

## **FICO<sup>™</sup> Xpress Optimization Suite**

# Xpress-Tuner User guide

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#### How to Contact the Xpress Team

#### Information, Sales and Licensing

USA, CANADA AND ALL AMERICAS

Email: XpressSalesUS@fico.com

#### WORLDWIDE

Email: XpressSalesUK@fico.com

*Tel:* +44 1926 315862 *Fax:* +44 1926 315854

FICO, Xpress team Leam House, 64 Trinity Street Leamington Spa Warwickshire CV32 5YN UK

#### **Product Support**

Email: Support@fico.com (Please include 'Xpress' in the subject line)

Telephone:

NORTH AMERICA Tel (toll free): +1 (877) 4FI-SUPP Fax: +1 (402) 496-2224

EUROPE, MIDDLE EAST, AFRICA Tel: +44 (0) 870-420-3777 UK (toll free): 0800-0152-153 South Africa (toll free): 0800-996-153 Fax: +44 (0) 870-420-3778

ASIA-PACIFIC, LATIN AMERICA, CARIBBEAN Tel: +1 (415) 446-6185 Brazil (toll free): 0800-891-6146

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## **FICO<sup>™</sup> Xpress Optimization Suite**

**Xpress-Tuner** 

#### User guide

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### 1 Xpress-Tuner purpose

FICO<sup>™</sup> Xpress solves MIP problems by applying a number of algorithms and techniques, such as cutting planes, heuristics, branch and bound search, *etc.* The Xpress internal algorithms are user customizable through *control parameters*. Xpress control parameters are designed to control one or more of:

- A choice (e.g. breadth-first versus depth-first search)
- A set of choices (e.g. pick and choose presolve techniques)
- An amount (e.g. number of rounds of knapsack cuts)
- A frequency (e.g. apply heuristics every N nodes)

Xpress-Tuner will find a *favorable set of control parameters* that allow the Xpress-Optimizer to solve a particular MIP problem (or a set of problems) faster than by using defaults.

Xpress-Tuner is designed to be easy to use by a non expert, as it always provides a concise winning strategy that can be readily implemented using the Xpress-Optimizer libraries, Xpress-Mosel or Xpress-BCL. At the same time it provides a wealth of information to users familiar with Xpress control parameters, for deeper analysis of the problem behavior with respect to different solution approaches.



#### 2 How to tune a problem

Upon starting Xpress-Tuner, the following application window appears:

🕌 Xpress-Optimizer Performanc	e Tuner 1.1	
Matrix or set of matrices		
File name (.LP or .MPS or .SET): C:V	XpressMP\examples\tuner\air04.mp	s (1) Browse
Create a set of matrices Ob	jective: 💿 Minimize 🔘 Maximize	2 View past results Delete past results
Goal	Select one tuning method:	
Target gap: 0 %3	Adaptive flexible comprehensive Adaptive flexible quick Adaptive flexible reat facure	6 Run 1 Simultaneous threads Start 10
Target run time: 5 s(4)	Adaptive flexible tree focus	
If gap AND time targets are both met	Adaptive pure quick Adaptive pure quick Adaptive pure root focus	Adaptive flexible
<ul> <li>Reduce time to gap</li> </ul>	Adaptive pure tree focus Combinations	'Adaptive flexible' starts by running all the basic strategies, one by one. The top 'N' strategies are mated with
Other options	Mixer Single run 1	each other in pair-wise fashion to create a second generation. After that, the evolutionary selection algorithm begins: each new strategy is obtained by mating the best strategy so far with the second best. If
O Improve solution	Single run 2	there's a conflict, the third best will be selected, etc. Every 'R'-th run, the "worst performing" control
Improve bound		parameter is eliminated from the current strategy.
<ul> <li>Find any solution</li> </ul>	0	Relaxation: O Primal  O Dual O Barrier O Network
		Basic strategies, one per line:
I oad directives ( <file name=""> dir)</file>		COVERCUTS=0
Lead adultar (/File years) als)		COVERCUTS=5
Luau solution (knie namestsk)		COVERCUTS=20 CUTDEPTH=0
Baseline control parameters:		CUTDEPTH=10
		CUTDEPTH=1000
		CUTFREQ=0 CUTFREQ=2
	Clone method	CUTFREQ=5
	[	Load factory defaults
	Ready.	

