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A Discussion of Minimax

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## COMMUNICATIONS TO THE EDITOR

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### Response to Taylor's "Resolution of a Paradox: Mini-Max Rehabilitated"

This is a response to "Resolution of a Paradox: Mini-Max Rehabilitated," by P. T. Taylor, which appeared in *Management Science* 19 (1972), pp. 466-467, and "Some Further Thoughts on the Minimax Principle," by Morton Davis, which is appearing in this issue of *Management Science*.

Taylor's paper is based on his own misconception concerning the normal form of the game. For example, his recommended strategy is not optimal since it guarantees player I an expected payoff equal to 2 (think of player II moving right), whereas  $(1/8L, 7/8R)$  guarantees player I  $31/2$ . There are other blunders in that short note. By the way, there is no need to rehabilitate the highly important minimax principle.

Davis's paper is much more serious. Our advice in Scene II of the "one act play" would differ from the advice implicitly attributed to us by Davis. It would run as follows: "*The Pro*: Chance has moved to the right and you did not commit yourself to a strategy. To you the situation resembles the matrix described by Davis, but *in addition*, you know that player II perceives a different payoff matrix. This is *not* a zero-sum two-person game in the classical game theoretic sense, and as a result, the maximin theory and the equilibrium theory diverge. Like a lawyer advising a client in a complex and many-sided legal situation, the best I can do here is explain all aspects of the situation. I cannot provide you with any recommendation. You will have to make your decision alone."

We maintain our claim that it makes no sense to base a decision on profits that would have accrued had chance made a certain move, when it is known that chance did not make this move. It is perfectly legitimate, however, to take advantage of the opponent's ignorance, which is the case in the last game in Davis's paper. In that case player I may claim that a wise player II would choose *R*, so player I might prefer to choose *L* and gain one util. This is not the case in our examples, where no such gain is possible.

Davis claims that in a zero-sum two-person game it is difficult to imagine how one can lose by postponing a decision until a later time, when more information is available. Our answer is that though we agree that it sounds difficult at first, we believe that our examples succeed in demonstrating precisely that.

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### A Discussion of Minimax

As long as everyone is quoting me ([1], [2]), I wish to make my position on the minimax principle clear. If I suggested (as, indeed, I did) that an optimal mixed strategy did not offer complete security *after the randomization*, I did not mean to suggest that

the minimax principle was unsound; my desire was to show, by *reductio ad absurdum*, the weakness of the Aumann-Maschler arguments. Unfortunately, my argument was misinterpreted by a logical process which is, of itself, not without interest. In effect, I suggested that, since  $A$  and  $B$  were not compatible,  $B$  should be discarded in favor of the (to my mind) more important  $A$ ; others have, however, taken this to mean that  $A$  is not so important after all.

There is a game-theoretic myth which states that the purpose of mixed strategies is to improve a player's security level. This is purely a myth, as I sought to show by my example. The real purpose of a mixed strategy is to avoid being outguessed by an opponent, who can (presumably) reconstruct any rational thought process, but cannot reconstruct the outcome of a random experiment.

In the game with matrix

$$\begin{pmatrix} 99 & 0 \\ 0 & 1 \end{pmatrix}$$

player II's optimal strategy is (0.01, 0.99). This can be played by putting 1 red and 99 black balls into an urn; if the red ball is drawn, II should use the "risky" first column. At this point, however, II may well object that this is a very dangerous strategy; column two gives him a much higher security level. Thus, if he seeks to be "safe," II will never use the first column. But then I will never use the first row, and so column one is quite safe after all. At this point we have retrogressed to the situation which existed before the development of the theory of games.

My point, then, is that an exaggerated desire for "safety" is not compatible with the original basis of game theory, and that consequently "safety" is not always the best policy. Others may feel instead, that safety is more important and thus discard the original developments. The question will doubtless be long unresolved.

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#### References

1. AUMANN, R. J., AND MASCHLER, M., "Some Thoughts on the Minimax Principle", *Management Science*, 18, No. 5 (1972), pp. P-54-P-63.
2. DAVIS, M., "Some Further Thoughts on the Minimax Principle," *Management Science*, Vol. 20, No. 9, (pp. 1305-1310).

## One Management Science Issue: An Excellent Representation of Ideals

About eight months ago, I read your *Management Science*, February, 1973 issue, and liked it very much because it contained a variety of articles on hospitals, libraries, bloodbanks, research and development, queuing systems, organization structures, promotional decision making, etc. At that time I thought that this was a number that could be used as a sample for promoting membership in TIMS and increasing the Journal's readership. During these past months I have heard several comments from friends and colleagues; all of them seem to consider it a real good number. The general feelings are that this is a group of articles which fully reflects the objectives, the function, the variety of research studies, that should be engaging the attention of Management Scientists/O.R. Analysts. The mixture of topics published in this issue