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This paper describes and documents an improved version of the optimal sortie allocation model (OPTSA) previously presented in IDA Papers P-992 and P-993, published in December 1973. OPTSA is a model for computing allocations of general purpose aircraft to combat air support airbase attack, and intercept missions. The mathematical problem is a two-side, zero-sum, multi-stage game with simultaneous moves at each

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20. continued

stage. The revised OPTSA model includes a substantially improved game-solving procedure and a more detailed simulation of warfare between the opposing sides.

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PAPER P-1111

REVISED OPTSA MODEL

Volume 2: Computer Program Documentation

Lowell Bruce Anderson
Jerome Bracken
Eleanor L. Schwartz

September 1975

INSTITUTE FOR DEFENSE ANALYSES
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PREFACE

This volume is a documentation of the computer program of the revised OPTSA II model. The program is operational on the CDC 6400 at IDA. It occupies about 66,000 octal (equivalent to 28,000 decimal) 60-bit words of core and requires 50 seconds to compile. It contains about 2,500 FORTRAN statements.

The game matrices are dimensioned to hold up to 11 pure strategies per period per side. Wars of up to 90 days can be played, with one, two, or three decision periods.

This volume contains guides to data-deck preparation, variable definitions, a program listing, sample output, and a guide to the various output options available.

Chapter I

PROGRAM FEATURES

A. PROGRAM SEGMENTS OF OPTSA

There are a main program and eight subroutines:

MAIN	Main program; calls CLRCOM, READ, and appropriate "SIMPL" routine, depending on number of periods in war (if one period, SIMPL3(1,1) is called; if two periods, SIMPL2(1,1); if three periods, SIMPL1).
CLRCOM( )	Initializes certain variables in blank COMMON to zero.
READ	Reads and prints input variables.
SIMPL1	First-stage game-solving routine.
SIMPL2(IB,IR)	Second-stage game-solving routine, when first-period strategy pair IB,IR is played.
SIMPL3(JB,JR)	Third-stage game-solving routine, when second-period strategy pair JB,JR is played.
CAM(IDL,IDU)	Performs assessment between days IDL and IDU.
CVFX( )	Performs interpolations for use in CAM.
CAMCLR	Initializes certain variables in CAM to zero.

B. ARITHMETIC STATEMENT FUNCTIONS

In the area fire-attack mode (mode 4), Newton's method is sometimes used to find the optimal proportion Q of ABA passes to attack sheltered aircraft. The use of Newton's method requires two functions corresponding to the first and second derivatives of the function to be optimized. In the program, these are defined as the arithmetic statement functions

```
F14(Q) = A2-A3-ALOG(A4)*A4**Q-A5*ALOG(A6)*A6**Q
```

and

```
F24(Q) = -A3*(ALOG(A4)**2)*A4**Q-A5*(ALOG(A6)**2)*A6**Q ,
```

where ALOG is the natural logarithm.

These function definitions are placed at the beginning of subroutine CAM. The quantities A2, A3, etc., are computed in the program. The same functions are used for the Blue and the Red airbases.

C. COMMON BLOCKS

Blank COMMON (located in all routines except CVFX and CAMCLR) contains all the input variables, plus the following variables (defined in Chapter III of this volume, below):

U(11,11),SUB(11,11,11),SUR(11,11,11) V(11,11),SVB(11,11,11),SVR(11,11,11) W(11,11),SWB(11),SWR(11),VALUE	Payoff matrices, game values, optimal strategies
SHELB(90),SHELR(90) BSHELK(90),RSHELK(90) BDI(3,90),RDI(3,90) BDD(3,90),RDD(3,90) BGF(90),RGF(90) BAI(4,90),RAI(4,90) BAD(4,90),RAD(4,90) BAF(90),RAF(90) BF(90),RF(90) FEBA(90) CBF(90),CRF(90) CBAF(90),CRAF(90)	Used in assessment routine
IDL1,IDUi,IDU2,IDU3	Lower and upper days of decision periods

Common block CAMVAR, which appears in subroutines CAM and CAMCLR contains variables that hold intermediate results on each day of the assessment routine:

