14
What Next

When you have a decision to take, be it in your private life, your career or business, it usually helps to set down on paper all the possible events that could occur, all possible actions that you could take and what their consequences might be. Edward de Bono recommends an approach of this sort to most of life's problems. This program takes you one stage further. It helps you find your way through the confusing and often contradictory mass offacts and assumptions and arrive at what is likely to be the best course of action.

The program is based on techniques of operational analysis that are applicable to decision-taking. The program is a relatively simple one and therefore has some limitations, as will be explained later. It is not infallible but, in spite of this, can give you useful pointers as to what your next step should be.

It might also be said that, by the time you have sat down and have thought about and listed the possibilities and the courses ofaction open to you, you will have arrived at a deeper understanding of what confronts you. You will be able to proceed to the best decision without having to use the program. If this is the case, the program will have achieved its stated objective!

What the program does

The program supposes that you are in a situation in which one or more of a number of different events (at least two, not more than ten) may occur and that you have a number of courses of action (at least two, not more than ten) available to you. The program will tell you which one or more of your courses of action will give you the best reward in the long run. Note the words 'in the long run'. The program assiimes that this is not just a single once-and-for-all decision, but a decision involving a continuing policy. No program could be expected to tell

you exactly what will happen on a single occasion. The program also assumes that your opponent also has access to the results of running the program and will always act so as to make things a bad as possible for you.

For the first example we will consider the decisions required in playing a simple game. We have chosen a game for this introductory example because a game has rules. The events that may occur and the actions that we may take are both governed by these rules, so that we can have a precise idea of what will happen. The rules also tell us how to work out the scores of the winner and the loser. The game is a traditional one called Two-finger Morra, a game for two players. On the word ' Go'both players raise their hands, showing either one or two fingers. At the same time, each player says ' Gnebr ' Two'trying to guess how many fingers the other player will show. If both players guess correctly, or both guess incorrectly, nothing furtherhappensinthatround.Butifjustoneplayerguessescorrectly, this player wins. The loser pays the winner an amount equal to the total number of fingers shown by both.

Suppose that you are player A and your opponent is player B. What B does is out ofyour control and is referred to as an evenJ . The four possible events are:

B shows 1 finger and guesses 1.
B shows 1 finger and guesses 2.
B shows 2 fingers and guesses 1.
B shows 2 fingers and guesses 2.

These are all the events the rules allow. Since the same rules apply to both players, you are able to do the same four things. Whenj;ou do them they are referred to as actions. The actions are under your control. In the table below we set out all possible events and actions:

	EVENTS (by B)			
	Show 1; guess 1	Show 1; guess 2	Show 2; guess 1	Show 2; guess 2
ACTIONS (by you, A)				
Show 1; guess 1	0	2	-3	0
Show 1; guess 2	-2	0	0	3
Show 2; guess 1	3	0	0	-4
Show 2; guess 2	0	-3	4	0

The cells of the table show what amount B is to pay you at the end of each round. When you both guess correctly or both guess incorrectly, the amount is zero. A positive amount shows that you alone guessed correctly, and won from B. A negative amount shows that B alone guessed correctly, and you lost to B. The amount is each cell is called the payoff, and this is a payoff table.

When we use the program (as explained later) we key in the payoff table. The computer then finds out which action or which combination (or mix) of actions you should use to obtain the maximum payoff. In doing this, the program assumes that B also knows the payoffs and will always act so as to make your payoff as small as possible. B is always out to beat you.

When the table above is keyed in, the program tells us that the best mix of actions for you is to show 1 finger and guess 2 on 57% of occasions and to show 2 fingers and guess 1 on the remaining 42% of occasions (the percentages do not necessarily add up to I 00%). How the computer arrives at this advice cannot be explained in the limited space available here. What the advice means is that, over a game of several rounds, you should always play in one of the two ways suggested. You should adopt one action on 57% of rounds, and the other on the 42% of rounds, but do this in an unpredictable way, of course, so that B cannot tell what you intend to do next.

