Cab Innovation

3 rue de la Coquille
31500 Toulouse
Tel. 33 (0)5 61 54 68 08
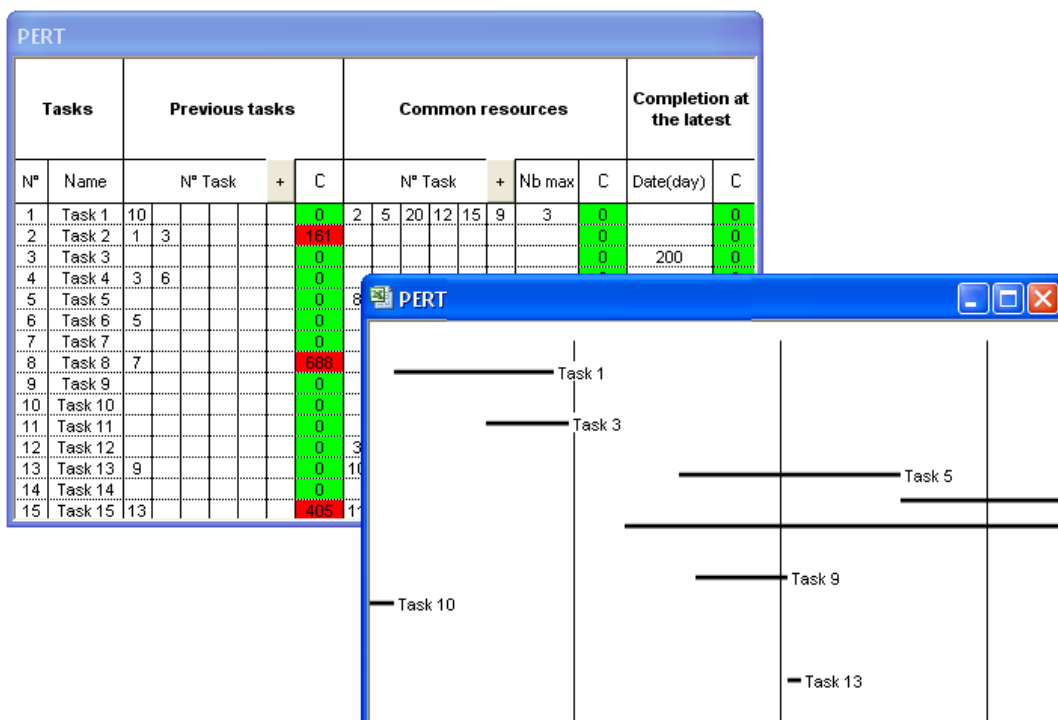**Fax. 33 (0)5 61 54 33 32**
Mail : Contact@cabinnovation.com
Web : www.cabinnovation.com

CABPLAN Version 5

using Microsoft EXCEL®

Scheduling and Project Risk Control

User's Manual

FOREWORD

The software *CABPLAN BASIC* version 4 includes some of the *CABPLAN* version 5 features. It is not the subject of a specific user manual.

CONTENTS:

1. CABPLAN Software

1.1 General Presentation

CABPLAN is a scheduling tool that optimises a graph of tasks by various criteria such as income maximisation (all profits and costs taking into account interest rates) under certain constraints.

These constraints may include rules of precedence (A task can not begin after the completion of the tasks B, C ...), shared resources (limiting the number of tasks carried out simultaneously) or end dates of task (task A urgently needs to be completed before the TA date).

Scheduling can be simulated to assess the impact of contingencies affecting certain tasks, particularly in order to assess whether certain security measures in light of delays and extra costs on scheduling.

By replacing the durations and costs of elementary tasks with random variables, the scheduling can be simulated (Monte-Carlo) to obtain the dispersion of the overall results (income and duration of the scheduling) from the input variables.

Optimisation can be made from Monte Carlo simulation results to obtain a more robust planning for contingencies.

CABPLAN uses a relatively complex method of optimisation by genetic algorithms and simplex nonlinear. But it requires no special knowledge of mathematics to be used. It comes with a set of its algorithms can however be changed by the user.
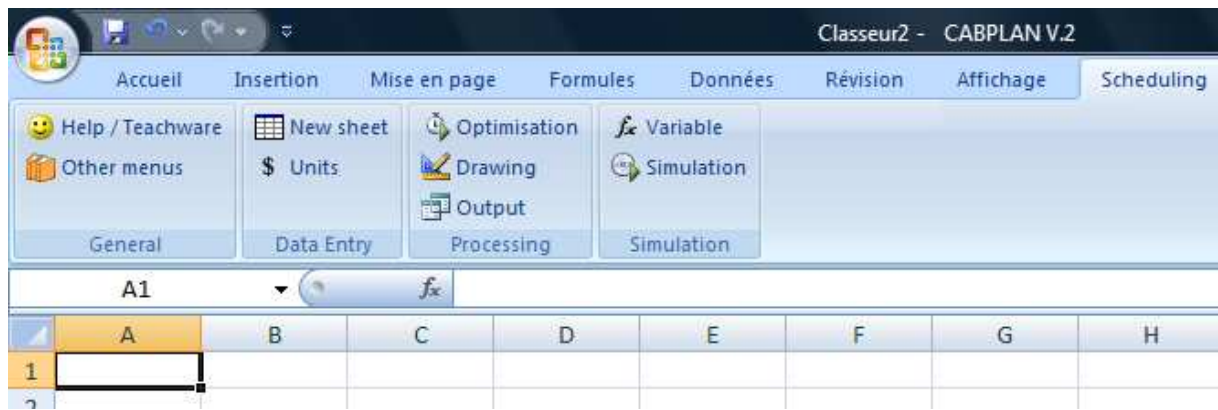
1.2 Installing CABPLAN on Hard Disk
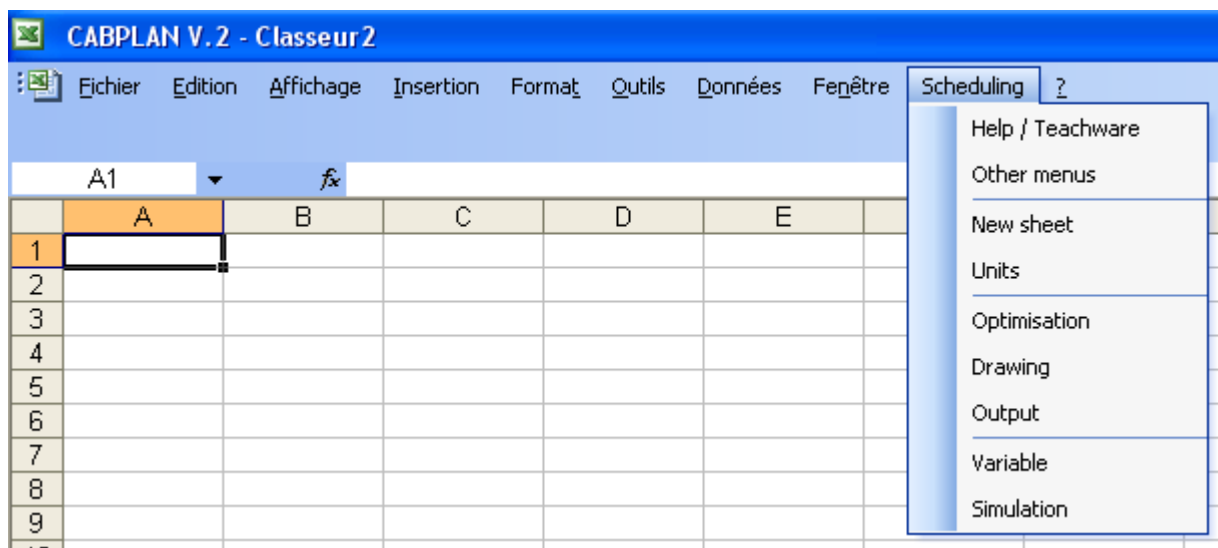
Please follow instructions of the CD Rom.

1.3 Staring CABPLAN

In EXCEL, open CABPLAN.XLA file.
Software's functionalities are then accessible using menu "Simulation", spreadsheet functionalities remaining always available.

Banner on Excel versions after 2007

Menu on Excel versions prior to 2007

Teachware and help are proposed in menu.

2. Entering a scheduling

The command "New Sheet" provides a scheduling worksheet with time units and cost can be changed using the command "Units".

The following example is offered in the online help, accessible by the command "Help / Teachware".

