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Multi-Party Multi-Period Supply Chain Coordination

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We use the following test settings for all three examples:

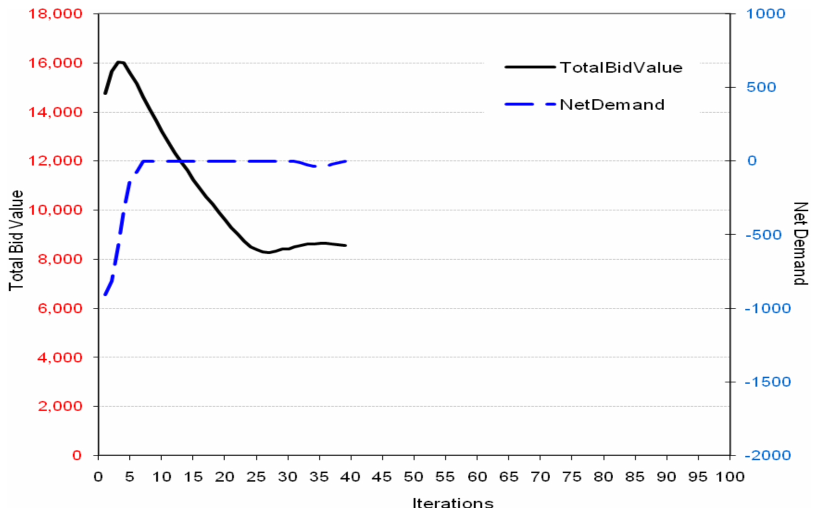
- Demand for product R_{jt} is randomly generated based on a Normal distribution N~(100, 25).
- Bill of material, $g_{jk} = 1 \ \forall \ j, k$.
- Parts holding cost h_{jk} = \$1 per part per day $\forall \ j, k$.
- Dedicated single source
  - $a_{jks} = 1$ for $s = k$, $\forall \ j$, and for $k \leq 4$ in Example A.
  - $a_{jks} = 1$ for $s = k$, $\forall \ j$, and for $k \leq 8$ in Example B.
  - $a_{jks} = 1$ for $s = k$, $\forall \ j$, and for $k \leq 12$ in Example C.
  - That is, supplier 1 can only produce part 1, supplier 2 can only produce part 2, and so on. This represents the situation where there is a dedicated single source for each part and each part costs \$10 (C_{jks} = \$10).
- Flexible source
  - $a_{jks} = 1$ for $\forall \ j$ and for k = 5 in Example A
  - $a_{jks} = 1$ for $\forall \ j$ and for k = 9 in Example B
  - $a_{jks} = 1$ for $\forall \ j$ and for k = 13 in Example C
  - That is, the last supplier is able to product all the parts. Being a flexible source, the cost of each part will be higher, and we set a 50% price premium of \$15 per part (Cjks = \$15).
- $a_{jks} = 0$ otherwise
- Lower inventory limit $\check{I}_{jkt} = 25 \ \forall \ j, k$, and $t \leq 5$, $\check{I}_{jkt} = 50 \ \forall \ j, k$, and t = 6. The at the last period of the time horizon is set at a higher value to take care of sudden surge in demand beyond the time horizon.

- Upper inventory limit $\hat{I}_{jkt} = 75 \ \forall \ j,k$.
- Minimum order quantity $\check{O}_{jkst} = 0 \ \forall \ j,k,s,t$.
- Maximum order quantity $\hat{O}_{jkst} = 100 \ \forall \ j,k,s,t$ and $a_{jks} = 1$, 0 otherwise.
- Relative difference tolerance $\varepsilon = 0.5\%$.

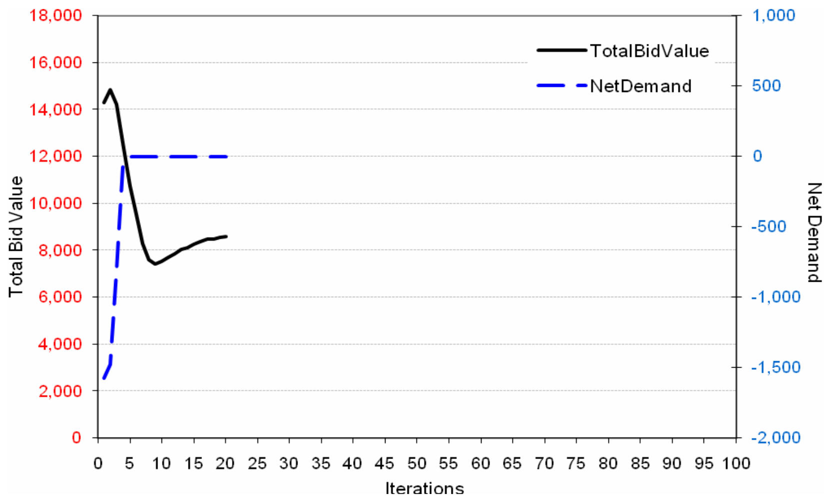
As the number of products, parts and suppliers increase from Example A to C, the following are set differently:

