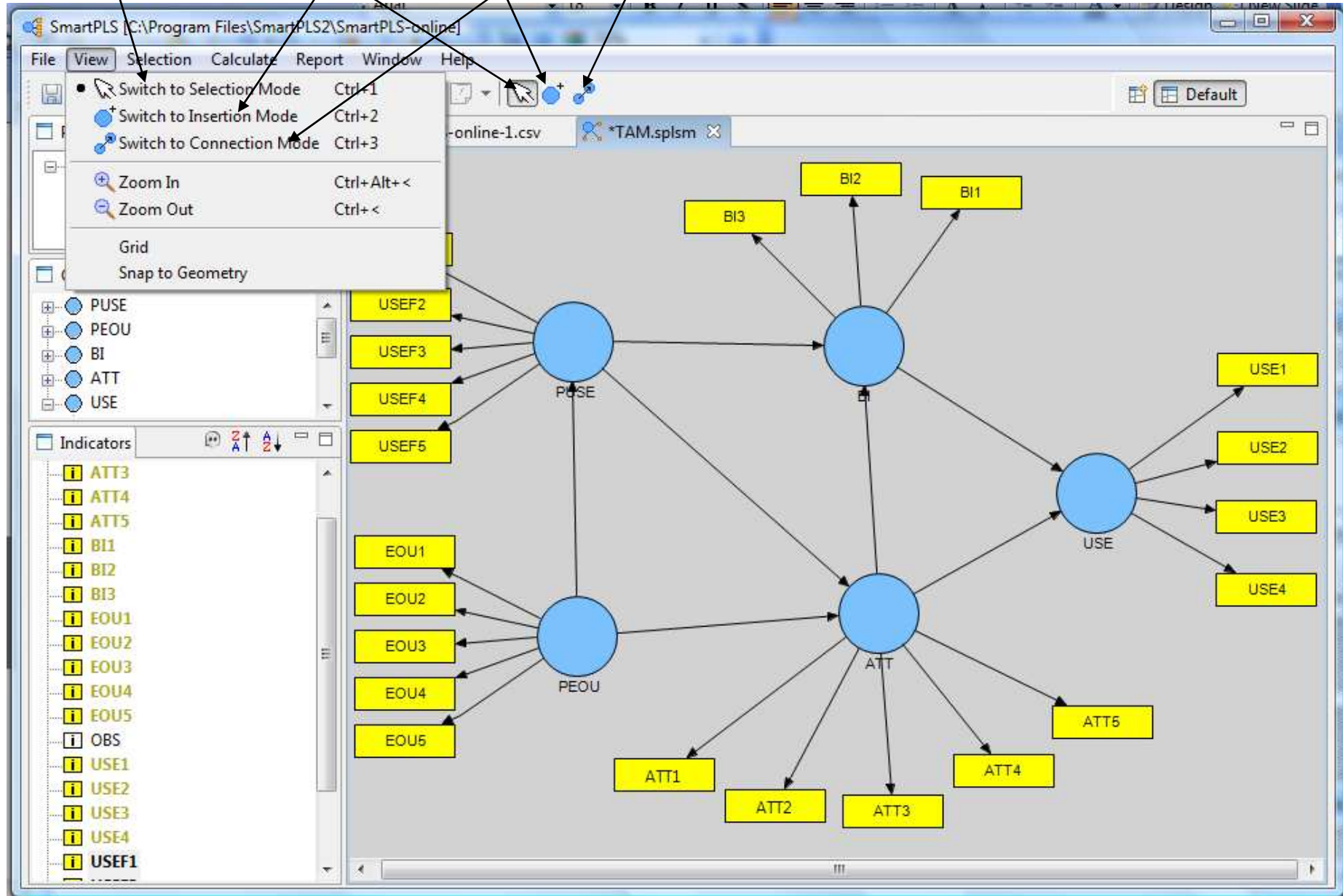


Selection Mode

Insertion Mode

Connection Mode

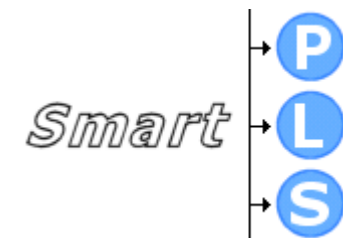
# Selection, Insertion, Connection Modes



