

GRIF 2012

Markov Graph



User Manual

Version 27 March 2012

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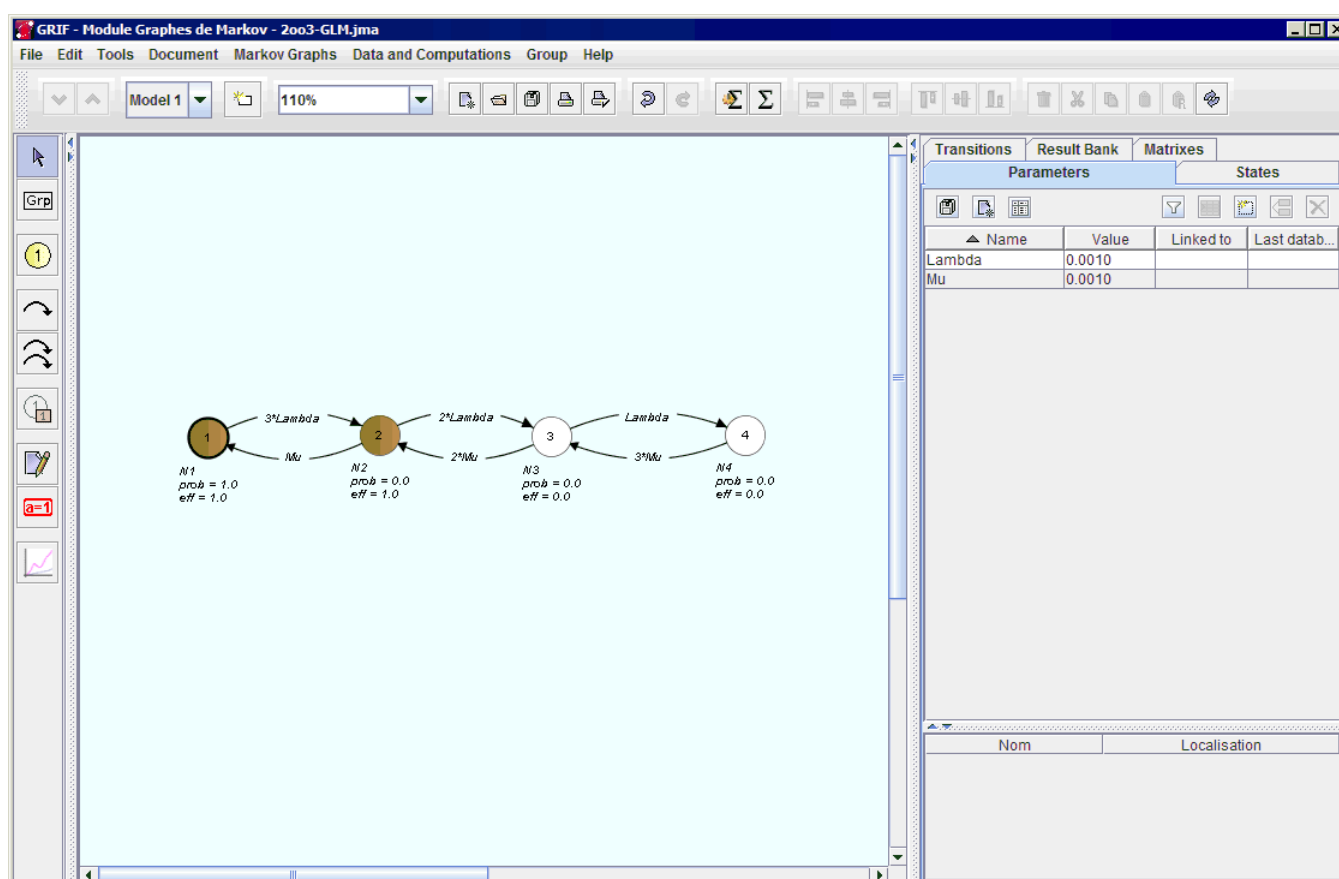
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1. Presentation of the interface

1.1. Main window of the Markov Graph module

The main window is divided into several parts:

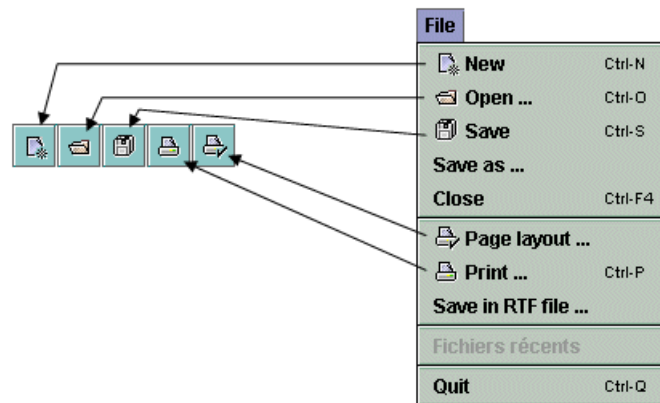
- **Title bar:** The title bar shows the names of the module and file being edited.
- **Menu bar:** The menu bar gives access to all the application's functions.
- **Icon bar (shortcuts):** The shortcut bar is an icon bar (horizontal) which gives faster access to the most common functions.
- **Tool bar:** The tool bar (vertical) allows you to select the elements for modeling.
- **Input zone:** A maximum amount of space has been left for the graphical input zone for creating the model.
- **Tree:** A tree is "hidden" between input zone and tool bar. It enables to walk through pages and groups of the document.
- **Set of tables:** Tables are gathered in "hidden" tabs on the right.



1.2. Description of the Menus

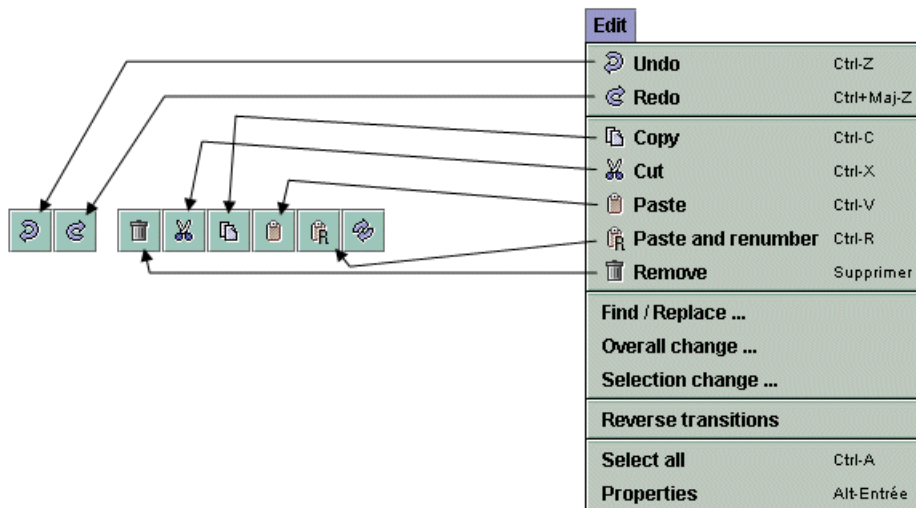
1. The **File** menu contains the standard commands used in this type of menu (open, close, save, print, etc.). The properties (name, creation date, created by, description, version) can be accessed and modified by selecting **Document properties**. The **Document statistics** provide information on the model's complexity. It is also possible to access a certain number (configurable) of recently modified files.

The icon bar just under the menus proposes shortcuts for most of the **File** commands:



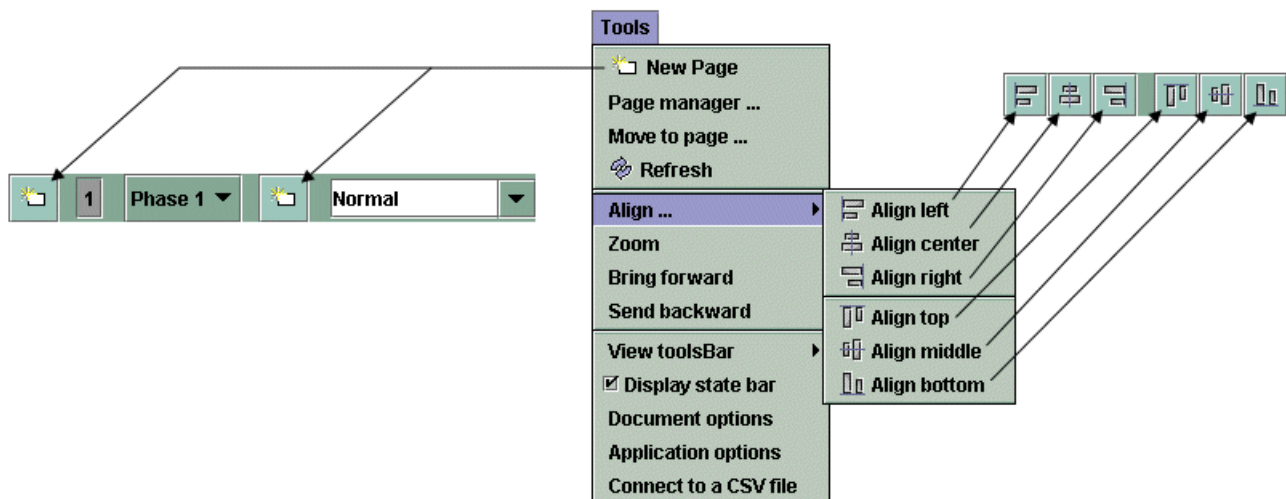
2. The **Edit** menu contains all the commands needed to edit the model being input graphically.

The icon bar just under the menus proposes shortcuts for most of the **Edit** commands:

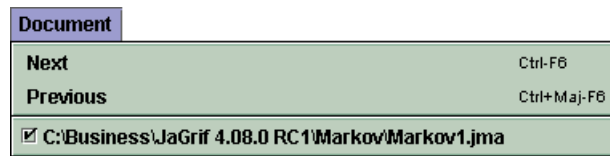


3. The **Tools** menu contains all the commands needed to manage the current model (page management, alignments, options, etc.).

The icon bar just under the menus proposes shortcuts for most of the **Tools** commands:

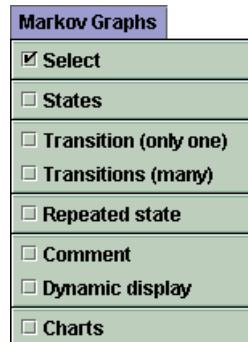


4. The **Document** menu gives access to all the documents being created or modified.

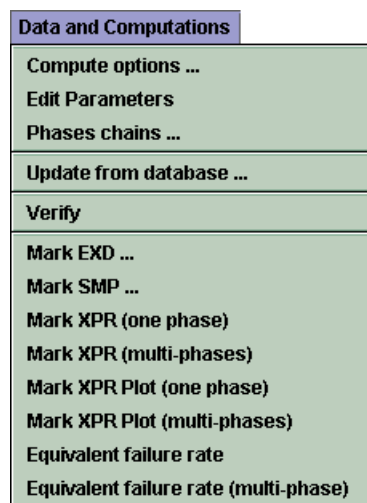


5. The **Markov Graph** menu contains all the commands needed to produce the graphical part of the current model.

The vertical icon bar on the left of the application provides shortcuts for each of the **Markov Graph** commands (cf. vertical tool bar).



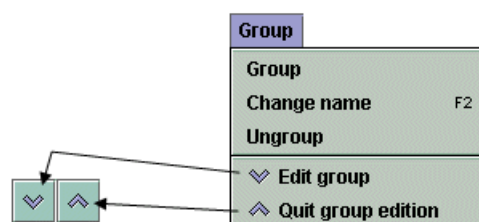
6. The **Data and Computations** menu is divided into two parts: data management (creation and management of the different parameters) and configuration/computation launch (computation time, desired computation, etc.).



NB: The **Verify** function detects any errors in the model: data without values (equal to **NaN**), states with an identical number, etc.

7. The **Group** menu concerns the input and management of submodels grouped into independent subassemblies.

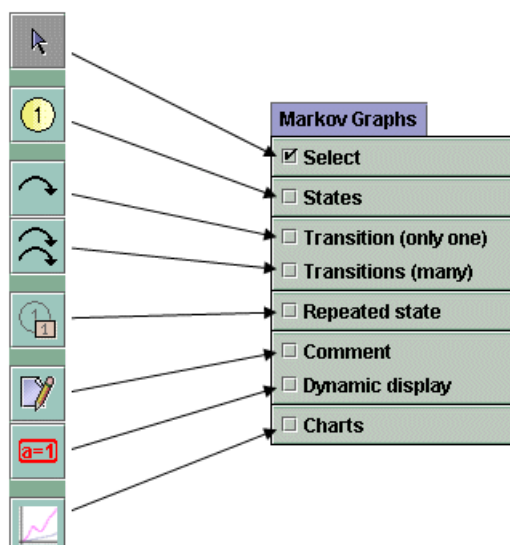
The icon bar just under the menus proposes shortcuts for two of the **Group** commands:



8. 9. Finally, the **Help** menu accesses the on-line Help, the Help topics and to "About".

1.3. Vertical toolbar

Each model used for operating safety has its own icons. All of the graphical symbols for the Markov graphs are shown on the vertical icon bar on the left of the input window.



The vertical toolbar contains the following items:

- **Select** to select the desired elements.
- **States** represented by circles.
- **Transitions** represented by arrows with two possibilities of input: one transition at a time or several transitions in a row.
- **Repeated state** to duplicate a state in order to add links between the different parts of a same model (on different pages or groups).
- **Comment** to directly add text to the graphic.
- **Dynamic display** to display the value of a model element.
- **Charts** to draw curves representing computations on the model.

2. Creating Markov's graph

2.1. Entering the graph

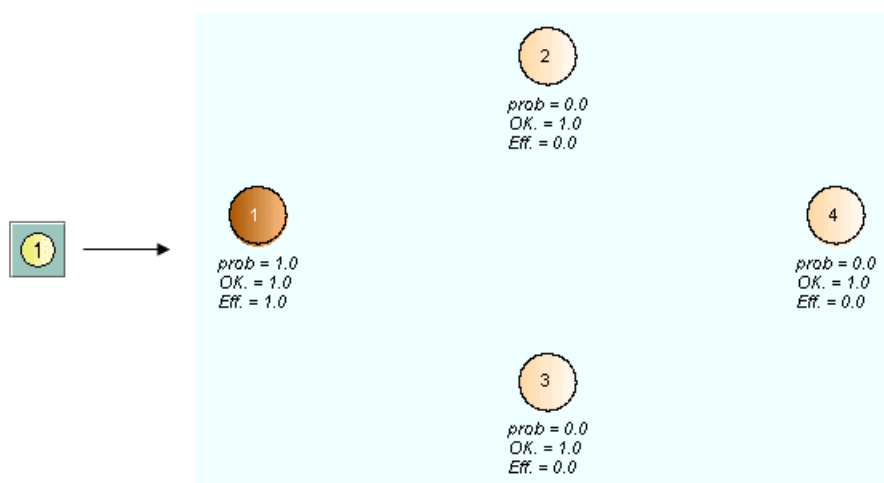
2.1.1. Entering states

To enter the various **States**, select the corresponding symbol on the vertical toolbar. A new element is then created whenever you left click on the graphical entry area. Each of the graph's states has five parameters:

1. A **number**: this number (located at the centre of the circle representing the states) is automatically generated and in principle, you do not have to modify it. It is the true identifier of the state (the one that will be used by the computation engine). This is why, when you wish to change the number of certain states, you must remember that two states cannot have an identical number (no duplicates). The numbers of all of the states of the graph must imperatively be consecutive.