- Suppliers' capacities for producing the parts have to be increased accordingly.
- Example A:
    - $\hat{O}_{kst} = 300$ for $s = k, \ \forall \ t$.
    - $\hat{O}_{kst} = 500$ for $s = 5, \forall \ t$.
    - $\hat{O}_{kst} = 0$ otherwise.
- Example B:
    - $\hat{O}_{kst} = 700$ for $s = k, \ \forall \ t$.
    - $\hat{O}_{kst} = 1100$ for $s = 9, \forall \ t$.
    - $\hat{O}_{kst} = 0$ otherwise.
- Example C:
    - $\hat{O}_{kst} = 1100$ for $s = k, \ \forall \ t$.
    - $\hat{O}_{kst} = 1700$ for $s = 13, \forall \ t$.
    - $\hat{O}_{kst} = 0$ otherwise.

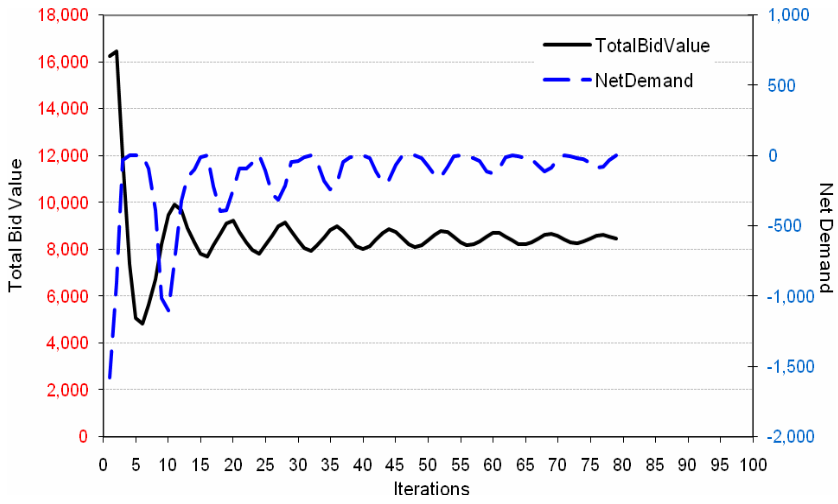
Example A-1: Asynchronous Bidding, Method 1.



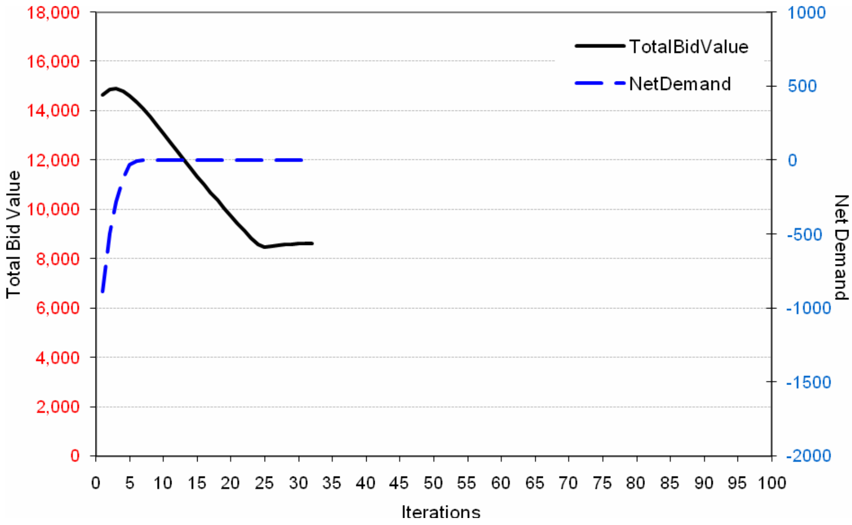
Example A-2: Asynchronous Bidding, Method 2.



