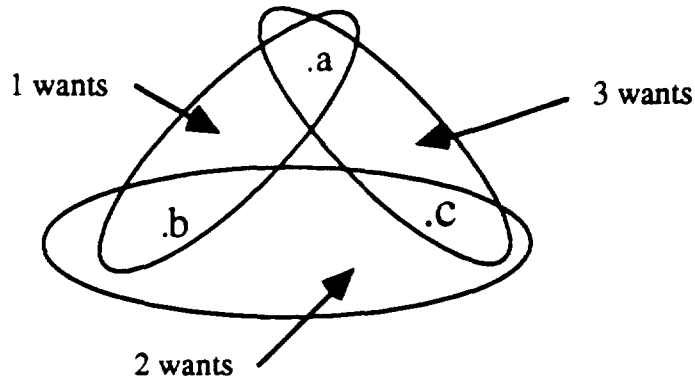
The Fitting Problem



	abc	ab	bc	ac	a	b	c
1	250	200*	100	110	60	50	50
2	255	110	200	100	50	60	50
3	250	100	125	200	50	50	75*

optimal value = 275

Equilibrium prices must satisfy:

(for 1) $200 \geq P_a + P_b$

(for 3) $75 \geq P_c$

(for 2) $200 \leq P_b + P_c$

$\Big]$ or $P_b \geq 125$

(for 3) $75 - P_c \geq 200 - P_a - P_c$ or $P_a \geq 125$

But then

$$200 \geq P_a + P_b \geq 250$$

New Problem: Suppose prices are such that 1 and 3

are "happy": $P_a=125$, $P_b=75$, $P_c=75$

Let 2 bid $P_b=80$, $P_c=80$ and win 40.

1 now loses 60-125=65

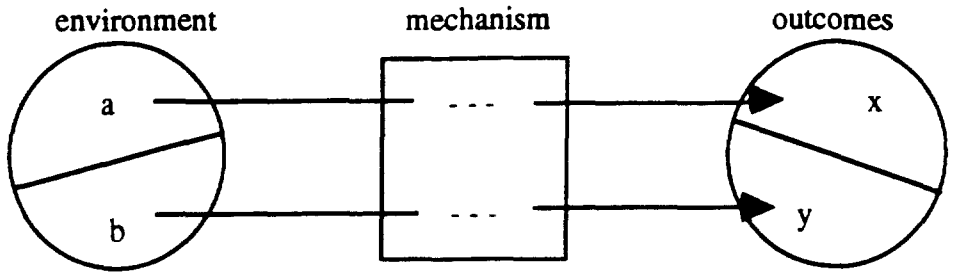
a) Can 1 withdraw? What then?

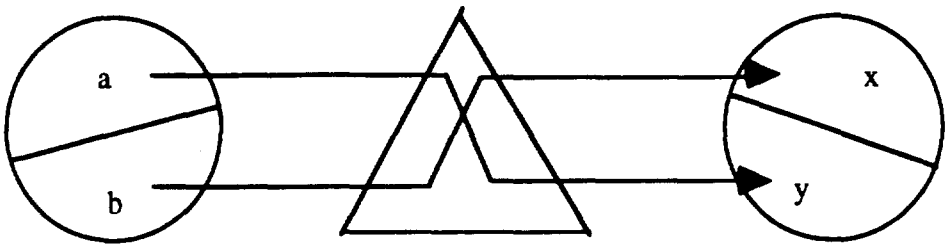
b) Path dependence, exposure, last one in wins (agenda manipulation), aftermarkets will not be efficient

Solution: Endogenous Combinatorics Simultaneously

Problems: Information and Computation

Applied Mechanism Design





Desirable Performance Characteristics

Efficiency (e.g. value maximization)

Revenue

Practicality (e.g. feasible, transparent)

Speed

Robustness

Low exposure

The Design Process

(Banks, Ledyard, Porter RAND 1989)

A fitting and coordination problem

Banks - Vickery - "too complicated", 2^k bids/person

Iterate - stopping rule?

withdrawal?