PERTDEMO_E.xls

N°	Name	Previous tasks N° Task	+	C	Common resources N° Task	+	Nb max	C	Completion at the latest Date(day)	C	Duration (day)	margin	Start at fixed date Date(day)	At the earliest	At the latest	Start Date(day)	End Date(day)	Cost to start work Date(day)	Cost versus time (K Euro)	Total cost at T0 (K Euro)	Profit at the end of task (K Euro)	Total profit at T0 (K Euro)
1	Task 1	10		0	2 5 20 12 15 9		3	0		0	150	5		Oui	Non	25	180	10	1	158,268		0
2	Task 2	1 3		168				0		0	50	6		Non	Non	19	75	20	2	119,535		0
3	Task 3			0				0	200	0	80			Non	Non	10	90	45	3	283,533		0
4	Task 4	3 6		0				0		0	125	2		Oui	Non	526	653	12	4	506,473		0
5	Task 5			0	8 9 11 20 6 24		2	0		0	215			Non	Non	8	223	50	25	5340,85		0
6	Task 6	5		0				0		0	302	1		Oui	Non	223	526	4	32	9455,48		0
7	Task 7			0				0		0	459		250	Non	Non	250	709	5	2	892,43		0
8	Task 8	7		666				0		0	76			Non	Non	21	97	78	3	304,498	5000	4929,69
9	Task 9			0				0		0	89		318	Non	Non	318	407	45	4	396,633		0
10	Task 10			0				0		0	25		0	Non	Non	0	25	13	2	62,9084		0
11	Task 11			0				0		0	46			Non	Non	22	68	2	7	322,909		0
12	Task 12			0	3 5 8 4		2	0		0	78			Non	Non	17	95	6	3	238,65		0
13	Task 13	9		0	10			0		0	13	1		Oui	Non	407	421	3	8	106,719		0
14	Task 14			0				0		0	46			Non	Non	9	55	7	9	419,596		0
15	Task 15	13		405	11 10 14			94		0	78			Non	Non	16	94	89	4	399,013	15000	14794,9
16	Task 16	2 5		22				0		0	54	2		Non	Non	3	59	2	3	163,335		0
17	Task 17	2 1		166				0		0	69	3		Non	Non	11	83	4	7	484,45		0
18	Task 18	16		47				0		0	12	1		Non	Non	11	24	6	12	149,853		0
19	Task 19	18 15		90	8 9			81		0	78			Non	Non	4	82	78	1	155,513		0
20	Task 20			0				0		0	150			Non	Non	8	158	2	1	150,357		0
21	Task 21	3 6		0	5 6 7 9 11		2	0		0	29	3		Oui	Non	526	558	3	3	89,5732		0
22	Task 22	3		73				0		0	69	1		Non	Non	16	86	5	8	554,161		0
23	Task 23	22 21		550				0		0	31	3		Non	Non	9	43	7	9	285,296		0
24	Task 24	23		18	12 14			81		0	49	1		Non	Non	24	74	6	50	2447,01		0
25	Task 25	24		82				0		0	53	4		Non	Non	12	69	45	7	414,371		0
26	Task 26	25		86				0		0	100			Non	Non	3	103	25	9	918,412		0
+	$			663				0	1300	0	0	0				26	26				15000	14942,9
		3235			237				0												

End of the last task: 709   Cost: 24820   Profit: 34668

Income at T0: 9848

Interest rate: 5,50%

Each line of the sheet corresponds to an elementary task that is referenced by a number in the first column. The action on the button ⊞ on the last line adds a new task at the bottom of the sheet.

The task name can be entered in the second column and precedence constraints, shared resources, and completion dates in the following columns. In this example, task 2 can begin only after the full implementation of tasks 1 and 3 and can not be concurrent with more than 2 tasks among tasks 1, 5, 20, 12, 15 and 9 for which certain resources material or human are shared.

These resources need not be explained and each condition can be expressed only once (if the task i can not take place during the task j, the task j can not be completed while the task i). This formulation allows defining the most constraints resulting from the use of multiple resources to one task (task 20 shares a resource with task 1 and another with task 5). When this is not possible, for example if three resources are used by two tasks, a dichotomy of tasks can always be done according to the resources used. Task 3 must be completed imperatively at time t = 200 days after T0, the beginning date of the first task of scheduling.

Two buttons ⊞ at the top of the table allow adding, if necessary, additional columns to express precedence constraints and shared resources.

The values listed in three columns "C", expressing satisfaction (null cell and green) or excess (not null and red) constraints relating to each task. The value of precedence and end date constraint is the sum of any unauthorized excess ($\sum$ [ti-tj]). The value of resource constraint is the sum of not authorised resource capacities. These constraint values are updated automatically when entering tasks.

Possibly with margin, the duration of each task is entered in both columns.

Three columns are used to set the start date for each task. This can be chosen at earlier or later (click of the mouse in the corresponding cell), fixed date (by entering a value in the corresponding cell), or calculated by the tool as a parameter optimisation.

Any circular references between tasks are reported by the tool during the entering. A terminal fictitious zero duration task ($) was added to the table to avoid problems such circular references (optimisation moving this task until the end of the scheduling).

The number of task scheduling is not limited (26 in the example), but the number of tasks computed by the tool (17 in the example) can not increase indefinitely because of the limitations of optimisation techniques used (significant loss of efficiency beyond 50 tasks).

Depending on the choices made, formulas corresponding to the dates of beginning and end of task automatically inserted in the next two columns.

Besides the satisfaction of constraints, the optimisation can include the overall duration of the scheduling or profit maximisation. Also can be attributed to each task in the columns following an initial cost (cost to start work), a cost proportional to the period (cost versus time) and a profit on completion (such a profit can be attributed to the fictional task "$" if it is conditioned by the completion of the total scheduling).

By applying an interest rate, formulas expressing the profits and costs of each task (at T0) automatically inserted in the corresponding columns.

3. Processing

3.1. Optimisation

CABPLAN uses the same algorithms as optimisation tool GENCAB. The user interface and dialog boxes are identical.

The command "optimisation" involves displaying the following dialog box that allows optimising the scheduling.
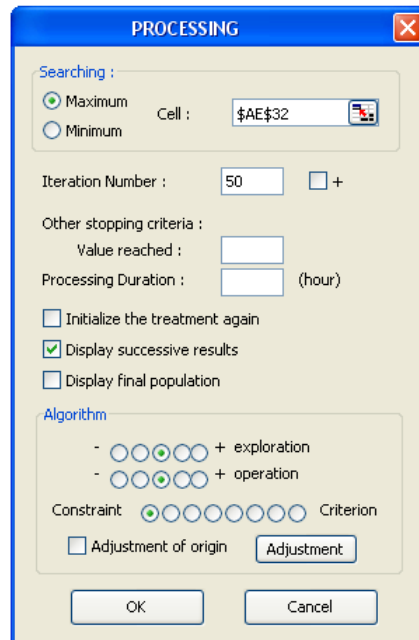
By default, the tool maximizes income, but the user can modify this criterion (minimizing the overall duration of the scheduling for example) by selecting the type of search to perform (minimum or maximum) and changing the reference of the cell in question (by clicking the mouse).
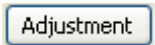
The user defines a number of processing loops as a criterion to stop the search.
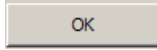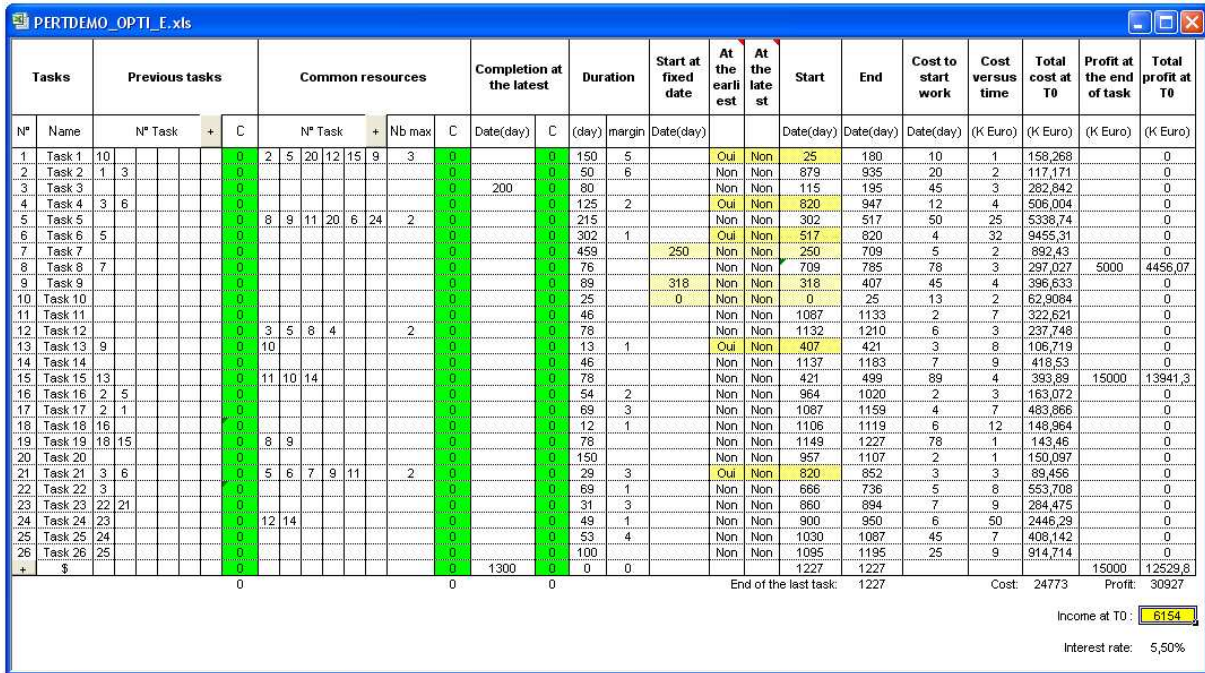
It may also use two other criteria to stop:
. Reaching a better result than an a-priori defined value,
. Outstripping a certain processing duration (in hours).