SORRB(2,3),SORRR(2,3)
BA(2,3),RA(2,3),BS(2,3),RS(2,3)
BAL(2,3),RAL(2,3),BSL(2,3),RSL(2,3)
BAKAA(2,3),RAKAA(2,3),BSKAA(2,3),RSKAA(2,3)
VBIDRA(2),VBADRI(4),VRIDBA(2),VRADBI(4)
BSENG(2,2),RSENG(2,2)
BPENG(2),RPENG(2)
BSFB(2,3),BAFB(2,3),RSFB(2,3),RAFB(2,3)
BAVUL(4),RAVUL(4),PBABA(2),PRABA(2)
BPOPS(4),BPOPNS(4),RPOPS(4),RPOPNS(4)
VBDRS,VBDRNS,VBKRS,VBKRNS
VRDBS,VRDBNS,VRKBS,VRKBNS

D. PREMATURE STOPS

In addition to the normal ending, there are three ways the program could stop:

(1) A negative payoff entry is generated whose absolute value is greater than variable GVA (the input amount added to each payoff entry to make it positive for game solution). The absolute value is printed out, and termination occurs. (The old version of OPTSA did not have this feature; infinite loops occurred when GVA was too small.) The testing is done in subroutine SIMPL3.

(2) Red attack mode 4 (area fire) is used at the Blue airbase, and Newton's method is used to find the optimal proportion of Red aircraft to attack Blue shelters. If, after 100 iterations of Newton's method, successive approximations are still more than EPS4 (input) amount apart, the program will stop. However, since Newton's method will rarely be needed for the optimization (and, if needed, it should converge very quickly), this premature stop will probably never occur.

(3) Similar to (2) above, but with Blue at attack mode 4 at the Red airbase.

For diagnostic purposes, these stops are labeled 223, 445, and 446, respectively.

Chapter II

INPUT

A. DEFINITIONS OF INPUT VARIABLES

The variables are listed in the order in which they are read (which corresponds closely to the order in which they are used in the program). They are listed alphabetically in Appendix A. The following input variables are used only in the SIMPL routines:

IPRV
IPRU
IR0,JR0,KR0
NB,NR
PB(,)
PR(,)
GVA

The following input variables are used only in subroutine SIMPL3 (the final-stage game):

MOE,MOET
BCWGT,BSWGT(3),BQWGT(2)
RCWGT,RSWGT(3),RQWGT(2)
} Used only for MOEs 4 and 5

The following input variables are used both in subroutine CAM (the assessment routine) and other routines:

PROPB(,)
PROPR(,)
IDL2,IDL3
NID
NPD

All the rest of the input variables are used exclusively in subroutine CAM. An asterisk indicates a discussion of the specified variable(s) in Section B of this chapter (below). A table of lower and upper limits on variables appears in Section C.

Variable Name, Dimension Limits, and Indices[1]	Definition
NKBD	Number of kinds of Blue divisions (up to 3).
NKRD	Number of kinds of Red divisions (up to 3).
*NKBA	Number of kinds of Blue aircraft.
*NKRA	Number of kinds of Red aircraft.
NID	Number of days in war (up to 90).
*NPD	Number of periods in war (up to 3).
*IDL2	First day of second period (if two periods, first day of first period--i.e., day 1).
*IDL3	First day of third period (if two periods, first day of second period).
*IR0	First Red allocation to use in solving first-period games (must not exceed NR).
*JR0	First Red allocation to use in solving second-period games (must not exceed NR).
*KR0	First Red allocation to use in solving third-period games (must not exceed NR).
*IPRV	Indicator for printing second-period game results: 0 - do not print; 1 - print.
*IPRU	Indicator for printing third-period game results.
IREPLB	Indicator for casualty replacement of Blue ground forces: 0 - no Blue ground casualties are to be replaced; 1 - all Blue ground casualties are to be replaced.
IREPLR	Indicator for casualty replacement of Red ground forces.

[1]The indexing variables TY, TYB, and TYR are declared to be integer in the program.

