Oligopsony 1.0

A Uniform Price Auction Monte Carlo Simulation Environment

Installation & User's Guide

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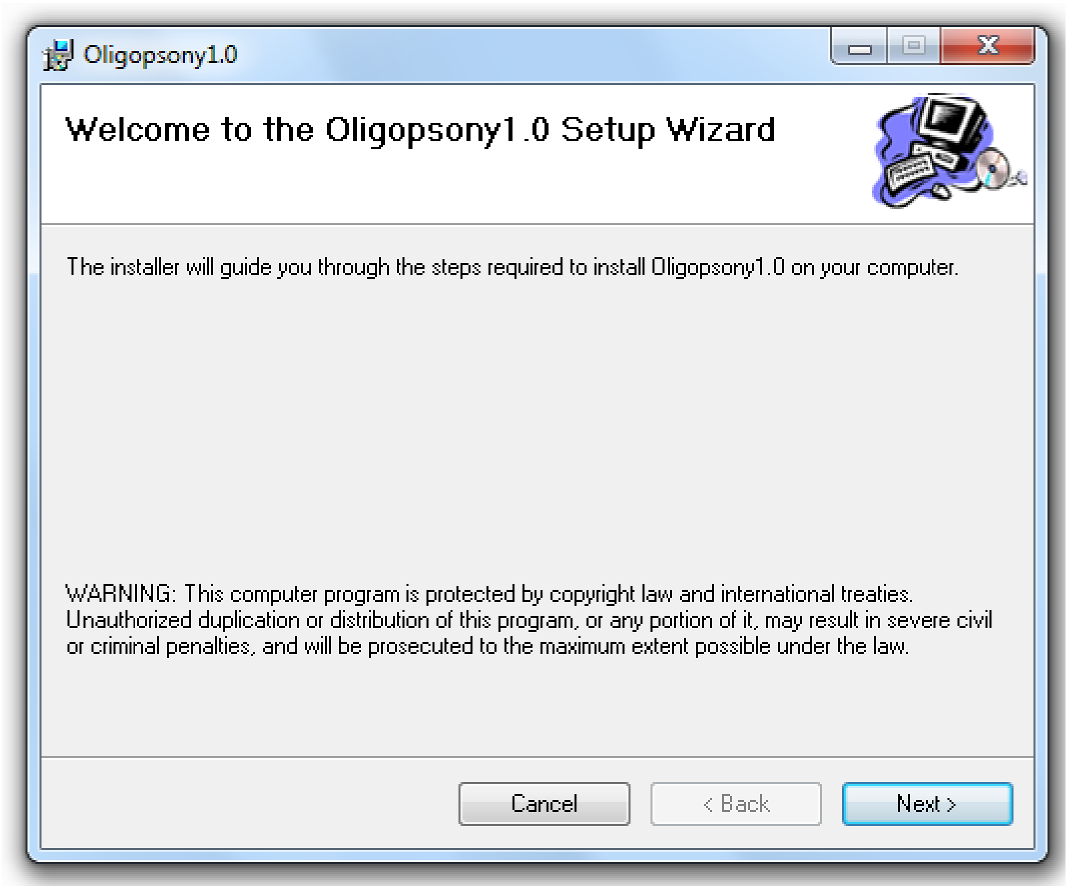
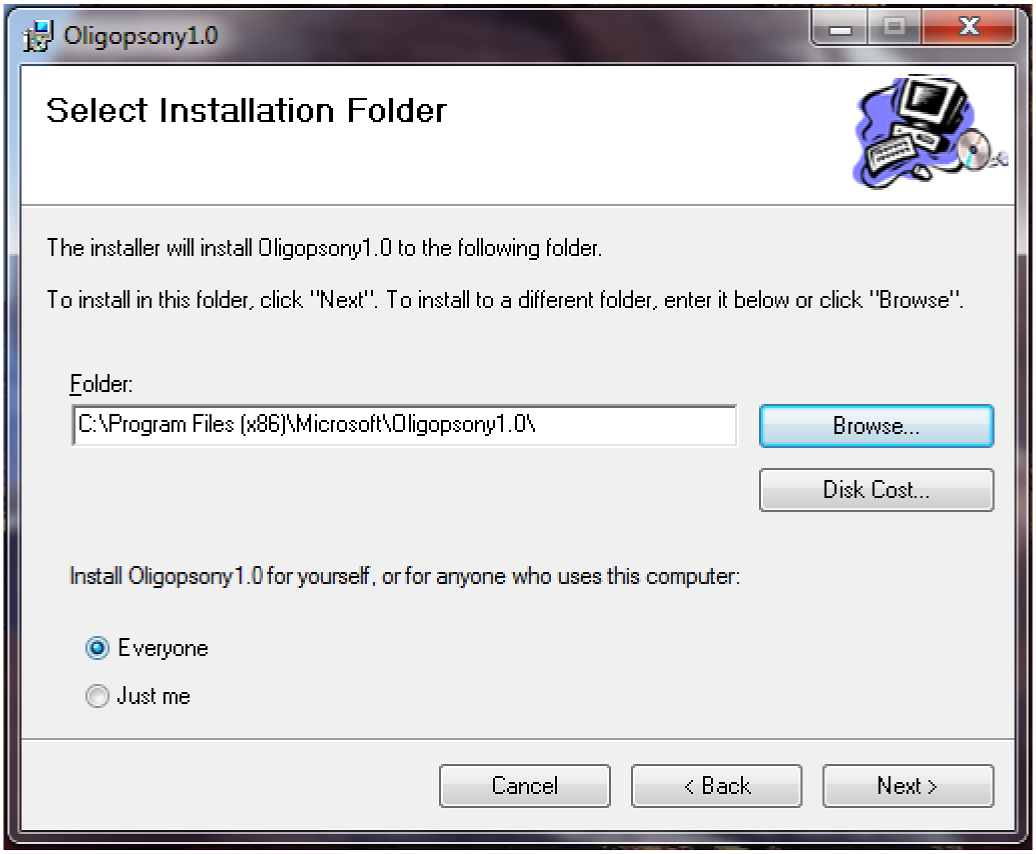
Installation Instructions