The most important user interface elements are:

- The problem file name: this can be an .MPS or .LP file, a compressed .MPS.GZ or .LP.GZ file, or a .SET file (containing a collection of matrices). It represents the file (or set of files) to be tuned. Note: Xpress-Tuner will create a working directory called "\tuner\" in the same directory where the problem file name is located. All tuner runs will be stored in the newly created directory.
- 2. Optimization direction: minimize or maximize.
- 3. The desired optimality gap for the problem. Usually 0%, but any number between 0-100% will work (e.g. 0.1%)
- 4. The desired run time for the problem. This should be a realistic expectation based on business requirements. For example, if Xpress takes 5 minutes to find the optimal solution and spends a lot of time branching, input an aggressive target time of 60 seconds. **Note:** Times are always in seconds.
- 5. Reduce time to gap is probably the most desired goal, but other goals are available as well.
- 6. Allow Xpress-Tuner to use more than one thread. For best overall performance, use no more than one thread per available CPU/core. Also impose a maximum time limit on all the runs in a tuning session. Note that a generous amount of time may be necessary to obtain a good tuned strategy. Allow a minimum of 200 runs for best results (e.g.  $60s \times 200$  runs = 12,000 s).
- 7. Optionally, force certain control parameter settings by entering them as baseline parameters. These will override any potential values that may be discovered by the automated tuner. Also check/uncheck the options to load a preexisting solution (.slx file) or a directives file (.dir) for *all* the tuner runs in a session.



- 8. Select a tuning method. Adaptive flexible comprehensive is the most comprehensive tuning method and is usually a good first choice. Other options (e.g. focus on root node, focus on branching) may be preferable if the performance shortcoming is better understood.
- 9. Customize the tuning method as necessary. Instructions are provided by each tuning method.
- 10. Clicking *Start* will launch the tuner.



### 3 Tuning process

📲 Xpress-Optimizer Performance Tun	er (C:\XpressMP\examples\tuner\air04.m	ips)			
Your goal Seeking to: Reduc Target gap: 0 % Within: 5 s	e time to gap 1 Gap: Time taken: Number of solutions: Best integer solution: Best bound: Gap:	Baseline 7.1 57562 55681.4 3.26709 %	7.2 2 56281 55721.5 0.994181 %	Best settings: Dual simplex for the LP relaxation. CUTSELECT=-6193 Auxilary: MAXTINE=-5 MIPRELSTOP=0	
Time elapsed: 1m 36s Time remaining: 23h 58m 24s Improvement: YES View Detailed Strategy Rankings Include runs from previous sessions	Thread 1 Phase 1: basic 18/109 Dual simplex for the LP relaxation. GOMCUTS=0 Auxiliary: MAXTINE=5 MIPPELSTOP=0	Stop		6 Strategy: Phase 1: basic 12/109	V
Activity log air04.mps Time: 75 Gap: 1.28024% air04.mps Time: 75 Gap: 3.26709% air04.mps Time: 75 Gap: 1.40793% air04.mps Time: 75 Gap: 1e+030%	Optimizer output: 8294 ( 0 spare) rows 8994 ( 0 spare) structural columns 81869 ( 0 spare) non-zero elements Global Statistics 8904 entities 0 sets 0 set members	4		Dijective Brithowski # solutions # nodes Available physical memory: 255	9 MB

While Xpress-Tuner is running, the display changes to:

The most important elements/regions are:

- 1. A summary of the tuning goal, including the target (desired) gap and the time allowed per run.
- 2. The progress update section shows how much time has passed since the tuning session was started and how much time remains (based on the time limit imposed when starting the Tuner). This section also shows if the Tuner managed to improve on Xpress-Optimizer defaults. Finally, the button *View Detailed Strategy Rankings…* will open a more detailed window (described in section 4 of this Xpress-Tuner user guide). The checkbox *Include runs from previous sessions* controls whether runs from previous tuning sessions of the same problem will be displayed in the detailed window.
- 3. The activity log shows a very brief summary of a few previously completed strategy runs.
- 4. This section shows the active control parameter strategy and the output from the active optimization run. The Tuner session can be interrupted by pressing the *Stop* button (all Tuner results are stored on disk so stopping a session is a safe operation; next time, the Tuner will resume where it left off by reading the previous results from disk)
- 5. Together with number 6, the most important display section of the Xpress-Tuner: the *Baseline* versus *Best so far* comparison shows how the current best tuned strategy compares to the baseline run. In most cases, the Tuner will compare favorably. After every strategy run, this section is updated to show the current winning strategy.
- 6. The winning strategy settings: a list of control parameters that make up the winning strategy. This list is updated in tandem with the current best strategy and offers constant feedback on how the Tuner is performing.

To compare strategies against each other, click on View Detailed Strategy Rankings.



### 4 Detailed results



After clicking on View Detailed Strategy Rankings, the following window appears:

Each line in the list represents a run; each run represents a unique strategy tried by the Tuner. The columns in the list are:

Machine	The computer name where the Tuner is running.
Xpress Version	Version of the Xpress-Optimizer.
When	The date and time (+milliseconds) when the run was initiated.
Alg	The algorithm used for the initial LP relaxation.
File	The matrix (or set of files) being tuned.
ΜΑΧΤΙΜΕ	The time limit per run (imposed by the user) for the global search.
MIPRELSTOP	The relative gap stopping criterion (imposed by the user).
Control parameters	A varying number of control parameters. No value means default.
Rank	Rank based on the goal specified by the user ( <i>e.g.</i> , best gap, best solution, <i>etc.</i> )
Run time	Actual time elapsed, for the entire solve, including initial LP relaxation.
Gap	The optimality gap. See the definition for MIPRELSTOP.
Objective	The best integer solution of the run.
Bound	The best bound of the run.
Root Gap	The optimality gap after the root node.
Root Objective	The best integer solution after the root node.



Root Bound	The best bound after the root node.				
Solutions	Number of integer feasible solutions found.				
Nodes	Number of branch and bound nodes explored.				

The shade of the color green indicates the relative rank of numbers *within* a column. *Lighter shades* of green indicate *smaller values*; *darker shades* of green indicate *larger values*. **Note:** Comparisons between columns are meaningless.

In some cases, such as for the *Gap* column, lighter shades of green are better and will correlate with lower (better) *Rank* values. In other case, such as for the *Bound* column for a minimization problem, larger values (highlighted with dark shades of green) are better.

The results in the table can be sorted by clicking on any column header. The sorting is stable, which means that several criteria can be applied in series (*e.g.* sort by gap, then by objective, then by number of nodes).

The results in the table can be copied to the clipboard (*Copy to clipboard*) and then pasted in Excel, *etc.* 

By right clicking in the results list, various options for manipulating the current selection will become available, such as selecting all the runs whose values in the current column are equal to the value currently under the mouse cursor. When one or more runs are selected, click on the button *View / Compare Selected...* to analyze the 2+ more runs side by side:

Compare logs side by side	$\mathbf{X}$						
Use fixed font	; together						
20071110 170353 203	20071110 170805 850						
20071113.170333.203	20071113.170003.033						
Strategy: Phase 1: basic 14/109	Strategy: Phase 1: basic 48/109						
Objective	Objective						
ded hand	Bet hand						
# solutions	# solutions						
# nodes	# nodes						
	A						
==>TUNER SETTING: DUALGRADIENT=0	==>TUNER SETTING: MAXTIME=-5						
==>TUNER SETTING: MAXTIME=-5	==>TUNER SETTING: CUTFACTOR=1						
==>TUNER SETTING: MIPRELSTOP=0	==>TUNER SETTING: MIPRELSTOP=0						
Reading Problem air04	Reading Problem air04						
Problem Statistics	Problem Statistics						
824 ( O spare) rows	824 ( O spare) rows						
8904 ( 0 spare) structural columns	8904 ( 0 spare) structural columns						
Clobal Statistics	Clobal Statistics						
8904 entities O sets O set members	8904 entities 0 sets 0 set members						
Presolved problem has: 564 rows 7604 cols 33570 non-zeros	Presolved problem has: 564 rows 7604 cols 33570 non-zeros						
LP relaxation tightened	LP relaxation tightened						
Its Obj Value S Ninf Nneg Sum Inf Time	Its Obj Value S Ninf Nneg Sum Inf Time						
0 632.000000 D 359 0 365.000000 0	0 632.000000 D 359 0 365.000000 0						
100 17587.00000 D 287 0 365.000000 0	100 17587.00000 D 287 0 365.000000 0						
200 32417.00000 D 236 0 304.000000 0	200 32526.00000 D 230 0 309.000000 0						
300 41955.00000 D 265 0 933.333333 0	300 42367.00000 D 196 0 309.000000 0						
500 46916 33750 D 327 0 718 125000 0	500 46070 50000 D 212 0 308 000000 0						
600 47453 08174 D 335 0 881 931697 0	600 47098 00000 D 199 0 447 333333 0						
700 48167.75049 D 328 0 422.246608 0	700 47663.43697 D 302 0 341.500000 0						
800 48779.80052 D 348 0 515.475588 0	800 48441.97450 D 293 0 1875.828589 0						
900 49483.22886 D 396 0 340.504621 0	900 49685.82331 D 308 0 575.630916 0						
1000 49872.30775 D 356 0 669.355239 0	🔽 1000 50588.55770 D 277 0 4299.938466 0 🔽						
<							



## 5 Tuning a set of problems

To ensure that the control parameter settings obtained using the Tuner are robust enough for an entire category of problems, it's a good idea to select a varied set of inputs to a mathematical model and generate several matrix instances of the same model. By grouping different matrix instances of the same model into a set and then allowing Xpress-Tuner to find a good tuned strategy for the set, you can better ensure that the settings will work well on new instances of the same model.