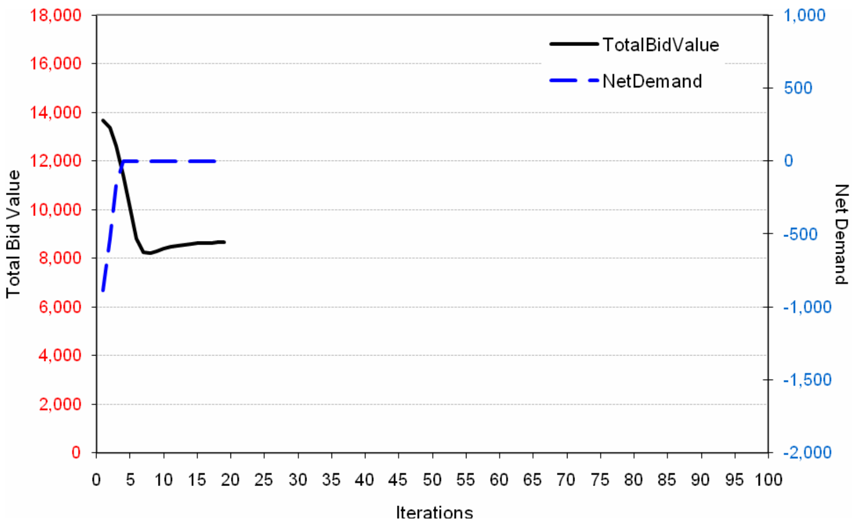
Example A-3: Asynchronous Bidding, Method 3



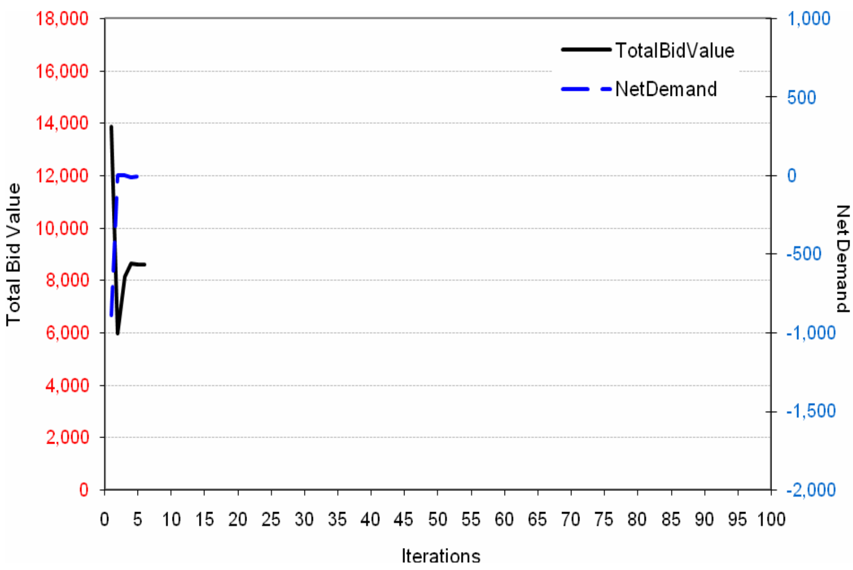
Example A-4: Synchronous Bidding, Method 1.



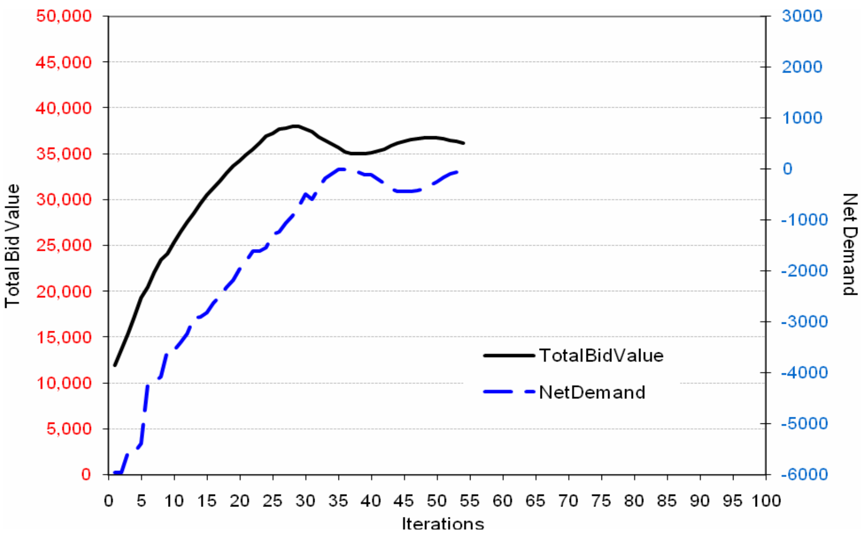
Example A-5: Synchronous Bidding, Method 2.