# Selection, Insertion, Connection Modes



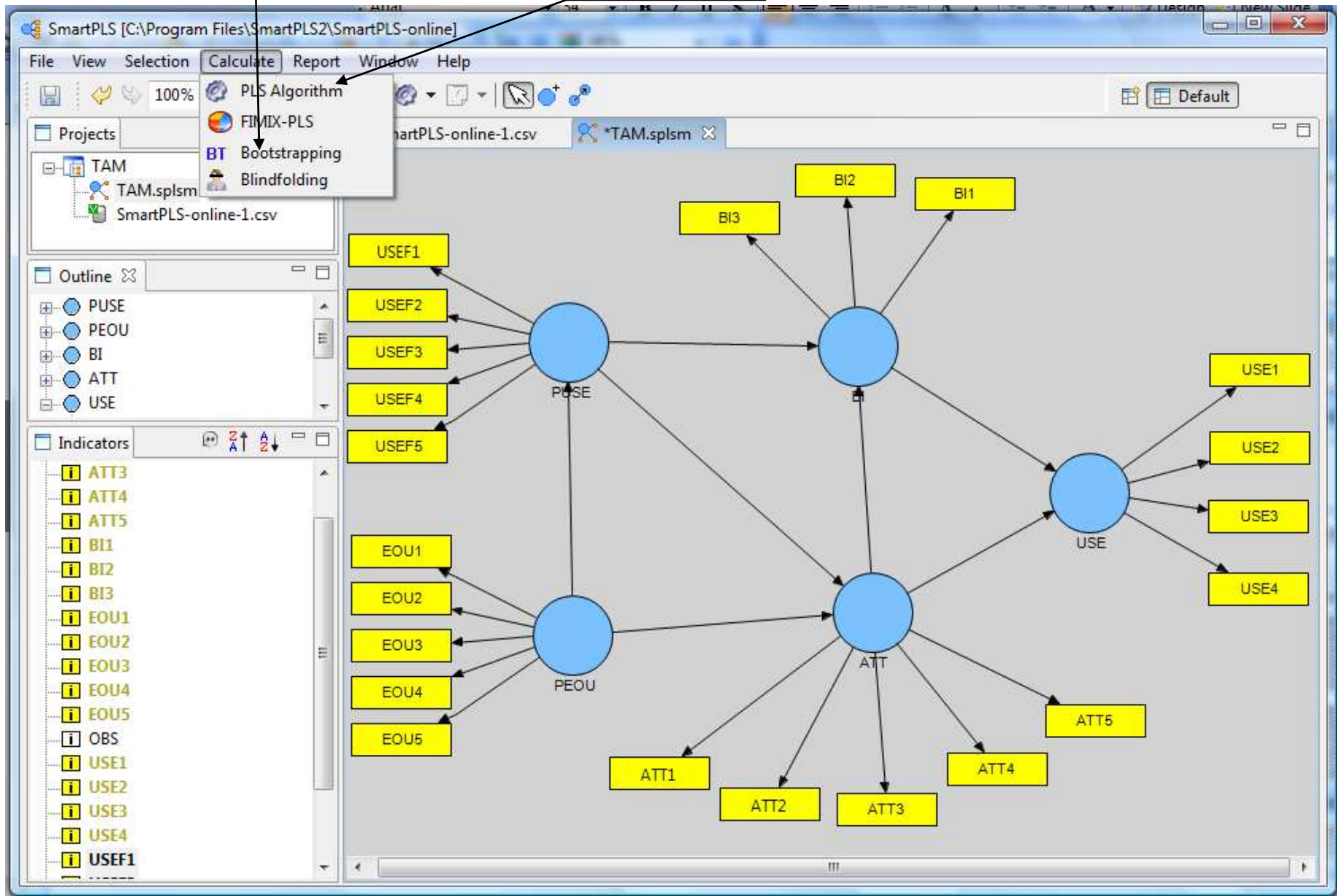
- Selection Mode
  - To select items in the drawing window
- Insertion Mode
  - To drag and drop new latent variables
- Connection Mode
  - To add paths to the model.



# Calculate: Bootstrapping and PLS Algorithm

Bootstrapping

PLS Algorithm



# Calculate Bootstrapping and PLS Algorithm



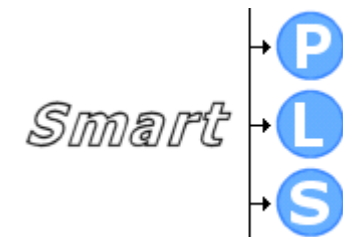
- Bootstrapping
- PLS Algorithm

*Smart* → P  
→ L  
→ S

# Bootstrapping



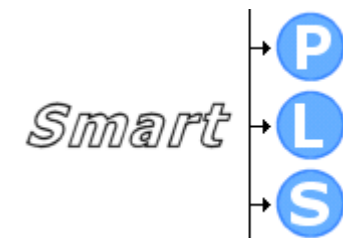
- Estimates t-values of item (factor) loadings (outer model) and path coefficients (inner model)
- Establish a number of subsamples to be created (e.g. 200)
- Randomly selects 1,190 cases (with replacement) and estimates the model 200 times
- Cases are drawn with a probability of  $1/1190$  from the data set (a certain observation may be selected 0 to 1,190 times when creating a bootstrap subsample).



