Getting Started with the PSG Models

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The Policy Simulation Group (PSG) offers three computer simulation models that together produce aggregate financial estimates and individual distributional estimates for both the government social security system and the employer-sponsored pension system in the United States.

SSASIM is a cell-based actuarial (CBA) model of social security trust fund solvency plus an simulator of social security benefits, taxes, and money's worth statistics for a handful of exemplary cohort individuals (ECI). Both the CBA mode and ECI mode models can be driven by either deterministic or stochastic projections of key macrodemographic and macroeconomic assumptions, as in the annual OASDI Trustees Report.

PENSIM is a microsimulation model of employer-sponsored pension (ESP) benefit accumulation and withdrawal behavior that is driven by the macro projections generated by SSASIM and produces estimates for a sample of individuals born in a specified year.

GEMINI is a microsimulation model that simulates social security benefits, taxes, and money's worth statistics for a representative cohort sample (RCS) generated by PENSIM. The GEMINI microsimulation results for many overlapping cohorts (OLC) can be aggregated by SSASIM into social security trust fund solvency estimates.

Working together, the three models can produce estimates of retirement benefits from pensions and social security under a wide range of assumptions concerning employer-sponsored pension offerings and government social security policy.

Contents

This short primer contains the following sections:

Capabilities of PSG Models

The three PSG models cooperate in a variety of ways to produce different kinds of estimates concerning the government social security program and the employer-sponsored pension system. The easiest way to explain the nature of this model cooperation is to characterize PENSIM and GEMINI as SSASIM add-ons. Of the three models, only SSASIM can operate on its own, but its most useful optional modes of operation require assistance from both PENSIM and GEMINI. PENSIM always requires assistance from SSASIM, and GEMINI always requires assistance from both SSASIM and PENSIM.

The nature of PSG model cooperation will be described by explaining how the models work together in each of five SSASIM modes of operation. As each SSASIM mode of operation is discussed, the reader will find it useful to refer to Figure 1.
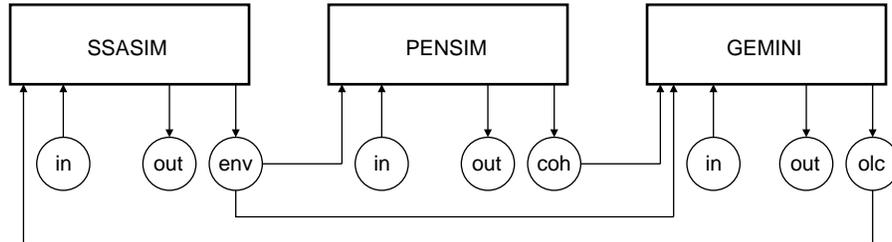

Figure 1: *Links between PSG Models. The inputs and outputs of each model are represented by circles below the model. The in circle represents the input database, the out circle represents the output files, the env circle represents the binary environment file, the coh circle represents the binary cohort file, and the olc circle represents the binary overlapping cohorts file.*

Cell-Based Actuarial (CBA) Mode.   This mode of SSASIM operation produces trust-fund solvency estimates using actuarial methods that represent the population as a collection of aggregate age-gender cells. These methods are similar to those used to produce estimates shown in the annual OASDI Trustees Report. While the average impact on each cell is easy to determine for reforms that have proportional effects across individuals, things are more difficult for reforms that have have non-proportional effects across individuals. As with the Trustees Report model, estimating the effects of reforms that have non-proportional effects requires use of a supplementary sample of individuals to estimate the average impact on each cell. A suitable supplementary sample, the Benefits and Earnings Public-Use File, is available from the Social Security Administration (SSA) Office of Policy website ⟨http://www.ssa.gov/policy/⟩. See the "How do I characterize reforms in CBA mode?" section of the *Getting Started with the RSF Toolkit* document for details about how to represent reforms in the CBA mode of operation.

The CBA mode of operation requires only SSASIM. SSASIM does not require an olc file as input and does not produce an env file as output.

Single-scenario, deterministic-assumption CBA mode runs execute almost instantaneously. CBA mode runs with stochastic assumptions take only a minute or two. For more detailed and up-to-date information on execution times, see the fast-running page on the PSG website ⟨http://www.polsim.com⟩.

