Understand Scenarios in IFs

Introduction to Scenarios

A scenario is a story or story outline. Thinking about the future normally involves creating alternative scenarios, or stories, about the possible evolution of drivers. Some such scenarios are exploratory and consider the possible unfolding of different futures around key uncertainties, such as the rate of some aspect of technological advance or the fragility of some element in the global environment. Other scenarios are normative and develop stories about preferred futures, such as a global transformation to sustainability.

Scenarios in a computer model typically are built from multiple interventions that collectively help build a coherent story about the future. Often, but somewhat imprecisely, the word scenario is used more loosely to refer to any intervention (such as the change of a fertility rate for a country or an alternative assumption about oil resources).

Scenarios or interventions with respect to what? When IFs or other computer simulations are "run", without making any changes to parameters or initial conditions specified as the default values, they generate a forecast that is typically called the base case (sometimes reference run). The IFs base case, always available when a model session is initiated, is itself a scenario. Sometimes the base case is incorrectly referred to as a trend extrapolation or a "business as usual" scenario. More accurately, however, the base case of IFs is a computation that involves the full dynamics of the model and therefore has very nonlinear behavior, often quite different from trends. It is a good starting point for scenario analysis for two reasons. First, it is built from initial conditions of all variables that have been given reasonable values from data or other analysis. These initial conditions and parameters make up the package of interventions that constitute the base case scenario. Second, the base case is periodically analyzed relative to the forecasts of many other projects across the range of issue areas covered by IFs and sometimes "tuned" to reproduce the behavior of respected forecasters.

Change initial conditions and parameters using the Quick Scenario Tree to create scenarios beyond the base case. Adjust parameters to make specific intended interventions, for example use the Government Spending by Destination and Sector multiplier parameter gdsm to increase government spending in education. A detailed guide of the different parameters and their potential uses can be found in the Guide to Scenario Analysis.

Use the Quick Scenario Tree to create and save two different kinds of files: Scenario-Load-Files (.sce) and Run-Result-Files (.run). The Scenario-Load-Files files represent changes that were made to the scenario tree but that were not yet entirely run through IFs software. The Run-Result-Files represent files that were originally changes to the scenario tree that were eventually entirely run through IFs software. The running of a Scenario-Load-Files file will make those changes permanent and therefore produce a Run-Result-File.

In addition to the base case, some versions of IFs will include a number of other previously-run scenarios, perhaps the set of scenarios for the National Intelligence Council's (NIC) 2020 Project or those for the five Shared Socioeconomic Pathways. In the **Scenarios** drop down in Flex Displays, a list of previously-run scenarios is shown before any new scenarios are run. Because those have already been run, based on a set of interventions constituting their foundations, their results can already be displayed.

Parameter Types

Parameters are numbers that determine relationships among variables in the equations of IFs. Parameters are often set to a single value across time and they therefore do not always "vary" as do "real" variables. Many parameters are "policy handles," the value of which is set in order to determine the behavior of the model. In IFs parameters are written in lower case form such as endemm and variables are written in upper case such as ENDEM. There are several types of parameters that include:

Multipliers. They have a normal value of 1. To increase whatever they multiply (say agricultural yield with ylm agricultural yield multiplier) by 50 percent increase the parameter to 1.5. To decrease it by 25 percent decrease the multiplier parameter to 0.75. Such changes are almost always spread out over time, keeping the multiplier's value at 1 in the base year and gradually increasing or decreasing it over a period of years. Never (or only under certain circumstances) change a multiplier in the initial year. The model is set up to provide accurate results for the first year and will compensate for and thereby offset changes. For instance, a multiplier on food production set equal to 1.5 for the first year and all years thereafter, may lead to results that are no different than in the base case. Instead gradually introduce a change, preserving the multiplier value of "1" in the initial year. Examples of multipliers include: enpm (energy production multiplier), or tfrm (total fertility rate multiplier). Note that multipliers typically end with the letter "m".