The program also works out the expected average payoff for each round, supposing that you follow its advice. Disappointingly, the payoff is zero. In a game of many rounds you are likely to finish with as much money in your pocket as you started with. Ifyou have more (or less), it will be simply good (or bad) luck! This is to be expected, for the rules do not favour one player or the other and it is just a guessing game in which both players have equal chances of success.

Now for an example in which the ' rulesare not so clear-cut, and in which they are not exactly the same for both ' players'Suppose you are running a Social Club which meets every Saturday night. Your club has a barbecue, disco equipmeht, a video recorder and a hall with badminton courts. There is one other club (call it Club B) in the same town which has much better disco facilities than your club. It also has a hall with a good selection of gymnastic apparatus and a fully equipped stage. Your club puts on a program during the year, in which each Saturday night is devoted to one type of entertainment, either a barbecue supper, a disco, a video show, or badminton. The other club also has a Saturday night program of either disco, keep fit classes or a drama group. Your aim is to increase the membership ofyour club, and

we will assume that if your club gains members, Club B loses them, or vice versa. We will also assume that most people will join one club or the other and, havingjoined will not readily switch from one to the other and back again — at least, not week-by-week. In other words, you have to organise and advertise a program which will keep your own members happy and induce members of Club B to leave that club and join yours.

To help you plan your program, you draw up a table showing the events (organised by Club B) and the *actions* (organised by you). The payoffs in the table are your estimates of how many members you would expect to gain when two kinds ofentertainment are presented on the same Saturday evening.

	EVENTS (Club B)		
	super disco	keep fit class	drama group
ACTIONS (your club)			
barbecue supper	30	0	-15
disco	-40	10	50
video show	20	-10	40
badminton	-50	25	10

The figure -40, fur example, is your estimate of how many members you would lose when your disco was in competition with the superior disco of Club B. The 40 shows hf)w many members you expect to gain if you put on a video show on the same evening as the drama group. These are your estimates, and the reliability ofthe advice given by the program can be no greater than the reliability of your estimates.

When the payoff table above is fed into the computer the advice it gives is to mix your actions in the following proportions:

barbecue supper	48%
disco	0%
video	23%
badminton	28%

It seems that you should abandon the Disco, and plan your program to include the other three entertainments in the proportions indicated. This will ensure that you obtain the maximum number of memberships from former Club B members. The expected payoff is given as 5, meaning that by adopting this advice you can expect to

increase your membership by 5. Note that the program indicates that you have a definite chance of increasing your membership, presumably because of the greater popularity of the entertainment you offer.

It is possible, though it is not strictly valid, to use the program when your opponent is not another person or organisation but is *b}ind fate' . A good example of' fate is the weather. Suppose you are planning how to spend your weekends, in order to give yourself the maximum happiness. Incidentally, payoffs can be money, members, happiness or anything else that you feel that you can express with a numerical value. The events ofthis example are the weather, which may be warm and sunny, cold and windy, or rainy. Your possible actions are to go to the seaside, to visit a stately home, to visit a leisure park, to go to a cinema, or to stay at home. Here is your payoff table, in which positive payoffs indicate happiness, while negative ones indicate unhappiness.

	EVENTS (fate)		
	Warm and sunny	Cold and windy	Rainy
ACTIONS (you)			
Stay at home	-30	20	10
Seaside	100	-50	-80
Stately home	20	10	5
Leisure park	-30	20	10
Cinema	-50	40	50

It is clear from this table that you are reasonably enthusiastic about stately homes. You love the seaside on a sunny day, but find it awful in bad' weather.The cinema is your first choice for a wet day but, if it is sunny, you do not enjoy it. You would rather have gone to the sea. So what mix of weekend activity is likely to give you the most happiness in the long run? The program gives this advice:

Stately home	86%
Cinema	13%

It gives zero for all others. This is not surprising for the leisure park and for staying at home. You have not rated these high for happiness on average. Although you have rated the seaside very high on a sunny day, you have rated it very low in bad weather. This brings out a point

concerning this program when used with ' fate'as ' p!ayerB' .The program assumes that player B always does its best to make things as bad as possible for you. Many people feel that the weather (or indeed any other aspect offate) is always against them. If this is how you feel, then the program reflects your expectations fairly accurately. Forget about going to the seaside for, ifyou do, the weather is certain to be awful!