Exemplary Cohort Individuals (ECI) Mode. This mode of SSASIM operation produces a wide range of benefit adequacy and money's worth estimates for as many as nine men and nine women born in a specified year and whose life histories are specified by the model user. If these exemplary individuals are specified to be married, then the same statistics are produced for each couple as well as each individual. This mode produces results for individuals with stylized life histories similar to those presented in SSA Office of the Chief Actuary solvency memoranda.

The ECI mode of operation requires only SSASIM. SSASIM does not require an olc file as input and does not produce an env file as output.

The run execution times for ECI mode runs are the same as for CBA mode runs.

Employer-Sponsored Pension (ESP) Mode. This mode of SSASIM operation produces PENSIM estimates of employer-sponsored pensions for a representative sample of individuals born in a specified year. The birth year and size of the sample are specified by the model user. The estimates are written to PENSIM output files located in the PENSIM database folder.

The ESP mode of operation requires SSASIM and PENSIM. SSASIM does not require an olc file as input and produces an env file as output. PENSIM requires an env file as input and does not produce a coh file as output.

ESP mode runs involve PENSIM life history calculations and employer-sponsored pension calculations, but no GEMINI social security calculations. Single-scenario ESP mode runs typically execute in a couple of minutes. For more detailed and up-to-date information on execution times, see the fast-running page on the PSG website ⟨http://www.polsim.com⟩.

Representative Cohort Sample (RCS) Mode. This mode of SSASIM operation produces GEMINI estimates of social security benefit adequacy and money's worth for a representative sample of individuals born in a specified year. The estimates for each individual are similar to those produced in the ECI mode. The birth year and size of the sample are specified by the model user. The estimates are written to GEMINI output files located in the GEMINI database folder.

The RCS mode of operation requires SSASIM, PENSIM, and GEMINI. SSASIM does not require an olc file as input and produces an env file as output. PENSIM requires an env file as input and produces a coh file as output. GEMINI requires a coh file as input and does not produce an olc file as output.

RCS mode runs involve PENSIM life history calculations as well as employer-sponsored pension calculations, and GEMINI social security calculations. Pension benefits are calculated for two reasons: (a) in order to calculate social security benefits accurately under WEP/GPO benefit reduction rules, and (b) in order to provide a more comprehensive estimate of total retirement income. Single-scenario RCS mode runs typically execute in a couple of minutes. For more detailed and up-to-date information on execution times, see the fast-running page on the PSG website ⟨http://www.polsim.com⟩.

Overlapping Cohorts (OLC) Mode. This mode of SSASIM operation produces trust-fund solvency results using microsimulation methods that represent the population as a sample of individuals born in many years. These methods are similar to those used by CBO to produce social security estimates using the CBOLT model. The solvency statistics produced in the OLC mode are the same as those produced in the CBA mode. But the use of microsimulation methods eliminates the need for the supplementary sample required by the CBA mode to analyze reforms that have non-proportional effects on the population. The size of the the cohort samples used in the OLC mode are specified by the model user.

The OLC mode of operation requires SSASIM, PENSIM, and GEMINI. SSASIM requires an olc file as input for each cohort born from 1935 through the last year of the solvency simulation. SSASIM gets these olc files by asking GEMINI to produce one for each cohort. GEMINI does this by asking PENSIM for a coh file for each cohort simulated with employer-sponsored pensions. And PENSIM does this by asking SSASIM for an env file. An OLC mode run with a seventy-five year solvency test period using 2015 Trustees Report assumptions requires 157 cohorts (1935–2091) to be simulated by PENSIM and GEMINI. Social security benefits for cohorts born before 1935 are supplied by the CBA mode.

In order to accelerate the execution of an OLC mode run, SSASIM can request more than one cohort simulation at a time. This multi-threading logic can take advantage of multiple chip computers and multiple core chips. On a computer with four CPU cores, single-scenario OLC mode runs typically execute in about three minutes. For more detailed and up-to-date information on execution times, see the fast-running page on the PSG website ⟨http://www.polsim.com⟩.