Performance - high variance, hit 100% once

Porter - Aftermarkets - no equilibrium

Performance - low efficiencies

- cannot coordinate

Ledyard (et al.) - ascending bid with packages

AUSM

Major components - provisional allocation
bidding and bumping rule
stopping rule
(standby queue)

Allocations, bidding, bumping

	a	b	c	d	
new allocation	1.1	1.1	2	3	1.1 is a package
bids	5		10	15	
#4 bids	(c,d) $30				

	a	b	c	d
new allocation	1.1	1.1	4.1	4.1
	5		30	
#5 bids	(a,c,d) $40			

	a	b	c	d
new allocation	5.1	x	5.1	5.1
		$40		

Stopping rule (others have been used since)

- no new bids in x minutes
  (tried "stop at T" - wrong!)

<u>Problem</u>:

	a	b	c	d	
	5.1	6	5.1	5.1	5.1 - $40
					6 - $5

Suppose 2 is willing to pay 20 for c

1 " " " " 10 " a

4 " " " " 20 " d

but 5 " " " " only 45 for acd

- Efficiency ⇒ give a to 1, c to 2, d to 4
- <u>But they cannot unilaterally bump</u>
- <u>Threshold</u> problem (multiple equilibrium)
- Solution: <u>Standby queue</u>

2 announces bid c $20

1 " " a $10

4 announces she will combine with 1 and 2 and bid d $20

The combined bids (not a package) at $50 bump 5 at only $40.

- can withdraw until accepted.

<u>Problems</u>: (a) coordination in the queue

(b) contingent bids in the queue

(c) flooding the queue

(a) and (b) can be helped by talking

(c) is simply mischievous behavior

Performance of AUSM

Efficiency - high in many (stressful) environments

Space Shuttle - AUSM > Vickery (iterative) > markets = Random

Space Station - AUSM = Markets

DSN - AUSM >> Random > Committee

Trains - high (see Brewer and Plott)

3 on 3 - good (see Porter)

5 on 6 - good >> simultaneous single units
(a serious fitting problem)

Speed - good (comparatively fast) (faster than simultaneous)

- best speed is Dutch Auction Clock

600 buyers and 4 clocks in one room

3.6 seconds/transaction = 7 min. for 102

(allocative efficiency for PCS would probably be bad)

Transparency - good (fair or good in large #'s?)

- best would be random allocation

Exposure - none

Robustness - very good.

Issues for Any Mechanism

Sealed vs. ascending bid - (packaging gains ⇒ ascending?)

Batch vs. continuous vs. continuous with pauses

- (batch ⇒ strategic exposure but time to calculate)

Scope of simultaneity

- (where are boundaries of returns to scale?)

Withdrawal rules

- sign of exposure
- can create cycles

Medium of operation

- lots of viable options (blackboard, spreadsheets, phones, Compuserve, internet, . . .)

Transparency

- of rules
- of strategies
- of exposure

Ties

- (needed only if batch)

Stopping rules

Stopping Rules

- Stop at T (or after R rounds) (no good)
- Stop if total revenue this round is less than x% increase over last 5 seconds (last k rounds) (no good)
- No new bids in last H hours (not too bad)
- Auctioneer discretion (not viable for public)
- Active 3 minutes, pause 1 minute, stop if no new bids in last 30 seconds (not counting pauses) or after 5 active periods whichever comes first (works well and allows time - during a pause - to think)

[need to keep pressure on to finish but not too fast - soft closes work best]

Factoids

1. Everyone wants a tried and true method - but none of the proposals is that - very little data about most.

2. Standard intuition based on homogeneous or single-unit environments can be misleading.

3. Details matter and are usually not noticed until the mechanism is tried in a testbed.

   - lab can sort some of this out

   - can always test more if you want to.

4. Endogenous packaging is feasible.

   - AUSM can tell us whether packaging matters for efficiency if you are unsure.