Note: numbers are automatically incremented as new states are created.

2. A **name**: it is just a succession of characters, which can be changed at will, and which does not undergo any specific verification. It simply makes it easier to read and understand the model. By default, states do not have names.
3. An initial **probability**: it is the probability that the system being studied will be in this state at time $t = 0$ (value necessarily found between 0 and 1). You must remember that the sum of the initial probabilities of all the states in the model must also be equal to 1. If this is not the case the computation engine will detect an error. The states that have a probability that is not equal to 0 will be represented in brown (the others will be in beige).
4. A **comment**: this field adds text below the state. This function makes the model more legible (by giving the specific features of the elements for example).
5. **Properties**: a change in the value of the variables can be associated with each state. Each state has two default properties that are **Eff.** and **OK.**.



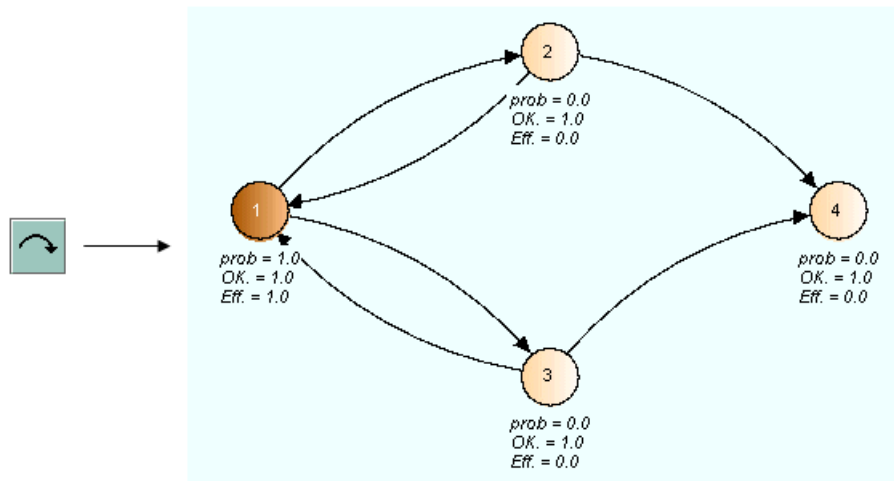
By default, the first state created is given an initial probability and efficiency (variable **Eff.**) that are equal to 1. The other states are given a default initial probability and efficiency that are equal to 0.

2.1.2. Entering transitions

Once the various states of the system have been created, they have to be interconnected by directional arcs to establish the Markov graph's logic. To make these connections, called **Transitions**, simply:

1. click on the corresponding icon on the vertical tool bar;
2. select a start element by a left click on the circle and hold the button down;
3. drag the mouse to the arrival element
4. release the button.

Each of the transitions in the model is characterised by a **Transition rate** which is the value of the parameter of the exponential law that governs the random aspect of the represented change of state. For each of the model's arcs, this value appears at the centre of the curve.



NB: the above icon makes it possible to create only one transition at a time. If you wish to create several in a row without having to reselect the transition creation icon, you can use the icon which is right below: **Transitions (several)**.



It is important to note that by default, the curve of the arcs is defined as follows:

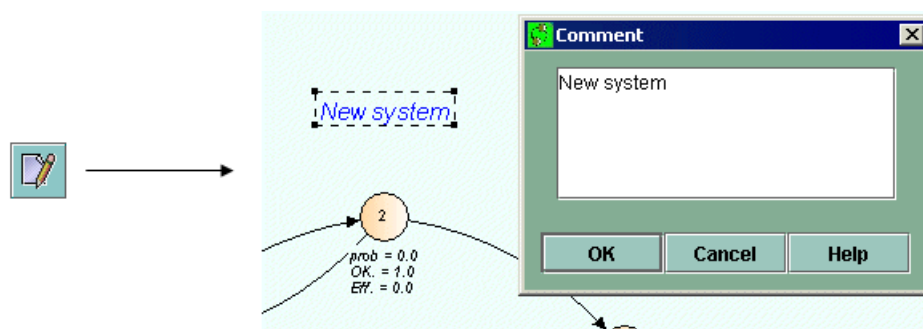
- the arcs drawn from left to right have a convex-upward shape;
- the arcs drawn from right to left have a convex downward shape.

If necessary, you can then modify this property "manually" (see further on)

2.1.3. Entering Comments

To add a comment anywhere on the chart, click the pencil icon and place yourself on a point in the graphical input zone. The **Comment** dialogue box opens where you can enter the desired comment.

Note: Character "%" is a reserved character, it must be type twice "%%" in order to display "%".

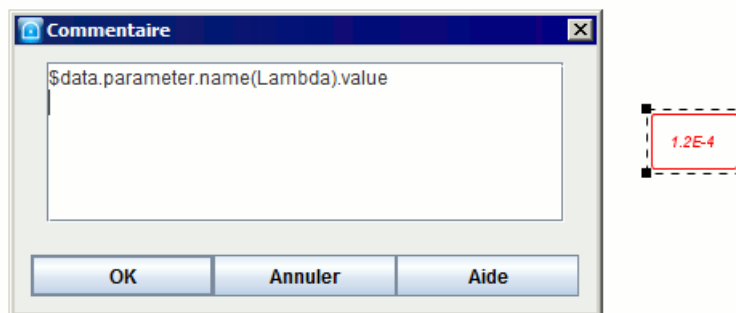


2.1.4. Dynamic fields

It may be useful to observe the change in the different parameters of the model. It is also useful to see a result next to its corresponding system. To do this, use dynamic fields by selecting the corresponding icon on the vertical tool bar:



The dynamic fields are a type of "improved comments". They can be used not only to enter words or phrases but also to insert model values or results.



If you want to display informations about a data of the model, you must use the following syntax:

`$data.'type of data'.'field used o search data'('value that the field must match').'information you want to display for the selected data'`

We can analyze the above windows as follows: I am looking for a "parameter" which "name" is "lambda", and I want to display its "value". When you type the first letters, a completion system helps to type script without error.

If you want to display a result of the result-bank, the syntax is the following:

`$result.bank('path in the bank').target('target result').'what you want to display'.'at what time'`

We can analyze the next picture as follows: I am looking for a result which path in the bank is "default-Moca", I want results for "TS3 for 'available' variable" and I want its value for the "last" time. If last is replaced by time(10) we obtain value at t=10.

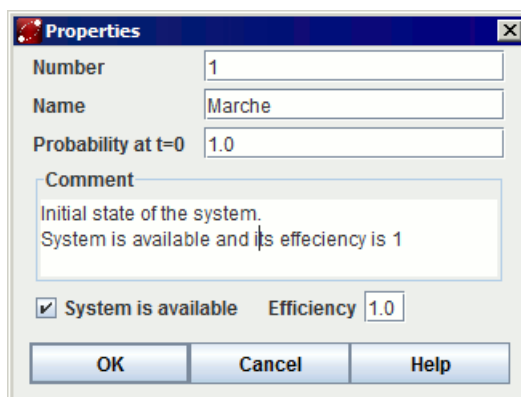


2.2. Configuring the elements

All the graphical elements can normally be edited with a double-click on them or using the **Edit - Properties** menu, or using the shortcut **Alt + Enter**.

2.2.1. Configuring the states

When you click right on a state, you can modify any one of these parameters:



The 'Properties' dialog box for a state contains the following fields and options:

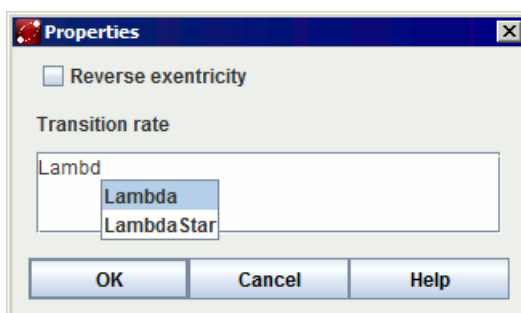
- Number:** 1
- Name:** Marche
- Probability at t=0:** 1.0
- Comment:** Initial state of the system. System is available and its efficiency is 1
- System is available** Efficiency: 1.0
- Buttons: OK, Cancel, Help

- change the **number** (making sure not to give a number already being used by another state);
- change the **name**;
- change the **probability** (remembering that the sum of probabilities of all the states in the model must be strictly equal to 1);
- read and/or modify the **comment** part;
- specify if system is available or not;
- specify efficiency (between 0 and 1) of the system in this state;

2.2.2. Configuring the transitions

When you click right on a transition, you can modify its various parameters:

- invert (or not) the eccentricity of the curve by ticking (or un-ticking) the corresponding box;
- enter (or modify) the **transition rate**.



The 'Properties' dialog box for a transition contains the following fields and options:

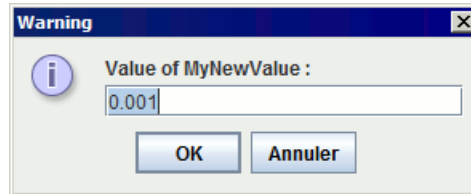
- Reverse exentricity**
- Transition rate:**
 - Lambda
 - Lambda
 - Lambda Star
- Buttons: OK, Cancel, Help

The transition rate of an arc can take on several forms. It can be:

- a real number (e.g.: **0.000412**);
- un parameter (e.g.: **Lambda1**);

- a formula (e.g.: $2*L1$ or $L1 + 0.5*L3$ or $2*(L1 - L2)$).

In the case where the inputted transition rate includes a non-existing parameter, a window appears in which you can give it a value. For example, if you type **NewValue** in the transition rate window and that this element does not yet belong to the table of parameters, the following window will appear:

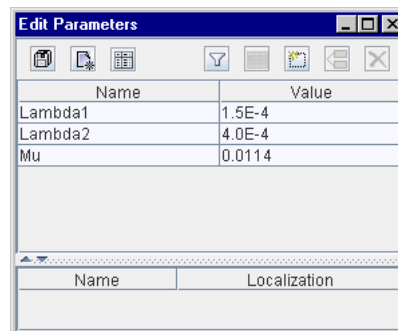


Once the value has been entered, the parameter **NewValue** can be found in the parameter table.

2.3. Data Editing Tables









2.3.1. Description of the Tables



To create or modify data (parameters, variables, etc.), tables are available in the **Data and Computations menu**. All the GRIF 2012 data tables operate in the same manner.



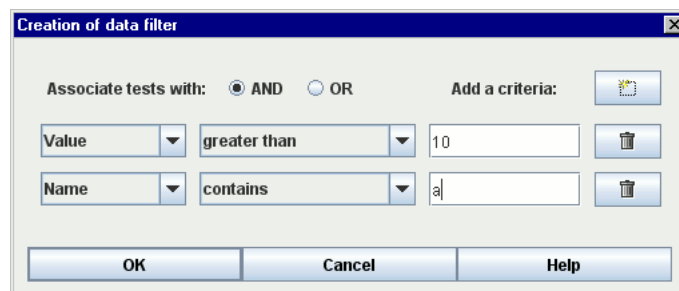
The data editing table/panel is divided into 3 parts:

- The top part containing the buttons.
- The main part containing the data table.
- The bottom part indicating what the selected data is used for.

	Saves the table in a text file.
	Opens the table in a text editor (that defined in the Options).
	Opens the column manager.
	When the display selection button is pressed, a click in the table leads to the selection in the input area.
	Displays the data filtering part.
	Multiple modifications made to all the selected data.
	Creates new data.
	Deletes the selected data (one or many).

	Enables data filtering or not.
	Defines the filter to be applied to the data.

Filtering allows you to display only what is necessary in a table. Several filtering criteria can be combined, as shown below:



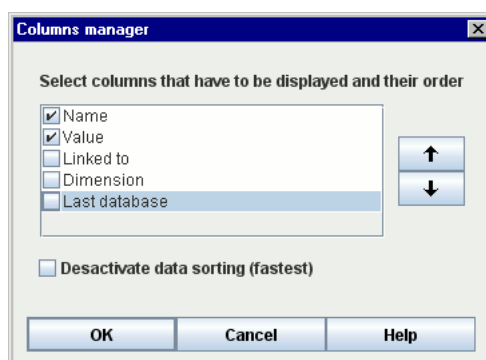
Select **AND** or **OR** to choose the type of association between each line (filter criterion). A line is a Boolean expression divided into 3 parts:

1. the first is the column on which the filter is used;
2. the second is the comparator;
3. the third is the value to which the data will be compared.

If the Boolean expression is true, the data will be kept (displayed); otherwise the data will be masked. When the filter is enabled its value is displayed between < and >.

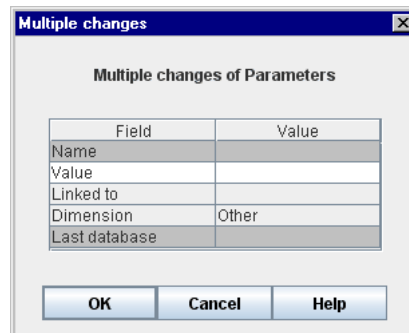
The data in a column can be sorted by double clicking the header of this column. The first double click will sort the data in ascending order (small triangle pointing upwards). The second double click on the same header will sort the column in descending order (small triangle pointing downwards).

A table can contain many columns, some columns may be unnecessary in certain cases. The "linked to database" column is unnecessary when no database is available. It is thus possible to choose the columns to be displayed and their order. To do this, click right on a table header, or click the **Columns Manager** button, the following window opens:



You can choose the columns to be displayed by selecting (or deselecting) the corresponding check boxes. The arrows on the right are used to move the columns up or down in the list to choose the order of the columns. The **Disable data sorting** check box disables the data sorting. This improves the application's performance with very complex models.

To modify data, double click the box to be modified. When several lines are selected (using the CTRL or SHIFT keys) changes can be made to all the selected data by using **Multiple changes**. A window then opens to allow you to make these changes.



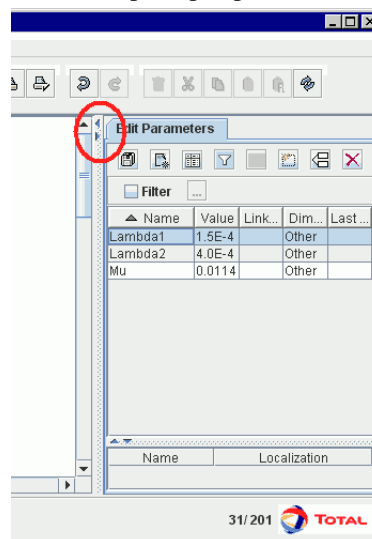
Items which cannot be modified are greyed. The white lines indicate that the selected data does not have the same value for the field in question. A new value can be entered which will be taken into account for all the selected data. The lines with no background colour indicate that all the selected data has the same value for this field (in this example the selected data is all "Float"); they can be changed to give a new value to all the selected data.

