THE AUCTION SOLUTION TO AIRLINE OVERBOOKING

The Data Fit the Theory

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INTRODUCTION

Airline overbooking is a continuing problem. The Civil Aeronautics Board is again holding hearings in 1976-77. And, as a result of Ralph Nader's suit which went to the U.S. Supreme Court, overbooking has come out of the closet. Previously airlines denied that they do it; now they admit the practice, but claim that it is necessary.

The Overbooking Auction Plan, which would leave *every one* satisfied—both customers and airlines—was first proposed in 1968 [8]. The scheme has been thoroughly discussed [2], [5], extended by Vickrey [11], and reinvented by Bierman and Thomas [1]. No logical or practical flaw has been found.

In brieff, the scheme is as follows: If more ticketed passengers show up than there are seats, each passenger writes a sealed "bid" of the lowest amount he or she is willing to accept in return for waiting until the specified next flight. The low bidders are given the amounts they bid and they take the next flight, satisfied. All other passengers fly as scheduled, satisfied. The airlines can overbook to a higher degree than now, and without complaint; they, too, would be satisfied, and the increased airline efficiency would be an important social gain.

Other schemes having some of the advantages of this auction plan have been tried: for example, selling lower-price tickets to people on condition that they fly only if there is room, and requiring penalties of no-shows.But every such scheme is less attractive than the auction plan, whether because it reduces airline revenue, or because it does not well match being "bumped" to the people who are most willing to be bumped, or because it has some other undesirable economic feature.

Various improvements in this auction scheme have been proposed: for example, asking the passengers to indicate bid amounts when buying tickets. But none of these improvements are crucial to its effectiveness.

The reasons that the airlines have not adopted the scheme apparently is that this plan is not "dignified" and does not accord with their self-image [9]. Some airlines have said this plainly, while others have offered transparent excuses for not adopting the scheme: for example, that non-English speakers would not understand it. (The airlines do not worry about this in explaining safety precautions!) A related objection by some officials of the Civil Aeronautics Board is that the plan is "too novel."

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A slightly more plausible objection has been that the passengers would conspire to fix a common high price. But the successful operation of a cartel of roughly one hundred persons who have never met before, to be organised in a matter of minutes, runs against all experience and logic.

The most reasonable objection is that the individual bids would be so high that the scheme would not be feasible. It is this objection that is studied here. We shall first see that economic theory runs against it. Then we shall examine empirical evidence that convincingly rules it out as a valid objection to the plan.

THE THEORY

The most general approach to theorising about the size of the bid that a passenger will make is that the bid will be above the value of the passenger's time, but not so much above that he does not expect to win the auction. An auction with a hundred persons bidding would not allow much spread between this floor and this ceiling, so the bid should be not far above the value of a person's time.

Our best estimate of the value of a person's time is that person's earning power for an amount of time equal to the waiting period. Of course a wait for another flight might create indirect additional costs for some people (though it might lead to indirect cost reductions for some). Just how great these additional indirect costs are, in fact, may be indicated by a discrepancy between the simply theory above and the empirical data to follow.

The median wage rate in the United States is roughly $5 to $7 per hour; for a random group of airline passengers it will be somewhat higher. Therefore, our first approximation to the average bid that will be made is $7 per hour. If this is really somewhere near the amount that must be paid to people to keep them happy to wait, the amount is almost absurdly low from the airline's point of view. Yet it is above the value of time estimated in other transport studies (e.g., Gronau [4]).

EMPIRICAL ESTIMATION METHOD

The theory is suggestive, but by itself it is not compelling. Therefore, we also made an empirical investigation. Our method was the hypothetical question. We went to waiting rooms in two airports—a pre-test at Willard in Champaign-Urbana, Illinois, and the main study at O'Hare in Chicago—and distributed questionnaires to casually chosen groups of people. The questionnaires specify a set of hypothetical conditions and ask how much the respondent would write as his or her bid. The question was phrased roughly as follows:

> Dear Air Traveller:
>
> As part of a research project at the University of Illinois, we ask you to participate in a two-minute experiment that could benefit future air travellers.
>
> Assume (hypothetically) that an airline agent just came to you and said: "Because of computer planning, the plane you are scheduled to fly on is

overbooked. There are slightly more than 100 people here in the airport with validated tickets for the 100 seats for your flight. No one will be caused inconvenience, however. Please write down at the bottom of this slip of paper the lowest amount of money you are willing to accept to wait for the next flight, which will be in 4 hours. Then seal the slip in an envelope. The people bidding the lowest amounts will receive the highest amount bid by that group of people, plus a ticket for the next flight. Thank you for your cooperation."

