

# Supplementary Materials: Combining Behavioral Approaches with Techno-Economic Energy Models: Dealing with the Coupling Non-Linearity Issue

Francesco Moresino \*, Emmanuel Fragnière

The supplementary materials contain two directories, one for the environment GLPK (GNU Linear Programming Kit) and the other one for the environment AMPL (A Mathematical Programming Language). GLPK is a free software mostly compatible with AMPL and can be download at <https://www.gnu.org/software/glpk/> or at <https://sourceforge.net/projects/winglpk/> for the Windows version. AMPL is a commercial software and can be bought at <https://ampl.com/>.

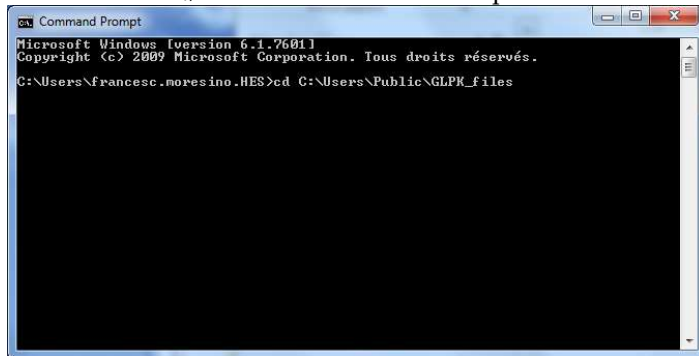
## 1. GLPK

To install GLPK for Windows, download the file at <https://sourceforge.net/projects/winglpk/>. Detailed instructions for the installation can be found at <http://www.osemosys.org/get-started.html>.

For the GLPK environment two file are provided. The file model.mod contains the modelling and the commands to retrieve interesting results in the file results.m (file for Octave/Matlab environment). The second file, namely model.dat contains data.

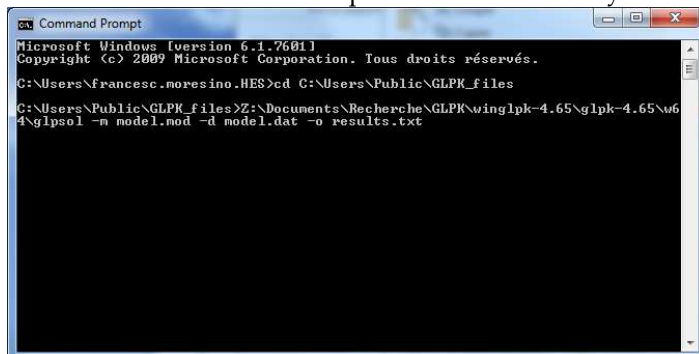
To run the model:

- Open “Command Prompt” in Windows
- Go to the directory where the files model.mod and model.dat are. To do so, type the command: `cd FILEPATH\`, where FILEPATH is the path to the directory.



In this example FILEPATH= C:\Users\Public\GLPK\_files

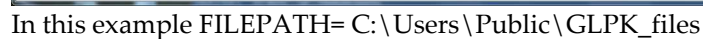
- To run the optimization, type the command: `SOLVERPATH\glpsol -m model.mod -d model.dat -o results.txt` Where SOLVERPATH is the path to the file where you saved GLPK.



In this example SOLVERPATH= Z:\Documents\Recherche\GLPK\winglpk-4.65\glpk-4.65\w64

The results files results.txt and results.m can be found in the directory FILEPATH. The file results.txt contains information given by the solver and is not very practical. The output file results.m contains selected results in an Octave (Matlab) format. Matlab is a commercial software and can be bought at <https://www.mathworks.com/> whereas Octave is a free software and can be downloaded <https://www.gnu.org/software/octave/>.

- Open Octave
- Go to the directory where the file results.m is. To do so, type the command:  
cd FILEPATH\, where FILEPATH is the path of the directory.



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- The screenshot displays the Octave IDE interface. At the top, the menu bar includes File, Edit, Debug, Window, Help, and News. Below the menu bar, the File Browser shows the current directory as C:\Users\Public\GLPK\_files, containing files model.dat, model.mod, results.m, and results.txt. The Command Window on the right shows the Octave version 4.0.0, copyright information, and a disclaimer. It also provides instructions on how to contribute, including visiting the Octave website and submitting bug reports. The Command History at the bottom shows a series of commands executed, including setting the current directory to C:\Users\Public\GLPK\_files and running the results.m script.
- File Edit Debug Window Help News
- File Browser
- Current Directory: C:\Users\Public\GLPK\_files
- C:\Users\Public\GLPK\_files
- model.dat  
model.mod  
results.m  
results.txt
- Command Window
- GNU Octave, version 4.0.0  
Copyright (C) 2015 John W. Eaton and others.  
This is free software; see the source code for copying conditions.  
There is ABSOLUTELY NO WARRANTY; not even for MERCHANTABILITY or  
FITNESS FOR A PARTICULAR PURPOSE. For details, type 'warranty'.  
  