The payoff of this table is ! I , so it seems that you are of a relatively happy disposition and, provided that you go to the stately homes six to seven times as often as you go to the cinema you will be reasonably happy most weekends. You seem to enjoy stately homes in any weather, so the computer advises you to spend most ofyour weekends visiting these. H owever, after visiting all the stately homes in the neighbourhood, boredom might offset your happiness. Ifyou then decide to give them ' amiss' for a while, Ieave out ' statelyhome' . You are then recommended to try the seaside (35%) and the cinema (64%). Payoff is 4. This illustrates the point that as time passes you should reassess the payoffs and alter your strategy accordingly.

Using the program

Before you use the program, write out a payoff table like those in the examples given above. There must be between 2 and 10 events (columns) and between 2 and 10 actions (rows). There need not be the same number ofeach. In any table, payoffs must all represent the same thing, such as money, happiness, or time.

When you run the program, the computer first asks how many events there are and how many actions you have available. Next the computer asks you to key in the payoffs. Key these in column by column. If you make a mistake, press ESCAPE, rerun the program and begin again. As soon as the last payoff has been entered, the screen clears. The message ' CALCULATING'appears. A few seconds later the analysis is complete. You will see that either one action or a mixture of actions is recommended. In the latter case, you are told what the ' mix'should be. Actions which are not to be recommended are often eliminated early in the calculation. Ifthis happens, the actions concerned are not mentioned in the display. Actions eliminated at a later stagg in the calculation are listed in the display, but with the percentage ' 0%'If. you are told to mix two or more actions on some occasions you should take one action and on other occasions one of

the others. Over a series of occasions, the actions should be taken at random (do not let B know in advance) with the frequencies indicated by the percentages. The result ofthis strategy is to give you a payoff close to the value displayed.

Keying in

Although it takes the Electron only a few seconds to produce the advice, the calculation is an extremely elaborate one which could take you an hour to perform on paper. Type the program accurately, paying special attention to the N' s, M' s, MM' s, MY' s and so on.

Program design

20-30 Initialisation.
40-130 Inputting payoff table.
140-690 Analysing the table to find if there are single actions to be recommended: deleting actions which are certainly not worth taking under any circumstances.
700-720 Preparing a table for simplex analysis.
730-910 Simplex analysis to determine the best mix ofactions.
920-990 Display of mix of actions.
1000-1020 Display of single best action.