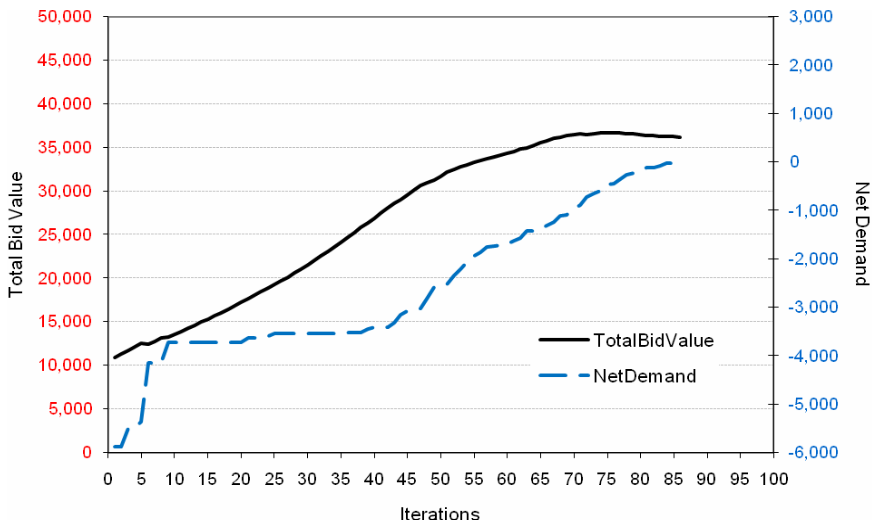
Example A-6: Synchronous Bidding, Method 3.



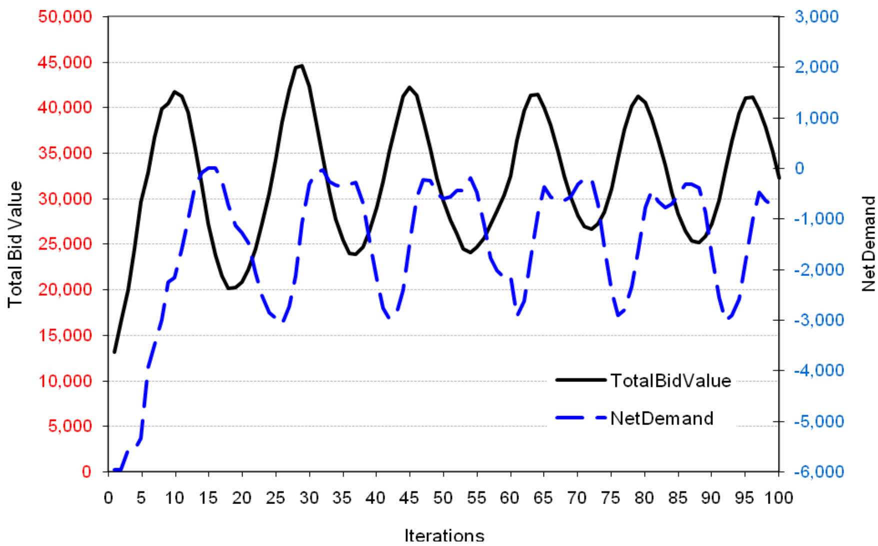
Example B-1: Asynchronous Bidding, Method 1.