Continue to assume yourself in this situation. What is the lowest amount you would be willing to accept together with a ticket for the next flight? $———.

The hypothetical time to wait for the next flight was variously stated as 2, 4, 6 and 8 hours.

Like all research methods, hypothetical questions have their drawbacks. The most important drawback here is that people's answers may not be similar to their actual behaviour. But this method has been accepted in other economic studies [3], [6], [7], [10], and in this case there would seem to be little reason to suspect that self-interest or other motivations would greatly bias the responses.

RESULTS

The result is straightforward: the bid amounts are incredibly low. The *median* person would be willing to wait for roughly ten dollars per hour of waiting time. And, in the likely situation of only one or two people being overbooked out of a hundred, the relevant bids are *two dollars an hour or less*.

Table 1 shows the raw data, and Figure 1 shows the cumulative percentage distributions by the amount of the bids. The differences between the distributions for 2, 4, 6 and 8 hours are not neat. But this mostly reflects lack of sharp differences, and emphasises that a large proportion of people do not ask for large sums for *any* waiting period.

We also collected data on the purposes of the trips—tourism, business, or other—and the destinations. But none of our analyses showed any relationships important for the purpose at hand.

SUMMARY AND CONCLUSION

Among the passengers ticketed for any airline flight there will always be a good many people who will accept very small sums to wait for the next flight. Ten dollars per hour of waiting time will satisfy half the people, and much less will be asked by the few who are necessary to handle any ordinary overbooking. These people who will be satisfied with small amounts can, however, only be identified by an auction system.

The proposed auction system is fair rather than arbitrary. At a miniscule cost it

will leave all passengers satisfield, and the airlines can operate more efficiently than at present by overbooking more than at present—and paying out smaller sums than the present CAB rules require.

TABLE 1

Two-Hour Waiting Time: Amounts Bid

	People Willing to Wait		
Amount $	*Number*	*%*	*Cumulative %*
0	5	15.15	15.15
1	1	3.03	18.18
5	1	3.03	21.21
10	4	12.12	33.33
20	4	12.12	45.45
25	2	6.06	51.51
30	1	3.03	54.54
44	1	3.03	57.57
45	1	3.03	60.60
50	1	3.03	63.63
53	1	3.03	66.66
60	1	3.03	69.69
100	5	15.15	84.84
150	1	3.03	87.87
400	1	3.03	90.90
500	1	3.03	93.93
1000	1	3.03	96.96
2000	1	3.03	100.00
TOTAL	33		

Four-Hour Waiting Time: Amounts Bid

	People Willing to Wait		
Amount $	*Number*	*%*	*Cumulative %*
0	1	4	4
10	1	4	8
15	1	4	12
20	4	16	28
25	3	12	40
30	1	4	44
35	1	4	48
40	2	8	56
50	3	12	68
86	2	8	76
100	2	8	84
175	1	4	88
200	2	8	96
500	1	4	100
TOTAL	25		

Six-Hour Waiting Time: Amounts Bid

	People Willing to Wait		
Amount $	*Number*	*%*	*Cumulative %*
10	4	17.40	17.40
15	5	12.74	39.14
25	1	4.35	43.49
40	1	4.35	47.84
50	2	8.70	56.54
60	1	4.35	60.89
75	1	4.35	64.24
90	1	4.35	69.59
100	3	13.06	82.63
200	1	4.35	86.98
250	1	4.35	91.33
500	1	4.35	95.68
2000	1	4.35	100.00
TOTAL	23		

Eight-Hour Waiting Time: Amounts Bid

	People Willing to Wait		
Amount $	*Number*	*%*	*Cumulative %*
0	1	4.16	4.16
2.5	1	4.16	8.32
5	1	4.16	12.48
10	1	4.16	16.64
20	1	4.16	20.80
40	1	4.16	24.96
50	3	12.48	37.44
80	1	4.16	41.60
84	1	4.16	45.76
100	6	24.96	70.72
150	1	4.16	74.88
240	1	4.16	79.04
400	2	8.32	87.36
500	2	8.32	95.68
1000	1	4.16	100.00
TOTAL	24		