The program

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   10 REM ** WHAT NEXT **
   20 MODE 4
   30 DIM T(22,11),MR(10),MC(10),D(10,10
),DR(10),E(10,10),ER(10)
   40 X=0:CLS:INPUT''"HOW MANY EVENTS? "
M$
   50 M=VAL(M$):IF M<2 OR M>10 THEN 40
   60 INPUT' "HOW MANY ACTIONS? "N$
   70 N=VAL(N$):IF N<2 OR N>10 THEN 60
   80 CLS:PRINT''"ENTER PAYOFFS"
   90 FOR J=1 TO M
  100 PRINT"EVENT";J
  110 FOR K=1 TO N
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  120 PRINT"   ACTION";K;:INPUT" "T(J,K)
  130 NEXT:NEXT
  140 CLS:PRINT'"CALCULATIONS"
  150 FOR K=1 TO N:MR(K)=T(1,K)
  160 FOR L=2 TO M
  170 IF T(L,K)<MR(K) THEN MR(K)=T(L,K)
  180 NEXT:NEXT
  190 MA=MR(1):BA=1
  200 FOR K=2 TO N
  210 IF MR(K)>MA THEN MA=MR(K):BA=K
  220 NEXT
  230 FOR J=1 TO M
  240 MC(J)=T(J,1)
  250 FOR L=2 TO N
  260 IF T(J,L)>MC(J) THEN MC(J)=T(J,L)
  270 NEXT:NEXT
  280 MY=MC(1)
  290 FOR J=2 TO M
  300 IF MC(J)<MY THEN MY=MC(J)
  310 NEXT
  320 IF MA=MY THEN 1000
  330 IF N<3 THEN 490
  340 FOR K=1 TO N
  350 FOR L=1 TO N
  360 FOR J=1 TO M
  370 IF T(J,K)>=T(J,L) THEN 390
  380 D(K,L)=1
  390 NEXT:NEXT:NEXT
  400 FOR K=1 TO N
  410 FOR L=1 TO N
  420 IF D(K,L)=0 AND K<>L THEN DR(L)=1
  430 NEXT:NEXT
  440 K=1:L=1
  450 IF DR(K)=0 THEN DR(L)=K:L=L+1
  460 K=K+1:IF K<N+1 THEN 450
  470 N=N+L-K:FOR K=1 TO N:FOR J=1 TO M:
T(J,K)=T(J,DR(K)):NEXT:NEXT
  480 IF N=1 THEN BA=DR(1):GOTO 1000
  490 IF M<3 THEN 610
  500 FOR J=1 TO M:FOR L=1 TO M:FOR K=1
TO N
  510 IF T(J,K)<=T(L,K) THEN 530
  520 E(J,L)=1
  530 NEXT:NEXT:NEXT
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  540 FOR J=1 TO M
  550 FOR L=1 TO M
  560 IF E(J,L)=0 AND J<>L THEN ER(L)=1
  570 NEXT:NEXT
  580 J=1:L=1
  590 IF ER(J)=0 THEN ER(L)=J:L=L+1
  600 J=J+1:IFJ<M+1 THEN 590
  610 M=M+L-J:FOR J=1 TO M:FOR K=1 TO N:
T(J,K)=T(ER(J),K):NEXT:NEXT
  620 FOR J=M+1 TO M+N:FOR K=1 TO N:T(J,
K)=0:NEXT:NEXT
  630 MM=T(1,1):FOR J=1 TO M:FOR K=1 TO
N:IF T(J,K)<MM THEN MM=T(J,K)
  640 NEXT:NEXT
  650 IF MM>0 THEN MM=0:GOTO 700
  660 MM=1-MM
  670 FOR J=1 TO M:FOR K=1 TO N
  680 T(J,K)=T(J,K)+MM
  690 NEXT:NEXT
  700 T(0,0)=1
  710 FOR J=1 TO M:T(J,0)=-1:NEXT
  720 FOR K=1 TO N:T(M+K,K)=1:T(M+N+1,K)
=1:NEXT
  730 L=0:FOR J=1 TO M+N
  740 IF T(J,0)<L THEN L=T(J,0):C=J
  750 NEXT
  760 IF L=0 THEN GOTO 920
  770 MR=1E10:FOR K=1 TO N
  780 X=T(C,K):B=T(M+N+1,K)
  790 IF X<=0 THEN GOTO 810
  800 TR=B/X:IF TR<MR THEN MR=TR:R=K
  810 NEXT
  820 P=T(C,R):FOR J=1 TO M+N+1
  830 T(J,R)=T(J,R)/P
  840 NEXT
  850 FOR K=0 TO N
  860 F=T(C,K)/T(C,R):IF K=R THEN 900
  870 FOR J=1 TO M+N+1
  880 T(J,K)=T(J,K)-F*T(J,R)
  890 NEXT
  900 NEXT
  910 GOTO 730
  920 CLS:PRINT''"THE BEST BLEND OF ACTI
ONS IS:"
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  930 FOR K=1 TO N
  940 PRINT'"ACTION ";DR(K);":   ";INT(T
(M+K,0)/T(M+N+1,0)*100)"%"
  950 NEXT
  960 PRINT''"EXPECTED PAYOFF IS: ";1/T(
M+N+1,0)-MM
  970 PRINT''''''"<SPACE BAR FOR ANOTHER
 ASSESSMENT>"
  980 IF NOT INKEY(-99) THEN 980
  990  RUN
 1000 CLS:PRINT''"THE BEST ACTION IS: ";
BA
 1010 PRINT''"EXPECTED PAYOFF IS: ";MA
 1020 GOTO 970
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