Variable Name, Dimension Limits, and Indices	Definition
BDA(3,90) KBD,ID	Blue divisions added, by kind of Blue division and day (including day 1).
RDA(3,90) KRD,ID	Red divisions added, by kind of Red division and day (including day 1).
BAA(4,90) KBA,ID	Blue aircraft added, by kind of Blue aircraft and day (including day 1).
RAA(4,90) KRA,ID	Red aircraft added, by kind of Red aircraft and day (including day 1).
DBQRA	Desired Blue Quick Reaction Alert aircraft level (number of aircraft).
DRQRA	Desired Red Quick Reaction Alert aircraft level (number of aircraft).
PBSHEL	Starting number of Blue aircraft shelters.
PRSHEL	Starting number of Red aircraft shelters.
FBD(3) KBD	Firepower per Blue division.
FRD(3) KRD	Firepower per Red division.
FBA(2) KBA	Firepower per successful Blue CAS sortie: 1 - by a GP plane on CAS; 2 - by an SP-CAS plane.
FRA(2) KRA	Firepower per successful Red CAS sortie: 1 - by a GP plane on CAS; 2 - by an SP-CAS plane.
*IDBSRC	Day for Blue sortie rates to change.
*IDRSRC	Day for Red sortie rates to change.
SORRB1(2,3) TYB,MSB	Sortie rates for Blue before day IDBSRC, by type of plane: 1 - GP; 2 - SP and by mission: 1 - CAS; 2 - ABA; 3 - INT.
SORRB2(2,3) TYB,MSB	Sortie rates for Blue on and after day IDBSRC, by type of plane: 1 - GP; 2 - SP and by mission: 1 - CAS; 2 - ABA; 3 - INT.

Variable Name, Dimension Limits, and Indices	Definition
SORRR1(2,3) TYR,MSR	Sortie rates for Red before day IDRSRC, by type of plane: 1 - GP; 2 - SP and by mission: 1 - CAS; 2 - ABA; 3 - INT.
SORRR2(2,3) TYR,MSR	Sortie rates for Red on and after day IDRSRC, by type of plane: 1 - GP; 2 - SP and by mission: 1 - CAS; 2 - ABA; 3 - INT.
IAA	Indicator for air-to-air combat mode: 0 - basic method; 1 - method whereby some attackers drop their ordnance, then shoot back at enemy interceptors.
XNBAA	Number of notionalized Blue air-to-air combat regions (on Blue side of FEBA).
XNRAA	Number of notionalized Red air-to-air combat regions (on Red side of FEBA).
*BALPHA(2,2) TYB,MSB	Fraction of Blue attackers that do *not* jettison their ordnance and fly back but continue on, by Blue attacker type: 1 - GP; 2 - SP and by attack mission: 1 - CAS; 2 - ABA.
*RALPHA(2,2) TYR,MSR	Fraction of Red attackers that do *not* jettison their ordnance but continue on, by Red attacker type and mission.
BIDRA(2,4) TYB,INDR	Air-to-air detection parameter for Blue interceptors detecting Red attackers (subscripted as for BIKRA, below).
BIKRA(2,4) TYB,INDR	Air-to-air kill parameter for Blue interceptors: 1 - GP; 2 - SP killing Red attackers: 1 - GP-CAS; 2 - GP-ABA; 3 - SP-CAS; 4 - SP-ABA.
*BADRI(4,2) INDB,TYR	Air-to-air detection parameter for Blue attackers detecting Red interceptors.
BAKRI(4,2) INDB,TYR	Air-to-air kill parameter for Blue attackers: 1 - GP-CAS; 2 - GP-ABA; 3 - SP-CAS; 4 - SP-ABA killing Red interceptors: 1 - GP; 2 - SP.

Variable Name, Dimension Limits, and Indices	Definition
RIDBA(2,4) TYR,INDB	Air-to-air detection parameter--Red interceptors detect Blue attackers.
RIKBA(2,4) TYR,INDB	Air-to-air kill parameter--Red interceptors: 1 - GP; 2 - SP kill Blue attackers: 1 - GP-CAS; 2 - GP-ABA; 3 - SP-CAS; 4 - SP-ABA.
*RADBI(4,2) INDR,TYB	Air-to-air detection parameter--Red attackers detect Blue interceptors.
RAKBI(4,2) INDR,TYB	Air-to-air kill parameter--Red attackers: 1 - CAS; 2 - ABA; 3 - CAS; 4 - ABA kill Blue interceptors: 1 - GP; 2 - SP.
BSAMZR(2,2) TYR,MSR	Proportion of Red attack sorties destroyed by Blue ground-to-air weapons, by type: 1 - GP; 2 - SP and by mission: 1 - CAS; 2 - ABA.
RSAMZB(2,2) TYB,MSB	Proportion of Blue attack sorties, by type and mission, destroyed by Red ground-to-air weapons.
IR3SH	Indicator for Red SP-ABA planes to be sheltered: 0 - *do* shelter them; 1 - do *not* shelter them.
*BFRAC1	Fraction of Blue aircraft on base before sortie rate change.
BFRAC2	Fraction of Blue aircraft on base after sortie rate change.
*RFRAC1	Fraction of Red aircraft on base before sortie rate change.
RFRAC2	Fraction of Red aircraft on base after sortie rate change.
FBSK	Fraction of Blue aircraft shelters hit by Red that are destroyed.
FRSK	Fraction of Red aircraft shelters hit by Blue that are destroyed.
BPASS(2) TYB	Number of passes per Blue ABA sortie by 1 - GP plane on ABA; 2 - SP-ABA plane.
RPASS(2) TYR	Number of passes per Red ABA sortie by 1 - GP plane on ABA; 2 - SP-ABA plane.