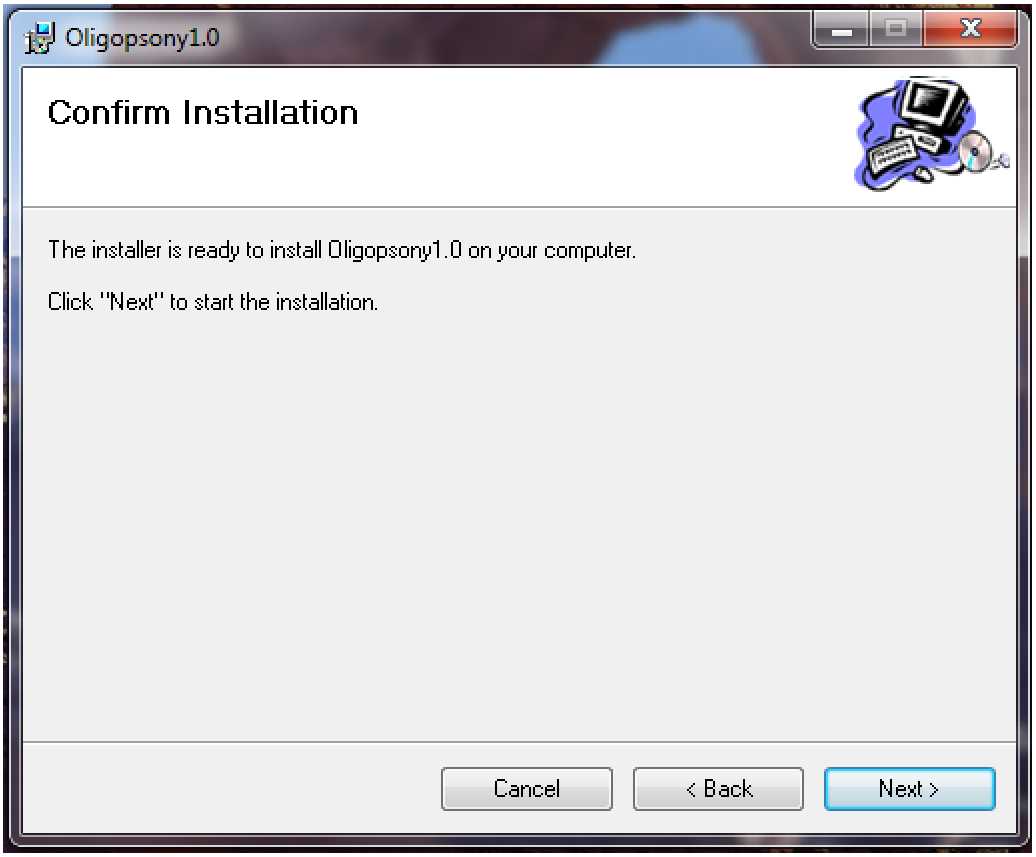
Step 1: Download the Microsoft Software Installation file OligopsonySetup.msi. Run the file and select 'next.'