The option **"Display successive results"** helps displaying the best result obtained all over the processing.

The option **"Display final population"** allows to display the features of population obtained at end of processing.

The tuning algorithm parameters can be performed by the user using the button [Adjustment] (see corresponding chapter)

Processing is initiated by activation of the button [OK]. The unsatisfied constraints of the table disappear gradually and the scheduling changes according to the criterion chosen. The tool shows in the status bar (bottom of the screen) the number of the current loop, duration of a loop, the number of evaluations performed during each loop and the duration of assessment. About 300 loops are required to process the example below, offered by the online help.

N°	Name	Previous tasks N° Task	+	C	Common resources N° Task	+	Nb max	C	Completion at the latest Date(day)	C	Duration (day)	margin	Start at fixed date Date(day)	At the earliest	At the latest	Start Date(day)	End Date(day)	Cost to start work Date(day)	Cost versus time (K Euro)	Total cost at T0 (K Euro)	Profit at the end of task (K Euro)	Total profit at T0 (K Euro)
1	Task 1	10		0	2 5 20 12 15 9		3	0		0	150	5		Oui	Non	25	180	10	1	158,268		0
2	Task 2	1 3		0				0		0	50	6		Non	Non	879	935	20	2	117,171		0
3	Task 3			0				0	200	0	80			Non	Non	115	195	45	3	282,842		0
4	Task 4	3 6		0	8 9 11 20 6 24		2	0		0	125	2		Oui	Non	820	947	12	4	506,004		0
5	Task 5			0				0		0	215			Non	Non	302	517	50	25	5338,74		0
6	Task 6	5		0				0		0	302	1		Oui	Non	517	820	4	32	9455,31		0
7	Task 7			0				0		0	459		250	Non	Non	250	709	5	2	892,43		0
8	Task 8	7		0				0		0	76			Non	Non	709	785	78	3	297,027	5000	4456,07
9	Task 9			0				0		0	89		318	Non	Non	318	407	45	4	396,633		0
10	Task 10			0				0		0	25		0	Non	Non	0	25	13	2	62,9084		0
11	Task 11			0				0		0	46			Non	Non	1087	1133	2	7	322,621		0
12	Task 12			0	3 5 8 4		2	0		0	78			Non	Non	1132	1210	6	3	237,748		0
13	Task 13	9		0	10			0		0	13	1		Oui	Non	407	421	3	8	106,719		0
14	Task 14			0				0		0	46			Non	Non	1137	1183	7	9	418,53		0
15	Task 15	13		0	11 10 14			0		0	78			Non	Non	421	499	89	4	393,89	15000	13941,3
16	Task 16	2 5		0				0		0	54	2		Non	Non	964	1020	2	3	163,072		0
17	Task 17	2 1		0				0		0	69	3		Non	Non	1087	1159	4	7	483,866		0
18	Task 18	16		0				0		0	12	1		Non	Non	1106	1119	6	12	148,964		0
19	Task 19	18 15		0	8 9			0		0	78			Non	Non	1149	1227	78	1	143,46		0
20	Task 20			0				0		0	150			Non	Non	957	1107	2	1	150,097		0
21	Task 21	3 6		0	5 6 7 9 11		2	0		0	29	3		Oui	Non	820	852	3	3	89,456		0
22	Task 22	3		0				0		0	69	1		Non	Non	666	736	5	8	553,708		0
23	Task 23	22 21		0				0		0	31	3		Non	Non	860	894	7	9	284,475		0
24	Task 24	23		0	12 14			0		0	49	1		Non	Non	900	950	6	50	2446,29		0
25	Task 25	24		0				0		0	53	4		Non	Non	1030	1087	45	7	408,142		0
26	Task 26	25		0				0		0	100			Non	Non	1095	1195	25	9	914,714		0
+	$			0			1300	0		0	0	0				1227	1227				15000	12529,8

| 0 | | 0 | 0 | End of the last task: 1227 | | | Cost: 24773 | Profit: 30927 |

Income at T0 : 6154

Interest rate: 5,50%

The optimum not necessarily achieved after processing, the user can restart it while keeping the best result so far.

Notes:

Genetic algorithms can find the global optimum of a function, without stopping at the first local optimum found, but no guarantee of finding it actually.

Finding the optimum is more effective with the principle of maximising income with that of the overall scheduling duration. Indeed, each change in start date of task influence the final result with the first criterion, which is not the case with the second (limited to only task temporarily placed on the critical path).

3.2. Drawing

The command "Draw" allows generating the PERT diagram corresponding to the table for easy reading of results:
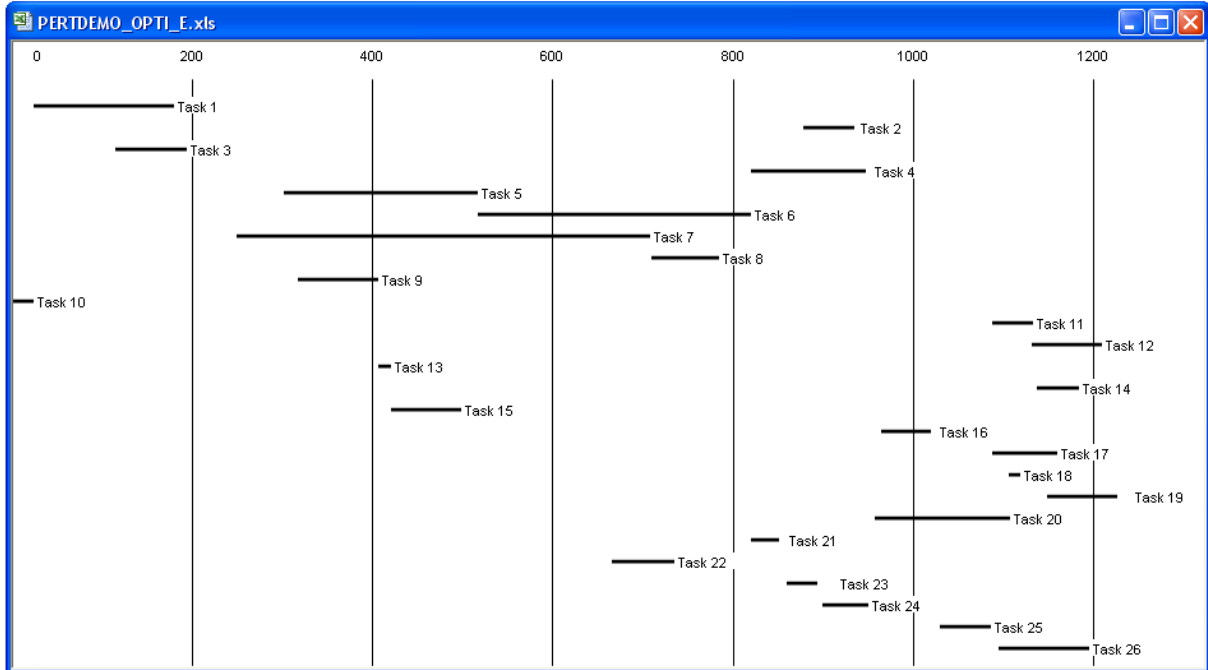
3.3. Output

The "Output" command creates a table similar to the first in which formulas freeze start date of task or modify it, if necessary, to satisfy the constraints of precedence between tasks.

Thus, changing the duration or cost of a task is automatically translated by a modification of scheduling and associated costs, noting any constraints not met.

Thus, we may at any time assess the impact of a hazard in terms of cost and delay on all of the scheduling order to assess the appropriateness of some relief actions (appealing to the elementary level, they can be globally unproductive).

As an illustration, the following table shows the effects generated in the previous example by increasing the duration of the task 18 from 12 to 150 days. The expected income and the overall duration of the scheduling are then affected. However, the constraints of shared resources are always met.