Reload         Copy to chpboard         View / Compare Selector norme strategies to compare. Lise CTRL+Clck to select one or more strategies to c	🕌 Strategy	🖁 Strategy Rankings 📃 🗆 🔀																		
Select one or more strategies to compare. Use CTRL+Click to select more than one strategy. Right-click for more selection options. Then click "Yeer / Compare Selected"         OPD up click           Select one or more strategies to compare. Use CTRL+Click to select more than one strategy. Right-click for more selection options. Then click "Yeer / Compare Selected"         Pop up click         Pop up click </th <th colspan="7">Reload Copy to clipboard View / Compare Selected Return to main window</th>	Reload Copy to clipboard View / Compare Selected Return to main window																			
Select one or more strategies to compare. Use CTRL+Click to select more than one strategy. Right-click for more selection options. Then click "New / Compare Selected"																				
Machine         Xpress         When         Ag         Field	Select one or	more strate	egies to compare. Use CTF	RL+Click	to select mo	re tha	an or	ne str	ategy. F	Right-	click I	or more	selection opti	ions. Then	click "View /	Compare Sele	cted"	Pop up	char	rt
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Machine         Viewsion         Alg         File		Varaaa				盐	I	U.	P		a	1	G		u	G	i	u	•	d
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HORIAMO       18.0.0.0       20071119.141718.093       Dud       air64.mps       -5       0       0       2       1.7.1       0.0610288       59199       55286.2       0.0612028       59199       55286.2       1       1       2       0       2       1.7.1       0.0610288       59199       55286.2       0.0612028       59199       55286.2       0.0612028       59199       55286.2       0.0612028       59199       55286.2       0.0612028       59199       55286.2       0.0612028       59199       55286.2       0.0612028       59199       55286.2       0.061208       59199       55286.2       0.061208       59199       55286.2       0.061208       59199       55286.2       0.061208       59199       55286.2       0.061208       59199       55286.2       0.061208       59199       55286.2       0.061208       59199       55286.2       0.061208       59199       55286.2       0.061208       59199       55286.2       0.061208       59199       55286.2       0.061208       59199       55286.2       0.061208       59199       5596.2       0.061208       59199       59199       59199       59199       59199       59199       59199       59199       59199       59199       591997       0	HORIAAMD	18.00.00	20071119.200656.015	Dual	air05.mps	-5	0	0			1	5.7	0.0243406	26592	25944.7	1	1e+040	25911	6	5
HORIAAMO       18.00.00       20071119;200771.390       Dual       air.set       -5       0       2       2       2       0.668699       12:400       11:4100       11:4100       12:4100 </th <th>HORIAAMD</th> <th>18.00.00</th> <th>20071119.141718.093</th> <th>Dual</th> <th>air04.mps</th> <th>-5</th> <th>0</th> <th>- 0</th> <th></th> <th></th> <th>2</th> <th>7.1</th> <th>0.0610288</th> <th>59199</th> <th>55586.2</th> <th>0.0610288</th> <th>59199</th> <th>55586.2</th> <th>1</th> <th>1</th>	HORIAAMD	18.00.00	20071119.141718.093	Dual	air04.mps	-5	0	- 0			2	7.1	0.0610288	59199	55586.2	0.0610288	59199	55586.2	1	1
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HORIAAMO       18.00.00       20071119.20077.37       Dual       air.set       5       0       0       3       12.8       0.5245       18.4       1	HORIAAMD	18.00.00	20071119.200707.734	Dual	air05.mps	-5	0	5		_	2	5.7	0.0486998	27387	26053.3	1	1e+040	25982.1	5	7
PhorpAraMo         16.0.00         2007/119.20076.97         Mail         afr.set         -5         0         2         1.2         0.2         1.2         0.2         1.2         0.2         1.2         0.2         1.2         0.2         1.2         0.2         1.2         0.2         1.2         0.2         1.2         0.2         1.2         0.2         1.2         0.2         1.2         0.2         1.2         0.2         1.2         0.2         1.2         1.2         0.2         1.2         1.2         0.2         1.2         1.2         0.2         1.2         1.2         0.2         1.2         1.2         0.2         1.2         1.2         1.2         0.2         1.2	HORIAAMD	18.00.00	20071119.141815.859	Dual	airu4.mps	-5	0			U	3	12.0	0 52425	1e+040	1-1100	1-1100	1e+040	55708.2	0	1
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HORIAMO       18.0.00       2071119.200731.031       Lust       afr.get       -5       0       200       4       12.6       0.589868       1s+100	HORIAAMD	18.00.00	20071119.141801.421	Dual	air04.mps	-5	Ő		20		4	7	1	1e+040	55708.2	1	1e+040	55708.2	0	1