Step 2: Select the file location on your PC for where you want the program installed. Note, remember this location. The software does not create a desktop shortcut.



Step 3: Run the installation program by selecting 'next.'



Background and Purpose of Oligopsony 1.0

Oligopsony 1.0 is a .Net forms application that simulates multi-bidder uniform price auctions in a Monte Carlo environment. Uniform price auctions are one common format of auction, commonly used to procure commodities like electricity, wine, etc. The application runs as many auction iterations as the user wishes, limited only by the user's computing power. The results can be evaluated through the software, or copied into text files to import into statistical software. The software also allows the user to specify up to two types of bidders, to incorporate features of oligopoly behavior in the auction.

The specific application of Oligopsony 1.0 began with an analysis into contemporary transferable property rights markets designed to curtail emissions from point sources such as electricity generators, also known as cap-and-trade markets. These markets have been used, and are currently being used, in many nations.

Within cap-and-trade markets, there has been great debate regarding the appropriate method for allocating, or distributing the allowances to be used by market participants. Historically, these allowances have been divvied out directly by central planning authorities, usually a federal or regional government. Directly allocating the allowances, or *grandfathering* them, has received criticism from policy experts because it has led to inefficient market outcomes, and political misallocation.

More recently, an alternative distributional method for these cap-and-trade markets has been proposed by policy experts. This alternative allocation method uses auctions to distribute allowances to market participants. Auctions have been shown to be particularly useful in the in the telecommunications sector, in determining more efficient allocations of broadband spectra.

In auctions, market participants are required to purchase allowances rather than receive them freely from central planning authorities. One strong positive for auctions is, that auctions can provide an additional incentive to market participants to reduce emissions output beyond the point that they would otherwise be in a system of grandfathering.

Despite the many allocative benefits of auctioning, fundamental problems associated with the market in which they operate can lead to gross inefficiencies and inefficacies of the cap-and-trade system. In particular, cap-and-trade systems are often utilized in the electricity sector. Because of the inherent design of most electricity markets (both regulated and deregulated), problems of natural monopoly remain. A natural monopoly occurs when services cannot (or should not) be provided by more than one firm. Electricity production is a key example. It would be highly inefficient for multiple companies to place competing power lines on the street in front of your home. As such, only one company provides these services within a relevant service area. To keep these companies from charging excessively high rates, markets are often regulated and extreme convolutions of overlapping markets can exist.

Just like firms in most other industries, however, firms within the energy sector can work as diligently as possible to reduce their production costs. Oftentimes, this means that they have an incentive to utilize cheap fuels and potentially dirtier generators. The purpose behind cap-and-trade markets is to find the most efficient production approach possible for realigning these incentives of firms, to minimize what economists call negative externalities. These are, essentially the negative effects to society from cheap and dirty production of electricity, in the form of smog, air and water pollution, or greenhouse gas emissions.