The bottom table in the data table indicates which elements in the model use the selected data. The first column of this table gives the name of these elements; the second indicates their location in the document (page, group). Clicking on a line in this bottom table opens the page where the element is located and selects the element.

2.3.2. Arrangement of tables

As said before, tables are available in **Data and Computations** menu, In this case, each table is opened in a separate window.

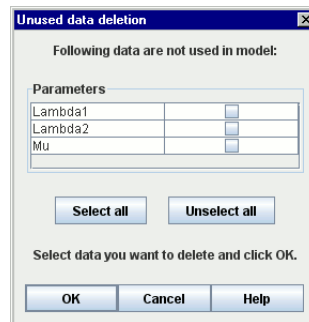
To decrease number of opened windows, tables are gathered in a tabbed pane at the right of the application. The pane can be "hidden" with the little arrows at the top of split-pane.



You can chose displayed tables with a right clic on the title of the tabs.

2.3.3. Table Cleaning

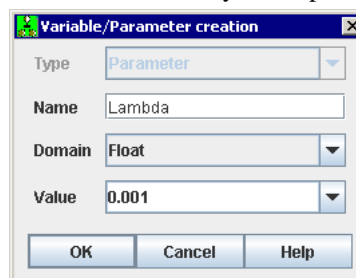
Data may not be used anymore, it can be used usefull to delete every unused data. To facilitate removal, use **Data and Computations / Unused data deletion** menu.



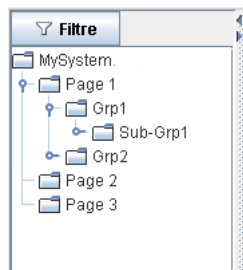
This window displays unused data. Select data you really want to delete and click OK.

2.3.4. Data creation

The **Parameter editor** is used to create "real" parameters. The following window is only used to choose the name of the new parameter. Its value must be entered later directly in the parameter table.



2.4. Arborescence



To help users to walk through the document (pages, groups and sub-groups), a tree is available at the leaf of the application. By default, every element is displayed, you can use **Filter** button in order to select elements you want to display or not.

You can expand or collapse a node in a recursive way with a right click on the node.

As explained for tables on the right, you can "hide" the tree.

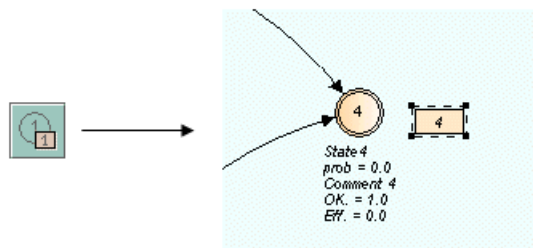
2.5. Shortcuts to the states (repeated states)

The concept of a **shortcut** (or repeated element) was introduced in the Markov Graph module for four main reasons:

- To link together portions of the model;
- To avoid graphically complex model, and keep readability;
- To simplify the use of the **Group** function (cf. below);
- To highlight what is essential and what is not.

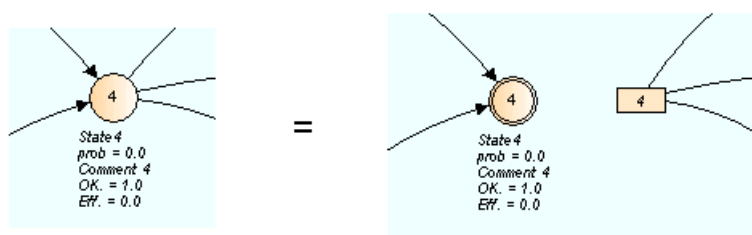
Let a state be called **State4**. To create a shortcut to this state, simply:

1. select the corresponding icon on the vertical toolbar;
2. click on the state to be duplicated.



Note: when a state has been shortcut, it is marked with an inner circle.

Although linked from the "computational logic" point of view, the two states are now graphically completely independent. They can now be placed on different pages or in different groups (see further on).



Note: obviously, if the original state is deleted then its shortcut is also deleted.

2.6. Page and group management

The use of shortcuts allowed us to obtain two Markov Graph which have no graphical link between them. They communicate only by **shortcuts**. This can be used, for example, to place each subpart on a different page:

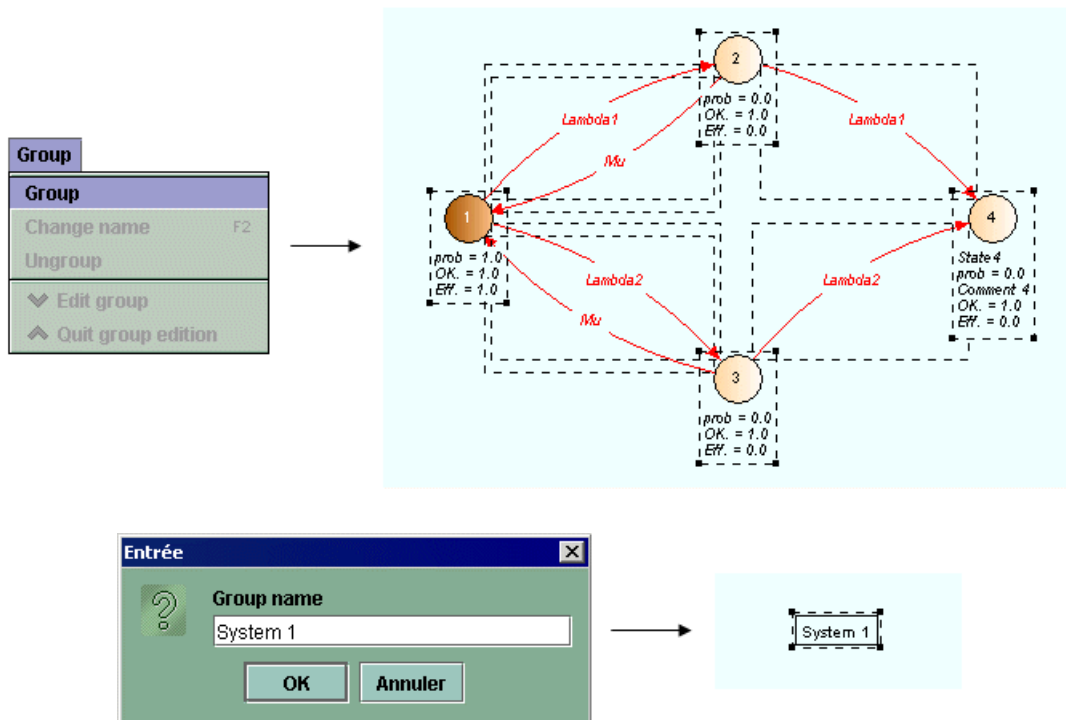
1. Create a new page by clicking the corresponding icon in the icon bar (or use menu **Tools - New Page**). A page number 2 is thus created.
2. Return to page 1 by selecting the page using the page selector in the ideographic command bar (or use menu **Tools - Page manager**).
3. Select the part to be moved.
4. Open menu **Tools - Change page**.
5. Select page 2 and click **OK**. The part selected is transferred to page 2 but it continues to communicate with page 1 via the **shortcuts**.

Note: For large models the division method described above is very useful.

Another possibility for entering large Markov Graph is to use the **Group** concept. This is made possible by the **shortcuts** and the fact that the data is global for a document. This allows quite separate subparts to be created:

1. Select a subpart.
2. Use menu **Group - Group**. A dialogue box then opens asking for the name to be given to the group being created.
3. Enter the desired name and click **OK** (e.g.: "System 1"). The group is created: the subnet is replaced by a rectangle assigned with the chosen name.

You can also create an empty group with **Group - New Group** menu or group tool in the left toolbar.



Each group can then be **edited**, **renamed** or **ungrouped** using the commands in the **Group** menu. The group can also be edited with a click right or using the "cursor down arrow" on the left of the page manager. In Edit mode, the submodel can then be modified as you wish. When the modification is terminated you return to the previous figure by exiting group editing by menu **Group - Quit Group Edition**, or using the "cursor up arrow" on the left of the page manager. It's also possible to choose a picture for a group by using **Group - Change Picture** menu.

Note: Groups can be grouped recursively.

2.7. Data Entry Aids

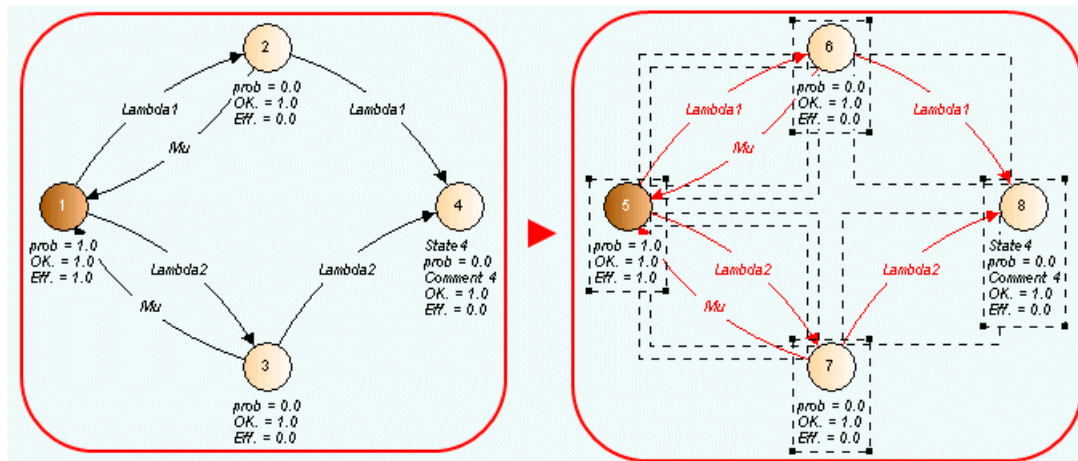
To simplify model creation the Markov Graph module has different data entry aids to automate time-consuming operations.

2.7.1. Copy / Paste / Renumber (without shortcut)

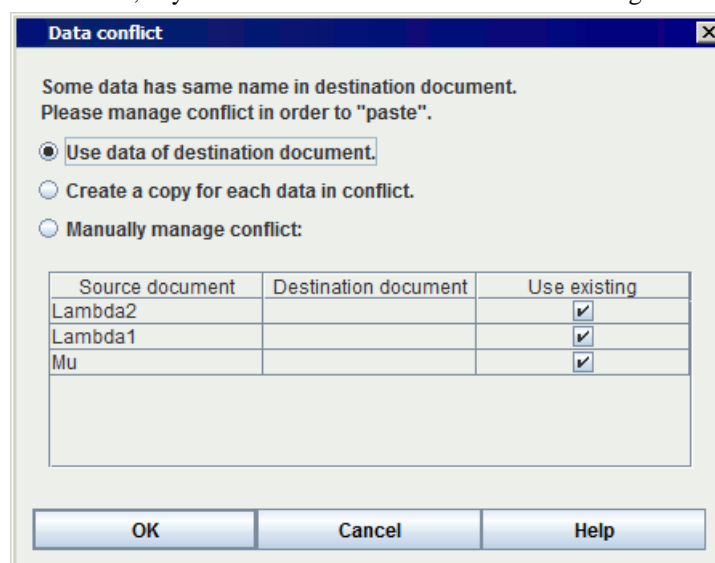
To assist with the entry of the repeated parts of the Markov Graph "Copy / Paste and Renumber" mechanisms have been provided. This operation is carried out in 6 steps:

1. Select the part to be copied.
2. Click the **Copy** icon, or use menu **Edit - Copy** or the shortcut Ctrl + C.
3. Click the **Paste and Renumber** icon, or use menu **Edit - Paste and Renumber** or the shortcut Ctrl + R.
4. A window appears where you choose the start number for the renumbering.
5. The previously selected part is copied and the copy is selected.
6. Move the copy to the desired location.

In the above example, each one of the graph's states has been renumbered for the copy. It is the only modification to have been carried out. The comments, the names of the states, the values of the transition rates, etc. have not been changed.



When copying to a new document, any data conflicts are handled in the following window:



This window shows all the data which has the same name in the source document and the destination document. There are three choices:

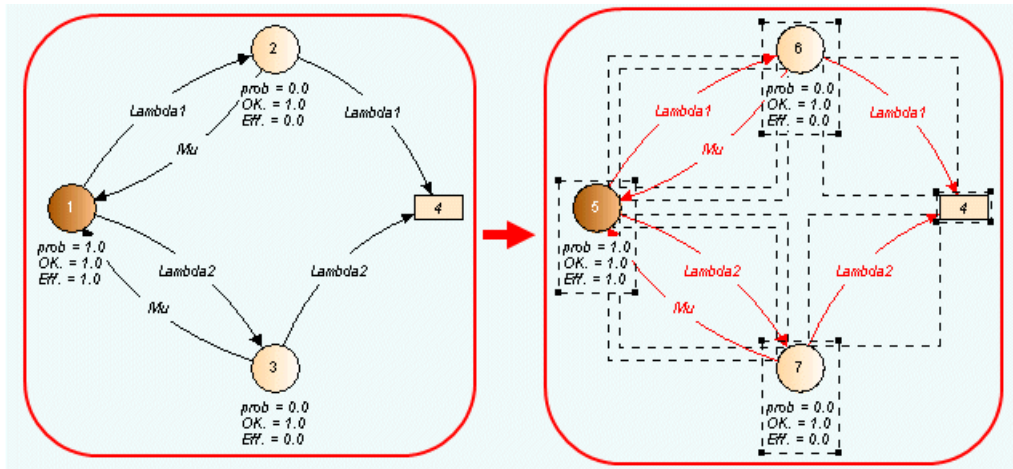
1. Use data of destination document, this will replace the occurrences of the data in the source document by the data with the same name in the destination document.
2. Create a copy for each data in conflict, this will replace the occurrences of the data in the source document by a copy with a name with the suffix "copy".
3. Manually manage conflict, this allows you to choose whether you use the existing data or not, depending on the data. You can also specify the name of the copy by double clicking on the box in the "destination document" column. The names in this column are normally masked when the **Use existing** check box is selected, since it is the data which is already in the destination document which will be used.

