
User guide for the price-point calculator

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1 Introduction

This user guide describes the functionality of the price-point calculator adapted to the context of the Austrian multiband auction. This software is designed to calculate from a set of principal stage bids and results the linear reference prices for each lot category.

Please note that the terminology 'principal stage' is used within the software and this documentation to mean the first stage of the combinatorial clock auction in which the number of lots that bidders win in each category is determined. The principal stage bids are made during the primary bid rounds or during the supplementary bids round. All these bids taken together constitute the 'principal stage bids'.

2 System requirements

The Windows version of the software has been tested to work on Windows 7. You may be able to use this software on other versions of these operating systems, but it cannot be guaranteed that they will function properly in different environments.

This software should only be run on a machine with at least 8GB of RAM.

It is important that you do not run any other programs when launching this software. The hardware requirements, in particular with regards to the CPU and RAM are such that other programs may become unresponsive or stall when you launch this software. **We will not take any responsibility for data loss or other damage that may result from running this software on your machine.**

3 Installation

The software consists of a command-line executable program. The software is distributed as a single zip file. You should unzip the file

into a single directory. This means that you should usually be able to install and use the software without any special administrative privileges. You can move the entire directory, but please leave the various components of the software in their relative locations within the directory, otherwise the software may cease to function.

4 Contents of the software package

Having unzipped the software, you will find the following contents in the installation directory:

- priceCalculator.exe - the command line tool for Windows;
- lpsolve55.dll - the lp_solve linear programming library for Windows (this should not be removed otherwise the software will not function);
- quadprog.dll - the QuadProg quadratic programming library for Windows (this should not be removed otherwise the software will not function); and
- a directory 'data' that contains some examples of specimen data files.
- a directory 'licences' containing the licence agreement for the software, for the lp_solve library and the QuadProg library as well as the source code for these two libraries.

5 File formats

All files used by the price calculator have to be in plain text and should only contain the appropriate delimiters (commas or semicolons and line breaks). Note that the expected value separators are “,” and “;”. CSV files created by Microsoft Excel usually have the appropriate delimiters and should work. However, if there are problems with reading a file, please amend it using a text editor.

5.1 Input files

There are three different input files related to the price-point calculator:

- a **principal stage bids file**, that contains all primary and supplementary bids. This file is required; and
- a **principal stage results file**, which provides information on the outcome of the principal stage.

5.1.1 The principal stage bids file

This file lists all primary and supplementary bids received in the principal stage.

The software performs some limited checks to ensure that the bids listed in the principal stage bids file are consistent with the auction rules. **However, as it is intended to be used with valid data generated by other components of the EAS it does not check that the bids processed are fully compliant with the auction rules and are indeed a set of bids that might have been produced by the process of bidding over multiple rounds during the principal stage; it is for the user to ensure that the bids inputted are fully compliant with the auction rules.** The checks performed ensure that:

- bids are at least equal to the reserve prices;
- there are no bids containing a negative number of lots; and
- there are no bids for packages specifying more lots than are available in a category.

If a bid is found that does not pass all of these checks, the software will terminate without producing results, and an explanation will be given in the console output.

Standard lot structure

The first line of the bids file is a header giving a list of field names. Each subsequent line should consist of the following tab-separated fields:

- **BidderID** (integer) - the index number of the bidder. Bidders are numbered sequentially starting from 1.
- **BidderName** (string) - a descriptor for the bidder. This should be the same across records for a given bidderID.
- **A1** (integer) - the number of type A1 lots in this bid package
- **A2** (integer) - the number of type A2 lots in this bid package
- **A3** (integer) - the number of type A3 lots in this bid package
- **B1** (integer) - the number of type B1 lots in this bid package
- **B2** (integer) - the number of type B2 lots in this bid package
- **B3** (integer) - the number of type B3 lots in this bid package
- **C1** (integer) - the number of type C1 lots in this bid package
- **C2** (integer) - the number of type C2 lots in this bid package
- **C3** (integer) - the number of type C3 lots in this bid package
- **BidAmount** (long long integer) - the amount of the bid for this package. The default currency unit is 'Euros'.

There is no particular requirement on the ordering of the data in the file.

Figure 1: Example principal stage bids file ("data\Example_Bids.csv")

Bidder	Round	A1	A2	A3	B1	B2	B3	C1	C2	C3	Bid
Bidder 1	1	0	4	0	0	0	0	0	0	0	128000000
Bidder 1	s	0	4	0	0	0	0	0	0	0	500000000
Bidder 1	s	1	2	0	0	0	0	0	0	0	300000000
Bidder 2	1	1	0	1	0	0	0	0	0	0	64000000
Bidder 2	s	0	2	0	0	0	0	0	0	0	250000000
Bidder 2	s	1	2	0	0	0	0	0	0	0	300000000

Figure 1 above shows an example principal stage bids file.