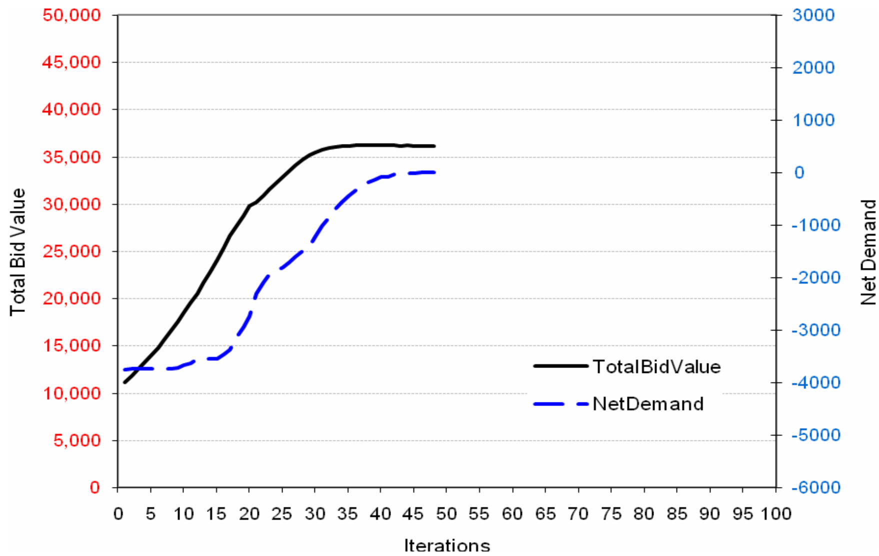
Example B-2: Asynchronous Bidding, Method 2.



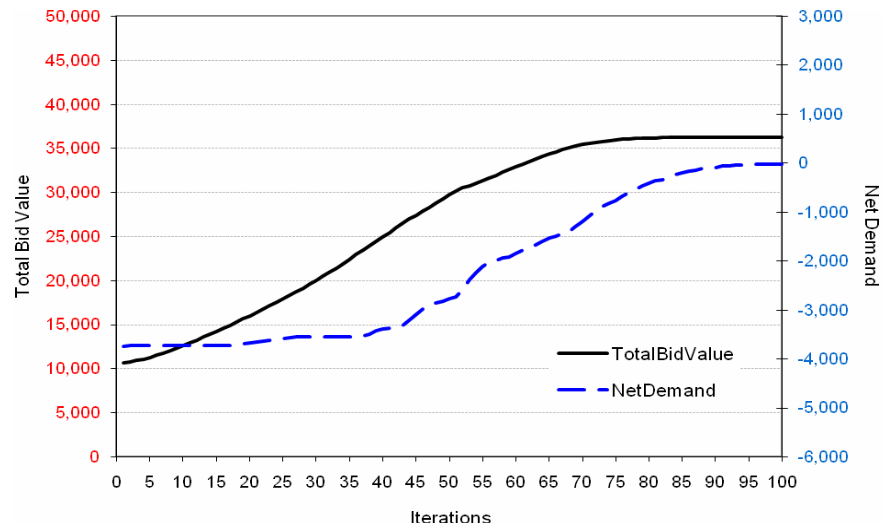
Example B-3: Asynchronous Bidding, Method 3.



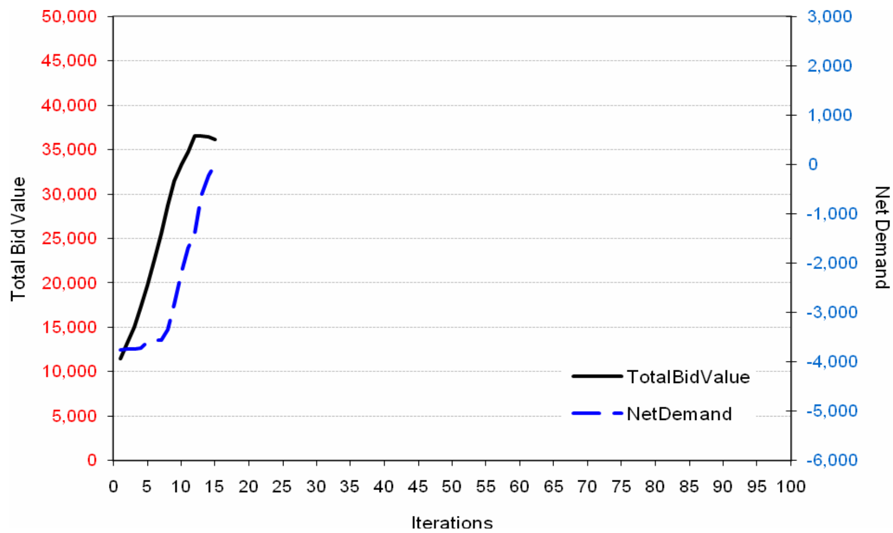
Example B-4: Synchronous Bidding, Method 1.