This means that a stochastic OLC mode run with 500 scenarios might take about 25 hours to execute. This long execution time for a single stochastic OLC run is why the Policy Simulation Group has developed a distributed processing capability that permits such a run to execute on twenty-five eight-core Linux servers rented inexpensively by the hour from Amazon Web Services (AWS), a leading cloud-computing vendor. Such an approach reduces the execution time of a stochastic OLC mode run to about one hour. For more information, start the AWS Toolkit from the RSF Toolkit Execute menu and select the getting started item on the AWS Toolkit Help menu.

Combining Modes in a Single SSASIM Run. A single SSASIM run can produce results from more than one mode. The SSASIM macro model produces solvency statistics using either the CBA mode or the OLC mode. The possible mode combinations for a single SSASIM run are as follows:

- Macro: CBA mode + Micro: ECI mode

- Macro: CBA mode + Micro: ESP mode and/or RCS mode

- Macro: OLC mode + Micro: ESP mode and/or RCS mode

When the ESP mode specifies PENSIM runs for more than one birth cohort, SSASIM use multi-threading logic to execute the PENSIM runs simultaneously. And when the RCS mode specifies GEMINI runs for more than one birth cohort, SSASIM use multi-threading logic to execute the GEMINI runs simultaneously.

Installation of PSG Models

The PSG models run under the Windows XP/Vista/7 operating systems. This section describes the procedure for installing the models, which is highly automated. This section also explains which models are free and which models require registration and payment of an annual subscription fee.

SSASIM comes in one version: the standard version, which is not free.

PENSIM comes in one version: the standard version, which is free.

GEMINI comes in two versions: the educational version, which is free but has some limitations, and the standard version, which is not free but has no limitations.

Which of the following installation options you select depends on your analysis needs and budget. Here are the installation options:

1. **SSASIM.** Install SSASIM using the automatic SSASIM installation procedure described below on page 7. Confirm the validity of the installation by passing the CBA mode benchmark test as described on page 7. Then convert to a fully functional SSASIM model by registering and paying an annual SSASIM subscription fee; read about the registration process and the SSASIM fee schedule on page 8. This option provides access to all the capabilities of the macro CBA mode of SSASIM operation and the micro ECI mode of SSASIM operation.

2. **SSASIM+PENSIM.** Adding PENSIM to option 1 is free and requires no registration; read about the automatic PENSIM installation procedure on page 9. This option provides the additional ability of producing pension estimates using the ESP mode of SSASIM operation.

3. **SSASIM+PENSIM+Edu-GEMINI.** Adding the educational version of GEMINI to option 2 is free and requires no registration; read about the automatic GEMINI installation procedure on page 9. *The educational version of GEMINI sets all OASDI taxes and benefits to zero, which means it cannot be used to conduct social security policy analysis.* What this option does provide is (a) the additional ability to analyze PENSIM employer-sponsored pension estimates using GEMINI output files and analyzer programs including the EDA Toolkit, which automates graphing of distributional results, and (b) the additional ability to analyze federal income tax liabilities of each sample individual's family.

4. **SSASIM+PENSIM+Std-GEMINI.** The free educational version of GEMINI can be converted to the standard version of GEMINI by registering and paying an annual GEMINI subscription fee; read about the registration process and the GEMINI fee schedule on page 9. This option provides, without any limitations, the additional capabilities of the macro OLC mode of SSASIM operation (for social security solvency analysis) and the micro RCS mode of SSASIM operation (for distributional analysis of social security and pension benefits). In addition, this option

provides access to the Linux version of the PSG models, which run on Amazon Web Services (AWS) computers via the AWS Toolkit.

Using the standard version of GEMINI is the complete modeling package: it provides the ability to produce social security solvency and distributional estimates under a wide range of social security policies using either deterministic or stochastic characterizations of macrodemographic and macroeconomic assumptions, and it provides the ability to produce pension benefit estimates under a wide range of assumptions about government pension policy, employer plan offerings, and employee pension behavior, using either deterministic or stochastic assumptions. Furthermore, the RCS mode can estimate both social security and pension benefits for each individual in a large cohort sample. Given the ease of specifying a model run, the speed of run execution, and the sophistication of included output analysis and graphing capabilities, this package can support an intensive program of retirement policy analysis conducted under time pressure. The option of using the standard versions of all three PSG models has been chosen by the Government Accountability Office (GAO), the SSA Office of Retirement and Disability Policy, and various non-governmental organizations, over the years.