Given this, it is perfectly rational to be concerned that the problems associated with natural monopolies may also spill over into the cap-and-trade market. This is possible because it is those exact same firms that operate regional monopolies that operate within the cap-and-trade market. The concern that this form of market failure (i.e., oligopoly) may still negatively affect these markets is ever present on the minds of regulators and policymakers alike. This motivated the design and structure of Oligopsony 1.0. It is a software application designed to simulate cap-and-trade emissions market auctions. The software enables the user to test the extent to which market power can be exercised within these markets, given varying parameter changes in the market structure itself. The software can also be applied to many other auction contexts using the uniform price format.

The user is encouraged to read a published paper by Dormady that introduces the software and utilizes it for analysis. This paper can be downloaded at: http://www.sciencedirect.com/science/article/pii/S0301421513005077

What is Monte Carlo Simulation and Why Should We Use It?

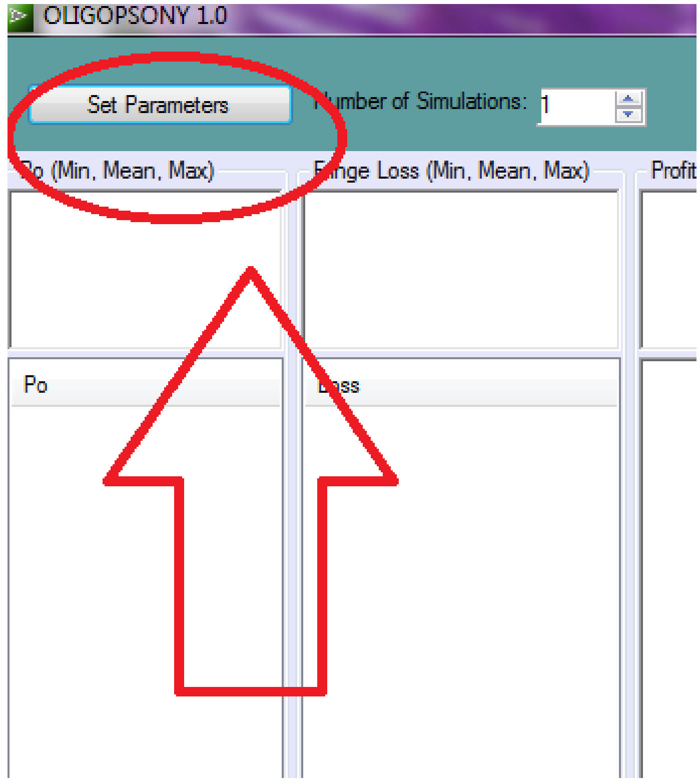
Monte Carlo simulation is a method of reproducing an event or occurrence in multiple iterations to determine the probabilistic nature of the event or occurrence. Oligopsony 1.0 in particular, reproduces hundreds or thousands of uniform price auctions, and returns to the user the entire range of possible outcomes from those auctions. The user can then take those values and determine the likelihood of a particular auction outcome or bidding event from the large sample.

Why use Monte Carlo for emissions auctions? It is an unfortunate state of affairs that when billions of dollars of public money are placed into private markets, standards of disclosure and accountability seem to be forgotten. In contemporary emissions markets, nearly all bidding information is hidden from public disclosure. The Regional Greenhouse Gas Initiative (RGGI Inc.), for example, has actually created a non-profit organization to conduct emissions auctions, making it quite difficult for federal or state sunshine and disclosure laws to apply.

If that information was available, standard forms of data analysis could be conducted with the data, such as tabulation, statistical and multivariate regression analysis, as well as more complex analyses. Given that information is not released, there are only a few options available for evaluating auctions, including game theoretic modeling and simulation.

More importantly, even if the auction data were available, it would be very difficult to run hypotheticals. In other words, what if you wanted to ask questions like the following. How would the auction results be different if bidders placed different types of bids? How would the auction results be different if there were more/fewer bidders? How would the auction results be different if the secondary/resale market currently cleared at a higher or lower price? Addressing these questions is of the utmost importance to policymakers, market participants, and other stakeholders involved in the markets, including academic researchers.