Variable Name, Dimension Limits, and Indices	Definition
IBABA	Indicator for Blue ABA attack mode of Red airbases (1, 2, 3, or 4).
IRABA	Indicator for Red ABA attack mode of Blue airbases (1, 2, 3, or 4).
XNBAB	Number of notionalized (identical) Blue airbases.
XNRAB	Number of notionalized (identical) Red airbases.
BPARK	Number of Blue parking areas for aircraft on each Blue airbase.
RPARK	Number of Red parking areas for aircraft on each Red airbase.
BDRS(2) TYB	Parameter for Blue detecting Red shelters: 1 - Blue GP aircraft; 2 - Blue SP-ABA aircraft.
BDRNS(2)	Parameter for Blue detecting Red nonsheltered aircraft: 1 - Blue GP aircraft; 2 - Blue SP-ABA aircraft.
BKRS(2)	Parameter for Blue killing Red shelters: 1 - Blue GP aircraft; 2 - Blue SP-ABA aircraft.
BKRNS(2)	Parameter for Blue killing Red nonsheltered aircraft: 1 - Blue GP aircraft; 2 - Blue SP-ABA aircraft.
RDBS(2) TYR	Parameter for Red detecting Blue shelters: 1 - Red GP aircraft; 2 - Red SP-ABA aircraft.
RDBNS(2)	Parameter for Red detecting Blue nonsheltered aircraft: 1 - Red GP aircraft; 2 - Red SP-ABA aircraft.
RKBS(2)	Parameter for Red killing Blue shelters: 1 - Red GP aircraft; 2 - Red SP-ABA aircraft.
RKBNS(2)	Parameter for Red killing Blue nonsheltered aircraft: 1 - Red GP aircraft; 2 - Red SP-ABA aircraft.

The following 21 variables are used only if ABA mode 4 (area fire) is played (variables beginning with "B" affect events taking place at the Blue airbase (IRABA=4); variables beginning with "R" affect events taking place at the Red airbase (IBABA=4)).

Variable Name, Dimension Limits, and Indices	Definition
B4B	Area (in square meters) of a typical airbase on which Blue aircraft might be located.
B4AL	Overlap factor (between 0 and 1) for Red munitions at the Blue airbase.
B4AN1,B4AN2	Lethal area covered by one pass of a Red general-purpose or special-purpose ABA aircraft (resp.) dropping "anti-nonsheltered" munitions against nonsheltered aircraft.
B4AS1,B4AS2	Lethal areas covered by one pass of a Red general-purpose or special-purpose ABA aircraft (resp.) dropping "anti-shelter" munitions against shelters.
B4NS1,B4NS2	A reduction factor applied to B4AN1 or B4AN2 (resp.) when "anti-nonsheltered" munitions are dropped on shelters.
B4SN1,B4SN2	An expansion (or reduction) factor applied to B4AS1 or B4AS2 (resp.) when "anti-shelter" munitions are dropped on nonsheltered aircraft.
R4B	Area of a typical airbase on which Red aircraft might be located.
R4AL	Overlap factor (between 0 and 1) for Blue munitions at Red airbase.
R4AN1,R4AN2	Lethal area covered by one pass of a Blue general-purpose or special-purpose ABA aircraft (resp.) dropping "anti-nonsheltered" munitions against nonsheltered aircraft.
R4AS1,R4AS2	Lethal area covered by one pass of Blue general-purpose or special-purpose ABA aircraft (resp.) dropping "anti-shelter" munitions against shelters.
R4NS1,R4NS2	A reduction factor applied to R4AN1 or R4AN2 (resp.) when "anti-nonsheltered" munitions are dropped on shelters.
R4SN1,R4SN2	An expansion (or reduction) factor applied to R4AS1 or R4AS2 (resp.) when "anti-shelter" munitions are dropped on nonsheltered aircraft.
EPS4	Convergence criterion for Newton's method used in attack mode 4.
[End of variables for area fire]	
NFRFA	Number (up to 15) of force ratios for FEBA advance.