Installing SSASIM. The whole automated installation process assumes that you have administrative privileges on your personal computer. This is an increasingly rare situation in large organizations and for those who have moved beyond Windows XP. *If you need the assistance of IT staff to do this installation, make sure the IT staff person reads this whole section before attempting to conduct an installation for you. And don't let the IT staff person leave before you turnoff your computer, restart it logging in as yourself, and can pass all the benchmark tests that are appropriate for your particular installation of the PSG models.*

Go to the Download page on the PSG website ⟨http://www.polsim.com⟩ and double click on the Install SSASIM link to download and execute the SSASIM installation program.

You are likely to be warned that the install-SSASIM.exe file is from an unknown software publisher that does not have a valid digital certificate. Ignore this warning and continue with the model installation.

This completes the basic installation of SSASIM. At this stage, you should have a limited version of SSASIM working on your computer. In order to determine that the installation is correct, perform the CBA mode benchmark test as follows:

CBA mode benchmark test

(a) Click on the red Tk icon to start the RSF Toolkit.

(b) From the Execute menu, select the CBA mode benchmark run item, which will start the simulator executing the benchmark run in a separate window. If you can't do this, there is an installation problem; read the "Solving Installation Problems" section below.

(c) After the benchmark run has completed execution, the benchmark script will invoke the compare-results utility to determine the validity of the run's output. If this utility reports any differences between the results just generated by the benchmark run (in the run*.* files) and the archive results (in the rxn*.* files that are distributed with SSASIM), then there is a problem with the SSASIM installation. If there is a problem, read the "Solving Installation Problems" section below.

Once you have passed the CBA mode benchmark test, it is important to make a few adjustments to Windows that will improve your experience working with the PSG models:

(1) Make sure your screen resolution setting is not too low: a minimal setting is something like 1280 x 768 pixels, while a better setting is something like 1440 x 900 pixels. Adjust the screen resolution by right clicking on your desktop, picking the Properties (or Personalize) item on the menu that pops up, and activating the (Display) Settings tab.

(2) Make sure you have the free Adobe Acrobat Reader (version 5.0 or higher) installed. You will get the highest quality graphics from the Trust-Fund Solvency (TFS) Toolkit if you also have Adobe Acrobat Standard or Professional installed. And you need the Excel spreadsheet for the Exemplary Cohort Individuals (ECI) Toolkit to work.

(3) Revise the properties of the command prompt windows that SSASIM starts frequently. Create a window in the SSASIM database folder by selecting the Output from Windows command prompt item on the Analyze menu. Right click that window's title bar and select the Properties item (or the Default item in Vista/7) on the menu that pops up. The Properties window has four tabs. Click on the Options tab and make sure the Window Display Option and the Quick Edit Mode are selected. Click the Font tab and select 8x12 if you want an easier to read type size in the window. Click on the Layout tab and make sure that the Width/Height are set to 80/4000 for the Screen Buffer Size and to 80/35 for the Window Size. And finally, click the Colors tab and select Screen Text and Screen Background colors that are easiest for you to read (for example, yellow on blue). If working under XP, click on the OK button, select the option to "Save properties for future windows with same title", and click OK again. In the same way, start another Command Prompt window from SSASIM to confirm that the properties you selected have been saved.

(4) Set the font used in the Windows Notepad program, which SSASIM starts often, to a readable fixed-width font, such as Courier New, Regular, 10 point, using the Font item on the Format menu in the Notepad.

Registering SSASIM. Install SSASIM and make sure you can pass the CBA mode benchmark test, as described on page 7. Then run the registration program using the "Registering this computer" option on the RSF Toolkit Help menu. After sending the indicated email, you will get a personalized version of the ssasim.use file and a version of ssasimx.exe that is registered to run on your computer. Upgrading to a registered version of SSASIM simply involves

replacing these two files that came in the installation package. Arrangements will also be make for you to pay the annual SSASIM subscription fee, which is $4,000 per registered copy.

Important note about installing on laptop computers. Registered versions of the PSG models will not run on a laptop computer unless steps have been taken to prevent battery-saving fluctuations in CPU chip speed.