How to Use Oligopsony 1.0



Setting Up the Initial Parameters

Setup for a simulation begins with the "Set Parameters" button in the top left of the program window. Click that button.

When the Set Parameters Window opens, you will see several input parameter text boxes. You can enter all of the market parameters you would like to simulate into each of those input boxes. What each of those boxes represent is described next.

Total Quantity to be Auctioned

This refers to the total quantity of the commodity to be auctioned. For the case of emissions markets, this refers to the total quantity of emissions allowances that will be auctioned. This value is the total market cap of allowances or permits sold in that particular auction, and does not refer to a total quantity cap per market participant.

Fringe Max Bid Quantity (Constraint)[1]

All of the fringe bidders (that are neither monopolists nor oligopolists) must place a quantity bid. This refers to the total number of allowances that they wish to purchase. Given that multiple bids per bidder are permitted in Oligopsony 1.0, the Fringe Max Bid Quantity is the total cap on the sum of all of each bidder's bids.

For example, if a value of '2,500' were entered, all bidders of the class "Fringe" could bid for as many as 2,500 emissions allowances. This means that an individual bidder could place one bid for 2,500, four bids that added to 2,500, two bids (2,000 and 500), or any possible combination therein.

Fringe Min Bid Quantity (Constraint)

This sets the minimum quantity that each bidder must bid for, who is in the class "Fringe". So, if the maximum value is set at 2,500 from above, and the minimum value is set at 500, then each bidder can bid for a total of no more

[1] Note: Oligopsony 1.0 considers two classes of bidders, firms that have market power (oligopsonists) and firms on the competitive fringe that have less influence over the market. Interested readers should see: Hahn, R.W. (1984). Market power and transferable property rights. *The Quarterly Journal of Economics, 99:* 763-765.

than 2,500 and no fewer than 500 emissions allowances.

Oligopsonist Max Bid Quantity (Constraint)

This has the exact same properties as the Fringe Max Bid Quantity, except that it applies to the bidder class "Oligopsonist." So, setting a value of 10,000 here means that the sum of all of any oligopsonist's bids (he can bid once or many times) cannot exceed 10,000 allowances.

Oligopsonist Min Bid Quantity (Constraint)

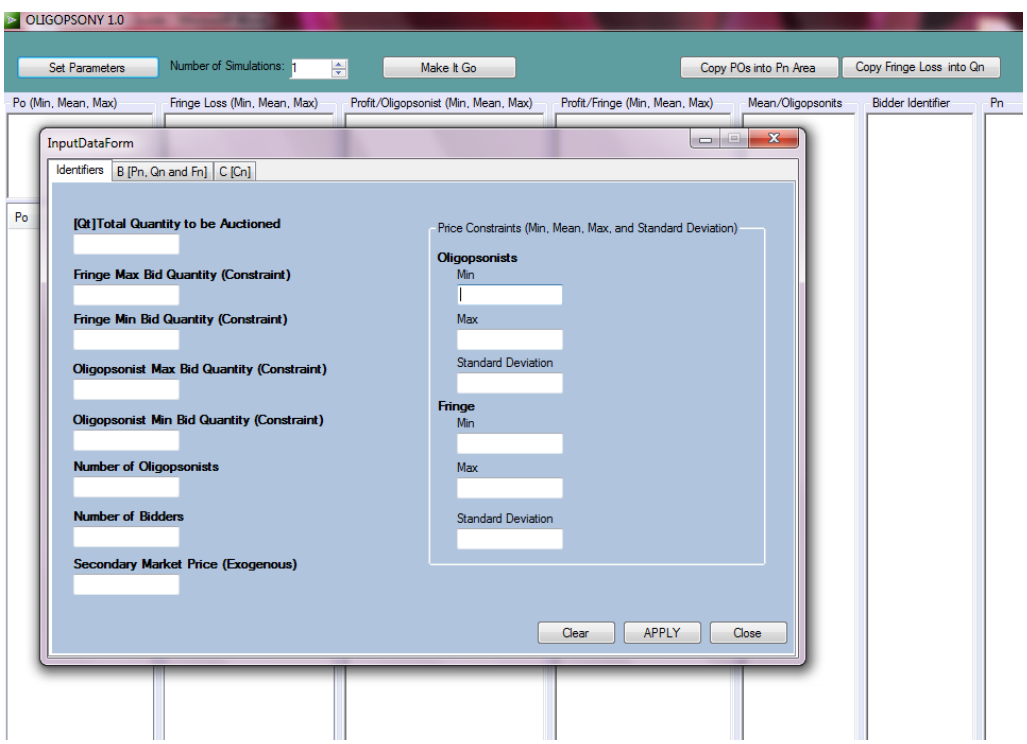
This has the exact same properties as the Fringe Min Bid Quantity, except that it applies to the bidder class "Oligopsonist." So, setting a value of 1,000 here means that the sum of all of any oligopsonist's bids cannot be less than 1,000 allowances.