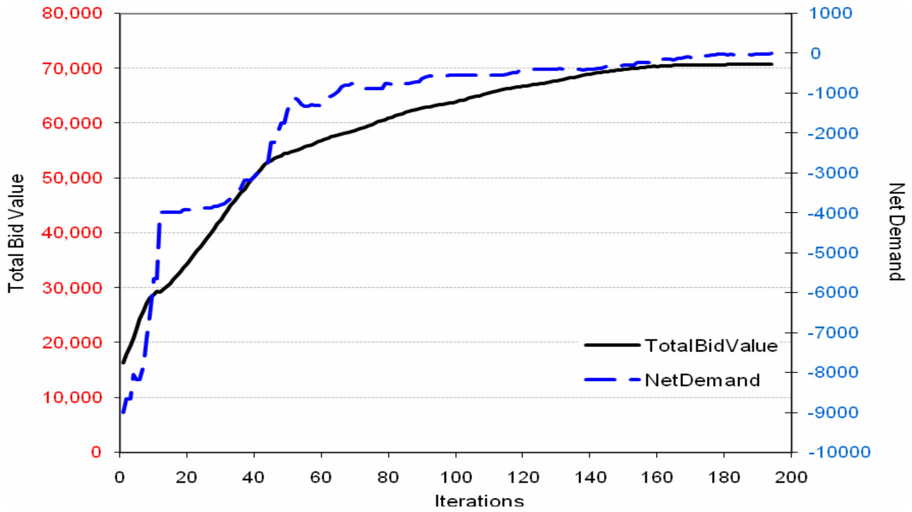
Example B-5: Synchronous Bidding, Method 2.



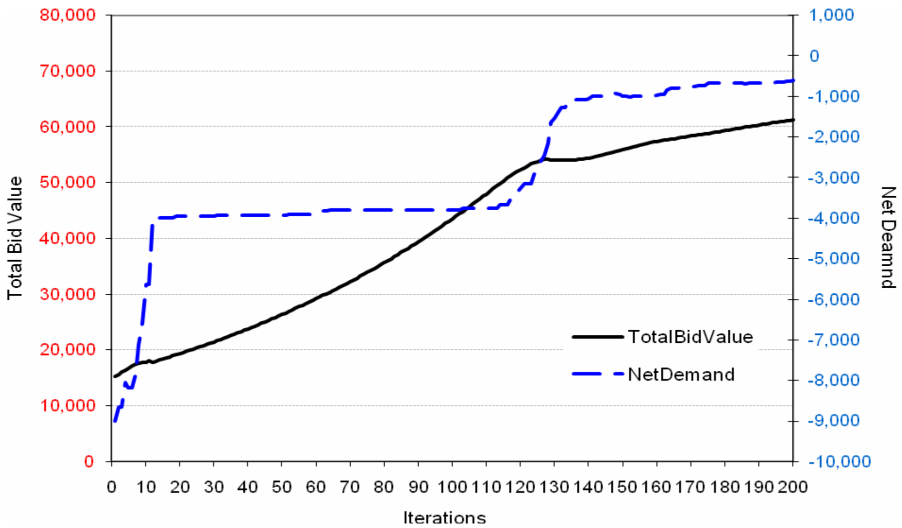
Example B-6: Synchronous Bidding, Method 3.