Tasks					Previous tasks							Common resources												Completion at the latest			Duration		Start at fixed date	Au plus tôt	Au plus tard	Start	End	Cost to start work	Cost versus time	Total cost at T0	Profit at the end of task	Total profit at T0
N°	Name		N° Task		+	C		N° Task						+	Nb max	C		Date(day)		C	(day)	margin	Date(day)			Date(day)	Date(day)	Date(day)	(K Euro)	(K Euro)	(K Euro)	(K Euro)
1	Task 1	10				0	2	5	20	12	15	9		3	0			0	150	5				25	180	10	1	158,268		0
2	Task 2	1	3			0									0			0	50	6				879	935	20	2	117,171		0
3	Task 3					0									0	200		0	80					115	195	45	3	282,842		0
4	Task 4	3	6			0									0			0	125	2				820	947	12	4	506,004		0
5	Task 5					0	8	9	11	20	6	24		2	0			0	215					302	517	50	25	5338,74		0
6	Task 6	5				0									0			0	302	1				517	820	4	32	9455,31		0
7	Task 7					0									0			0	459					250	709	5	2	892,43		0
8	Task 8	7				0									0			0	76					709	785	78	3	297,027	5000	4456,07
9	Task 9					0									0			0	89					318	407	45	4	396,633		0
10	Task 10					0									0			0	25					0	25	13	2	62,9084		0
11	Task 11					0									0			0	46					1087	1133	2	7	322,621		0
12	Task 12					0	3	5	8	4				2	0			0	78					1132	1210	6	3	237,748		0
13	Task 13	9				0	10								0			0	13	1				407	421	3	8	106,719		0
14	Task 14					0									0			0	46					1137	1183	7	9	418,53		0
15	Task 15	13				0	11	10	14						0			0	78					421	499	89	4	393,89	15000	13941,3
16	Task 16	2	5			0									0			0	54	2				964	1020	2	3	163,072		0
17	Task 17	2	1			0									0			0	69	3				1087	1159	4	7	483,866		0
18	Task 18	16				0									0			0	150	1				1106	1257	6	12	1785,28		0
19	Task 19	18	15			0	8	9							0			0	78					1257	1335	78	1	142,422		0
20	Task 20					0									0			0	150					957	1107	2	1	150,097		0
21	Task 21	3	6			0	5	6	7	9	11			2	0			0	29	3				820	852	3	3	89,456		0
22	Task 22	3				0									0			0	69	1				666	736	5	8	553,708		0
23	Task 23	22	21			0									0			0	31	3				860	894	7	9	284,475		0
24	Task 24	23				0	12	14							0			0	49	1				900	950	6	50	2446,29		0
25	Task 25	24				0									0			0	53	4				1030	1087	45	7	408,142		0
26	Task 26	25				0									0			0	100					1095	1195	25	9	914,714		0
+	$					108									0	1300		0	0	0				1227	1227				14301,76	11946,6
						108										0		0						End of the last task:	1335		Cost:	26408	Profit:	30344

Income at T0 : 3936

Interest rate: 5,50%

Effects caused by the increase in task duration

This new table can also be simulation Monte Carlo to obtain the results in the form of statistical distributions (see following paragraphs).
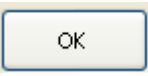
3.4.   Random variable

To achieve results in the form of statistical distributions, the tool can replace the duration and cost of elementary tasks with random variables characterized by different probability laws.

CABPLAN uses the same algorithms as the simulation tool SIMCAB. The user interface and dialog boxes are identical.

If the selected cell corresponds to the duration or cost (to start work or versus time) of an elementary task, the "variable" command allows to display the following dialog box, in which the name of the variable in question appears:
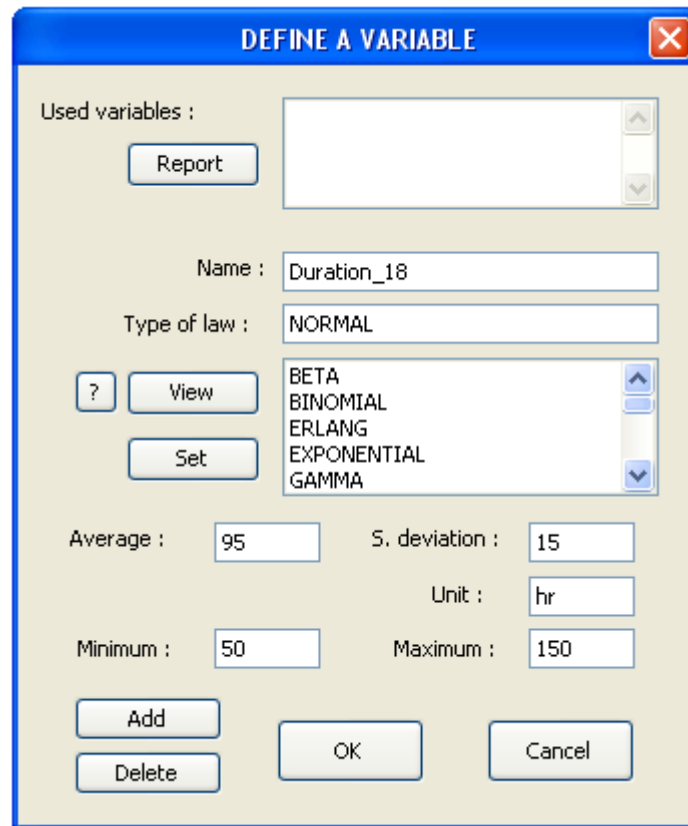
The user can then choose a statistical distribution in a scrolling list (Normal), enter the value of the parameters of the law (average 95, standard deviation: 15) and may specify the unit (hr), the minimum limits (50) and maximum (150) values can be taken by the variable.

After action on the button ⟨OK⟩ or ⟨Add⟩, a value is allotted to the variable name as soon as the latter is defined, and its name is added up to the scrolling list of variables being used. Activating the latter helps display the features of preliminarily-defined variables.

Button ⟨Delete⟩ allows deleting a preliminarily-defined variable, selected in scrolling list.

Button ⟨View⟩ allows to perform a simulation of selected law, then to display the results.

Button ⟨Report⟩ allows generating a document containing all characteristics of the variables and results previously entered.

Button ⟨?⟩ allows initiating an online hotline specifying the operating conditions of selected law.

Button ⟨Set⟩ allows setting the law selected from experimental data. When activated, it initiates the display of the following dialog box which helps user inform the chronological-series address through a selection by using the mouse. Such series should be preliminarily entered in line or column on a calculation sheet (but not necessarily the one being selected).
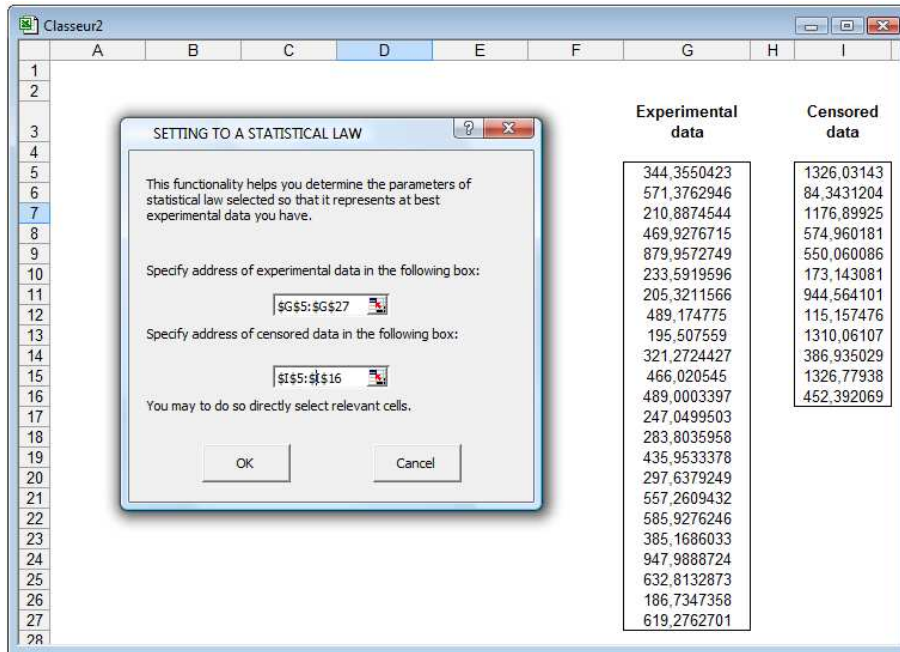
From all values of series, setting is achieved by software using maximum-likeliness method (optimization achieved using Simplex method). At completion of such setting, software displays the experimental distribution function and function of law obtained together with statistical-test results (Khi-2, Kolmogorov-Smirnov) enabling user to validate law's selection.
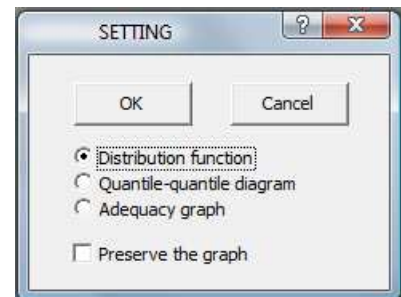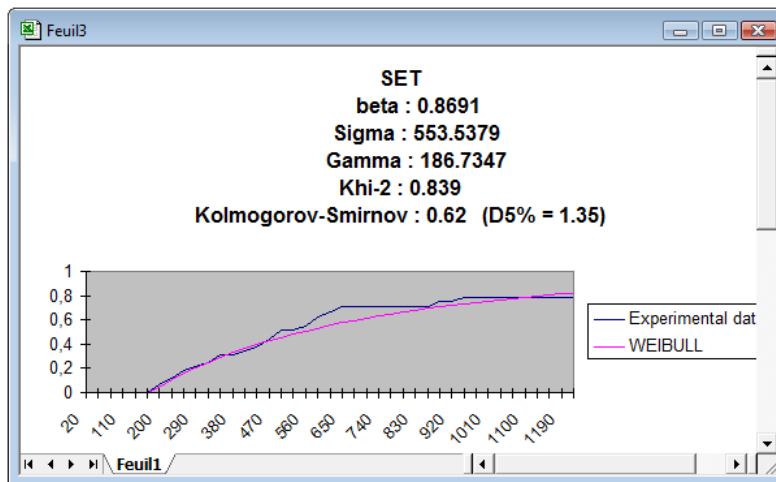
If setting is accepted by user, dialog box « Define a variable » is newly displayed with optimal parameters of the informed law.