# Bootstrapping - more



- Bootstrapping provides t-values for
  - Inner (structural) model path coefficients
  - Outer (measurement) model item loadings
- Bootstrapping procedure provides mean values for
  - weights in the inner (structural) model
  - weights in the outer (measurement) model
  - outer (measurement) model item loadings



# Bootstrapping Screen

The image shows the SmartPLS software interface. A dialog box titled "Run the Bootstrapping Algorithm" is open, displaying various settings for the bootstrapping procedure. The dialog box includes sections for "Missing Values - Settings", "PLS Algorithm - Settings", and "BT Bootstrapping - Settings". The "BT Bootstrapping - Settings" section is highlighted, showing "Sign Changes" set to "No Sign Changes", "Cases" set to 1190, and "Samples" set to 200. Two callout boxes with arrows point to the "Cases" and "Samples" fields, with labels "Number of original observations" and "Number of re-samples" respectively. The background of the software shows a path diagram with nodes labeled BI2, BI1, USE1, USE2, USE3, USE4, ATT, ATT4, and ATT5.

**Run the Bootstrapping Algorithm**  
Applies the standard bootstrapping procedure.

Missing Values - Settings

Data File: SmartPLS-online-1.csv  
Configured Missing Value: <not configured> (doubleclick the datafile for configuration)  
Missing Value Algorithm: Mean Replacement  
Apply Missing Value Algorithm:

PLS Algorithm - Settings

BT Bootstrapping - Settings

Sign Changes: No Sign Changes

Cases: 1190  
Samples: 200

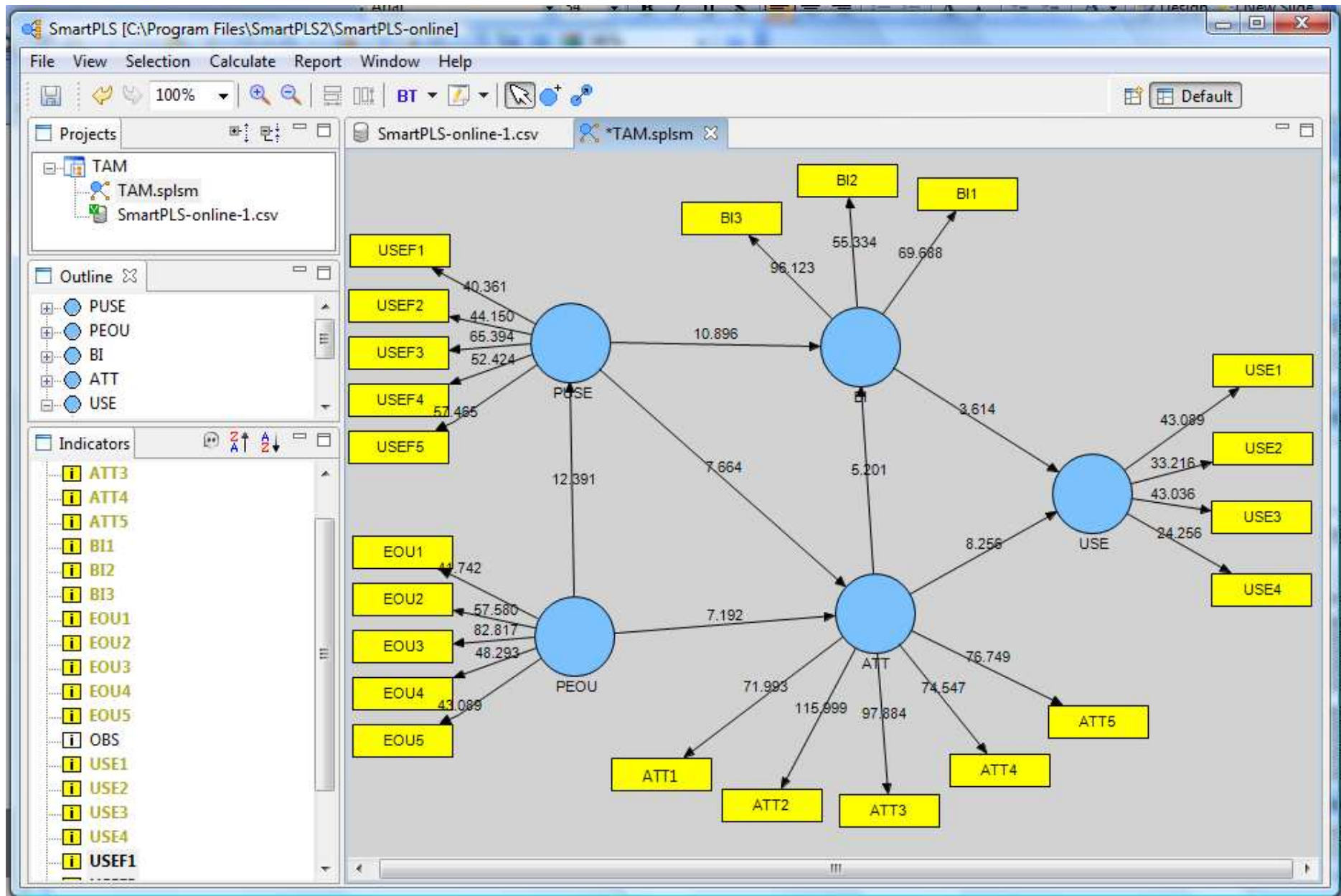
Number of original observations  
Number of re-samples