Installing PENSIM. Using a registered version of SSASIM, make sure you can pass the CBA mode benchmark test, as described on page 7. Then go to the PSG website Download page ⟨http://www.polsim.com⟩ and double click on the Install PENSIM link to download and execute the PENSIM installation program. After the installation process is finished, make sure you can pass the PENSIM benchmark test, which is analogous to the CBA mode benchmark test described on page 7, except that you execute the ESP mode benchmark run rather than the CBA mode benchmark run.

There is no registration or subscription fee required for PENSIM.

Installing GEMINI. Install the PENSIM, as described above. After passing both the CBA mode and ESP mode benchmark tests, go to the PSG Download page ⟨http://www.polsim.com⟩ and click on the Install GEMINI link to download and execute the GEMINI installation program. After this installation of GEMINI, you should have the educational version of GEMINI working on your computer. In order to confirm this, make sure you can pass the ESP+ mode benchmark test, which is analogous to the CBA mode benchmark test described on page 7, except that you execute the ESP+ mode benchmark run rather than the CBA mode benchmark run.

Registering GEMINI. There is no separate computer registration process for GEMINI; the SSASIM registration information is sufficient. However, there is a separate annual subscription fee for the standard version of GEMINI. The total subscription fee is the same for one, two, three, four, or five registered copies of GEMINI: $50,000 per year. The subscription fee for each additional registered copy of GEMINI, beyond five copies, is $10,000 per year. Upon receipt of the fee, you will receive a personalized version of the gemini.use file and a version of geminix.exe that is registered to run on your computer. Getting the standard version of GEMINI simply involves replacing these two files that came in the installation package.

After you have the standard version of GEMINI installed on your computer, make sure you can pass the GEMINI benchmark test, which is analogous to the CBA mode benchmark test described on page 7, except that you execute the RCS mode benchmark run rather than the CBA mode benchmark run. If you pass this GEMINI benchmark test, you should also be able to execute the OLC mode benchmark run successfully.

Solving Installation Problems. Three possible problems are discussed here.

(1) The most common problem with the automatic installation procedure is that the PATH and model environment variables do not get set correctly. A typical symptom of this situation would be that clicking on the red Tk icon produces an error message something like "Windows cannot find 'tclkit.exe' ..." even though tclkit.exe is in your SSASIM executables installation folder. To remedy this problem it may be necessary to set several environmental variables by hand. Follow the procedure below to do this:

Right click on the My Computer icon, select the Properties menu, and then click on the Advanced (or Advanced System Settings) tab and the Environmental Variables box. These operations will produce a window in which new User (not System) variables can be changed. Edit the PATH and add three new variables, using the Variable Name and Variable Value lines, so they look something like this:

```
VARIABLE:     VALUE:
PATH          C:\SSASIM;C:\PENSIM;C:\GEMINI
ssasim        C:\SSASIM
pensim        C:\PENSIM
gemini        C:\GEMINI
```

Be sure to leave no blank spaces in the value of the path variable. **Note that the above values for the variables are just examples.** When you specify the variable values, be sure to use the actual drive (`C:` or `D:` or some other letter) and directory tree (`\Users\username\SSASIM`, for example) that describe where the models have been installed. Also, note that this specification of the environmental variables will work just fine even if you do not install the PENSIM or GEMINI add-ons to SSASIM.

After specifying this change in the environment, the computer must be restarted before the new environment will become effective.

If following this procedure does not solve this problem, send an email to martin.holmer@gmail.com with details about the problem you are experiencing.

(2) Another type of problem is that the benchmark run starts executing, but ends with an error. If the error occurs during a benchmark run, simply select the View error.log file item on the RSF Toolkit Execute menu to view the error.log in the Windows Notepad. Send an email to martin.holmer@gmail.com with the contents of the error message copied into the body of the message.

(3) Another kind of problem is that the benchmark run starts and completes execution without an error, but there are differences between the output files produced by the run (run*.*) and the archive output files (rxn*.*) that are part of the model installation. In this case, send an email to martin.holmer@gmail.com with a list of the output files that have different results.