2.7.2. Copy / Paste / Renumber (with shortcut)

The "Copy / Paste and Renumber" command creates new "instances" i.e. new sub-graphs similar to the sub-graphs copied:

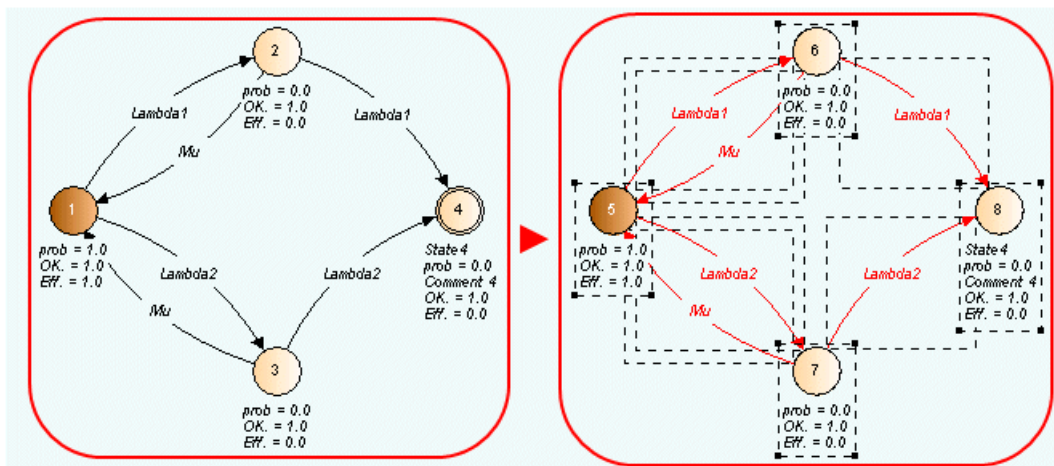
- Same graphical structure;
- Same parameters;
- The states' numbers change;
- Same comments.

When repeated states are part of the selection to be copied / pasted and renumbered, they will remain unchanged in the copy. They will always point towards the same state if the latter is not part of the copy.



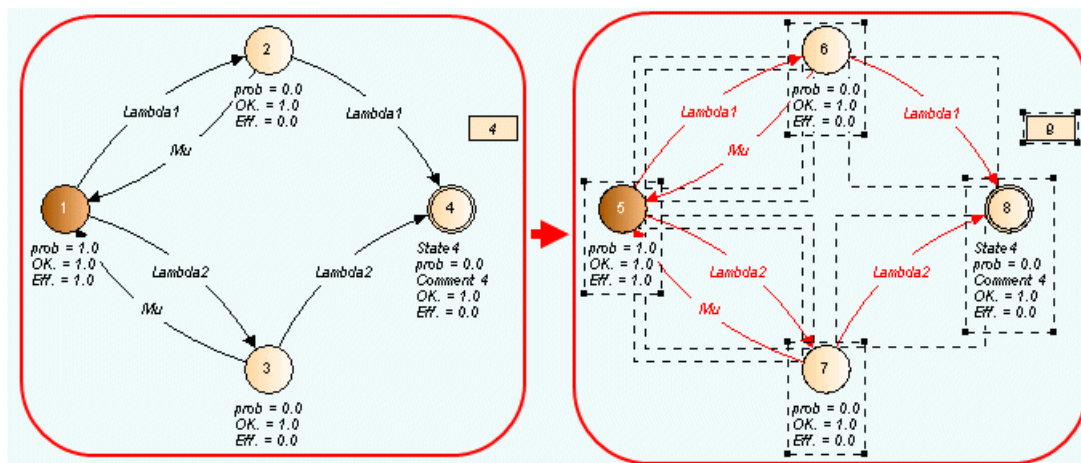
In the above example, all of the states have been renumbered. The shortcut to state 4 has not been modified.

When a state that has been shortcut is part of the selection to be copied/pasted and renumbered but the shortcut itself is not included, it will be renumbered in a classical fashion.



In the above example, all of the states have been renumbered normally. State 4 has given a new state for the copy that has no particular specificity

When shortcuts and their initial state are part of the selection to be copied/pasted and renumbered, new shortcuts will be created that will be linked to the new states.



In the above example, the state that has been shortcut has been renumbered (4 -> 8) so its shortcut has also been modified.

You can navigate between an element's different shortcuts, using menu **Tools/Navigate to shortcuts**. A window opens and displays the list of shortcuts. Clicking on a shortcut automatically positions the view on this shortcut. You can return to the original element by clicking on its name at the top of the window.

2.7.3. Ordinary Copy/Paste

In addition to the "Copy / Paste and Renumber" command there is an ordinary "Copy / Paste" function. It is used to make a single copy without renumbering. We thus obtain double elements which, from a formal viewpoint, is incorrect but which must be temporarily tolerated to simplify data entry.

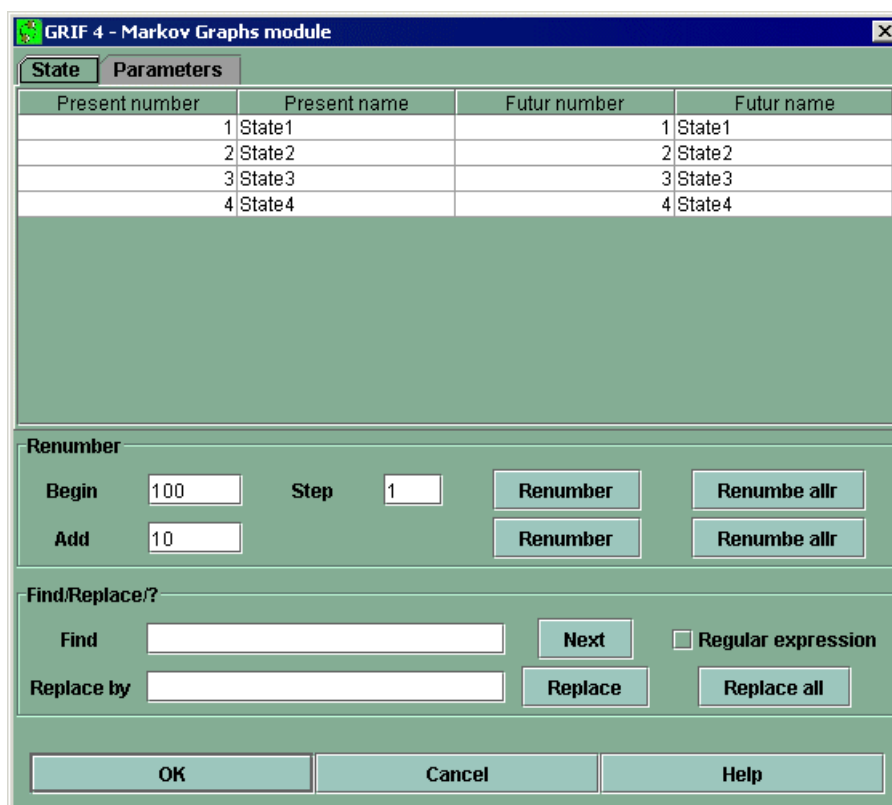
Where possible, the "Copy / Paste and Renumber" function must be used in preference to the simple "Copy / Paste" function to minimise the risk of errors. But when it is used you must take the necessary precautions to re-establish the correct numbering to eliminate the duplicates.

2.7.4. Overall change

When creating the Markov Graph it may be necessary to change a large part of the elements in the models: changing the names, numbers, etc. The "Replace all" function in the **Edit** menu allows you to perform overall changes:

- Use the **Edit / Overall changes** function.
- Choose the type of elements to be modified among available tabs.
- The "Find / Replace" part changes a character string present in one or more variable labels, place labels or transition labels. It is replaced by the string entered in the "Replace" part.
- The "Renumber" part only concerns the places. It is used to change place numbers. You indicate a **Start** number then specify a constant **Step**, or **Add** a constant value to the current numbers.
- Click **OK** to return to the chart. The changes are validated.

Note: The name changes and renumbering can be done manually if the necessary precautions are taken (avoiding duplicates, etc.). You click the **Future number** or **Future name** column and enter the change. Do not forget to validate it with the "ENTER" key.



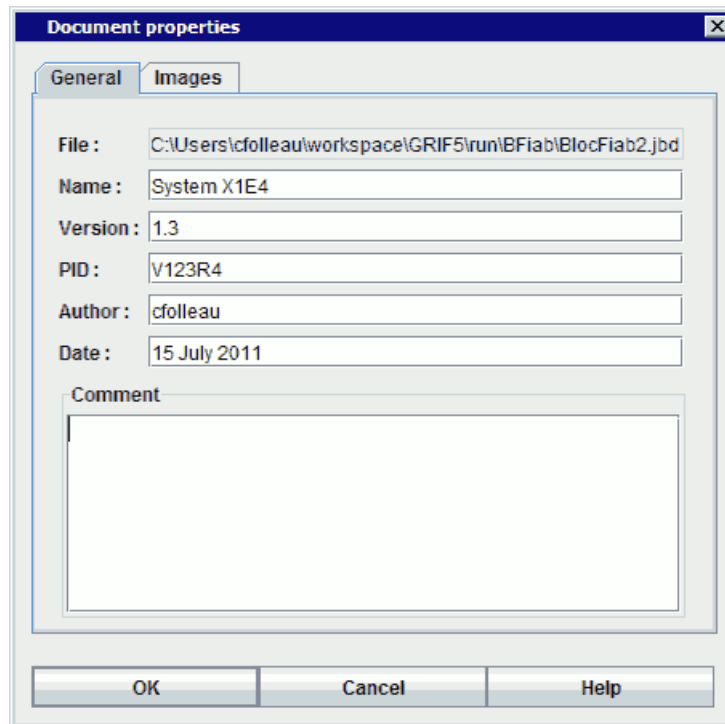
2.7.5. Selection change

In addition to the "Copy / Paste and Renumber" command there is an ordinary "Copy / Paste" function. It is used to make a single copy without renumbering. We thus obtain double elements which, from a formal viewpoint, is incorrect but which must be temporarily tolerated to simplify data entry.

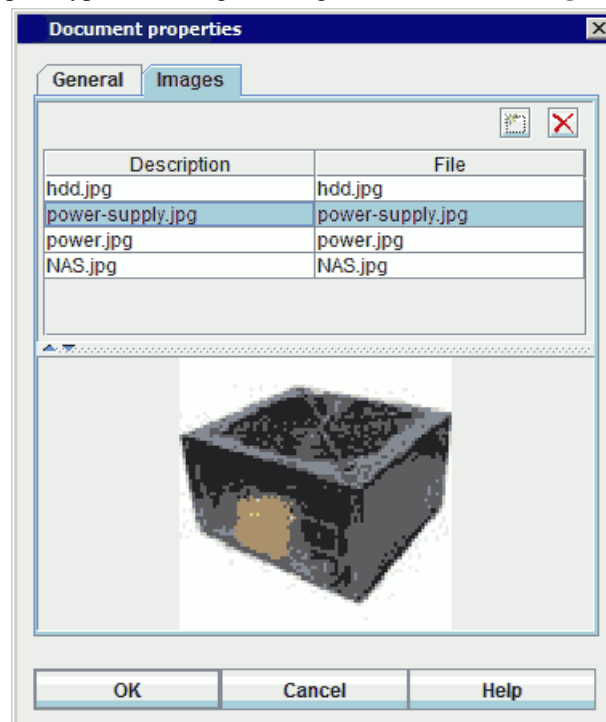
Where possible, the "Copy / Paste and Renumber" function must be used in preference to the simple "Copy / Paste" function to minimise the risk of errors. But when it is used you must take the necessary precautions to re-establish the correct numbering to eliminate the duplicates.


2.7.6. Document properties / Images management

File - Document properties menu enable to save information about document : name, version, comment, ... These informations are available in **General** tab.



Images may be very useful to represent sub-system. GRIF 2012 enables to save images that can be used in different parts of software (groupes, prototypes, ...). Images management is made in **Images** tab.



To add a new picture into document, use  icon. A double click in **File** column enables to select an picture (jpg, gif or png). A double click in **Description** column enables to give a name or a description to selected image.

Once in document, picture can be linked to a groupe with **Group - Picture change** menu.

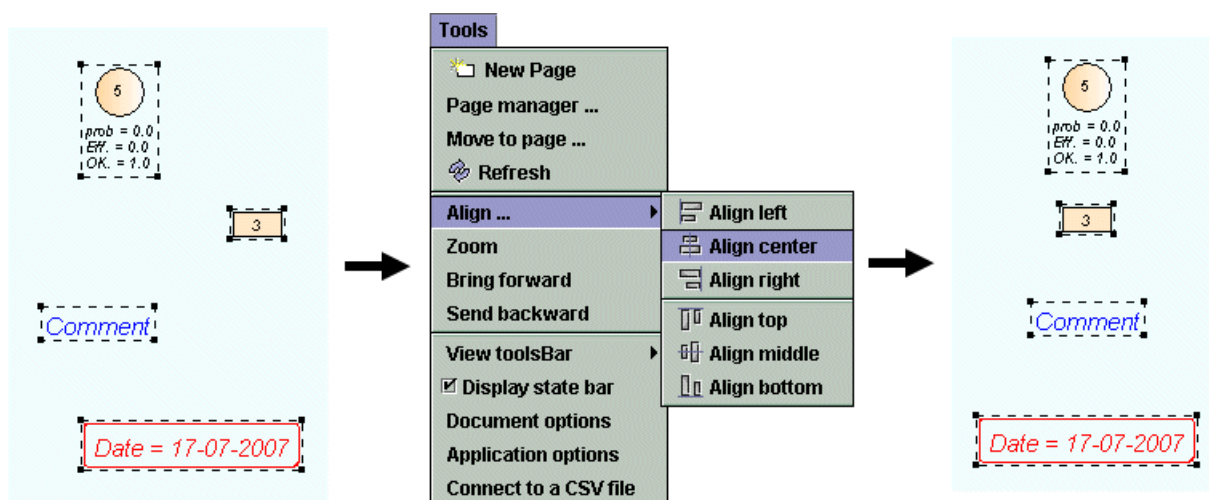
Images are saved inside document, pay attention to picture size. Because images are inside document, you have to re-add picture if picture is modified externally.

2.7.7. Alignment

To improve the legibility of the model the selected elements can be aligned vertically or horizontally. To do this, use the **Align** command in the **Tools** menu.

The following figure shows how the command works. For example, to align selected places and transitions vertically, proceed as follows:

1. Select the elements (places, transitions, comments, etc.) to be aligned;
2. Go into the **Tools** menu and select the **Align** function;
3. Choose the type of alignment: **Align center**;
4. Click left on the mouse.



Similarly, to align elements horizontally select the type **Align middle** which aligns the ordinates while keeping the abscissa constant. The principle is the same as that described above.

2.7.8. Multiple selection

It may sometimes be useful to select several elements located in the four corners of the input zone. To simplify this type of selection click on each of the desired elements one by one while holding down the Shift key on the keyboard.

2.7.9. Selecting connex (adjacent) parts

It is sometimes difficult to select an additional part of a model. To simplify the selection process, select a graphical element then use menu **Select connex part** in the **Edit** menu. The additional part can be selected directly by clicking on the element while keeping the Control button pressed.