Finish Cancel

Path Diagram Nodes: BI2, BI1, USE1, USE2, USE3, USE4, ATT, ATT4, ATT5



# Bootstrapping t-values



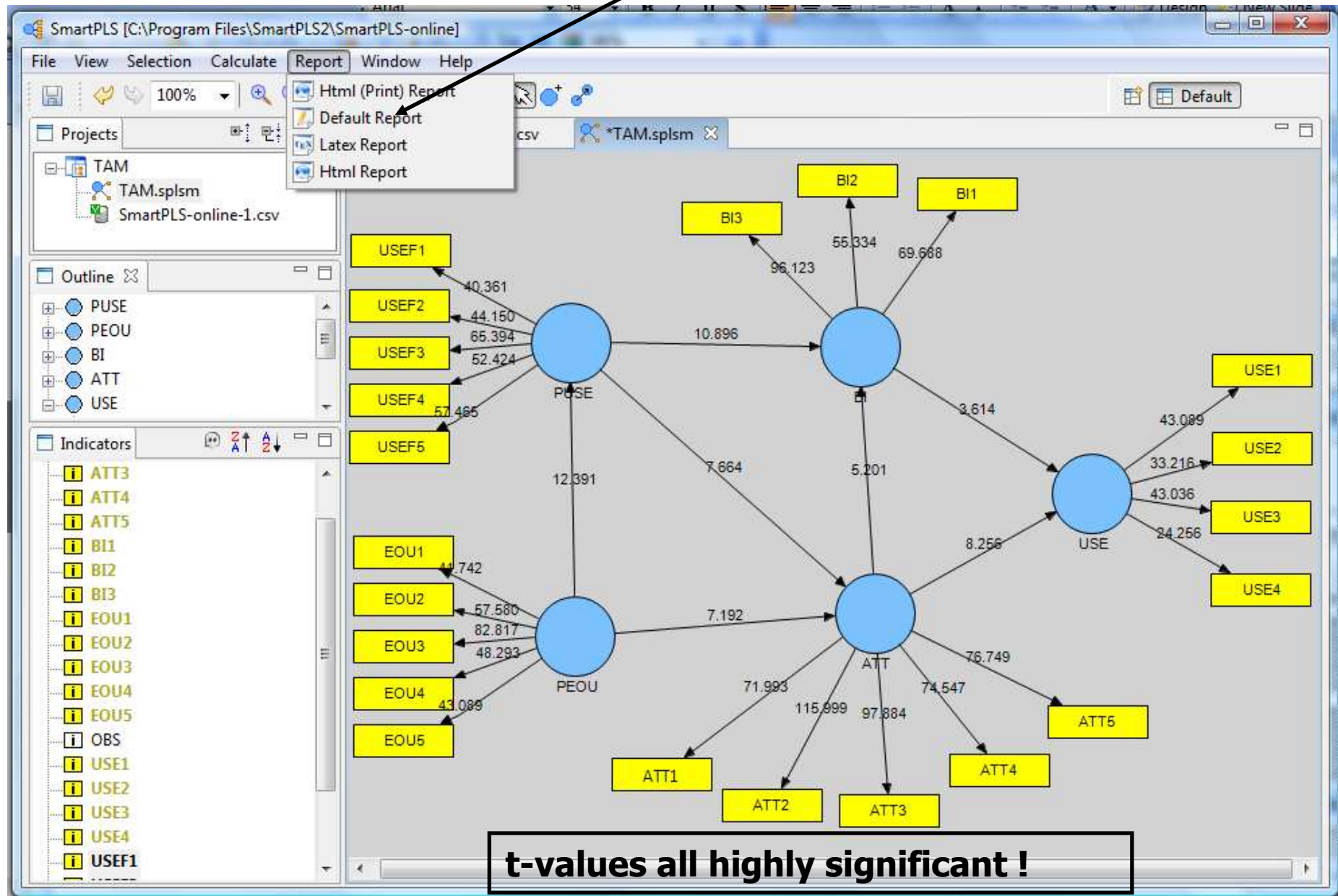
# Are t-values Significant?