3.5. Monte-Carlo simulation

CABPLAN uses the same algorithms as the simulation tool SIMCAB. The user interface and dialog boxes are identical.

The command "simulation" can display the following dialog box:
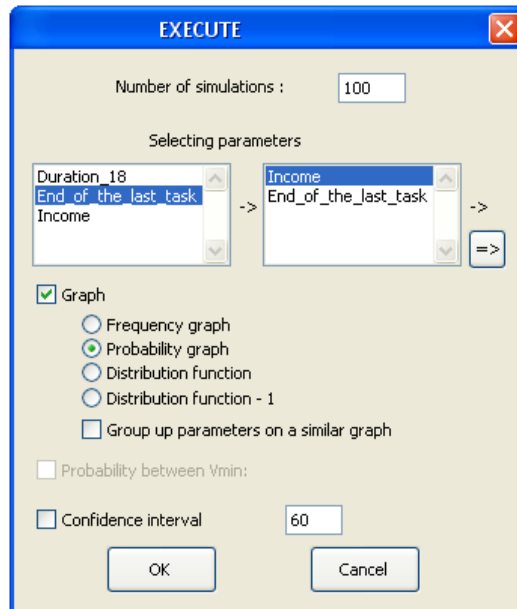
Input or result variables to be subject to a simulation are to be selected in left list including all preliminarily-defined variable and result names. A mouse click on one of names initiates such name in the right-hand list of variables selected. A mouse click on one of right list's names makes it disappear from the list hereof.

The number of simulations required is limited to 16 000. The more such number is high, the better the accuracy of results obtained, but this is detrimental to the processing time. Therefore, it is recommended to start simulation with a low number (100) then carry on subsequently by increasing such number.

Results of simulation may be presented in frequency graph, probability graph, distribution function or 1 – distribution function.

Variables may be grouped up on a same graph or be subject to separated graphs.
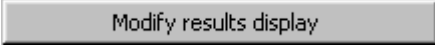
A confidence interval around the average value of each result can be evaluated according to a certain rate of confidence.

Initiating button [OK] runs therefore simulation and controls the requested-results display as shown in examples below.
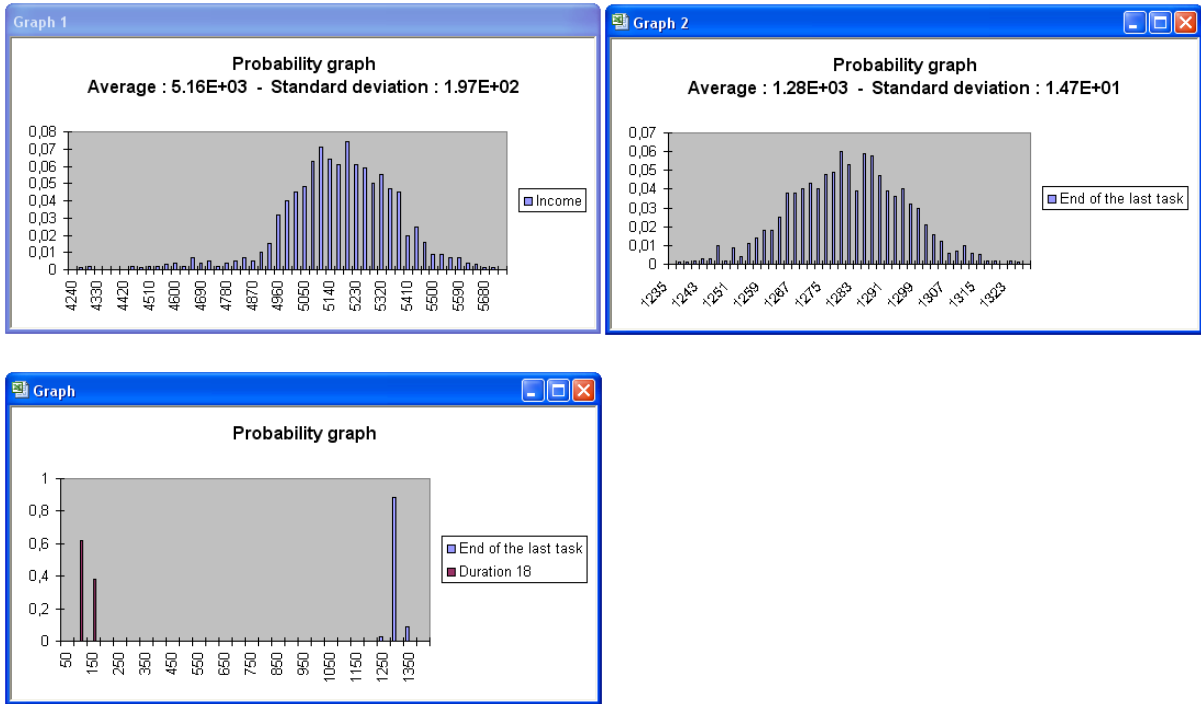
These different charts are accompanied by following dialog box which allows to carry on simulation (doubling of number of achieved simulations is proposed by default), to modify results overview, or to perform on results various statistical processing.
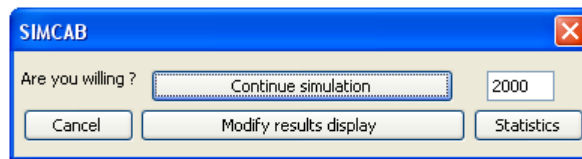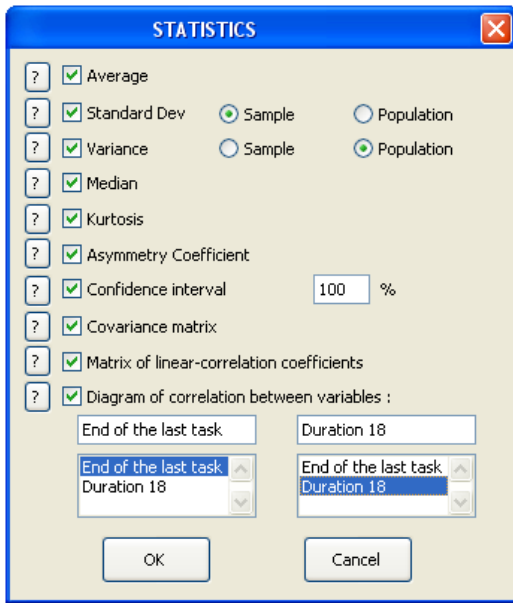

Pressing button initiates the display of following dialog box allowing modifying the type of graph selected, modifying minimum and maximum limiters as well as the viewing step, and possibly requesting the confidence-interval display...
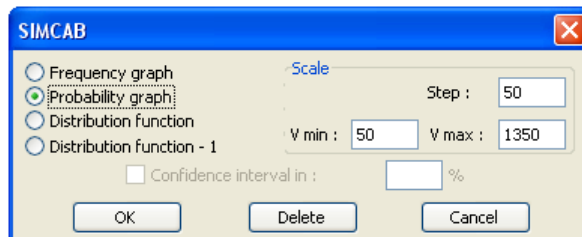
Modifying one of limiters initiates the display on graph of probability that variable be beyond that limiter.

The button on the previous dialog box allows getting various statistical results from the simulation results. A dialog box offers the various options presented below.