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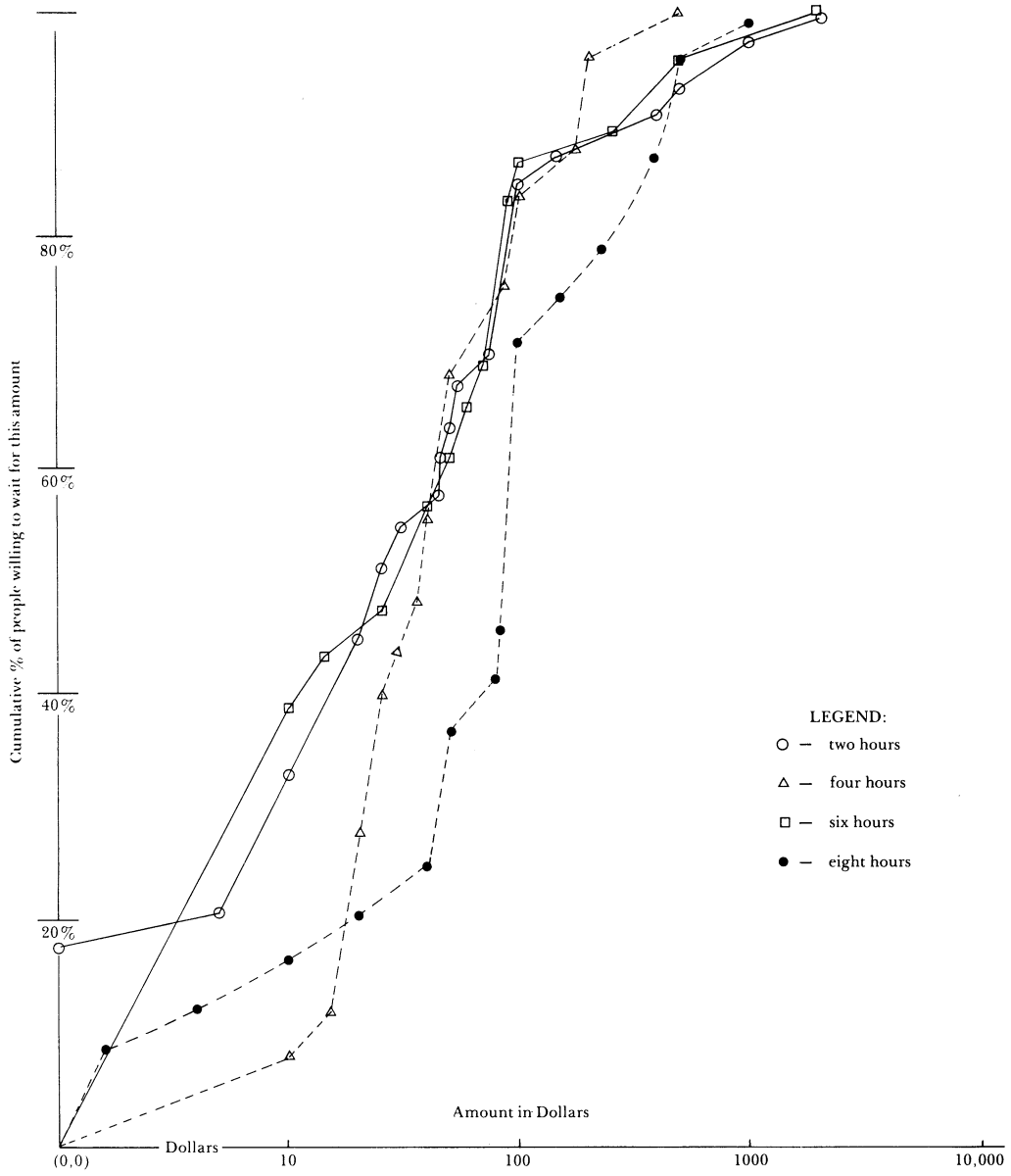
FIGURE 1: Cumulative percentage of people willing to wait for next flight for given amount of money



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