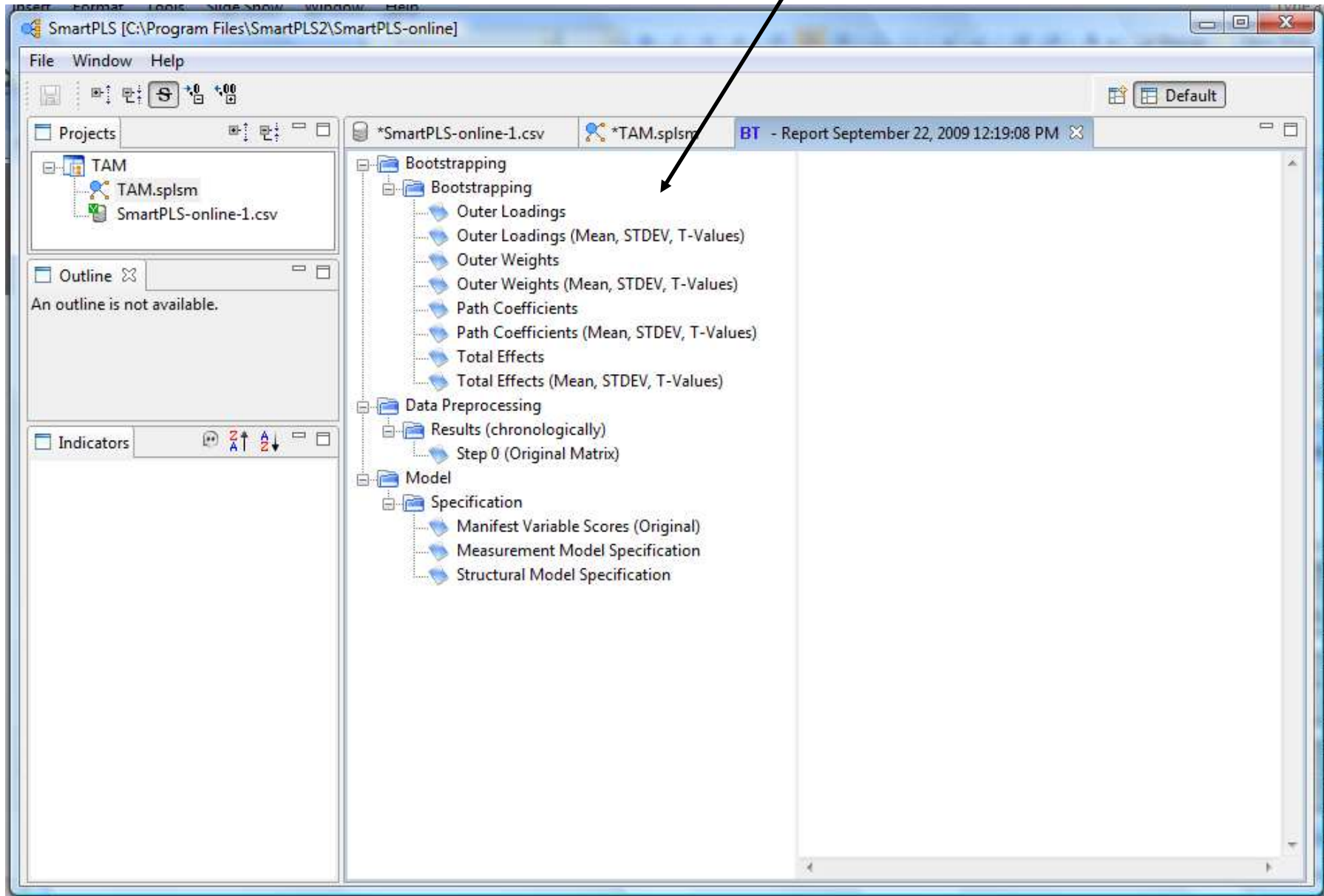
- Look at the t-values for the item loadings (outer model) and for the path coefficients (inner model)
  - Are they significant ? (e.g.  $t > 1.96$  at  $p < 0.05$ ,  $t > 2.576$  at  $p < 0.01$ ,  $t > 3.29$  at  $p < 0.001$  for two-tailed tests)
  - If so, good !
  - If not, might want to revise the measurement model (in practice, you may leave an insignificant relationship in the inner path model)
- Note: If your measurement model has problems, the structural model has problems, too!
  - By default since your items used to measure the latent constructs are problematic !