Number of Oligopsonists

The number of oligopsonists refers to the number of oligopsonists the user wishes to simulate. Entering a value of 4 here would simulate an auction market in which there would be 4 oligopsonists (plus other fringe firms).

Number of Bidders

Entering a value of 50 here would produce a market simulation in which there are a total of 50 firms overall. If the user entered '4' oligopsonists in the Number of Oligopsonists entry, and a '50' in the Number of Bidders entry, the simulation would proceed with 4 firms in the category oligopsonist, and 46 firms in the category fringe, with a total of 50 firms in the market overall. As a result, an additional entry field for the number of fringe firms would represent an impractical redundancy.



Secondary Market Price (Exogenous)

Oligopsony 1.0, calculates the profit of each individual firm bidding into the market.[2] Profit in cap-and-trade markets is not clear cut, which should be stated at the outset. Profit in energy markets, which is often highly regulated at the state level, can come from an agreed upon rate of return from state regulators. Profit can also come from resale of excess allowances onto secondary and bilaterial markets. Given that the approved rate of return varies across jurisdictions via a highly complicated regulatory process, Oligopsony 1.0 allows the user flexibility to indirectly set the rate of return by calculating the profit from an assumed 100 resale, and allowing the user to specify the secondary market (resale) price exogenously. Simply put, the user-specified secondary market price sets the current prevailing market price for the commodity being auctioned.

Price Constraints (Min, Max and Standard Deviation)

As mentioned previously, Monte Carlo analysis of this sort can benefit from structured random variation. The bid price associated with each firm's bid(s) is independently and randomly drawn from a Gaussian (Standard Normal) distribution. Oligopsony 1.0 allows the user to specify these parameters separately by type of firms (oligopsonist/fringe).

Running a Single Auction Simulation

Oligopsony 1.0 provides a full bidding matrix if the user selects a single iteration. This can be done by inserting '1' in the number of simulations box.

When this is done, the bidding matrix will pop up and will indicate all bidders and their bids, rank ordered by bid price. The bid matrix contains three columns. The first column is the bidder's bid price, the second column is the bidder's bid quantity, and the third column indicates the bidder number, or identifier.

Note that the software limits the quantity of individual bids of any single bidder to at most four separate bids. Also note that the software separately color codes oligopolist bids in red color font. This allows them to be easily distinguished by visual inspection.

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[2] The profit of firms bidding into the market is given by the simple profit function:

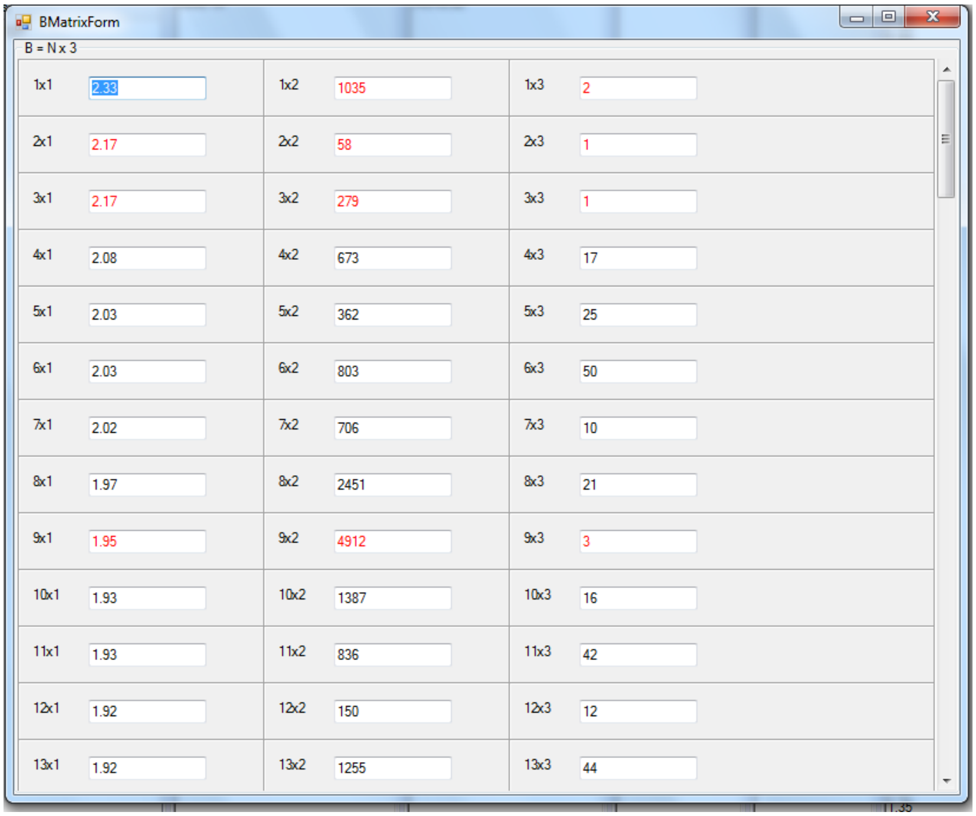
$\pi_F = (V_F - P_0)(Q'_F - Q_{F,a})$ = $\Delta P \bullet \Delta Q$, in which;

Π_F = The secondary market profit function associated with bidder 'F',

V_F = The secondary market resale value of allowances for bidder 'F',

Q'_F = The quantity of allowances awarded to bidder 'F', and

$Q_{F,a}$ = The quantity of allowances bidder 'F' must surrender for compliance obligations. Oligopsony 1.0 sets $Q_{F,a}$ to zero endogenously, as the compliance function of individual firms is beyond the scope of Monte Carlo analysis. Readers are encouraged to see: Dormady, N. 2013. Market Power in Cap-and-Trade Auctions: A Monte Carlo Approach. *Energy Policy, 62*: 788-797.