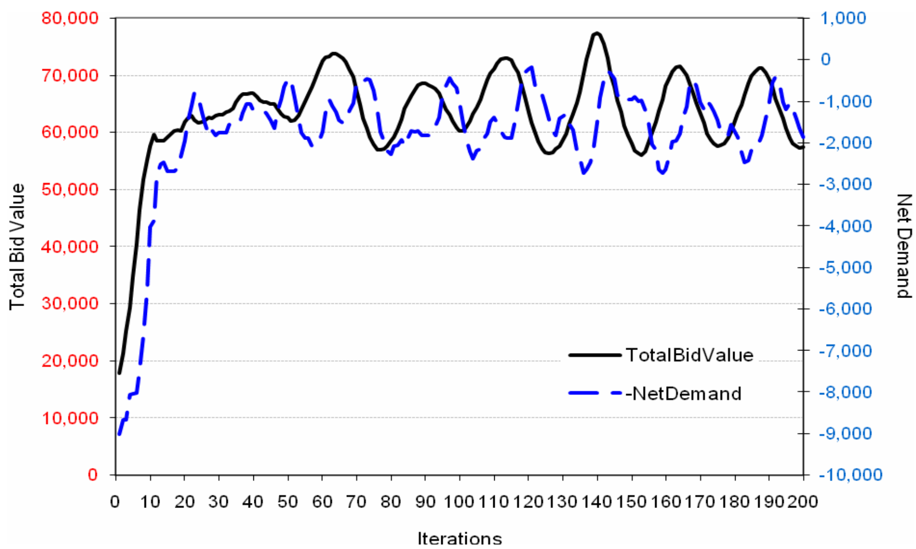
Example C-1: Asynchronous Bidding, Method 1.



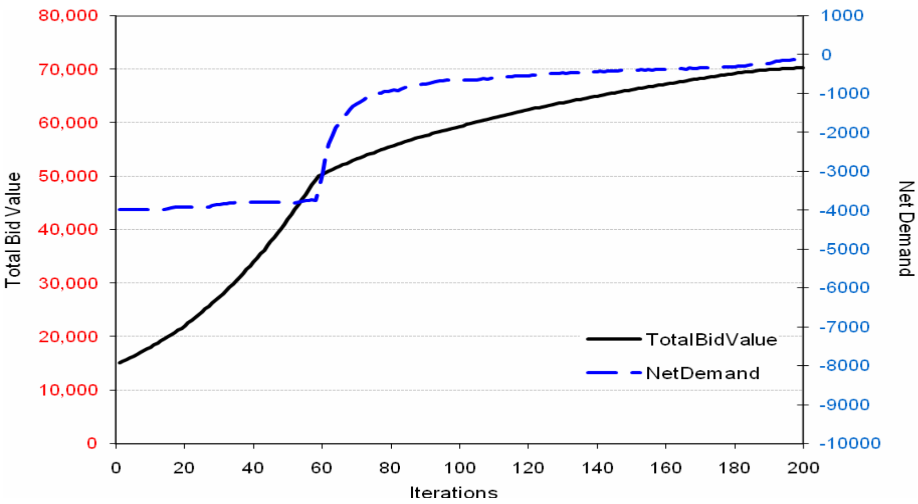
Example C-2: Asynchronous Bidding, Method 2.



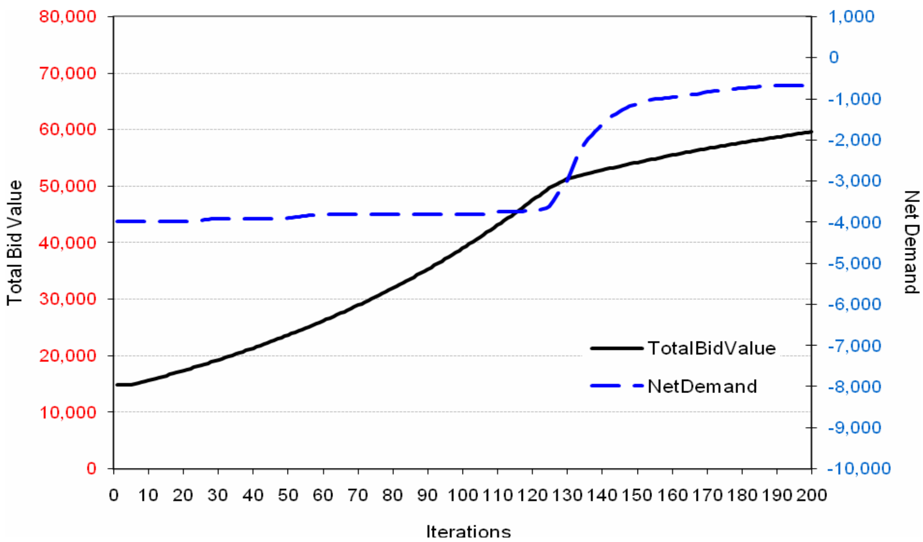
Example C-3: Asynchronous Bidding, Method 3.



Example C-4: Synchronous Bidding, Method 1.



Example C-5: Synchronous Bidding, Method 2.



Example C-6: Synchronous Bidding, Method 3.