Adaptive User Selection Mechanism: Experimental Tests and Demonstration

Robin Hanson and David Porter
California Institute of Technology

January 27, 1994

Outline:

1. Background Design Issues: The Cassini Barter System
2. Simple Experimental Stress Tests
3. Data from Stress Test
4. Procedures for Demonstration
5. Overview of Demonstration Parameters
6. Participate and View Demonstration

Background Design Issues

- The software design and user interface modified from Cassini Resource Exchange
- The Cassini Resource Exchange (CRE) is a real-time bulletin-board trading system designed, developed and operated by the Caltech Economics Laboratory (PrOD)
  - system allows mission resourceholders to trade resources
- CRE is a barter market where trades for packages of resources are submitted
  - CRE can assist in finding and executing chains
- System runs over the Internet and uses X-Windows graphics
- All clearance, settlement, and engineering changes done by JPL's Instrument Manager

Quick View of the Cassini Trading System

Background Experimental Tests

- We have conducted some preliminary experiments on some simple test environments

- Description of the mechanisms and data will provide orientation for the demonstration

- We have examined two environments and two mechanisms:
  - Environments: Yugo, Puzzle
  - Mechanisms: English Batch (no packaging), Continuous AUSM

Description of the Experiments

- Mechanisms:

English Batch Process:

- Submit sealed bids for any single items
- Highest bid is provisional winner (second highest posted)
- Must have high bid for an item or bid 5% over winning bid to be active
- Process stops if no bid is 5% above the winning bid (no ties)
- Withdrawal after market close

Continuous AUSM Process:

- Market is open for X minutes, bids for packages can be submitted
- To be provisionally accepted, bid must be higher than the sum of the packages it must replace
- Bids can be submitted to standby for combining (only highest are listed)
- If no new bid to market is submitted in Y minutes market closes
- If we reach the X minutes we pause and allow bids to standby market only

- Environments:

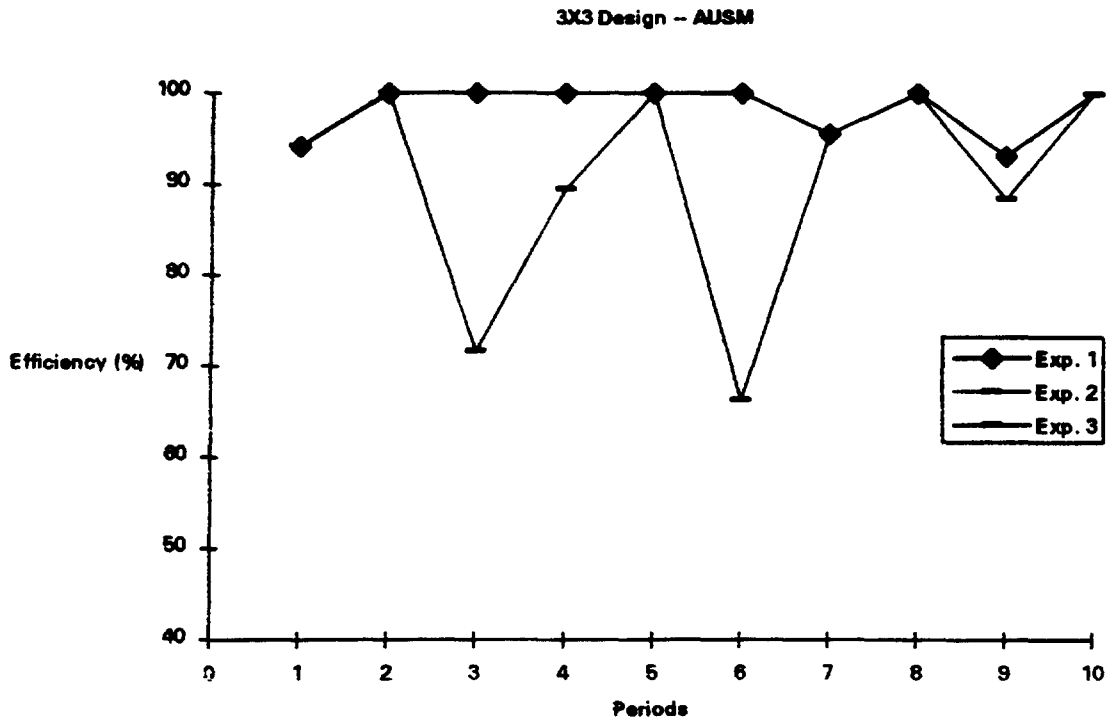
Yugo(3X3)