Solving Performance Problems. Given current computer hardware, the problem of slow run execution is likely to be severe only for OLC or RCS mode runs, particularly if those runs use stochastic assumptions. The solution to this problem is simple: run the PSG models on a computer with one or two

dual-core or quad-core chips and adjust the value of the SSASIM RUN.threads input database parameter to use all available cores. And if you need to increase run execution speed even more, use the distributed processing capabilities of the Linux version of the PSG models, which run on Amazon Web Services (AWS) computers that can be rented cheaply by the hour. The logistics of the distributed processing are handled automatically by the AWS Toolkit, which is available as part of the standard version of GEMINI.

Uninstalling the PSG Models. The model installation procedure does only four things: writes files into the specified installation folders, creates a program icon (for the RSF Toolkit), adds the three installation directories to the user PATH environment variable, and creates three model environment variables. You can do a complete model uninstall by deleting the installation folders and icon (by dragging the folders and icon to the Recycle Bin), removing the model installation directories from the user PATH, and deleting the three new model environment variables.

Information for IT Staff. The model install/upgrade programs are built with the Inno Setup 5 compiler ⟨http://www.jrsoftware.org/isinfo.php⟩. Along with the PSG model files installed on the user's computer, a program called SetEnv.exe ⟨http://xanya.net/site/display_code.php?id=2&t=utils⟩ is installed and used by the install program to set the PATH and the three model-name environment variables described above. There are a number of command-line parameters that can be used to customize the operation of the install/upgrade programs. A complete list of command-line parameters is available at the "Setup Command Line Parameters" page under Other Information on the Inno Setup help web page ⟨http://www.jrsoftware.org/ishelp/⟩. The most common customizations are described here using a few examples.

First, the model installation directory can be controlled, and the setup wizard's installation directory selection page can be suppressed, by invoking the install programs in the following way:

```
install-SSASIM.exe /silent /dir=D:\PSG\SSASIM
install-PENSIM.exe /silent /dir=D:\PSG\PENSIM
install-GEMINI.exe /silent /dir=D:\PSG\GEMINI
```

where the `/dir=...` parameters end with the model name, have the same parent directory, and contain no embedded blanks. If you use the `/silent` parameter, you must also use the `/dir=...` parameter.

Second, in the above example, the SetEnv.exe program sets the environment variables as system-wide (as opposed to user) environment variables. If, for some reason you want to have the environment variables set as user environment variables, then invoke the install programs using the `/userenvvars` command-line parameter.

If you have any suggestions about how to make the PSG model install programs easier to use by IT staff, please send email to martin.holmer@gmail.com with your thoughts.

Operation of PSG Models

This section of the primer provides answers to a number of "How do I ... ?" questions. It assumes that the PSG models have been installed and have passed the benchmark tests (see section on model installation that begins on page 6).

How do I start working with the models? Use the RSF Toolkit, which is started by clicking on the red "Tk" icon. Once the Toolkit has started, click on the Getting Started with the RSF Toolkit item on the Help menu to read a short tutorial.

How do I perform policy analysis with the models? Policy analysis typically compares the results of two runs: one of which specifies a reference policy (often current-law policy) and the other of which specifies a reform policy, with all other aspects of the two runs being the same. Using the models to do policy analysis involves repeating a three-step cycle: specify a model run, execute the model run, and analyze the output of the model run. The RSF Toolkit provides access to all three activities in this policy analysis cycle. The RSF Toolkit automates the process of run specification, provides capabilities of executing runs that have been specified, and provides access to several other Toolkits that automate the process of analyzing output produced by executed runs. There are three output analysis toolkits: (1) the TFS Toolkit automates the analysis of solvency consequences of reforms, (2) the EDA Toolkit automates the analysis of distributional consequences of reforms for a representative cohort sample, and (3) the ECI Toolkit automates the analysis of distributional consequences of reforms for a handful of exemplary cohort individuals.

How do I backup my work? Use the RSF Toolkit backup capability to archive all run specification files, and other model-related files, in a zip file. This archive file should be stored somewhere safe: on a network drive that gets backed up every night or on a CD or in the cloud.

How do I ... ? ...

PLEASE SUBMIT SUGGESTED "HOW DO I ... ?" QUESTIONS TO martin.holmer@gmail.com