STATISTICS

- ☑ Average
- ☑ Standard Dev ● Sample ○ Population
- ☑ Variance ○ Sample ● Population
- ☑ Median
- ☑ Kurtosis
- ☑ Asymmetry Coefficient
- ☑ Confidence interval 100 %
- ☑ Covariance matrix
- ☑ Matrix of linear-correlation coefficients
- ☑ Diagram of correlation between variables :

End of the last task | Duration 18

End of the last task / Duration 18 | End of the last task / Duration 18

OK   Cancel

	End of the last task	Duration 18
Average	1279,46028	94,5481358
Standard deviation (S)	15,2011148	15,2011148
Variance (P)	230,842817	230,842817
Median	1279,49845	94,5863022
Kurtosis	-0,17207752	-0,17207752
Asymmetry	-0,10259762	-0,10259762

Confidence interval in 99 %

	End of the last task	Duration 18
Borne min.	1278,22208	93,3099284
Borne max.	1280,69849	95,7863432

Covariance Matrix

	End of the last task	Duration 18
End of the last task	230,842817	230,842817
Duration 18	230,842817	230,842817

Matrix of Linear-Correlation Coefficients

	End of the last task	Duration 18
End of the last task	1	1
Duration 18	1	1

Diagram of Correlation

(chart: End of the last task vs Duration 18)
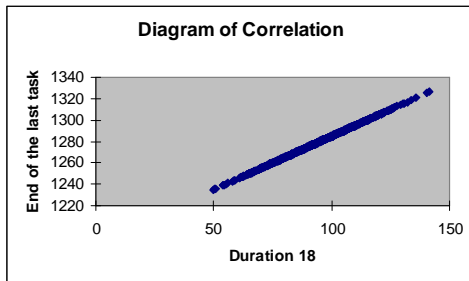
Remarks:

All graphs obtained are in specific calculation sheets which include all results of relevant simulation.

Performing the simulation initiates the creation of two additional names for each variable defined as result, « Average_Result » and « Standard_Deviation_Result », which correspond to the average value and standard deviation of variable with name « Result », respectively. In the same way the names "CMax_Result", "CMin_Result", "Confidence_rate" and "Nb_simu" are also created if the calculation of the confidence interval is required. These names correspond respectively at the lower and higher boundaries of the confidence interval, the corresponding rate and the number of simulations carried out.

3.6. Optimisation from simulation results

Optimisation can be achieved from Monte Carlo simulation results to obtain a more robust planning for hazards identified in risk analysis of the project, each being characterized by a random variable.

However, the processing duration is so much longer and is a first approximation, multiplied by the number of simulations for each assessment.

Therefore CABPLAN implements an original technique of coupling optimization and simulation can significantly reduce the duration. This is to vary the number of simulations of each assessment, using the mean and variance of the results obtained during a first rough evaluation.

The user can set the number of simulations during the rough estimate (N0) and the necessary precision required (N) by adjusting algorithms (see Section 4.6).

4. Algorithms' Selection and Setting

This chapter is intended for advanced users who already have extensive knowledge in the field of optimization (genetic algorithms and simplex nonlinear).

The activation of the button Adjustment on the dialog box "optimisation" involves displaying the following dialog box that allows adjusting the optimization settings.
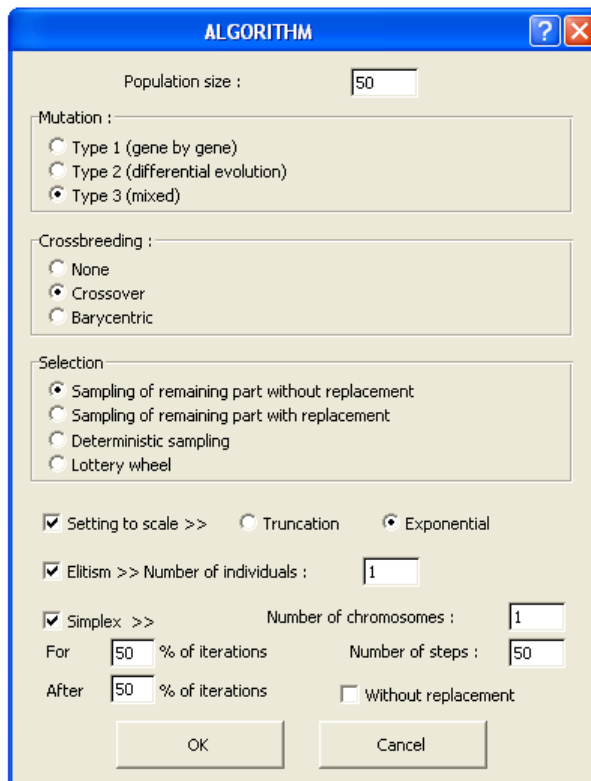
The user may define the population size and choose among different mutation, crossbreeding and selection operators.

He may also select a setting to scale, by choosing between two different techniques (Truncation or Exponential), an elitism operator, by specifying the number of individuals to be maintained for each generation, and a link with Simplex algorithm, possibly limited to certain loops of calculation (in proportion and starting from a certain row)..

If Simplex is selected, the user should define a number of chromosomes, among the best of the population, from which a local optimum will be searched. He should also indicate a number of processing steps to be carried out for this research and possibly select the option **"Without Replacement"**.

When such option is requested, the chromosome is no longer replaced by the local optimum being found by simplex but its fitness assumes the value of that of the optimum, which may increase chances to find out new optima on subsequent mutations.
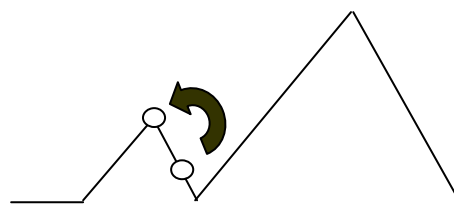

Simplex with replacement

Depending on options selected, validation generates the display of different additional dialog boxes.

4.1 Mutation

Three operators of change are proposed to the user. According to the type of operator chosen, the following dialog boxes allow to define the mutation probability of each chromosome, the decrease in mutation amplitude of a real or integer gene and the mutation probability of a binary gene.
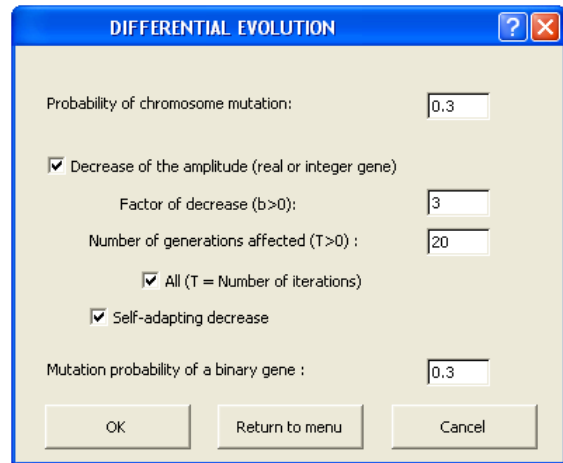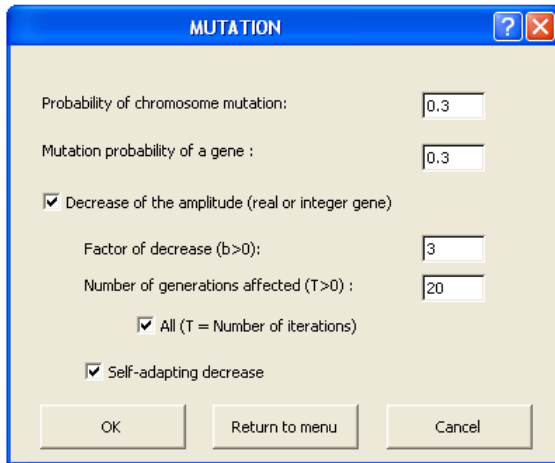
The mutation amplitude of a real or integer gene can be governed by an adaptive control or the following expression:

$$1 - r^{(1-\frac{t}{T})^b}$$

where r is a random number comprised between 0 and 1 and t the number of the processing loop.

$0 < b < 1$

$b > 1$
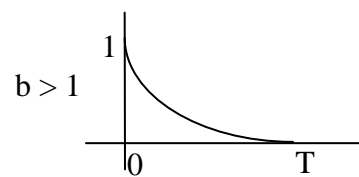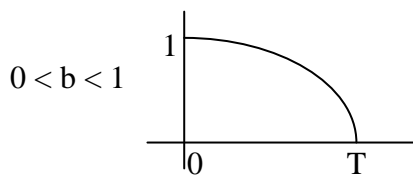
4.2 Crossbreeding

One of the two crossbreeding operators described in Figure 4.4 (Crossover or barycentric) may be selected by the user. The above described dialog box helps define the crossbreeding probability of each population chromosome with another one randomly chosen in such population.
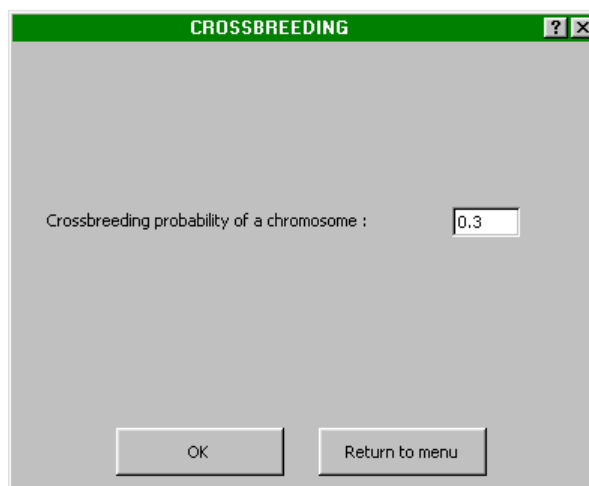
4.3 Selection

In addition to the selection with lottery wheel shown in Figure 4.5, the software proposes three other selection operators:

. Sampling of remaining part without replacement
. Sampling of remaining part with replacement
. Deterministic sampling

Such operators, which cannot be parameterized, perform the selection as follows:

Sampling of remaining part without replacement

Assuming a population of n individuals, the expected number n_i of descendants for each individual i is computed by the following formula:

$$n_i = n * \frac{f(i)}{\sum_{i=1}^{n} f(i)}$$ where f designates the adaptation function.

