23 Double auctions

18 points

Introduction

A double auction is an economic mechanism to allocate identical goods from different vendors to multiple buyers. In a double auction, potential buyers submit their bids and potential sellers simultaneously submit their ask prices to an auctioneer. Then an auctioneer chooses some price p that clears the market: all the sellers who asked less than p sell and all buyers who bid more than p buy at this price p. As well as their direct interest, double auctions are reminiscent of Walrasian auction and have been used as a tool to study the determination of prices in ordinary markets. In this exercise we want to implement a double auction market where HP sellers will offer their ink supplies and HP customers will bid for them.

To clear the auction, the M^{th} and $(M + 1)^{st}$ prices are computed, where M is the total number of asks. Conceptually, finding the M^{th} and $(M + 1)^{st}$ prices is simply a matter of sorting the bids and asks in descending order (bigger to smaller), merging them in a single lists of prices, and identifying the M^{th} and $(M + 1)^{st}$ elements in it. The prices between the M^{th} and $(M + 1)^{st}$ bids (inclusively) represent the range of prices for which supply balances demand.

The pricing policy that we will be using is the so named k-pricing policy where PK is computed as follows:

$$PK = k * P_{(M+1)} + (1-k) * P_M$$

Where k is the so-named welfare factor and P_M and $P_{(M+1)}$ are the M^{th} and $(M + 1)^{st}$ prices correspondingly.

Input

The input will start with the input of the k welfare factor, followed by the sequence of bids (ended by a -1.0) and followed by a sequence of asks (also ended by a -1.0).

```
0.5       ← this is the value of the welfare factor.
22.1
22.5
22.7
23.0
21.9
20.1
19.8
22.6
-1.0      ← this is the end of the bids, starting asks
22.1
23.6
22.2
22.4
-1.0      ← this is the end of asks
```

Output

The program must output the final price, the asks sold sorted in ascending order (small to big) and the bids sold sorted by descending order (big to small).

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Price: 22.55
Asks sold: 22.1, 22.2, 22.4
Bids sold: 23.0, 22.7, 22.6
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Detailed explanation

M = 4 (number of asks)
Sorted bids and asks in descending order.
23.6
23.0
22.7
22.6 -> Mth price
22.5 -> Mth +1 price
22.4
22.2
22.1
22.1
20.1
19.8

K = 0.5
P = (0.5 * 22.5) + ((1 - 0.5) * 22.6) = 22.55
Asks below 22.55 match with bids over 22.55
Asks sold: 22.1, 22.2, 22.4
Bids sold: 23.0, 22.7, 22.6