Octave was configured for "i686-w64-mingw32".  
  
Additional information about Octave is available at <http://www.octave.org>.  
  
Please contribute if you find this software useful.  
For more information, visit <http://www.octave.org/get-involved.html>.  
  
Read <http://www.octave.org/bugs.html> to learn how to submit bug reports.  
For information about changes from previous versions, type 'news'.  
  
>> cd C:\Users\Public\GLPK\_files
- Command History
- Filter
- ```

>> exit
# Octave 4.0.0, Wed Jul 04 11:28:56 2018 Europe de l'Ouest (heure d'été) <unknown@HEG-W5-0140>
cd C:\Users\Public\GLPK_files
# Octave 4.0.0, Wed Jul 04 11:33:54 2018 Europe de l'Ouest (heure d'été) <unknown@HEG-W5-0140>
# Octave 4.0.0, Wed Jul 04 11:34:10 2018 Europe de l'Ouest (heure d'été) <unknown@HEG-W5-0140>
cd C:\Users\Public\GLPK_files
# Octave 4.0.0, Wed Jul 04 11:35:39 2018 Europe de l'Ouest (heure d'été) <unknown@HEG-W5-0140>
cd C:\Users\Public\GLPK_files
results
# Octave 4.0.0, Wed Jul 04 12:48:53 2018 Europe de l'Ouest (heure d'été) <unknown@HEG-W5-0140>
cd C:\Users\Public\GLPK_files

```
- Command Window Edit Documentation

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- The screenshot shows the Octave environment. The main editor window contains the following code:
- ```

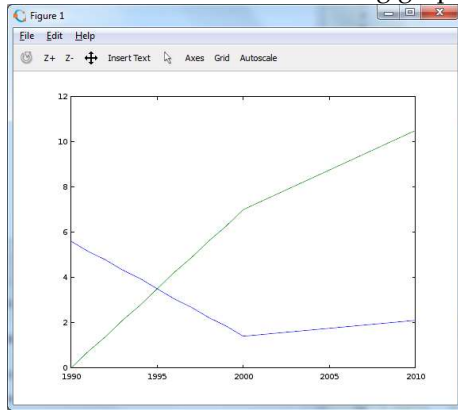
1 clear;
2
3 year = [];
4 1980
5 1981
6 1982
7 1983
8 1984
9 1985
10 1986
11 1987
12 1988
13 1989
14 1990
15 2001
16 2002
17 2003
18 2004
19 2005
20 2006
21 2007
22 2008
23 2009
24 2010
25 if
26
27 cost = zeros(126123);
28 cost_subvention = 0.000000;
29 RateCRDemand = [];
30
31 5.1269992 5.2619412 5.088992 5.261945 8.400840 5.269328
32 5.269342 5.269412 5.269342 5.269412 8.820082 5.327295
33 5.542691 5.697479 5.542691 5.697479 8.240624 5.695261
34 5.697481 5.665566 5.794841 5.665566 5.660366 5.765327
35 6.046791 4.032613 6.046791 4.032613 10.081008 4.031194
36 6.239740 4.201481 6.239740 4.201481 10.501050 4.199160
37 6.350880 4.369743 6.350880 4.369743 10.921092 4.367127
38 6.462020 4.538045 6.462020 4.538045 11.341134 4.535089

```
- The Command History shows the following commands:
- ```

# Octave 4.0.0, Wed Jul 04 11:28:56 2018 Europe de l'Ouest (heure d'été) <unknown>#HEG-W5-014>:
cd C:\Users\Public\GLPK_files
# Octave 4.0.0, Wed Jul 04 11:33:54 2018 Europe de l'Ouest (heure d'été) <unknown>#HEG-W5-014>:
cd C:\Users\Public\GLPK_files
# Octave 4.0.0, Wed Jul 04 11:35:39 2018 Europe de l'Ouest (heure d'été) <unknown>#HEG-W5-014>:
cd C:\Users\Public\GLPK_files
results
# Octave 4.0.0, Wed Jul 04 12:48:53 2018 Europe de l'Ouest (heure d'été) <unknown>#HEG-W5-014>:
cd C:\Users\Public\GLPK_files

```
- The Command Window shows the output of the script, including a table of 'RateCRDemand' and 'cost\_subvention' values for each year.

- You will obtain the following graphic



- The file results.m contains the results for the most interesting variables and can be modified as desired.

## 2. AMPL

For the AMPL environment, three files are provided. The file model.mod contains the modelling whereas the file model.dat contains data. The file model.run contains the commands to run the optimization and retrieve results in the file results.m (see previous section). To run the model under AMPL, you must type the command: include model.run.