Condensed lot structure - 1

5.1.2 The principal stage results file

This file lists the combination of winning bids from the principal stage and prices. The first line of the file is a header giving a list of field names. Each subsequent line consists of the following tab-separated fields:

- **BidderName** (string) - a descriptor for the bidder.
- **A1** (integer) - the number of type A1 lots in this bid package
- **A2** (integer) - the number of type A2 lots in this bid package
- **A3** (integer) - the number of type A3 lots in this bid package
- **B1** (integer) - the number of type B1 lots in this bid package
- **B2** (integer) - the number of type B2 lots in this bid package
- **B3** (integer) - the number of type B3 lots in this bid package
- **C1** (integer) - the number of type C1 lots in this bid package
- **C2** (integer) - the number of type C2 lots in this bid package
- **C3** (integer) - the number of type C3 lots in this bid package
- **BidAmount** (long long integer) - the amount of the bid for this package. The default currency unit is 'Euros'.
- **BasePrice** (long long integer) - the Base price to be paid for this package by the winner. The default currency unit is 'Euros'.

Figure 2: Example principal stage results file ("data\Example_PSResults.csv")

Bidder	A1	A2	A3	B1	B2	B3	C1	C2	C3	Bid	Base price
Bidder 1	1	2	0	0	0	0	0	0	0	300000000	114000000
Bidder 2	0	2	0	0	0	0	0	0	0	250000000	200000000

5.2 Output file

The price calculator produces a results file that contains the linear reference price determined for each category.

The first line of the file is a header giving a list of field names. Each subsequent line consists of the following tab-separated fields:

- **Category name** (string) - name of the category;
- **Linear lot price** (long integer) - linear lot price determined for this category. The default currency unit is 'Euros'. Note that all linear lot prices are rounded down to the nearest whole amount.

The following figure provides an example results file.

Figure 3: Example linear reference prices results file (generated from "data\Example_Bids.csv" and "data\Example_PSResults.csv")

Category	Linear lot price
A1	36000000
A2	118000000
A3	0
B1	0
B2	0
B3	0
C1	0
C2	0
C3	0

6 Running the price calculator

The following typographical convention is used throughout this document:

- Commands that have to be entered by the user are printed in `this font`.
- Parameters, options and other flags as well as field names in files are printed in ***bold italic***.

The price calculator must be run from the command line. The software can be launched from a terminal window by changing to the directory that contains the software (i.e. the directory created when unzipping the distribution file). The executable file is called "priceCalculator.exe".

To determine linear reference prices, the price calculator needs to be provided with two input files:

- The principal stage bids file (see Section 5.1.1); and
- The principal stage results file (see Section 5.1.2).

The command line tool in Windows needs to be opened in the installation folder for the following command to work.

To determine linear reference prices, the price calculator is launched using the following command.

Box 1: Generic command to determine linear reference prices

```
priceCalculator.exe -B bidsFile -O
psResultsFile -R lrpResultsFile [-hr] [-l X]
```

The input options specify the following:

- **-B** allows the user to specify the name of the file (**bidsFile**) containing the principal stage bids and needs to be a tab-separated file ending in .csv, the format of which is specified in Section 5.1.1.
- **-O** allows the user to specify the name of the file (**psResultsFile**) which contains the principal stage results. The format of this file is specified in Section 5.1.2.
- **-R** allows the user to specify the name of the results file (**lrpResultsFile**) into which the software will write the results obtained following the format discussed in Section **Error! Reference source not found.**
- **-h** prints a help screen that will provide a list of all options and a brief explanation of all options that can be specified when running the price calculator.
- **-r** disables the revenue constraint in the linear-reference price determination.
- **-l X** allows the user to specify a different lot structure. Available lot structures are 0 (default), 1 (merges A1, A2, A3 into 800MHz; B1, B2, B3 into 900MHz; and C1,C2,C3 into 1800MHz)

Note that the file extension .csv should not be added to any of the file names when calling the executables.

To run the linear-reference pricing methodology on the example files provided, the following command should be used.

Box 2: Command to run linear-reference prices example

```
priceCalculator.exe -B data\Example_Bids -O
data\Example_PSResults -R lrp_results
```

This command will run the linear-reference prices methodology on the bids provided in the file "data\Example_Bid.csv" assuming that the outcome of the principal stage was as provided in the principal stage results file "data\Example_PSResults.csv". The results are printed to the file "lrp_results.csv".

The command line output that the price calculator produces may be quite long. To save this to a file automatically, it is possible to pipe it into a log file as shown in the following box.

Box 3: Command to run linear-reference prices example - saving command line output

```
priceCalculator.exe -B data\Example_Bids -O  
data\Example_PSResults -R lrp_results >  
lrp_terminal.log
```

This saves all the terminal output produced by the price calculator to the file "lrp_terminal.log".

To disable the revenue constraint in the LRP determination, the price calculator needs to be run with the -r flat as shown in the following box.

Box 4: Command to run linear-reference prices example - disabling the revenue constraint

```
priceCalculator.exe -B data\Example_Bids -O  
data\Example_PSResults -R lrp_results -r
```

The LRP calculator can condense the categories to overall band categories. This is achieved by invoking the price calculator with the -l 1 flag. The price calculator converts the categories as follows:

- A1, A2 and A3 are aggregated to 800MHz;
- B1, B2 and B3 are aggregated to 900MHz; and
- C1, C2 and C3 are aggregated to 1800MHz.

The following box is as shown in the following box.

Box 5: Command to run linear-reference prices example - condensing lot structure 1

```
priceCalculator.exe -B data\Example_Bids -O  
data\Example_PSResults -R lrp_results -l 1
```