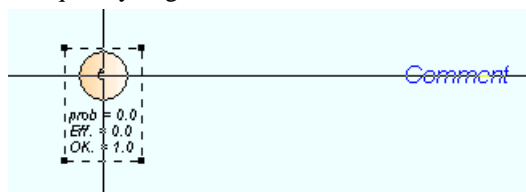
2.7.10. Page size

If, during modeling, the page size is insufficient it can be changed using menus **Increase page size**, **Reduce page size** or **Page size** in the **Tools** menu.

2.7.11. Cross hair

To be able to create an ordered and legible model quickly, the **cross hair** can be used to align the different elements with each other (but less accurately than the **Align** function in the **Tools** menu). The **cross hair** is enabled (or disabled) in the **Graphics** tab of the **Option** menu.

The following picture show how to quickly align two element of the model.



In order to align horizontally, select **Align au middle** which align keeping constant abscissa.

2.7.12. Gluing/Associating graphics

When objects are where you want, you can glue a set of object by right-clicking and selecting **Glue**. This command create a group (a graphical one, not a hierarchical one) with selected objects, so that moving one moves the others.

2.7.13. Line

To be able to draw a line, polyline or arrow, the **Line** can be used. Draw the line and edit properties of line to make an arrow.

3. Multi-phase Markov graphs

The Markov module makes it possible to implement two different markovian approaches:

- Ordinary modelling involving a single Markov graph (single-phase Markov graphs);
- Modelling involving several Markov graphs linked together and joined by transition matrices (multi-phase Markov graphs).

3.1. Creation/deletion of the different models

In the Markov module, the notions "Page" and "Model" are intimately related. To simplify the management of the various graphs, each one is to be represented on a different page and on one page only. This is why, in this module, the notion of "Model" present in all GRIF modules is equivalent to the notion of "Model". Each page will contain a behavior-model of the system.

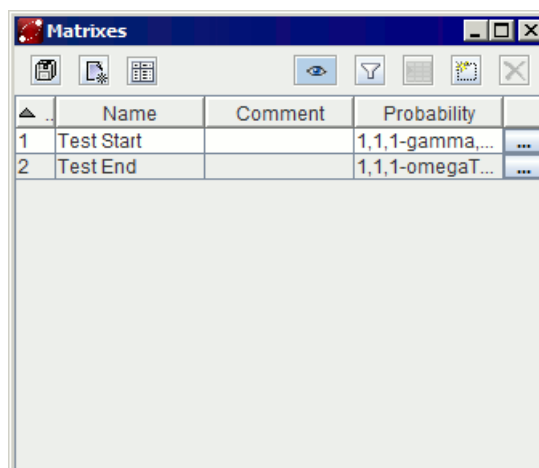
Each phase corresponds to a specific, individual and complete Markov graph. To create a new phase or to delete one, proceed in the same way as for the pages (same icons and same menu - **Tools - New Page**).

Note: Numbering states in a phase has no link with other phases. That is why users must pay attention. States of models must have the same name and number if they represent the same state of the system in the real life.


3.2. Phase transition sequence

3.2.1. General data

Once the Markov graphs relating to the various phases have been entered, it is necessary to indicate how they will be linked to each other. Do do this, we need chaining matrixes. The Matrixes tab on the right and the **Data and Computations - Phase transition** menu is meant for this purpose.



	Name	Comment	Probability	
1	Test Start		1,1,1-gamma...	...
2	Test End		1,1,1-omegaT...	...

The list of chaining matrix (or transition matrixes) is displayed in a table. As every data table, user can add new matrix with . You can edit all matrix field at a time with the "..." button in the last column.

The window is divided into four parts:

- The first three part let you enter ID, name and Comments
- The right-hand part enables you to enter the transition matrix of the selected sequence.

3.2.2. Transition matrices

DEFINITION:

The function of the transition matrix of phase i to phase i+1, is to specify the probability that a state j at the end of phase i will give a state k at the beginning of phase i+1.

To make this definition clearer, here is an example of a transition matrix of a phase i with 4 states to a phase i+1 with 3 states:

Beginning	End	Probability
1	1	0.3
1	3	0.7
2	3	1.0
3	2	0.5
3	1	0.5
4	1	1.0


Here is how this matrix should be read:


At the end of phase i,

- in state 1, the probability of being in state 1 at the beginning of phase i+1 is equal to 0.3;
- in state 1, the probability of being in state 3 at the beginning of phase i+1 is equal to 0.7;
- when in state 2, the probability of being in state 3 at the beginning of phase i+1 is equal to 1;
- when in state 3, the probability of being in state 2 at the beginning of phase i+1 is equal to 0.5;
- when in state 3, the probability of being in state 1 at the beginning of phase i+1 is equal to 0.5;
- in state 4, the probability of being in state 1 at the beginning of phase i+1 is equal to 1.

It is important to note that when a same state in phase i points towards several states of phase i+1 (states 1 and 3), then the sum of probabilities is strictly equal to 1. In the above example, for state 1 we have "0.3 + 0.7 = 1" and for state 3, "0.5 + 0.5 = 1".

INPUT:

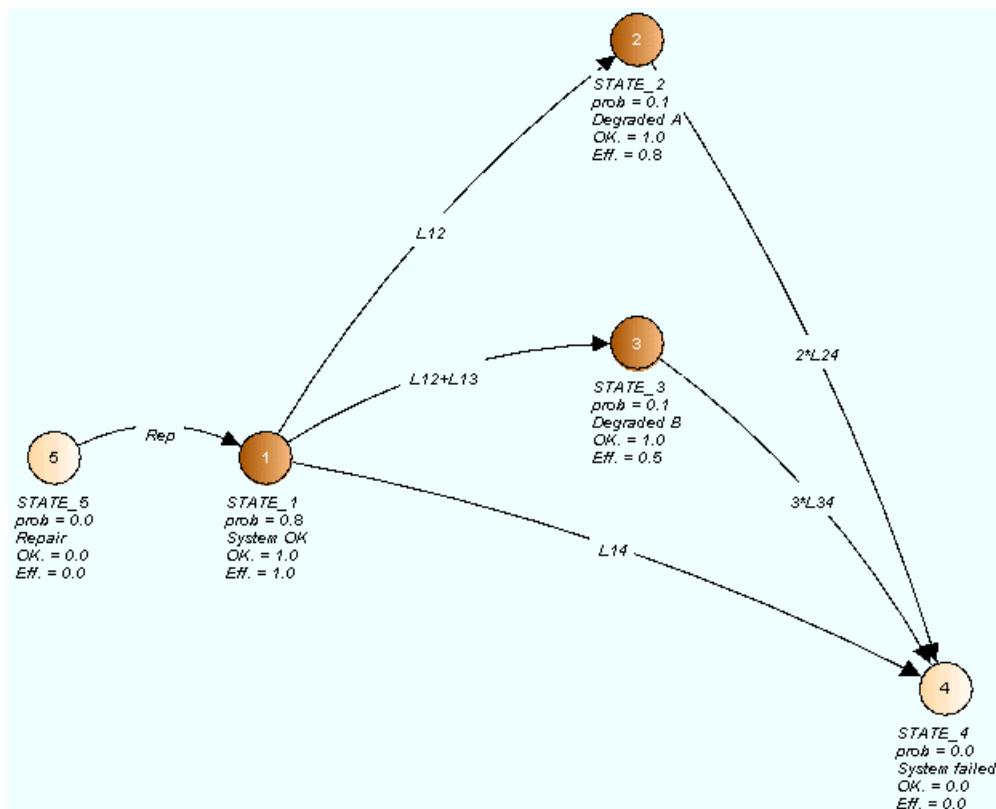
To start with, the transition matrix of all the phases of the model has no lines. So you first have to generate lines using the  button.

Note: the button right next () enables you to delete the selected line.

The line that you have created has a default configuration. This default configuration specifies that state num. j will be found in the state num. j of the next phase (whether these states exist or not) with a probability equal to 1. To then modify one of the three fields in the line, simply double-click on the targeted element and enter the new value.

4. Example of a Markov graph

Here is a single-phase Markov graph, modelling the behaviour of any system that has five possible states: "work", "degraded A", "degraded B", "failure" and "repair".



Edit Parameters	
Name	Value
L12	4.824E-6
L13	2.378E-7
L14	1.4341E-7
L24	2.62431E-6
L34	2.62431E-6
Rep	0.04166666
Name	Localization

The above Markov graph has five states:

- **State 1**
 - Number: 1
 - Name: STATE_1
 - Probability: 0.8
 - Comment: "System OK"
 - Properties: **OK.** = 1.0 and **Eff.** = 1.0
- **State 2**
 - Number: 2

- Name: STATE_2
- Probability: 0.1
- Comment: "Degraded A"
- Properties: **OK.** = 1.0 and **Eff.** = 0.8

- **State 3**
 - Number: 3
 - Name: STATE_3
 - Probability: 0.1
 - Comment: "Degraded B"
 - Properties: **OK.** = 1.0 and **Eff.** = 0.5

- **State 4**
 - Number: 4
 - Name: STATE_4
 - Probability: 0
 - Comment: "System Failed"
 - Properties: **OK.** = 0 and **Eff.** = 0

- **State 5**
 - Number: 5
 - Name: STATE_5
 - Probability: 0
 - Comment: "Repair"
 - Properties: **OK.** = 0 and **Eff.** = 0

It is easy to check whether the sum of probabilities of the graph's five states is equal to 1. Indeed,

$$\text{Proba}[\text{STATE}_1] + \text{Proba}[\text{STATE}_2] + \text{Proba}[\text{STATE}_3] + \text{Proba}[\text{STATE}_4] + \text{Proba}[\text{STATE}_5] =$$

$$0.8 + 0.1 + 0.1 + 0 + 0 = 1.0$$

The logic of the Markov graph is governed by six transitions:

- transition from **State_1** to **State_2** with rate **L12**;
- transition from **State_1** to **State_3** with rate **L12 + L13**;
- transition from **State_1** to **State_4** with rate **L14**;
- transition from **State_2** to **State_4** with rate **2 * L24**;
- transition from **State_3** to **State_4** with rate **3 * L34**;
- transition from **State_5** to **State_1** with rate **Rep**;

Even though this model only has one phase, it is still possible to define a transition matrix to manage the transition of this phase to itself (multi-phase mode). For example, this method can be used to model periodically tested systems.

Beginning	End	Probability
1	1	1.0
2	5	1.0
3	5	1.0
4	5	1.0
5	5	1.0

Phase 1 will go round in a loop and the above transition matrix will manage the transitions that take place every 5 years, that is every 43,800 hours (duration of phase 1).

If the system is still in a "work" state after five years it will remain so for the next phase. If, however, it is in a "degraded", "failure" or "repair" state (highly unlikely given the value of parameter **Rep**) then it will necessarily be in a "repair" state at the beginning of the next phase.

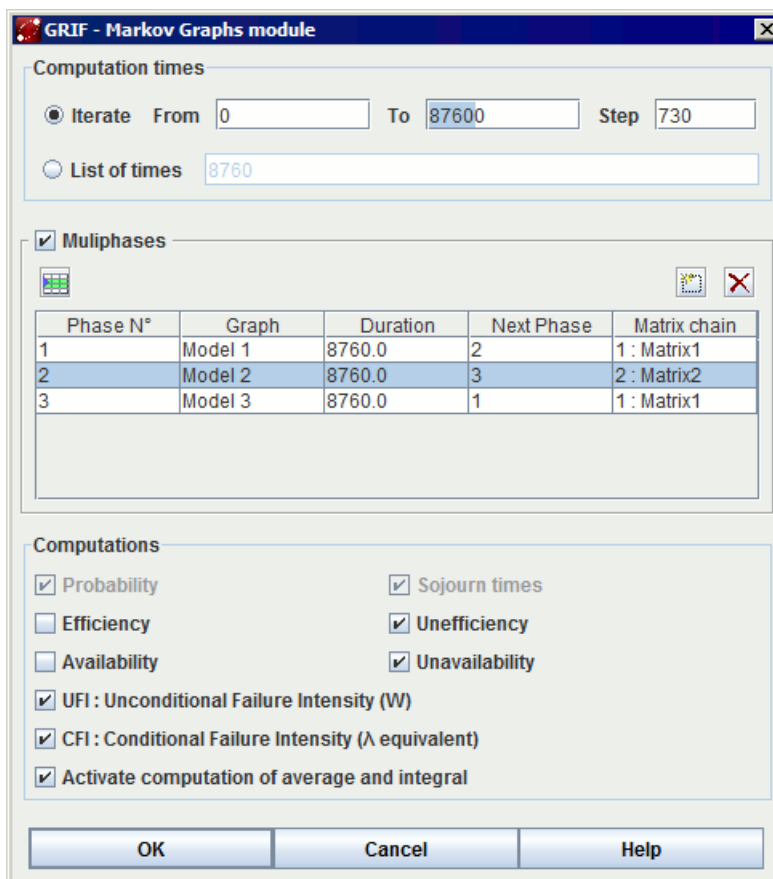
With the help of this simple example, it is interesting to see how useful the multi-phase function is. Multi-phase Markov graphs make it possible to model a change in behaviour of the system with respect to a recurrent and regular event. For example, the day/night effect on maintenance, the effect of seasons on repair time or the impact of periodical tests on security systems, etc.

Using this model, it is now possible to launch various computation engines to evaluate the system's efficiency for example.

5. Computations

5.1. Launching computations

In Markov module you can obtain many informations about states and system. Configuration of computation is made in **Data and computation / Computation setup and launching**



The screenshot shows the 'GRIF - Markov Graphs module' window. It is divided into three main sections:

- Computation times:**
 - Iterate From To Step
 - List of times
- Multiphases:**
 - Multiphases
 - Table with columns: Phase N°, Graph, Duration, Next Phase, Matrix chain

Phase N°	Graph	Duration	Next Phase	Matrix chain
1	Model 1	8760.0	2	1 : Matrix1
2	Model 2	8760.0	3	2 : Matrix2
3	Model 3	8760.0	1	1 : Matrix1
- Computations:**
 - Probability
 - Efficiency
 - Availability
 - UFI : Unconditional Failure Intensity (W)
 - CFI : Conditional Failure Intensity (Λ equivalent)
 - Activate computation of average and integral
 - Sojourn times
 - Unefficiency
 - Unavailability

Buttons: OK, Cancel, Help

This window is made of 3 parts.

- **Computation times** : Iteration From A To B step C: calculations are made for each value of time from A to B with a step of C. **List of times**: calculations are made for each value of time in the list (separator is comma).
- **Multiphase** : Using multiphase, you can treat system whose behavior model is not always the same. We call Phase, the phase of the life of the system which is driven by a model M during a period T. This table defines phases and the way to pass from one phase to another using phase-chaining matrices.
- **Computations** : Probabilities to be in each state and sojourn time are always calculated. You can also compute:
 - **Unavailability** : Unavailability of the system
 - **Availability** : Availability of the system (1 - Unavailability)
 - **Unefficiency** : Unefficiency of the system
 - **Efficiency** : Efficiency of the system(1 - Unefficiency)
 - **UFI** : Intensité Inconditionnel de Défaillance (W). Use CFI(t) et A(t)

- **CFI** : Conditional Failure Intensity (Equivalent Lambda).
The last option activate post-treatment for average and sum calculations.