*Smart* → P  
→ L  
→ S

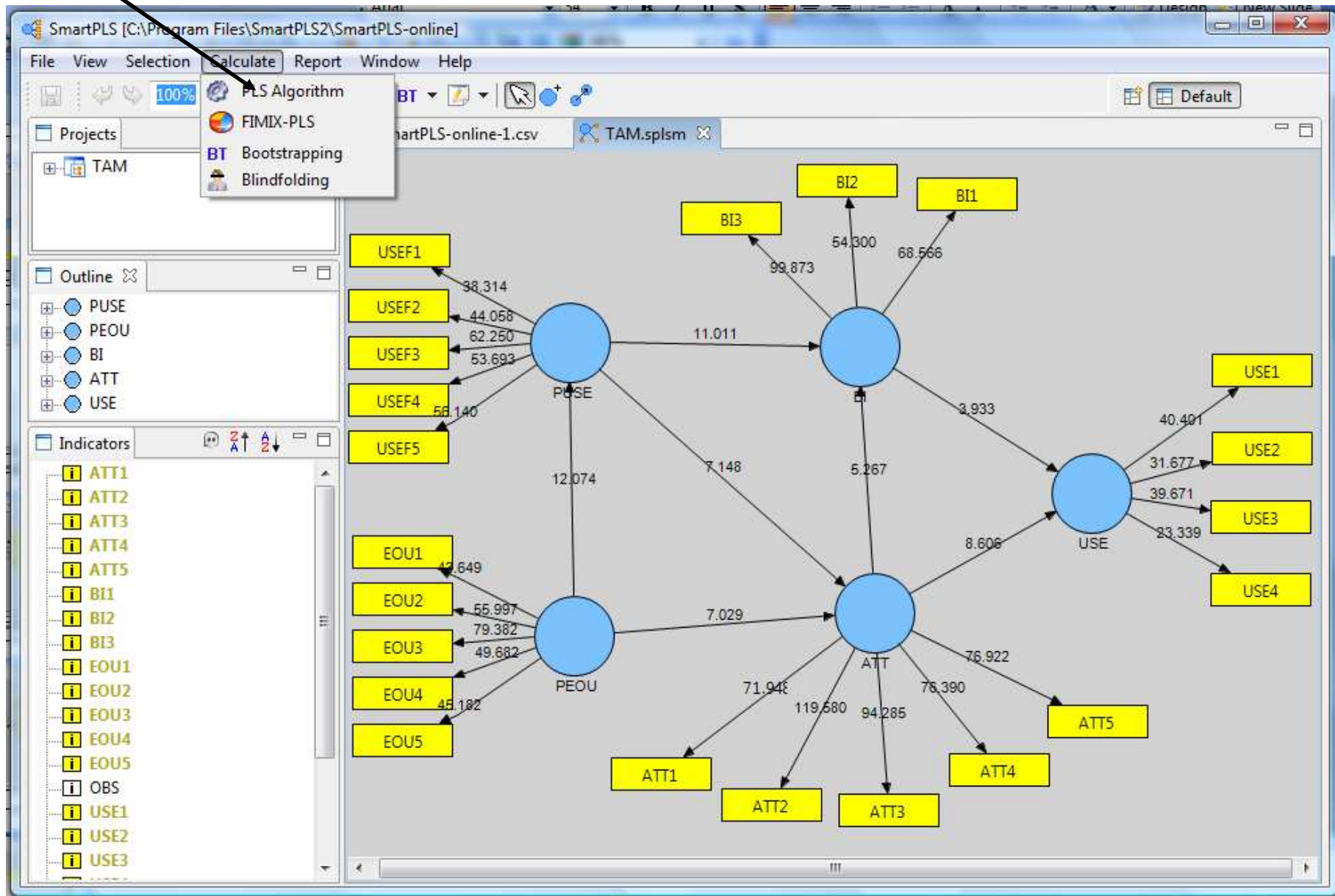
# Default Report



# Default Report



# Calculate: PLS Algorithm



# Calculate: PLS Algorithm

The image displays the SmartPLS software interface. On the left, a dialog box titled "Run the PLS Algorithm Algorithm" is open, showing the following settings:

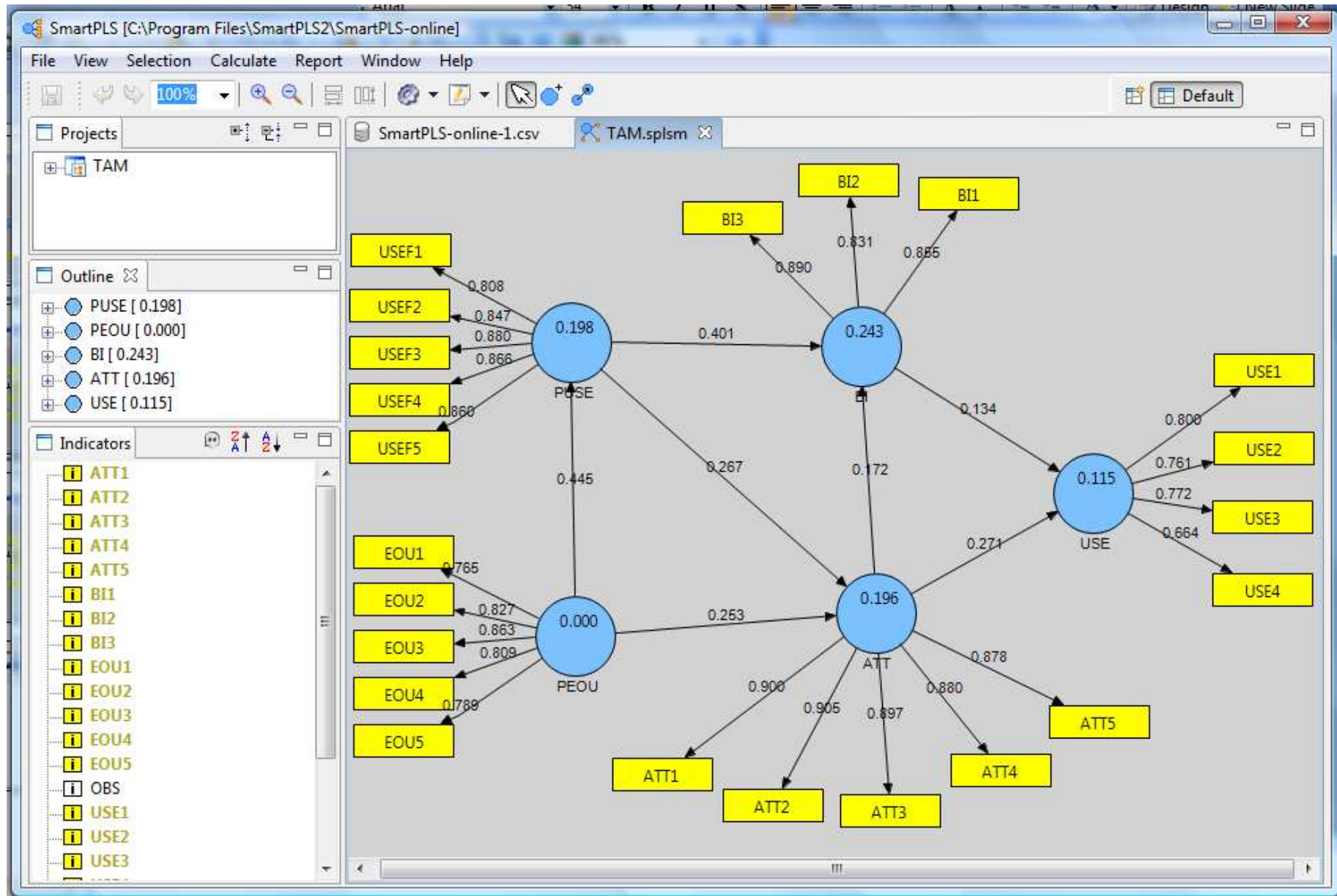
- Missing Values - Settings**
  - Data File: SmartPLS-online-1.csv
  - Configured Missing Value: <not configured> (doubleclick the datafile for configuration)
  - Missing Value Algorithm: Mean Replacement
  - Apply Missing Value Algorithm:
- PLS Algorithm - Settings**
  - Weighting Scheme: Path Weighting Scheme
  - Data Metric: Mean 0, Var 1
  - Maximum Iterations: 500
  - Abort Criterion: 1.0E-5
  - Initial Weights: 1.0

At the bottom of the dialog box are "Finish" and "Cancel" buttons.