HORIAAMO       18.00.00       20071119.1200750.546       Dual       afr05mps       5       0       1000       4       5       7       0.0779729       28.174       2597.2 <td>HORIAAMD</td> <td>18.00.00</td> <td>20071119.200731.031</td> <th>Dual</th> <td>air.set</td> <td>-5</td> <td>0</td> <td></td> <td>20</td> <td></td> <td>4</td> <td>12.6</td> <td>0.538986</td> <td>1e+100</td> <td>1e+100</td> <td>1e+100</td> <td>1e+100</td> <td>1e+100</td> <td>1</td> <td>0</td>	HORIAAMD	18.00.00	20071119.200731.031	Dual	air.set	-5	0		20		4	12.6	0.538986	1e+100	1e+100	1e+100	1e+100	1e+100	1	0
HORIAMMO       18.00.00       20071119.141739.443       Dual       aird+mps       5       0       20       5       1.2       0.338966       1e+100	HORIAAMD	18.00.00	20071119.200750.546	Dual	air05.mps	-5	0		1000		4	5.7	0.0779729	28174	25977.2	0.0779729	28174	25977.2	1	1
HORIAAMO       18.00.00       20071119.200713.593       Dual       air.set       -5       0       20       5       5.5       0.779729       28174       2597.2       0.077929       28174       2597.2	HORIAAMD	18.00.00	20071119.141739.843	Dual	air04.mps	-5	0	-20			5	- 7	1	1e+040	55708.2	1	1e+040	55708.2	0	1
HORIAAMO       18.00.00       20071119;210731.031       Dual       ario5 mps       5       0.77978       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.079729       28.174       2977.2       0.0779729       28.174       2977.2       0.0779729       28.174       2977.2       0.0779729       28.174       2977.2       0.0779729       28.174       2977.2       0.0779729       28.174       2977.2       0.0779729       28.174       2977.2       0.0779729       28.174       2977.2       0.0779729       28.	HORIAAMD	18.00.00	20071119.200713.593	Dual	air.set	-5	0	-20			- 5	12.6	0.538986	1e+100	1e+100	1e+100	1e+100	1e+100	1	0
HORIAAMO       18.00.00       20071119.141746.000       Lud       air04.mps       -5       0       0       6       5.6       0.077929       20174       25970.2       1       1e+040       55706.2       0       1       1e+040       55706.2       0       1e+040       55706.2       1e+040       55706.2       0       1e+040       55706.2	HORIAAMD	18.00.00	20071119.200731.031	Dual	air05.mps	-5	0		20		5	5.5	0.0779729	28174	25977.2	0.0779729	28174	25977.2	1	1
HORIAAMO       18.00.00       2007119.20073.939       Ual       ards: rset       -5       0       model       as       model       ass       as       as       model       as       as       model       as       as       as       model       as       as       model       as       as<	HORIAAMD	18.00.00	20071119.141746.000	Dual	air04.mps	-5	0		0		6	7	1	1e+040	55708.2	1	1e+040	55708.2	0	1
PORLAMMO         10:00:00         2007/119:200719.9100         Data         anset.         -5         0         0         0         12:47         00:20000         12:100 <th>HORIAAMD</th> <th>18.00.00</th> <th>20071119.200713.593</th> <th>Dual</th> <th>airU5.mps</th> <th>-5</th> <th>0</th> <th>20</th> <th></th> <th></th> <th>6</th> <th>5.6</th> <th>0.0779729</th> <th>28174</th> <th>25977.2</th> <th>0.0779729</th> <th>28174</th> <th>25977.2</th> <th>1</th> <th>1</th>	HORIAAMD	18.00.00	20071119.200713.593	Dual	airU5.mps	-5	0	20			6	5.6	0.0779729	28174	25977.2	0.0779729	28174	25977.2	1	1
Include for the state of t	HORIAAMD	19.00.00	20071119.200719.406	Dual	air.set	-5	0		1000		7	12.7	0.530900	10+040	55709.2	100	10+040	55709.2		
HORIAAMD         18.00.00         20071119.200725.234         Dual         air.set         -5         0         10         7         12.7         0.535966         1e+100         1e+100 <td>HORIAAMD</td> <td>18 00 00</td> <td>20071119.141000.025</td> <th>Dual</th> <td>air05 mps</td> <td>-5</td> <td>0</td> <td></td> <td>1000</td> <td></td> <td>7</td> <td>5.6</td> <td>0.0779729</td> <td>28174</td> <td>25977.2</td> <td>0.0779729</td> <td>28174</td> <td>25977.2</td> <td>1</td> <td></td>	HORIAAMD	18 00 00	20071119.141000.025	Dual	air05 mps	-5	0		1000		7	5.6	0.0779729	28174	25977.2	0.0779729	28174	25977.2	1	
HORIAMO         18.00.00         20071119.14710,781         Dual         ar04-mps         5         0         8         7         1         1=4400         55708.2         1         1=4400         55708.2         0         1           HORIAMO         18.00.00         20071119.200649.37         Dual         ar65.mps         5         0         6         18.2         0.559868         1=4100	HORIAAMD	18.00.00	20071119.200725.234	Dual	air.set	-5	ñ		10		7	12.7	0.538986	1e+100	1e+100	1e±100	1e+100	1e+100	1	i i i