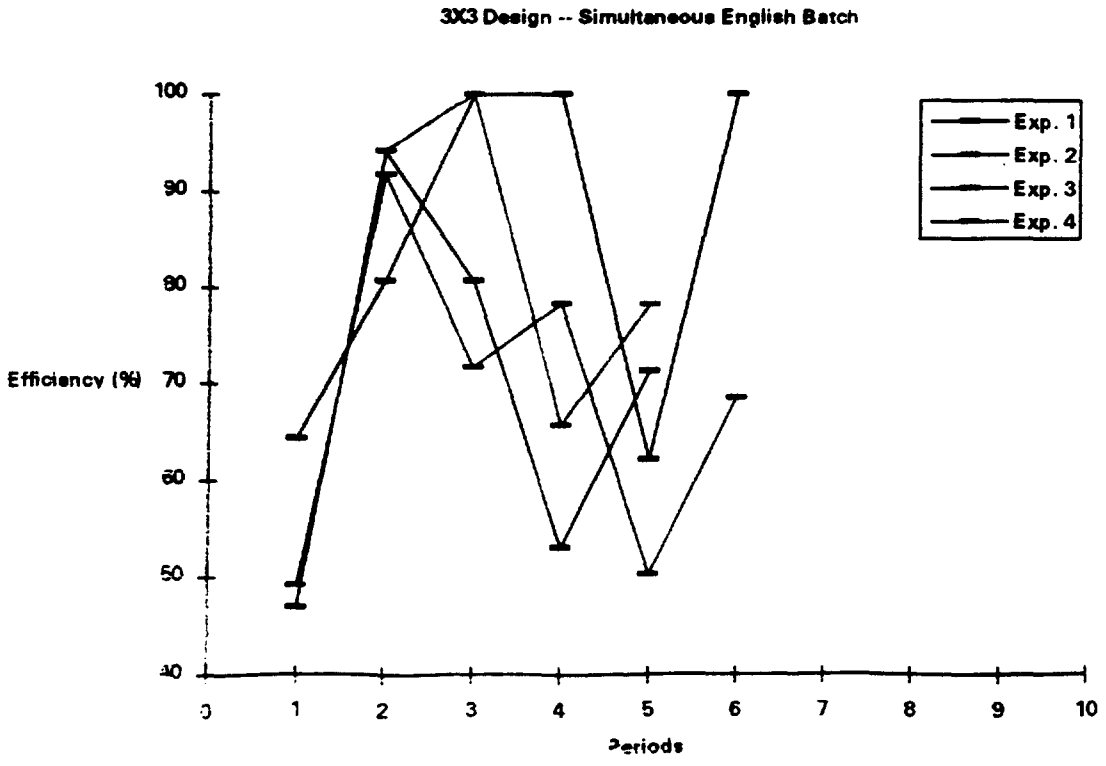
A	B	C

A, B, C ~ [0,98] ABC ~ [0,249]

Period 1 Draws:

	A	B	C	ABC
1	34	40	36	112
2	67	68	60	88
3	87	59	45	180

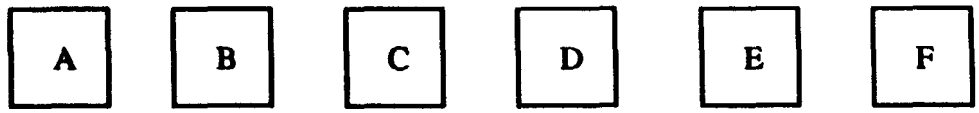

3X3 Design -- AUSM
Efficiency (%)
100
90
80
70
60
50
40
0
1
2
3
4
5
6
7
8
9
10
Periods
Exp. 1
Exp. 2
Exp. 3


3X3 Design -- Simultaneous English Batch
Efficiency (%)
100
90
80
70
60
50
40
0
1
2
3
4
5
6
7
8
9
10
Periods
Exp. 1
Exp. 2
Exp. 3
Exp. 4

Description of the Experiments (Cont.)

Puzzle (5X6)

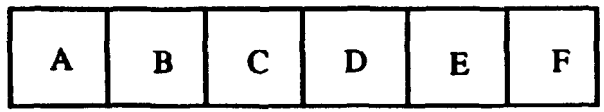
Puzzle pieces



~ [0,10]

..... ~ [20,40]

..... ~ [110,140]