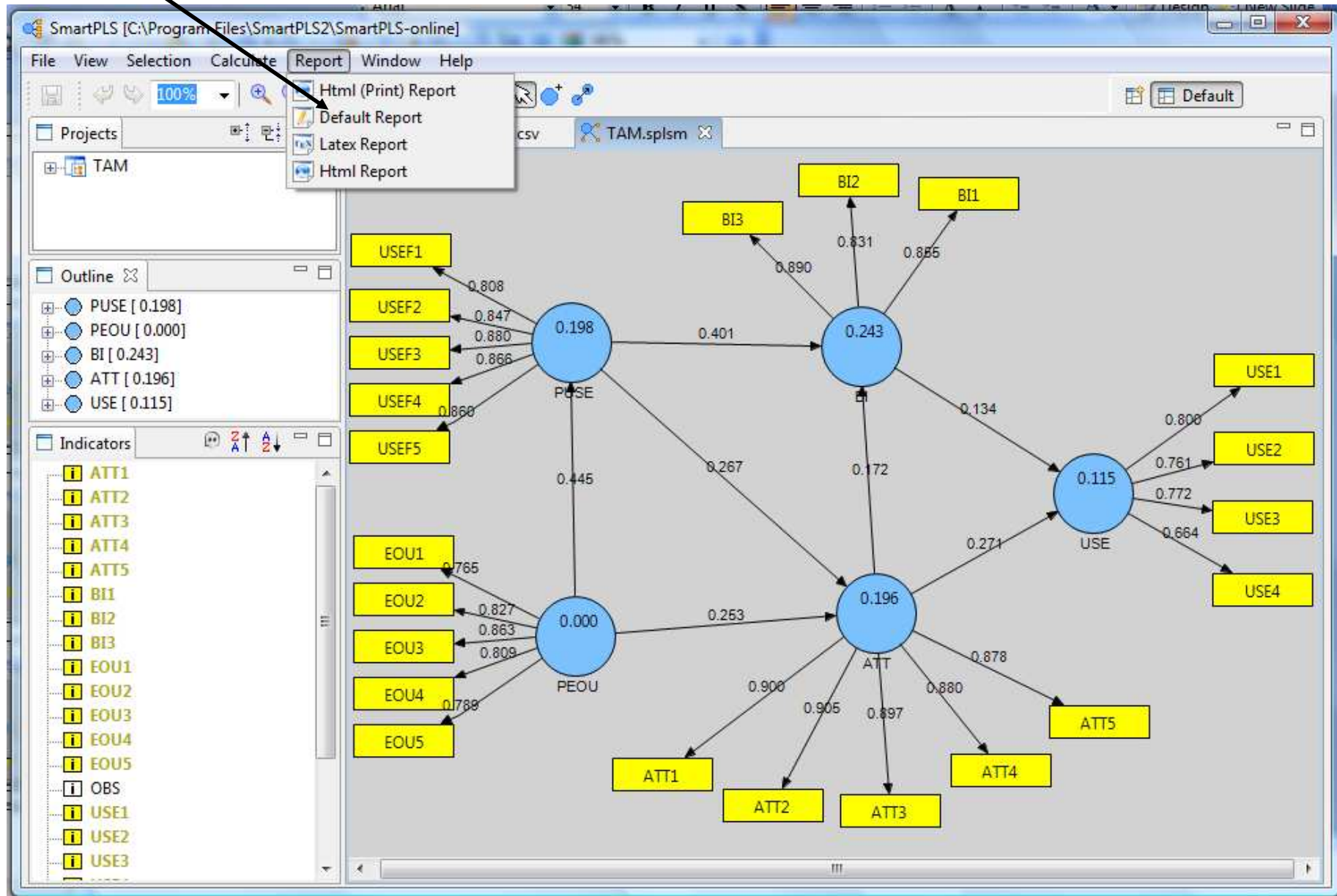
On the right, a path diagram is visible, showing the following structure and path coefficients:

- Latent Variables (blue circles):** BI, ATT, USE
- Manifest Variables (yellow rectangles):** BI1, BI2, ATT1, ATT2, ATT3, ATT4, ATT5, USE1, USE2, USE3, USE4
- Path Coefficients:**
  - BI → BI1: 68.566
  - BI → BI2: 54.300
  - BI → USE: 3.933
  - ATT → ATT1: 71.948
  - ATT → ATT2: 119.680
  - ATT → ATT3: 94.285
  - ATT → ATT4: 76.390
  - ATT → ATT5: 76.922
  - ATT → USE: 8.608
  - USE → USE1: 40.401
  - USE → USE2: 31.677
  - USE → USE3: 39.671
  - USE → USE4: 23.339

# PLS Algorithm Results



# PLS Results Default Report





# PLS Results Default Report

The screenshot displays the SmartPLS software interface. The title bar reads "SmartPLS [C:\Program Files\SmartPLS2\SmartPLS-online]". The menu bar includes "File", "Window", and "Help". The toolbar contains icons for file operations and zooming. The left sidebar has three sections: "Projects" with a "TAM" project, "Outline" with the message "An outline is not available.", and "Indicators" with navigation icons. The main window shows a tree view of the report structure:

- SmartPLS-online-1.csv
- TAM.splsm
- Report September 23, 2009 9:15:24 AM
- Default
- Data Preprocessing
  - Results (chronologically)
    - Step 0 (Original Matrix)
- Index Values
  - Results
    - Index Values for Latent Variables
    - Latent Variable Scores (unstandardised)
    - Measurement Model
    - Measurement Model (restandardised)
    - Path Coefficients
- Model
  - Specification
    - Manifest Variable Scores (Original)
    - Measurement Model Specification
    - Structural Model Specification
- PLS
  - Calculation Results
    - Latent Variable Scores
    - Manifest Variable Scores (Used)
    - Outer Loadings
    - Outer Weights
    - Path Coefficients
    - Stop Criterion Changes
  - Quality Criteria
    - Cross Loadings
    - Latent Variable Correlations
    - Overview
    - Total Effects

A black arrow points from the title "PLS Results Default Report" to the "Index Values" section of the tree view.

# After-Class Exercise . . .



- If you have not done it already, use SmartPLS to re-create the basic TAM PLS-SEM model that we reviewed in this presentation.
  - Use the enclosed data file TAM.csv