5.2. Tables and Panels to display results

5.2.1. Result-tables

Result-tables are made of data and a top part to set table up.

Time	Value	Average	Integral
0	1	1	0
2.4E1	0.9976	0.9988	2.3971E1
4.8E1	0.9952	0.9976	4.7885E1
7.2E1	0.9928	0.9964	7.1741E1
9.6E1	0.9904	0.9952	9.5541E1
1.2E2	0.9881	0.994	1.1928E2
1.44E2	0.9857	0.9928	1.4297E2
1.68E2	0.9833	0.9916	1.666E2
1.92E2	0.981	0.9905	1.9017E2
2.16E2	0.9786	0.9893	2.1368E2
2.4E2	0.9763	0.9881	2.3714E2
2.64E2	0.9739	0.9869	2.6055E2
2.88E2	0.9716	0.9857	2.8389E2
3.12E2	0.9693	0.9846	3.0718E2
3.36E2	0.967	0.9834	3.3042E2
3.6E2	0.9646	0.9822	3.536E2
3.84E2	0.9623	0.981	3.7672E2
4.08E2	0.96	0.9799	3.9979E2
4.32E2	0.9577	0.9787	4.228E2
4.56E2	0.9554	0.9775	4.4576E2
4.8E2	0.9531	0.9764	4.6866E2
5.04E2	0.9508	0.9752	4.9151E2
5.28E2	0.9486	0.9741	5.143E2

Columns can be sort by clicking on their header. The filter icon activates a filter set-up with the following window:

Creation of data filter ✕

Associate tests with: AND OR Add a criteria:

Name


Value

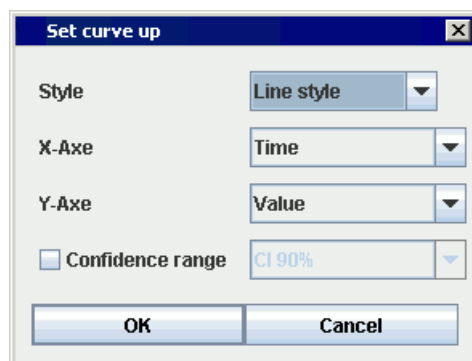
OK Cancel

When filter is activated, a small (+) is displayed near column title. Filter can be remove with button.

5.2.2. Export data

Values that are visible in this table can be exported in CSV file format with button.

Results can also be displayed with a Curve by clicking on . Data used for x-axis and y-axis must be specified in the following window:



The 'Set curve up' dialog box contains the following settings:

- Style: Line style
- X-Axe: Time
- Y-Axe: Value
- Confidence range: CI 90%

Buttons: OK, Cancel

Then, chart is displayed in a window :

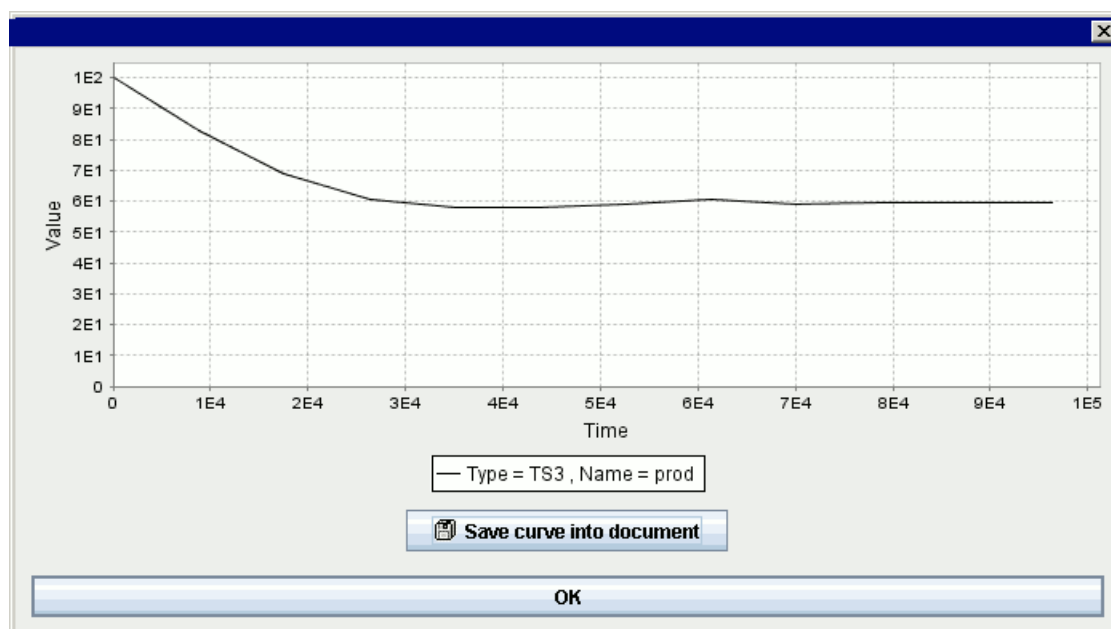
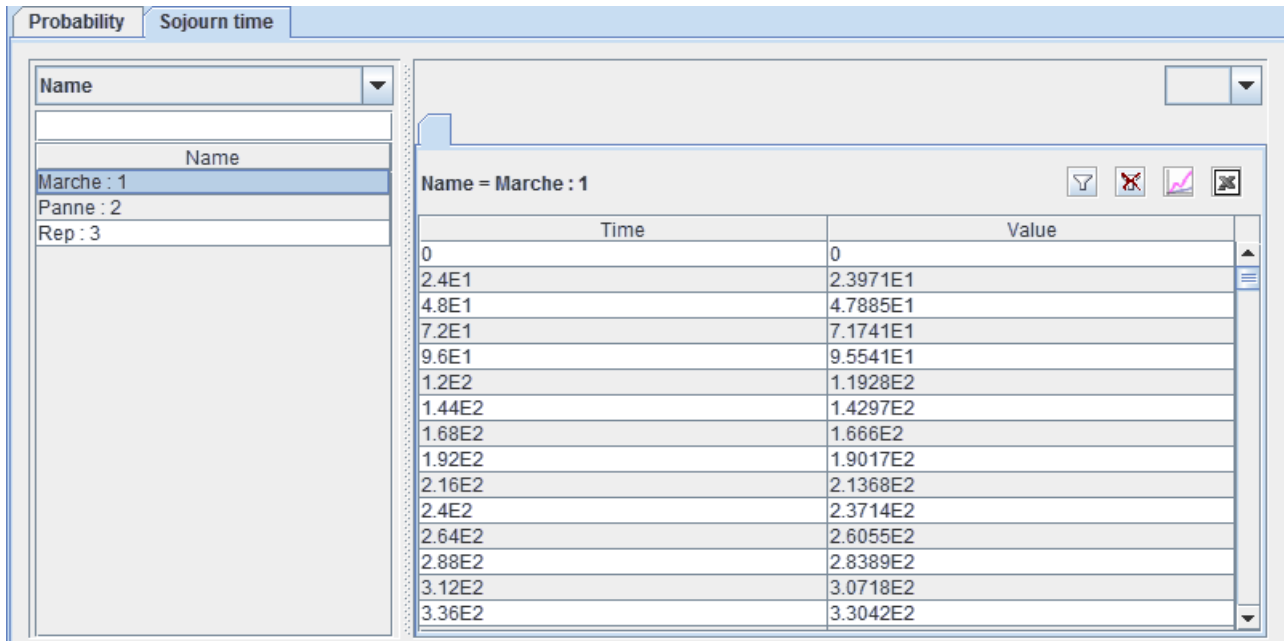


Chart can be saved in the current document with the button at the bottom.

Nb : when chart is in document, points are no more modifiable.

5.2.3. Result-Panels

Result-panels have been created to facilitate data access in tables with many columns. The aim is to make a prior filter to keep wanted data.



The screenshot shows a software interface with two tabs: 'Probability' and 'Sojourn time'. The 'Sojourn time' tab is active. On the left, there is a list of values under the heading 'Name': 'Marche : 1', 'Panne : 2', and 'Rep : 3'. The 'Marche : 1' item is selected. On the right, there is a table titled 'Name = Marche : 1'. The table has two columns: 'Time' and 'Value'. The data in the table is as follows:

Time	Value
0	0
2.4E1	2.3971E1
4.8E1	4.7885E1
7.2E1	7.1741E1
9.6E1	9.5541E1
1.2E2	1.1928E2
1.44E2	1.4297E2
1.68E2	1.666E2
1.92E2	1.9017E2
2.16E2	2.1368E2
2.4E2	2.3714E2
2.64E2	2.6055E2
2.88E2	2.8389E2
3.12E2	3.0718E2
3.36E2	3.3042E2

This panel is made of a combo-box in the upper-left corner which enables to remove the column from the table and creates a list on the left which contains every values in the removed column. When you select a value in the left list, it modifies the table in order to show lines whose removed column contains the selected value.

The combo-box in the upper-right corner enables to choose which column C will be used to cut table. The table will be cut in many tables, each one in a tab whose title is equal to the value used to filter the C column. Then C column is removed since it contains only the one value in a given tab.

5.3. Markovian results

Every result is displayed in a tab in a multifunctions table for each computation type

Results of computation

States System Results

Efficiency Unefficiency Availability Unavailability W Equivalent Lambda

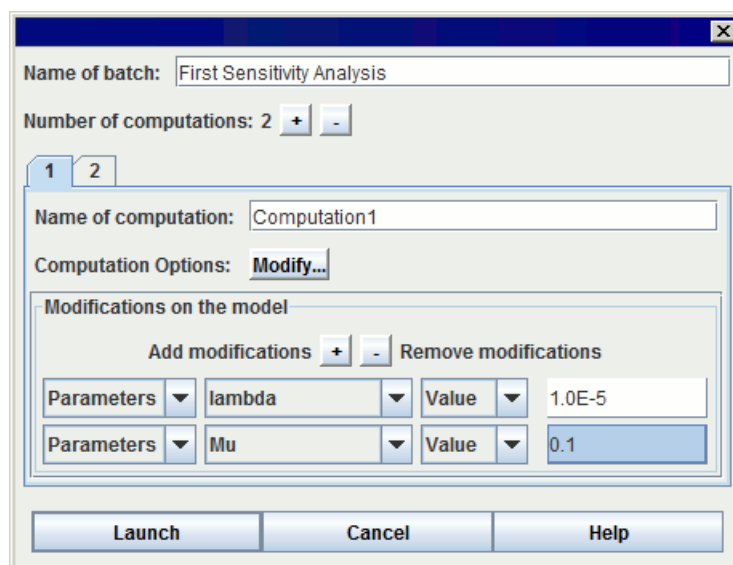
Time	Value	Average	Integral
0	1	1	0
2.4E1	0.9976	0.9988	2.3971E1
4.8E1	0.9952	0.9976	4.7885E1
7.2E1	0.9928	0.9964	7.1741E1
9.6E1	0.9904	0.9952	9.5541E1
1.2E2	0.9881	0.994	1.1928E2
1.44E2	0.9857	0.9928	1.4297E2
1.68E2	0.9833	0.9916	1.666E2
1.92E2	0.981	0.9905	1.9017E2
2.16E2	0.9786	0.9893	2.1368E2
2.4E2	0.9763	0.9881	2.3714E2
2.64E2	0.9739	0.9869	2.6055E2
2.88E2	0.9716	0.9857	2.8389E2
3.12E2	0.9693	0.9846	3.0718E2
3.36E2	0.967	0.9834	3.3042E2
3.6E2	0.9646	0.9822	3.536E2
3.84E2	0.9623	0.981	3.7672E2
4.08E2	0.96	0.9799	3.9979E2
4.32E2	0.9577	0.9787	4.228E2
4.56E2	0.9554	0.9775	4.4576E2
4.8E2	0.9531	0.9764	4.6866E2
5.04E2	0.9508	0.9752	4.9151E2
5.28E2	0.9486	0.9741	5.143E2

lundi, 20 juin 2011 16:20:05 CEST

Save and exit Exit without saving Save as

5.4. Batch computation

In order to do fast sensibility analysis or to compare some results with different parameters, it can be very usefull to do calculation one after another automatically. To do this, use the **Data and Computation / Batch computation ...** menu.



The batch launching window is made of two part, the first is for the name of the batch and the number of computations in the batch. Then each computation can be set up :

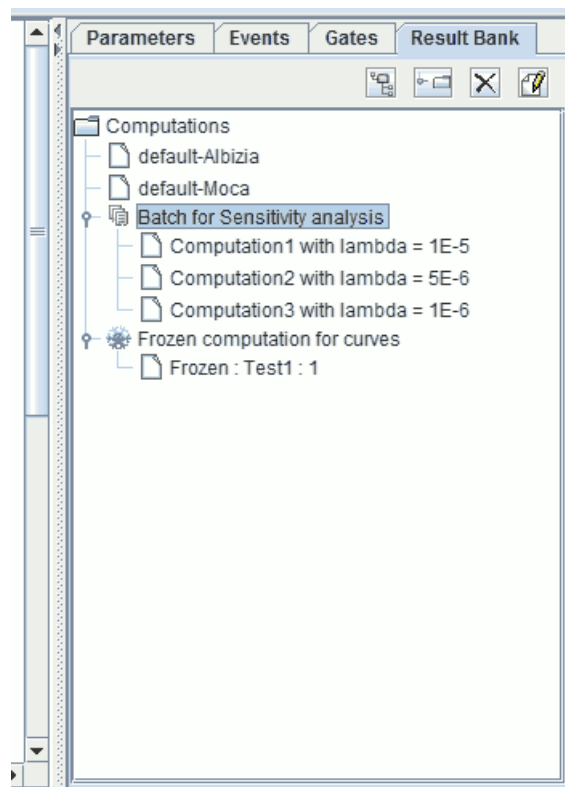
- **Name of computation:** for identification in results
- **Computation options:** contains every options related to this computation (times, types ...)
- **Modifications on the model:** specifies modifications that will be made on the model before computation launching. You can add as many modification as you want with the + button. Each modification is made of 4 parts:
 1. 1 drop-down menu for object type
 2. 1 drop-down menu for the object that will be modified
 3. 1 drop-down menu to spécify what will be modified on this object (value for a parameter, law for other object ...)
 4. Then you must enter the new value in the cell



The above exemple shows a batch with 2 computations, the first is made with a lambda parameter with 1.0E-5 value and a mu parameter with 0.1 value.

After a computation, the model is always reset up to an initial state without modification.

5.5. Result Bank

Every GRIF computation is stored in result bank which is available on the right of the module.