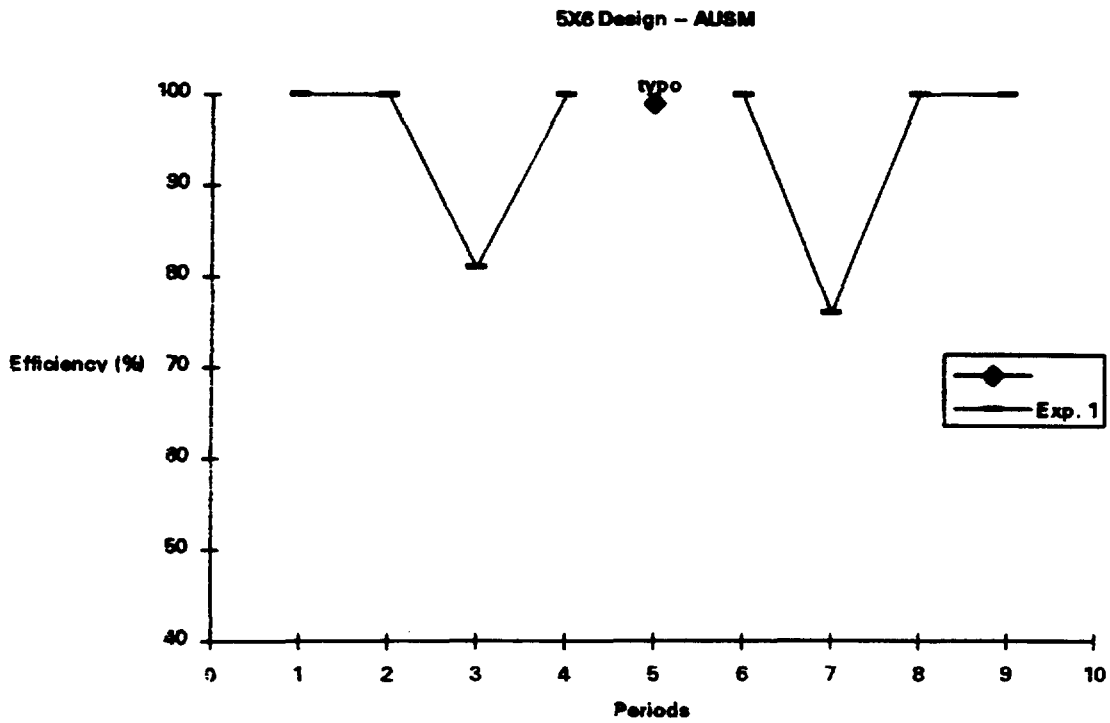


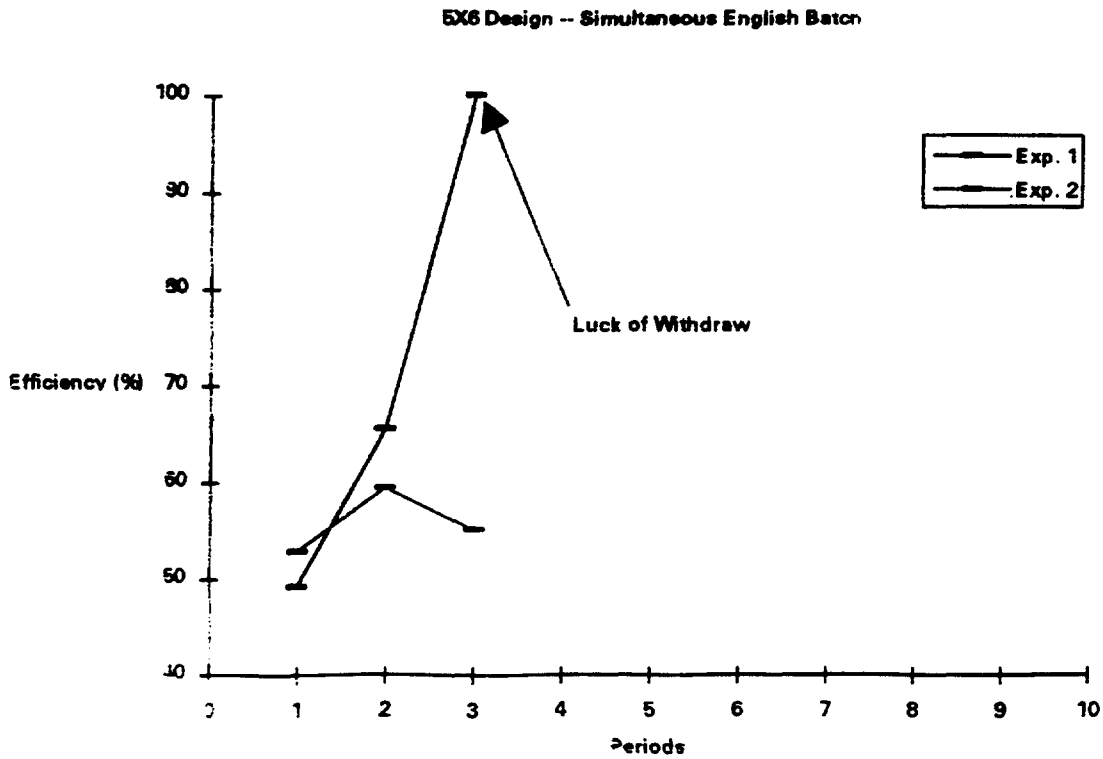
..... ~ [140,180]

Period 3

1		2		3		4		5	
C D	23	B	1	E	3	A	8	D	1
A B	29	B E	29	C F	25	F	0	C	7
A C F	129	A E	20	C D E	111	A F	26	C E	25
A C D	127	A D F	124	B D E	111	B C F	111	A B E	126
A B C D E F	159	A B C	124	C E F	124	B D F	117	A E F	115

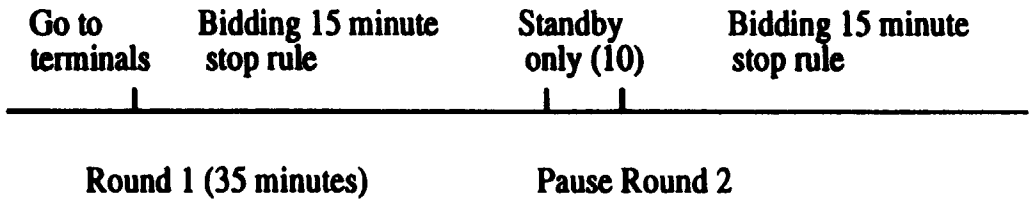
A C F	129
B D E	111
	240


5X6 Design -- AUSM
typo
Efficiency (%)
100
90
80
70
60
50
40
0
1
2
3
4
5
6
7
8
9
10
Periods
Exp. 1