Each individual i is reproduced, in new population, a number of times equal to the whole part of number n_i.
In order to complete the population and bring it back to its initial size n, individuals are successively subject to a random draw by considering the decimal part of number n_i as probability of success.
The two other selection operators differ from the previous one only by the processing operated on decimal parts of numbers n_i:

Sampling of remaining part with replacement

To complete the population, decimal parts of numbers n_i are used to form a lottery wheel.

Deterministic sampling

Decimal parts of n_i are arranged in decreasing order, and chromosomes corresponding to first elements of list complete population.

The method of selection with lottery wheel offers a great variance and often conducts to results far from those expected (especially disappearance of best elements).
But no one could really demonstrate to date the superiority of one of the other selection methods being proposed.

4.4 Setting to Scale

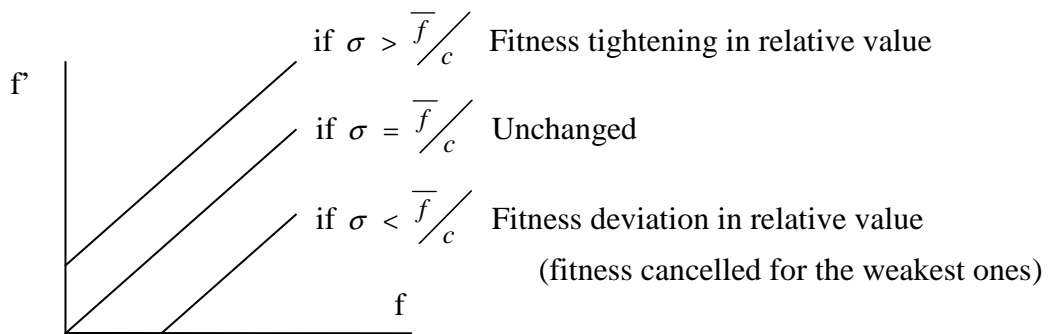Two different techniques of setting to scale are offered to user.

Setting to scale by truncation in sigma

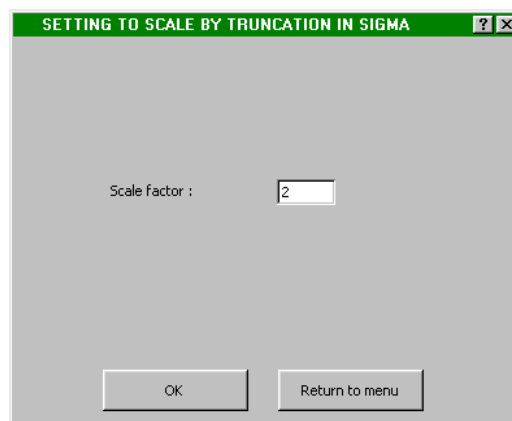The preliminary transformation of fitness of each chromosome is performed as follows:

$$f' = f - (\overline{f} - c\,\sigma)$$

with $\overline{f}$ the average of fitness for all chromosomes and σ the typical deviation.

Transformation may be represented as follows :

f' | if $\sigma > \overline{f}\big/c$ Fitness tightening in relative value

if $\sigma = \overline{f}\big/c$ Unchanged

if $\sigma < \overline{f}\big/c$ Fitness deviation in relative value

(fitness cancelled for the weakest ones)

f

User using dialog box below defines scale factor «c».

SETTING TO SCALE BY TRUNCATION IN SIGMA

Scale factor :   2

OK   Return to menu

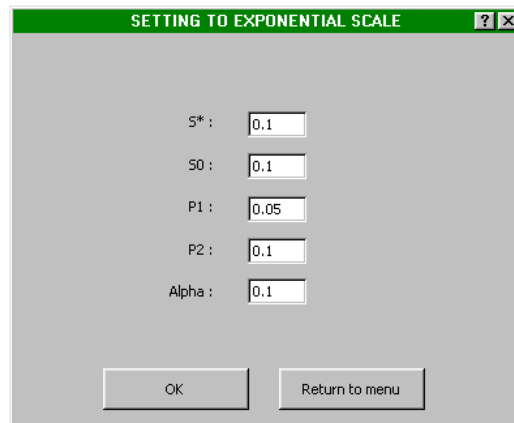Preliminary fitness transformation of each chromosome is carried out as follows:

$$f' = f^{\,I(k)}$$ with $$I(k) = \left(\frac{s^*}{s_0}\right)^{p_1} \tan^{\,p_2\left(\frac{s_0}{s^*}\right)^{\alpha}}\left(\frac{\pi}{2}\,\frac{k}{N+1}\right)$$
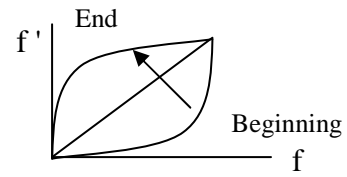
where: k is the current generation

      N the number of generations being wished (iteration number)

      And parameters S*, S0, P1, P2 and α are defined by the following dialog box:
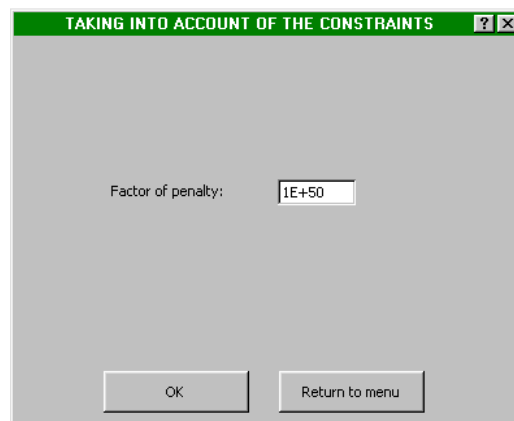

4.5 Taking into account of the constraints

The taking into account of the constraints is carried out by the addition of a term of penalty to the result of the function to optimize. This one with the following form in which fp can be adjusted by the user:

$$Tp = fp * \sum (dci)^2$$

with dci = Max(0, B-A) if A >= B, = B-A if A = B or = A-INT(A) if A Integer

This adjustment is in particular necessary in the case of constraints of the equality type or Integer value not to block the algorithm in its research by a too strong penalty (to increase the penalty gradually).

4.6 Optimization starting from results of simulation

The following dialog box makes it possible to the user to activate the optimized strategy of coupling between optimization and Monte-Carlo simulation (described in paragraph 4.1.4) and to define the minimum number N_0 of simulations carried out for the coarse evaluation as well as maximum number N necessary to the necessary precision.
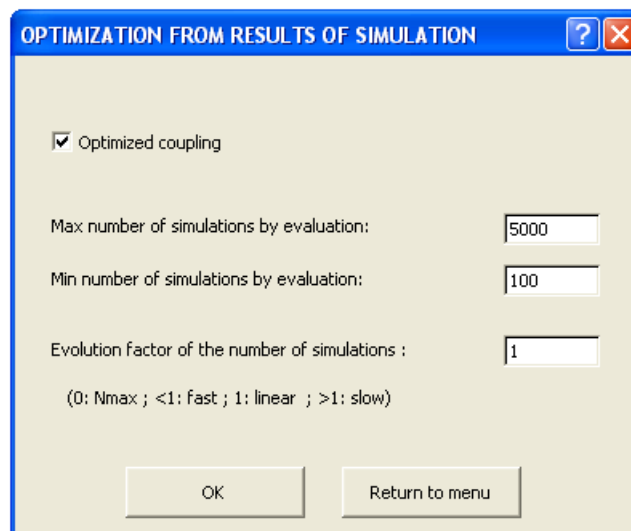
According to the entered value of a coefficient K, this required precision can be fixed or progress during the treatment according to the following formula, parallel to the progressive improvement of the population of solutions.
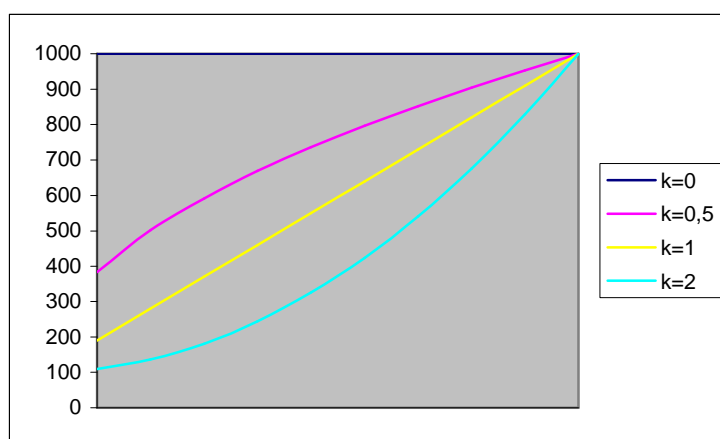
N = MIN(Nmin+INT((Nmax-Nmin)*(N° of iteration / Number of iterations)^k) ; Nmax)

OPERATING LICENCE AGREEMENT

OF CABPLAN SOFTWARE PACKAGE

ARTICLE 1 : SUBJECT

The purpose of this Agreement is to define the conditions in which the CAB INNOVATION Company grants the customer with a non-transferable, non-exclusive and personal right to use the software package referred to as "CABPLAN" and whose features are specified in user's manual.