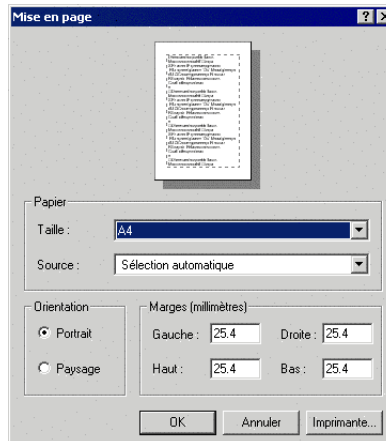


You can display a result with a double-click on it. There is a default result for each computation engine, it is the place where "standard" computation are stored. Then, each  is a batch computation directory, it contains as many results as computations asked for the batch. Finally, the  directory contains results for curves that have been frozen.

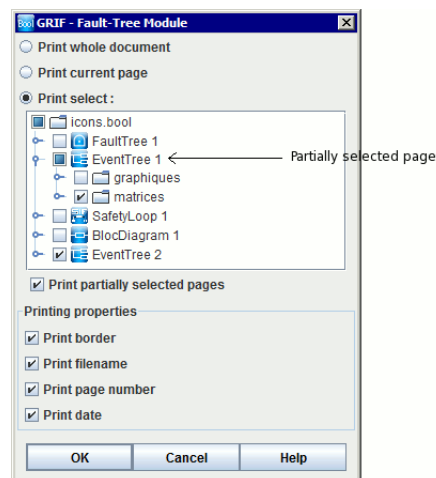
6. Printing

For printing, you have several commands at your disposal in the **File** menu **File**:

- The **Page setup** function allows you to choose the page orientation, the size of the margins, etc.



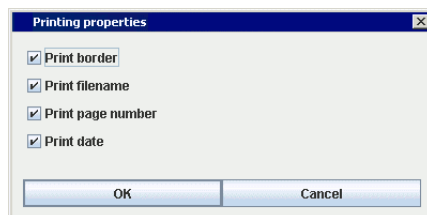
- The **Print** function allows you to export .pdf document pages. Graphics are exports in a vectorial format in order to scale its without deterioration.



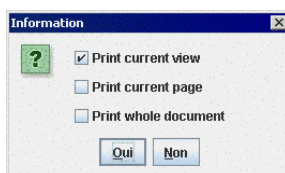
The print window appears and user can selected pages to print and configuration.

- Print whole document** : Allows to print whole document.
- Print current page** :Allows to print the current page.
- Print select** : Allows to print the selected pages. The **Print partially selected pages** allows you to print pages marked by a blue square.
- Print border** : Print a border on each page.
- Print filename** : Print the filename on the top left corner of each page.
- Print page number** : Print the page name and number on the bottom of each page.
- Print date** : Print the date on the top right corner of each page.

- The **Save in RTF file...** function initially gives access to a window called **Printing properties**. Then to another called **Information**. And thirdly, a window is displayed allowing you to choose the folder in which the RTF file is to be saved.



When you select the **Save in RTF file** function, the first box to appear is that shown above. You can then select your preference: Print border, Print filename, Print page number and/or Print date.



Secondly, an **Information** window appears. It allows you to indicate whether you wish to print the current view, print the current page or print the whole document.

7. Curves

The curves can be drawn to study the model and the results better. To do this, click left on the corresponding icon on the vertical task bar then draw a box. This box will be the space assigned to displaying the curve(s). Initially it is only a white box with two axes without graduation.

Charts icon:

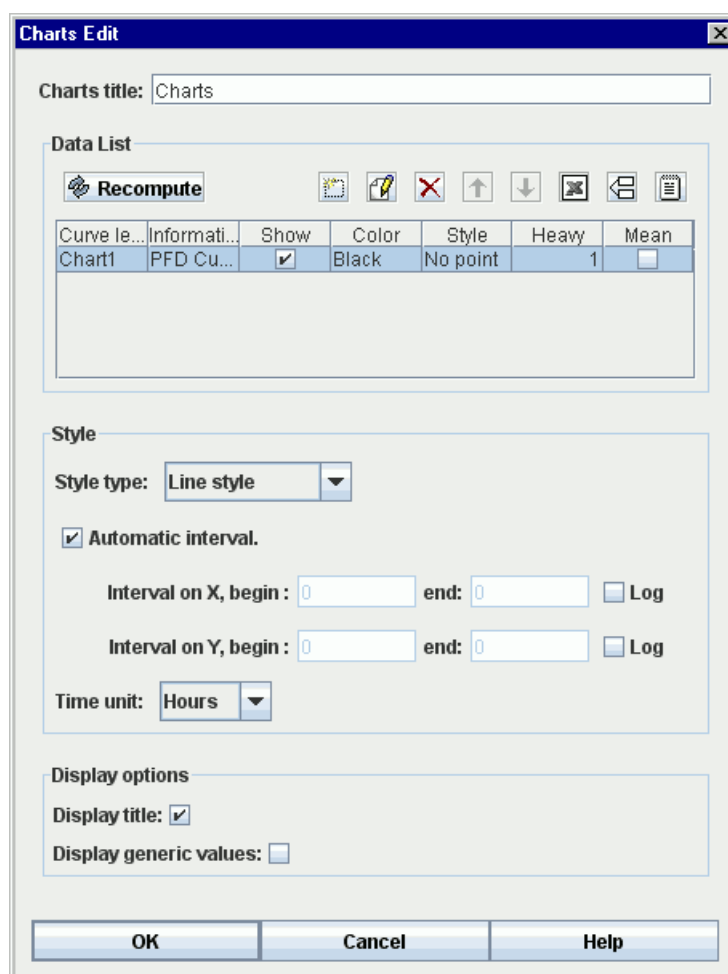


We must now define the curves to be drawn. To do this, click right on the box to display the **Charts Edit** window.

7.1. Charts Edit window

Note: It is important to specify that drawing curves requires a computation to be launched which is completely independent of that accessible in menu **Data and computations -**





The Charts Edit window is the same for all the GRIF modules



This window is divided into several parts:

1. **Charts Title**: allows you to give a title to the graphic.

2. **Data List:** This part contains a three-column table listing the chart's different curves (name, description, display, curve colour, curve style, curve thickness). Several buttons are available above this table.

- **Add** : sends you to a Curve type window to add a curve to the chart (cf. following chapter).
- **Edit:** modifies the selected curve.
- **Delete** : deletes the selected curve from the chart.
- **Up** : moves the selected curve upwards in the list.
- **Down** : moves the selected curve downwards in the list.
- **Save:** the list of points computed for the selected curve in CSV format. This export doesn't contains generic values. In order to export with generic values, use right-click and select **Separate export**.
- **Duplicate:** creates a new curve identical to the selected curve.
- **Results:** display in a text editor the results of the selected curve.

For each curve, you can specify its colour, its style of points, its thickness and its display options.

3. **Computation options:** allows you to configure the computation (optional depending on the module used).

4. **Style:** This part deals with displaying curves.

- **Style type:** specifies the type of all the chart's curves (line or histogram).
- **Intervals on X and Y:** Specifies the display interval for the X and Y axes (default interval or user-defined interval). This last function can, for example, be used to zoom in on the most interesting parts of the curve.

The **log** check boxes are used to enable the logarithmic scale on the axis concerned. Important: 0 cannot be represented on a log scale, remember to give a strictly positive starting point (e.g.: E-10). If 0 is given, the log scale will start with an arbitrary value E-15.


When domain axe deals with time, you can choose time unit among : hours, days, months, years. Default display is "hours" because it is the usually used unit for modeling. It's only available in SIL module.

When computation engine allows it, you can **display confidence range** checking the checkbox.

With historam style, a checkbox allows to do a cumulated histogram.

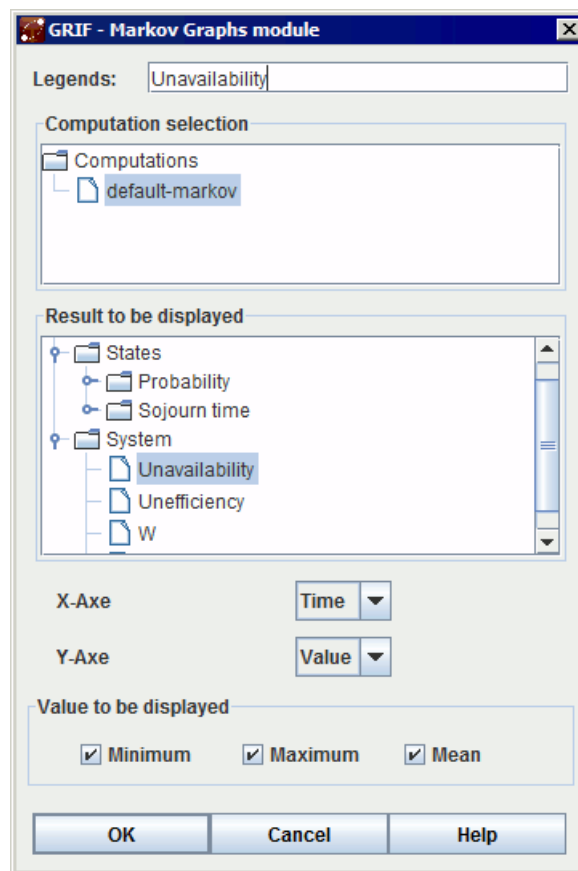
5. **Display options:** enables (or not) the **Display title** function (displays the title of the chart) and the **Display generic values** function (displays the min., max. and mean values of each curve).

When a curve is edited, its edition window contains 3 parts : times used for computation, target of computation, further information (generic values) that be be displayed or not under the curve.

Remark: it's sometimes useful to refresh all charts in document. Use the **Tools / Refresh** command or press F5 or  icon.

7.2. Curves from data in result-bank

When you click the **Add** button in the **Data list** part you reach a window for curves setup. Each curve displays data stored in the result-bank. The following window helps users to specify how to retrieve data.



- **Legend:** legend of the curve.
- **Computation selection:** select the computation in the result-bank.
- **Result to be displayed:** each computation contains many results. Select the one you want to be drawn.
- **Axes:** When a result is selected, select what must be in X-Axe and what must be in Y-Axe.
- **Value to be displayed:** Then you can display addition informations about the result (min, max, moyenne)

8. Databases

In each GRIF module a connection can be established to a database. It is possible to have two different types of connections:

- connection to a CSV file;
- connection via a JDBC link.

8.1. Connection to a CSV file

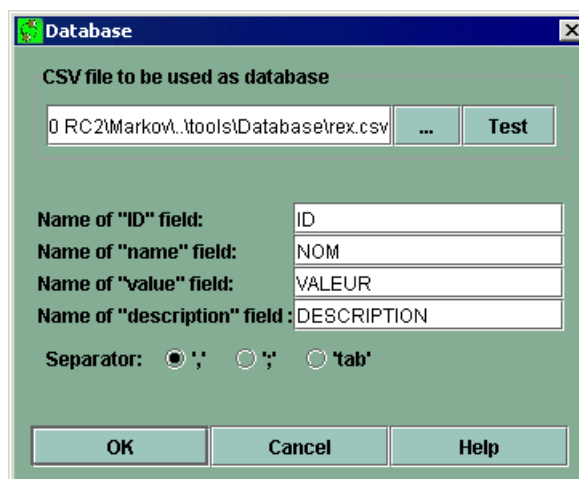
8.1.1. Form of the database

This type of connection is the simplest to make. A CSV file has the extension ".csv". It is a simple text file where the different fields are separated by commas, tabs or semi-colons. It is the simplest form of database.

```
ID;NOM;VALEUR;DESCRIPTION
1;Lp1comp;0.006;comment1
2;Lp2comp;0.004;comment2
3;Lp3comp;0.002;comment3
4;Lp4comp;0.001;comment4
```

8.1.2. Connection

To connect GRIF to this database, go into menu **Tools - Connection to a CSV file**. A dialogue box is then displayed:



This window is divided into three parts:

- You must initially enter the path leading to the CSV file. To do this, there is an explorer available (... button). A Test function is used to check the connection.
- You must then enter the names of the four fields of the CSV file.
- Finally, specify the types of separators used in the CSV file.

Note: A CVS connection must be made with a CVS File (which means generated from only one sheet of a EXCEL File).

8.2. Connection via a JDBC link (example with ODBC connector)

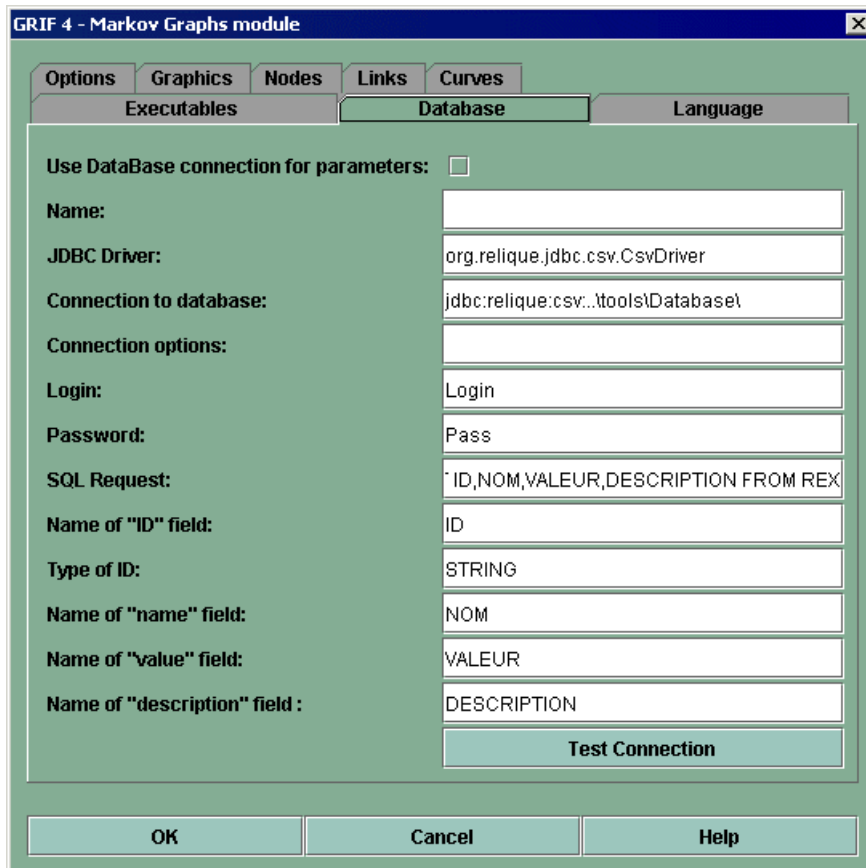
8.2.1. Form of the database

The database can initially be in the form of an EXCEL or ACCESS file. Then, using the operating system, an ODBC system data source must be created. In the case of WINDOWS, for example, this operation is performed in menu "Control Panel - Administration tools - data source (ODBC)". Here is an example of an EXCEL database:

	A	B	C	D
1	ID	NOM	VALEUR	DESCRIPTION
2	1	Lp1comp	0.006	comment1
3	2	Lp2comp	0.004	comment2
4	3	Lp3comp	0.002	comment3
5	4	Lp4comp	0.001	comment4

8.2.2. Connection

To connect GRIF to this ODBC database, go into menu **Tools - Application options - Database**. A window is then displayed which must be filled in as follows:



The screenshot shows the 'GRIF 4 - Markov Graphs module' dialog box with the 'Database' tab selected. The 'Use DataBase connection for parameters' checkbox is unchecked. The fields are filled as follows:

- Name: (empty)
- JDBC Driver: org.relique.jdbc.csv.CsvDriver
- Connection to database: jdbc:relique:csv:...toolsDatabase\
- Connection options: (empty)
- Login: Login
- Password: Pass
- SQL Request: ID,NOM,VALEUR,DESCRIPTION FROM REX
- Name of "ID" field: ID
- Type of ID: STRING
- Name of "name" field: NOM
- Name of "value" field: VALEUR
- Name of "description" field: DESCRIPTION

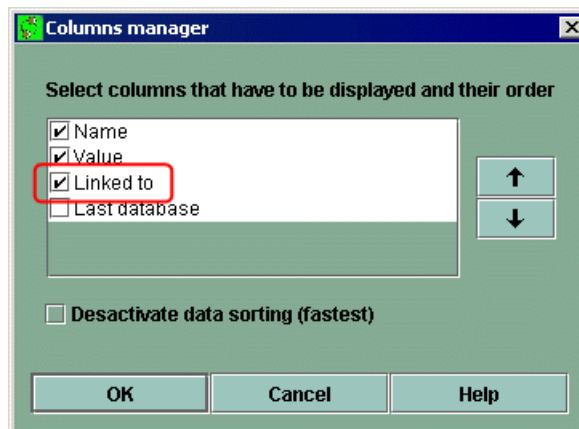
Buttons: OK, Cancel, Help, Test Connection

Notes:

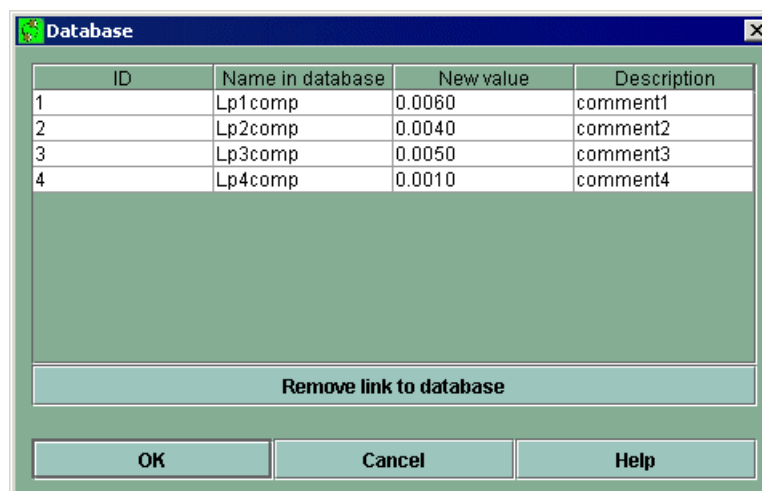
1. `sun.jdbc.odbc.JdbcOdbcDriver` is the driver name
2. `jdbc:odbc:REX` specifies that "REX" is the name of the ODBC link
3. The fields **Connection options**, **Login** et **Password** are unnecessary here.
4. `SELECT ID,NOM,VALEUR,DESCRIPTION FROM [Feuil1$] $` is called the query where Feuil1 is the name of the EXCEL sheet containing the data.

8.3. Operation

The aim is now to link some of the model's parameters to the database. To do this, start by displaying the column **Linked to** in the parameters table (click right on the top of the columns).

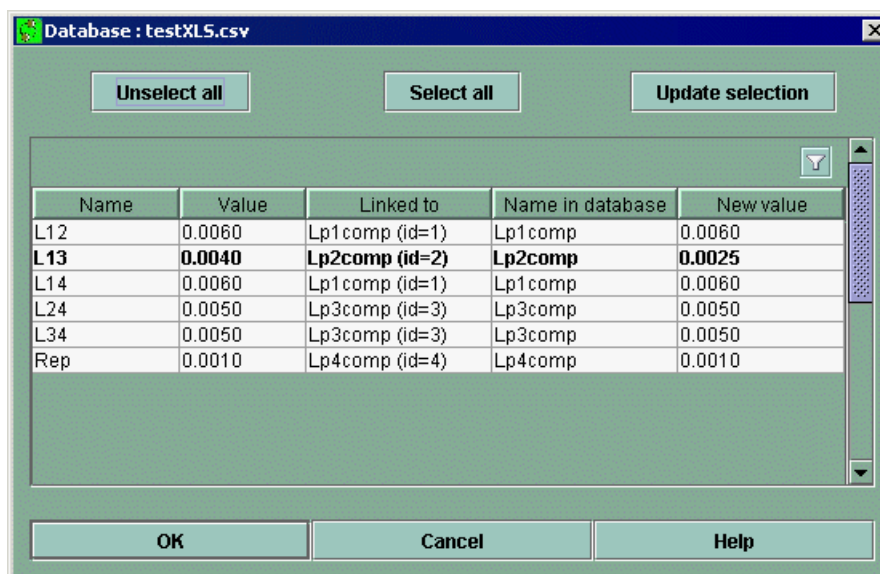


Then double click in the **Linked to** column to display the database items. When one of these items has been selected, click **OK** to validate the connection. The parameter then takes the value of the item to which it is now connected.



Note: The button called **Remove link to database** at the bottom of the table breaks the link between the parameter and the database item.

If some of the database values to which GRIF is linked are modified, the parameters connected to this database can be updated. To do this, select **Data and computations - Update from database...** and display the **Database window**.



The parameters whose values are not up to date are automatically detected and indicated in bold. One or more of these parameters can then be selected for updating using the **Update selection** button. Two other buttons are available to simplify the selection process: **Unselect all** (deselects all the table's parameters) and **Select all** (selects all the table's parameters).

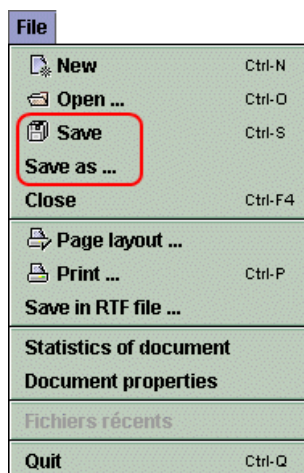
Remark: you can also directly copy parameter from database using menu **Data and Computation/Database/Copy parameters from database**. A window is displayed, you can select parameters you want to copy into document. Parameter will be automatically linked to the right parameter in database.

9. Save

Here is a summary of all the data which can be saved from a same model.

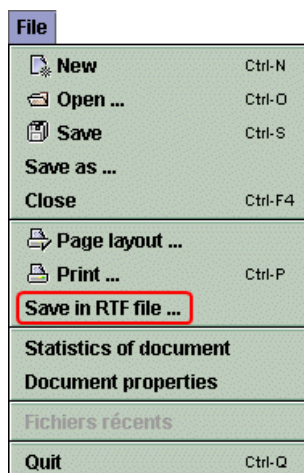
9.1. Model

It is obviously possible to save and reload the models which are made. To do this go into menu **File - Save** or into **File - Save as...**



9.2. RTF File

A model can also be saved in RTF format. This allows the saved model to be reloaded in WORD to insert the graphical part of the model in any document. To do this, go into menu **File - Save in RTF file...**



Note: There is another way to insert model in a report. Select the part of the model, copy it, and paste it in Microsoft WORD or other software.

9.3. Input data

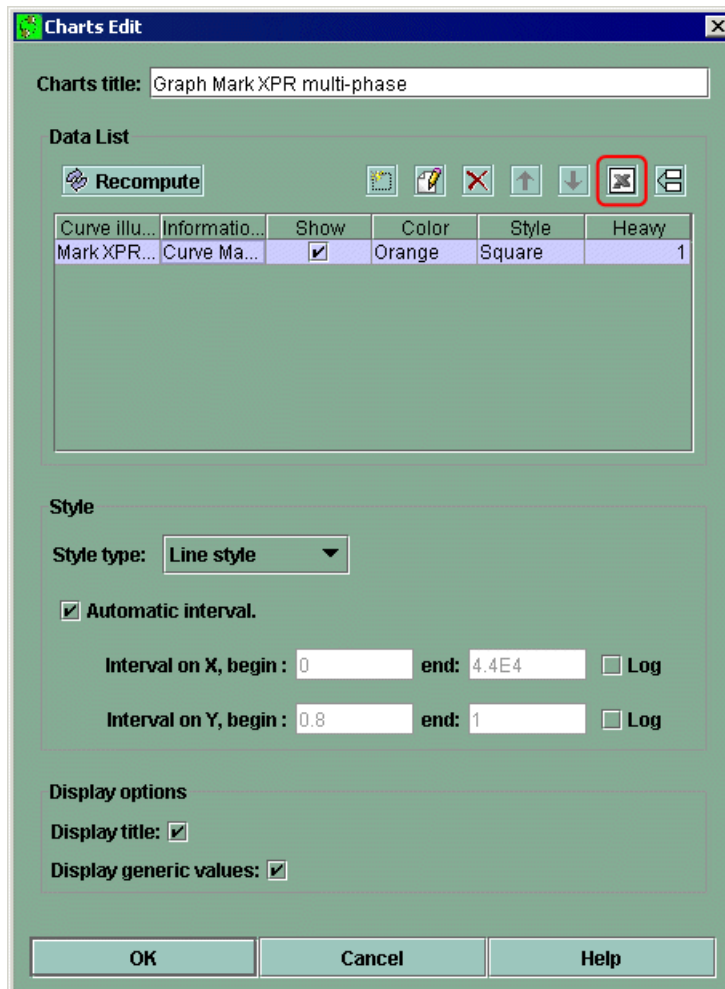
When the input data for the computation engine is generated, it can be saved. This type of file has the ".don" extension. These files can therefore be modified using a text editor then reloaded to launch computations on them (for example). This action should be made only by advanced user.

9.4. Results

The results file can also be saved, in order to be used in EXCEL for example.

9.5. Curves

For each curve drawn, the points which have been computed in CSV format can be saved. This list of points can then be used to draw new curves or to perform further computations.



10. Options of GRIF - Markov Graph

Tools - Application Options menu opens a window containing the following tabs:

10.1. Executables

Executables tab enables to specify path to external executables :

- **Editor path** : Specifies text editor path.
- **Automatically open PDF files** : Specifies if PDF reports must be opened avec generation.
- **Style-sheet from XML to DocBook.** : Style-sheet allowing converting from XML report to docbook file.
- **Style-sheet from XML to HTML.** : Style-sheet allowing converting from XML report to HTML file.
- **Style-sheet from DocBook to PDF.** : Style-sheet allowing converting from docbook file to PDF file.
- **MarkXPR path** : Path of Mark-XPR engine.
- **Additional point at beginning of phase at** : Additional point à beginning of phase at :
- **epsilon for MarkXPR** : This parameter is used to determine when a computation has reached its fixpoint
- **Automatic dtratio for MarkXPR** : Let GRIF choose the best dtRatio for the model.
- **dtratio for MarkXPR** : Rate used by Mark-XPR to choose the computation step (dtRatio/max(rate)).

10.2. Database

Database tab enables to configure database connection :

- **Use DataBase connection for parameters** : Select if database must be use.
- **Name** : Database name will be put into parameter during its update. It enables to know from which database parameter has been lastly updated.
- **JDBC Driver** : Enter name of JDBC driver to be used(sun.jdbc.odbc.JdbcOdbcDriver, oracle.jdbc.driver.OracleDriver, ...).
- **Connection to database** : Database Url.
- **Connection options** : Connection properties.
- **Login** : Login to be used to connect to database.
- **Password** : Password to be used to connect to database.
- **SQL Request** : Request that have to be executed to retrieve data from database.
- **Name of "ID" field** : Name of field containing data ID.
- **Type of ID** : Type of ID field (INTEGER, FLOAT, VARCHAR(32), ...)
- **Name of "name" field** : Name of field containing data name.
- **Name of "value" field** : Name of field containing data value.
- **Name of "description" field** : Name of field containing data description.
- **Name of "dimension" field** : Name of field containing data dimension.
- **Test Connection** : Name of field containing data description.

10.3. Language

Language tab enables to choice language :

- **Language** : Language changes are taken into account when option windows is closed. Available language are French and English.

10.4. Options

Options tab enables to tune application behavior :

- **Save working document options as default options in application** : Save options of current doc as application default options.

- **Application manage default options of documents. Apply default options to current document** : Apply - Application options- to current document.
- **Number of undo** : Specifies number of possible undo/redo.
- **Number of recent files** : Specifies number of files in recent files list.
- **Window display** : Enables separate tables (external) or linked tables (internal).
- **Columns to be resized in tables** : Enables to specify the columns on which space will be taken for resizing.
- **Use net protection key (Red)** : Check this box only if a network key is used (reg key).
- **Manage new names to avoid name conflict** : Tries to avoid name conflict, creating new objects whose name is unik (when pasting for example).
- **Synchronize view with tables** : Select objects in tables (on the right) when they are selected in view.
- **Synchronize view with explorer** : Select objects in explorer (on the left) when they are selected in view.

10.5. Graphics

Graphics tab enables to modify GUI look :

- **Element Zoom** : Changes graphics size.
- **Comment size** : Changes comment font size.
- **Activate cross hair** : Activate cross hair which enables object alignment.
- **Activate smoothing for texts** : Activate anti-aliasing (smoothing) for texts, it can slow the display.
- **Activate smoothing for images** : Activate anti-aliasing (smoothing) for images, it can slow the display.
- **Activate tooltips** : Activate tooltip-system.

10.6. Digital format

Digital format tab enables to customize digits display :

- **Display of parameters** : Specifies the display of parameters (number of digits, ...).

10.7. States

States tab enables to change state display. :

- **Display name** : Enables to display name or not
- **Label size** : Specifies label font size.
- **Display description** : Enables to display description or not.
- **Display number** : Enables to display number or not.
- **Display probability** : Enables to display initial probability of a state.
- **Display efficiency** : Enables to display efficiency of a state.

10.8. Links

Links tab enables to change links display :

- **Label size** : Specifies label font size.
- **Link arrow width** : Specifies arrow width.
- **Link arrow height** : Specifies arrow height.
- **Display formula** : Enable to display transition rate under transition.
- **Transition excentricity** : Enable to specify excentricity of line for transition.

10.9. Curves

Charts tab enables to change charts drawing :

- **Set graphics borders** : Add borders to charts.
- **Set generic values borders** : Add borders to generic values under charts.
- **Display grid** : Display grid on curves area.

- **Display legends** : Display legends under curves.
- **Drawing zone transparency** : Activate curves area transparency.
- **Graphic transparency** : Activate charts transparency.
- **Title size** : Specifies charts title font size.
- **Generic values size** : Specifies generic values font size.
- **Point size** : Specifies point size on curves.
- **Coordinates size** : Specifies coordinates font size.
- **Legend size** : Specifies legends font size.