Additive Factors. Most have a normal value of 0, thereby leaving what is added (ex. exports) unchanged. The parameter number to achieve a 50 percent increase depends on the amount that the target variable is starting at. Most additive parameters are, however, applied multiplicatively to the quantity they modify (that is, 1 plus the additive parameter is multiplied times the quantity), thereby scaling the parameter. In that case, the base or normal value of the parameter will be zero, but a 50 percent increase in the quantity modified can be achieved with a parameter value of 0.5 and a 50 percent decrease with -0.5. Never (or rarely) change the base year value of additive parameters because it will either incorrectly change model results in the base year or, more likely, will result in model compensation to protect initial model results. An example of an additive parameter is: xshift (export shift as a result of the promotion of exports). Although earlier versions of IFs used additive factors and multipliers with comparable frequency, most additive factors have been replaced by multipliers to standardize parameter change.

Exponents. For instance, many "elasticities" raise a variable to a power. For these parameters the "normal value" will vary greatly, but they will most often fall between -2 and 2, with many clustering around 0. In most cases it will make sense to change these parameters for all years including the first - generally the model will not use them in the first year and they will affect results only in subsequent years. Examples include: elass (elasticity of energy supply to profit), and engel (Engel's coefficient on personal consumption).

Growth Rates. It is possible to force some processes to grow at specified rates. More commonly, the specified rates serve as targets and the dynamics of the model often shift actual growth rates toward the target, necessitating experimentation with targets to achieve a desired growth. Examples include: eprodr (energy production growth rate) and tgrld (target growth in cultivated land).

Transforming coefficients. Some coefficients transform units of variables, for example, change a unit values from positive to negative for carfuel1 (carbon generated from burning oil) to simulate technology change in sequestration.

Variables. This category should technically not be called parameters at all. They could and would be computed endogenously, if the model included the appropriate theoretical structure. They generally do not determine the interaction of other variables. Some variables values can be set exogenously, similar to parameters. Examples in IFs are: AQUACUL (agricultural fish production) and GOVDEBT (government debt as a percentage of GDP).

Initial conditions. Again, these are not strictly parameters, but rather first-year values for variables subsequently computed by the model. Although many initial conditions, like the population (POP) of the U.S., are sufficiently well-known that they should not be changed, others, like the ultimate availability of oil and gas resources are only reasonable guesses. Change some initial conditions based on new data or even simply to test the implications. This category includes a great many variables, such as: resor (ultimate resource of fossil fuels) and igdpr (initial GDP growth rate).

Switches. These parameters turn something on or off. They generally take on values of 1 (on) or 0 (off), but can have additional settings. For instance, some switches not only turn on some process, but set a key value within it (like the level of energy exports). Switches are most often on or off for the entire run, but it sometimes makes sense to "throw a switch" in the middle of a run. Switches fundamentally alter the structure of a model. Switch examples include: agon (agriculture economy linkage) and squeez (economic impact of energy shortage).

Reactivities. These are factors that relate growth in one process to growth in another. Although many will range between -2 and 2 (with 0 eliminating linkage of the processes), some have very large values. They are very much like elasticities, but the formulations that use them do not have exponential form. Examples include: cdmf (civilian damage factor in war; to a portion of the economy), reac (reaction of countries in military spending to a threat of another).

Allocating coefficients. Coefficients are often used in multiplicative relationships with other variables, but many such coefficients are not what were earlier called multipliers (with a base value of 1). Instead they can serve an allocating role. For instance, to allocate governmental spending to health, education, and the military. Allocating coefficients frequently have values between 0 and 1. Again, generally do not change these parameters in the initial year because the model will often compensate for changed values in the first year. Instead, change them by series over time. Examples of allocating coefficients in IFs include: aidlp (foreign loan portion of aid), and drcpow(depreciation rate of conventional power).

Relationship Parameters. These parameters alter or set relationships between two parameters or variables. These parameters may also be captured in another grouping described above, for example elasminc (elasticity of imports to income level).

The focus here is on exogenous parameters only - on those elements of the model that can be manually changed. Many computed variables are used in the computation of other variables in the same way that parameters are, as multipliers, additive factors, coefficients, and so on. These can be displayed too, but unlike true parameters, they cannot be changed.

Understanding Model Computations

It is critical that there be as much transparency as possible with respect to computations that underlie the variables chosen for display. In a large, integrated model, achieving such transparency is not simple. Look at the pages under the extensive Help section called "'Understand IFs" for extensive documentation via flow charts, equations, and computer code.

While working with display of variables, however, there are several ways in which to drill down for explanations of what lies behind their computations. After a variable or parameter is added to the Quick Scenario with Tree, learn more about how a parameter or variable is generated by clicking on it and exploring the options.