5X6 Design -- Simultaneous English Batch
Efficiency (%)
100
90
80
70
60
50
40
0
1
2
3
4
5
6
7
8
9
10
Periods
Luck of Withdraw
Exp. 1
Exp. 2

Demo Procedures

- We will auction off 54 items to ten participants (values described later)
- Ten subjects recruited who have participated in several experiments and understand the process and software
- Subjects will make the decisions (they keep the earnings)
- At most two observers per subject are allowed
- The auction will last at most 90 minutes (two rounds lasting 35 minutes)
- Observers can leave at any time
- The timeline is as follows:



Who Wants What How Much

- 10 subjects (index i), 54 MTAs (index j), many MTA packages (index k)

True value	:	$V_{ik} = C \cdot S_i \cdot P_k \cdot b(P_k)$
Told value	:	$\tilde{V}_{ik} = \tilde{C}_i \cdot S_i \cdot P_k \cdot b(P_k)$
Common value	:	$C \sim [20,30]$
Signal	:	$\tilde{C}_i = C + \sim [-5,5]$
Strength	:	$S_i \sim [100,125]/100$
Population	:	$P_k = \Sigma_{j \in k} P_j$
Factor	:	$b(P) = 1/5 + 3/(1+1/P)$

	p	b(p)
min →	.01	.2
	.25	.8
	.5	1.2
mean →	1	1.7
	2	2.2
	4	2.6
	8	2.9
	16	3.0
	32	3.1

Demo Land

--	--	--	--	--	--	4	7	--
3	--	6	--	--	--	--	--	--
--	--	--	--	--	2	--	--	--
5	--	--	--	--	--	8	--	1
--	--	--	--	--	--	--	--	--
9	--	--	--	10	--	--	--	--

Homes

--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	43	53	--	--	--
--	--	--	34	44	54	--	--	--
--	--	--	--	45	55	--	--	--

Sample MTA Package

--	--	--	30	40	50	--	--	--
--	--	--	31	41	51	--	--	--
--	--	--	32	42	52	--	--	--
--	--	--	33	43	53	63	73	83
--	--	--	34	44	54	64	74	84
--	--	--	35	45	55	65	75	85

Sample Region Package

USES OF LABORATORY EXPERIMENTAL METHODS IN THE DESIGN OF THE PCS AUCTION

Charles R. Plott, California Institute of Technology

1. The Why and How of Laboratory Methods In Economics

a. Incentives, Procedures, Performance Measures
b. An electronic double auction (demonstration on network from lab.)
c. Demonstration of types of equilibration in markets
   (i) Equilibration to fundamentals
   (ii) Bubbles and expectations
d. The importance of auction rules, institutions, and organization and the importance of simple case studies
   - the EPA SO_2 auction as an example

2. Special Electronic Auction Processes Related to the Spectrum Auction (a demonstration of the actual market in operation and data from experiments)

a. A type of combinatorial auction-a railroad track allocation auction (demonstration on the network from the laboratory)
b. An electronic Japanese auction (demonstration on network from lab.)
c. An electronic simultaneous auction (demonstration on network from lab.)

3. Preliminary Comparisons of Auction Performance

a. Parameters

a.1. Series 1: nine items:
(i) super additive value of collection of all items < sum of 1st values of independent items
(ii) super additive value of collection of all items > sum of 1st values of independent items

a.2. Series 2: nine items:
(i) super additive value of 2 collections of three items, value of collection of items <sum 1st values of independent items
(ii) super additive value of 2 collections of three items, value of collection of items >sum 1st values of independent items

a.3 Series 3: nine items:
super additive value of collection of all items randomly above and below sum of 1st values of independent items
expected value of items provided as public information

b. Institutions
Primary institutions: Japanese auction in random order with sealed bid for package
Simultaneous auctions for all items (with and without release-to-market provision)
Japanese auction in order from highest to lowest with sealed bid for package of seven items