HORIAAMO         18.00.00         20071119.200649.397         Dual         air.set         -5         0         6         12.80         0.589868         1=+100         1=+1	HORIAAMD	18.00.00	20071119.141710.781	Dual	air04.mps	-5	Ū				8	7	1	1e+040	55708.2	1	1e+040	55708.2	Ō.	1
HORIAAMO         18.00.00         20071119.1200755.234         Dual         ar05.mps         5         0         10         8         9         7.1         18.0440         5577.2         0.077929         28174         25977.2         0.077929         28174         25977.2         0.077929         28174         25977.2         0.077929         28174         25977.2         0.077929         28174         25977.2         0.077929         28174         25977.2         0.077929         28174         25977.2         0.077929         28174         25977.2         0.077929         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0	HORIAAMD	18.00.00	20071119.200649.937	Dual	air.set	-5	0				8	12.8	0.538986	1e+100	1e+100	1e+100	1e+100	1e+100	1	0
HORIAAMO         18.00.00         20071119.141754.203         Dual         air04.mps         -5         0         10         9         7.1         1         1±+040         55706.2         1         1±+040         55706.2         1         1±+040         55706.2         1         1±+040         55706.2         1         1±+040         55706.2         1         1±+040         55706.2         1         1±+040         55706.2         1         1±+040         55706.2         1         1±+040         55706.2         1         1±+040         55706.2         1         1±+040         55706.2         1         1±+010         55706.2         0         1         1±+010         1±+010         1±+010         1±+010         1±+010         1±+010         1±+010         1±+010         1±+010         1±+010         1±+010         1±+010         1±+010         1±+010         1±+010         1±+010         1±+010         1±+010	HORIAAMD	18.00.00	20071119.200725.234	Dual	air05.mps	-5	0		10		8	5.6	0.0779729	28174	25977.2	0.0779729	28174	25977.2	1	1
HORIAAMO         18.00.00         20071119.200649.937         Dual         airS6.ms         5         0         9         12.7         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779729         28174         25977.2         0.0779739         28174         25977.2         0.0779739         28174         25977.2         0.0779739         28174         25977.2         0.0779739         28174         25977.2         0.0779739         28174         25977.2         0.0779739         28174         25977.2         0.0779739         28174         25977.2         0.0779739         28174         25977.2         0.0779739         28174         25977.2         0.0779739         28174         25977.2         0.0779739         28174         25977.2         0.0779739         28174         25977.2         0.07793	HORIAAMD	18.00.00	20071119.141754.203	Dual	air04.mps	-5	0		10		9	7.1	1	1e+040	55708.2	1	1e+040	55708.2	0	1
HORIAAMD         18.00.00         20071119.200756.390         Dual         air.set         -5         0         0         9         12.7         0.538986         1e+100         1e+100 <th>HORIAAMD</th> <th>18.00.00</th> <th>20071119.200649.937</th> <th>Dual</th> <th>air05.mps</th> <th>-5</th> <th>0</th> <th></th> <th></th> <th></th> <th>9</th> <th>5.7</th> <th>0.0779729</th> <th>28174</th> <th>25977.2</th> <th>0.0779729</th> <th>28174</th> <th>25977.2</th> <th>1</th> <th>1</th>	HORIAAMD	18.00.00	20071119.200649.937	Dual	air05.mps	-5	0				9	5.7	0.0779729	28174	25977.2	0.0779729	28174	25977.2	1	1
HORIAAMD         18.00.00         2007/119.141823.062         Dual         air04.mps         -5         0         2         10         7.1         1         1e+040         55708.2         1         1e+040         55708.2         1         1e+040         55708.2         0         1         3         1 <th1< th=""></th1<>	HORIAAMD	18.00.00	20071119.200756.390	Dual	air.set	-5	0			0	9	12.7	0.538986	1e+100	1e+100	1e+100	1e+100	1e+100	1	2
HORIAAMD 18.00.00 20071119.200701.990 LUBB airus nps -> 0 Letter 10 5.6 0.1.23992 25642 2596.6 1 1 14-104 2596.6 1 3 4 HORIAAMD 18.00.00 20071119.200750.546 Dub airus +> 0 1000 10 12.8 0.538966 14+1000 14+1000 14+1000 1	HORIAAMD	18.00.00	20071119.141823.062	Dual	air04.mps	-5	0	-		2	10	7.1	1	1e+040	55708.2	1	1e+040	55708.2	0	1
TORTWAILD 10:00:00 200/1119/200/30/300 Ddal all/sec -3 0 1000 10 12:0 0/33000 18+100 18+100 18+100 18+100 18+100	HORIAAMD	18.00.00	200/1119.200/01.890	Dual	airus.mps	-5	U	2	1000		10	5.6	0.123992	29642	25966.6	101100	10+040	25966.6	1	3
HORIAAMD 18 00 00 20071119 141732 640 Dual air04 mps -5 0 5 11 7 1 1 1e+040 55681 8 1 1e+040 55681 8 0 1	HORIAAMD	18.00.00	20071119.200750.546	Dual	air04 mps	-5	0	5	1000		11	7.1	0.000986	1e+040	55681.8	101+91	1e+040	55681.8		4