ARTICLE 2 : SCOPE OF THE OPERATING RIGHT

The customer may use the software package on one single computer and on a second one provided that the second computer does not operate at the same time as the first one. The customer can only have one software package copy maintained in a safe place as a backup copy.

If this license is regarding a performance on site, the customer may install the package software on a server, while scrupulously complying with purchase conditions stated on specific conditions especially defining the maximum number of users authorized to use the software package from their terminal and the maximum number of users authorized to use it simultaneously. The customer is therefore authorized to perform a number of software package documentation copies equal to the maximum number of users allowed to use it..

CAB INNOVATION will be in a position to perform inspections, either itself or through a specialized entity purposefully authorized by CAB INNOVATION, at customer premises to verify if customer has met its requirements : number of software package copies used, location of such copies, etc... Parties will agree as regards the practical modalities of performance of such inspections so as to disturb minimally customer's activity.

ARTICLE 3 : DELIVERY, INSTALLATION AND RECEPTION

The software package and attached supplies will be delivered to the customer on mail reception date. The customer installs, at its own costs, the software package using relevant manual delivered by CAB INNOVATION.
The customer performs the inventory and shall inform CAB INNOVATION, within three working days of the delivery, of any apparent nonconformity with respect to the order. The customer is liable for any loss or any damage caused to supplies as from the delivery.

ARTICLE 4 : TESTING AND GUARANTEE

Guarantee is effective as from the mail delivery date set forth in Article 3 and has a three-month validity.
During the guarantee validity, if the customer experiences a software package operation trouble, he should inform CAB INNOVATION about it, so as to receive any helpful explanations with the purpose of remedying such trouble. If the trouble is continuing, the customer will return the C.D. ROM to CAB INNOVATION, at CAB INNOVATION's Head Office, at his own expense and with registered mail with acknowledgement of receipt, by specifying exactly the troubles encountered.

Within the three months of reception of consignment set forth in preceding paragraph, CAB INNOVATION will deliver, at its own expense, a new product version to the customer. This new version will be benefiting of the same guarantee as benefited the first version.

The customer looses the benefit of the guarantee if he does not comply with the instructions manual recommendations, if he performs modifications of configuration set forth in Article 2 above without obtaining a prior written consent from CAB INNOVATION, or if he performs modifications, additions, corrections, etc... on software package, even with the support from a specialized service company, without obtaining a prior written consent from CAB INNOVATION.

ARTICLE 5 : PROPERTY RIGHT

CAB INNOVATION declares to be holding all the rights provided for by the intellectual property code for CABPLAN package software and its documentation.

As this operating-right granting generates no property-right transfer, the customer abstains from :
- any CABPLAN software package reproduction, whether it is wholly or partly carried out, whatever the form assumed, excepting the number of copies authorized in Article 2 ;
- any CABPLAN software package transcription in any other language than that provided for in this Agreement (see Appendix), any adaptation to use it in other equipment or with other basic software packages de base than those provided for in this Agreement.

To ensure this property protection, the customer undertakes especially to

- maintain clearly visible any property and copyright specifications that CAB INNOVATION would have affixed on programs, supporting material and documentation ;
- assume with respect to his staff and any external person any helpful information and prevention step.

ARTICLE 6 : USING SOURCES

Any CABPLAN software package modification, transcription and, as a general rule, any operation requiring the use of sources and their documentation are exclusively reserved for CAB INNOVATION.
The customer holds the right to get the information required for the software package interoperability with other softwares he is using, under the conditions provided for in the intellectual property code.
In each case, an amendment of these provisions will set out the price, time limits and general terms of performance thereof.

ARTICLE 7 : LIABILITY

The customer is liable for :
- choosing CABPLAN software package, its adequacy with his requirements, precautions to be assumed and back-up files to be made for his operation, his staff qualification, as he received from CAB INNOVATION recommendations and information required upon its operating conditions and limits of its performances set forth in user's manual;
- the use made for results he obtains.

CAB INNOVATION is liable for the software package conformity with his documentation. The customer shall prove any possible non-conformity.
CAB INNOVATION does not assume any whatsoever guarantee, whether explicit or implicit, relating to the software package, manuals, attached documentation or any supporting item or material provided and, especially, any guarantee for marketing of any products relating to software package or for using software package for a determined use, any guarantee for absence of forgery, etc...
Under no circumstances CAB INNOVATION could be held responsible for any whatsoever damage, especially loss in performance, data loss or any other financial loss resulting from the use or impossibility to use the CABPLAN software package, even if CAB INNOVATION was told about the possibility of such damage.
In the event where CAB INNOVATION liability is retained, it is expressly agreed upon that the total amount of compensation to be paid by CAB INNOVATION, all cases taken together, could not in any way exceed the initial-royalty price reduced by 25 % per period of twelve months elapsed as from the mailing delivery date.

ARTICLE 8 : DURATION

This Agreement is entered into for an undetermined period of time as of the date set forth in Article 3.

ARTICLE 9 : TERMINATION

Each party may terminate this Agreement, by registered mail with acknowledgement of receipt forwarded to the other party, for any breach by such party of its obligations, despite a notice remaining unresponsive for 15 days, and this occurring with no prejudice to damages it could claim and provided that the last paragraph of Article 7 above, be enforced.

At end of this Agreement or in case of termination for whatsoever reason, the customer will have to stop using CABPLAN software package, pay all sums remaining due on date of termination and return all elements composing the software package (computer programs, documentation, etc ...) without maintaining any copy of it.

ARTICLE 10 : ROYALTY

As a payment for the operating-right concession, the customer pays CAB INNOVATION an initial royalty the amount of which is determined in specific conditions.

ARTICLE 11 : PROHIBITED TRANFER

The customer refrains from transferring the software package operating right granted personally to him by these provisions. The customer also abstains from making documentation and supporting material (CD ROM), even free of charge, available to a person not expressly set forth in second paragraph of Article 2.

ARTICLE 12 : ADDITIONAL SERVICES

Any additional services will be subject to an amendment of these provisions, possibly through an exchange of letters, so as to specify the contents, modalities of achievement and the price.

ARTICLE 13 : CORRECTIVE AND PREVENTIVE MAINTENANCE

The corrective and preventive maintenance may be subject, upon customer's request, to a separate Agreement attached to these provisions.

ARTICLE 14 : ENTIRETY OF THE AGREEMENT

The user's manual defining the CABPLAN software package features is appended to these provisions.
The provisions of this Agreement and his Appendix express the entirety of the Agreement entered into between the parties. They are prevailing among any proposition, exchange of letters preceding its signing up, together with any other provision stated in documents exchanged between the parties and relating to the Agreement's subject matter.
If any whatsoever clause of this Agreement is null and void with respect to a rule of Law or a Law in force, it will considered as not being written though not involving the Agreement's nullity.

ARTICLE 15 : ADVERTISING

CAB INNOVATION could mention the customer in its business references as a CABPLAN software package user.

ARTICLE 16 : CONFIDENTIALITY

Each party undertakes not to disclose any kind of documents or information about the other party that it would have been informed of on the Agreement's performance and undertakes to have such obligation fulfilled by the persons it is liable for

ARTICLE 17 : AGREEMENT'S LANGUAGE

This Agreement is entered into and drawn up in the French language.
In the event where it is translated into one or more foreign languages, only the French text will be deemed authentic in case of any dispute between the parties.

ARTICLE 18 : APPLICABLE LAW - DISPUTES

The French Law governs this Agreement.
In the event of any disagreement over the interpretation and performance of any whatsoever provision of this Agreement, and if parties fail to reach an agreement under an arbitration procedure, only Toulouse's Courts will be competent to settle the dispute, despite the plurality of defendants or the appeal for guarantee.