Running Multiple (or thousands) of Simulations

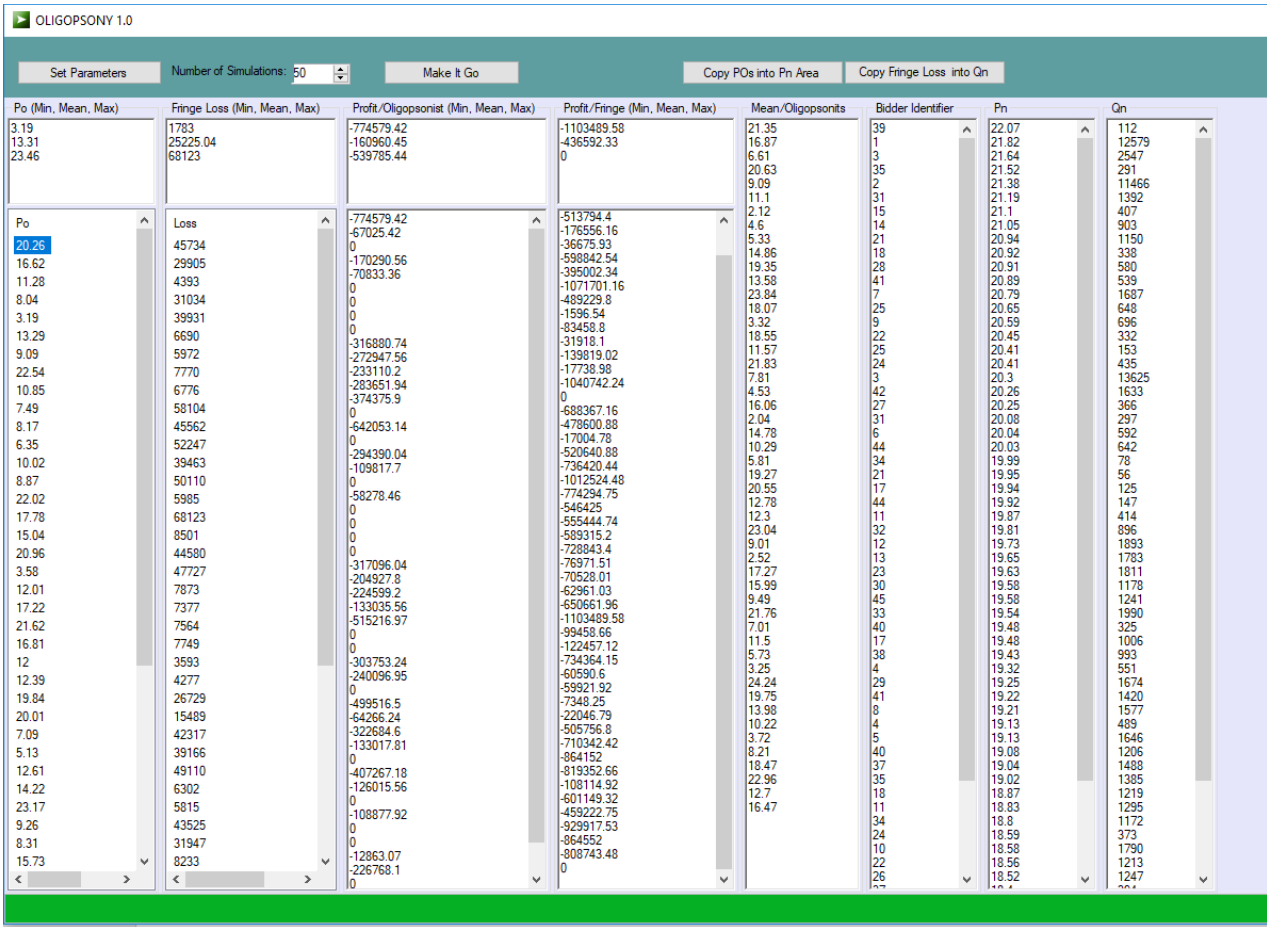
Running multiple simulations, or iterations, can be done by increasing the iterations count in the simulations input box. You can run thousands!

When the user runs multiple auction simulations, the individual bid matrix does not pop up as a separate pop up box. The user can view that information individually for any of the n auction iterations by clicking on any row in the price box. When an individual auction is selected by clicking on a price row, the individual bid prices and quantities for each bidder identifier are provided in the far right three columns.

The left four columns provide auction clearing information. The first column provides auction clearing price. The second column provides the fringe loss. This is the quantity of permits that non oligopolist bidders bid for, but did not win or obtain in the auction. The third column provides the total profit of the user-specified n oligopolists. And the fourth column provides the total profit of the user-specified n fringe firms.

Simple summary statistics are provided in the boxes directly above those columns. The values provided are the minimum, mean, and maximum.

The column labeled “Mean/Oligopolist” indicates the average bid price of the user-specified n oligopolists.



Exporting Data

The output boxes in the far three columns are all formatted as text boxes. This means that the user can copy and paste the outputs directly from those boxes into spreadsheet applications or statistical software applications.

Exporting aggregate auction clearing statistics, such as all auction prices and all fringe loss values, can also be done. In the top right-hand side of the application there are two buttons labeled “Copy POs into Pn area” and “Copy Fringe Loss into Qn.” By clicking on either or both buttons, the user copies the first two columns directly into the last two columns, converting the auction clearing summary statistics into exportable text. Then, the user can simply copy and paste the auction summary statistics.

Enjoy!