The Strategy Rankings window looks different when comparing set runs:

Note that individual matrix runs are listed alongside set runs and ranked relative to each other. The screenshot above was obtained by grouping air04.mps and air05.mps into a set called air.set. A run of air04.mps indicating *Rank 1* is better than a run of air04.mps indicating *Rank 2*. Thus, the detailed strategy rankings window allows you to compare not only sets but also set components against each other. Further insights may be gained from this comparison.



## 6 Tuning methods

Several tuning methods are available by default:



**Note 1:** All tuning methods are customizable.

**Note 2:** Any tuning method can be cloned and then customized. **Tuning methods:** 

Adaptive flexible comprehensive	The best choice for most purposes. A comprehensive tuning method, it initially contains a large number of diverse strategies to try (this is user customizable).
Adaptive flexible quick	The same tuning method as <i>Adaptive flexible comprehensive</i> but with fewer initial strategies. Not as broad as the comprehensive method, this method allows the Tuner to reach the adaptive phase quicker. This method sacrifices some quality to save tuning time.
Adaptive flexible root focus	This method focuses on control parameters that impact the root node of the MIP search.
Adaptive flexible tree focus	This method focuses on control parameters that impact the branching phase of the MIP search.
Adaptive pure comprehensive	This tuning method initially contains the same number of strategies as <i>Adaptive flexible comprehensive</i> . It uses a very elitist evolutionary selection scheme for choosing derived strategy candidates.
Adaptive pure quick	Same as <i>Adaptive pure comprehensive</i> , but with fewer initial strategies.
Adaptive pure root focus	Same as <i>Adaptive pure comprehensive</i> , but with a focus on the root node.



Adaptive pure tree focus	Same as <i>Adaptive pure comprehensive</i> , but with a focus on the branch and bound search.
Combinations	Try all combinations of values for a small number of control parameters
Mixer	Read all previous compatible runs from disk and apply the adaptive evolutionary algorithm to all these runs to derive better strategies. For example, a Tuner session focusing on cutting strategies can be combined with a Tuner session focusing on strong branching by running them separately and then starting a third run using the Mixer tuning method.
Single run 1	A shortcut to trying a single strategy.
Single run 2	A shortcut to trying another single strategy.



## 7 Terminology

Terms used in this user guide are described below in the context of the Xpress-Tuner.

Control parameter	setting A control parameter is a named setting which can be used to customize the Xpress-Optimizer. For example, CUTSTRATEGY=0 is a control parameter setting that instructs the Optimizer to disable applying cuts to a problem.
Problem	A matrix file to be solved.
Run	A run represents one execution of the Xpress-Optimizer on a given <b>problem</b> using a given <b>strategy</b> .
Session	A session refers to the complete execution of a <b>tuning method</b> . After clicking the <i>Start</i> button to start a tuning session, Xpress-Tuner will try different <b>strategies</b> according to selected <b>tuning method</b> and either run out of the given time limit or be stopped by the user upon pressing the <i>Stop</i> button.
Set	A number of <b>problems</b> grouped together into a set (using the <i>Create a set of matrices</i> button in the Xpress-Tuner application). Xpress-Tuner will automatically run all the problems in the set and compute results for the entire set. <b>Note:</b> Average gap for all <b>runs</b> of all the <b>problems</b> in the set is the only criterion used for comparing set <b>runs</b> against each other.
Strategy	A number of <b>control parameter settings</b> applied together in a <b>run</b> . For example, CUTSTRATEGY=0, HEURSTRATEGY=3 is a strategy.
Tuning method	Each of several adaptive or non-adaptive techniques for executing <b>runs</b> , whose goal is finding a favorable <b>strategy</b> for solving a <b>problem</b> or a <b>set</b> of problems.