Variable Name, Dimension Limits, and Indices	Definition
*FRFA(15)	Force ratios for FEBA advance--vector of breakpoint abscissas for interpolation.
*FA(15)	FEBA advance—vector of breakpoint ordinates for interpolation.
NFRBD	Number (up to 15) of force ratios for Blue division destruction.
*FRBD(15)	Force ratio for Blue division destruction--vector of breakpoint abscissas for interpolation.
BD(15)	Proportion of Blue divisions destroyed--vector of breakpoint ordinates for interpolation.
NFRRD	Number (up to 15) of force ratios for Red division destruction.
*FRRD(15)	Force ratios for Red division destruction.
RD(15)	Proportion of Red divisions destroyed.
NB	Number of Blue pure strategies (all pure strategies are available in each period).
NR	Number of Red pure strategies (all pure strategies are available in each period).
*PB(20,3) IBA,MS	Proportion of Blue general-purpose aircraft assigned to mission MS (1 - CAS; 2 - ABA; 3 - INT) by Blue pure strategy IBA; note that $\sum_{MS=1}^{3} PB(IBA,MS) \leq 1.0$, for IBA = 1,NB.
*PR(20,3) IRA,MS	Proportion of Red general-purpose aircraft assigned to mission MS by Red pure strategy IRA.
*MOE	Measure of effectiveness to be optimized: (1) FEBA; (2) firepower difference; (3) air firepower difference; (4) surviving aircraft, weighted by type; (5) generalized air measure, including QRA.
MOET	Day on which MOE is to be found.
The following six variables are used as weights if MOE=4 or 5:	
BCWGT	Weight for cumulative Blue CAS firepower delivered (must be zero if MOE=4).

Variable Name, Dimension Limits, and Indices	Definition
BSWGT(3) MS	Weights for surviving special-purpose aircraft (KBA=2,3,4), by kind of aircraft (1 - SP-CAS; 2 - SP-ABA; 3 - SP-INT).
BQWGT(2)	If MOE=4, BQWGT(1) = weight for surviving Blue general-purpose aircraft; BQWGT(2) is not used. If MOE=5, BQWGT(1) = weight for Blue general-purpose surviving aircraft minus desired Blue QRA; BQWGT(2) is weight for desired-minus-actual Blue QRA.
RCWGT	Weight for cumulative Red CAS firepower delivered (must be zero if MOE=4).
RSWGT(3) MS	Weights for surviving special-purpose Red aircraft, by kind of aircraft.
RQWGT(2)	Weights for Red surviving general-purpose aircraft and/or QRA (analogous to BQWGT(•)).
*GVA	Game value added (i.e., value added to each payoff entry to make it positive for the game-solving procedure).

B. EXPLANATORY NOTES ON THE INPUT VARIABLES

NKBA,NKRA	These input variables would usually be either 1 (general-purpose aircraft only) or 4 (general-purpose and all kinds of special-purpose aircraft).
NPD,IDL2,IDL3	There can be up to three periods. The first and last days of the periods are denoted by the variables IDL1=1, IDU1, IDL2, IDU2, IDL3, and IDU3=NID (resp.). They should be in increasing order. Furthermore, IDU1, the last day of the first period, equals IDL2-1 (one day before the first day of the second period), and IDU2=IDL3-1. From the inputs IDL2 and IDL3, all the other period limits can be found. A two-period war is considered as the last two periods of a three-period war and is marked by the variables IDL2 (which must be input as 1), IDL3 (input), IDU2=IDL3-1, and IDU3=NID. The variables IDL1 and IDU1 are not used. In a one-period war, IDL3 must be input as 1.
IR0,JR0,KR0	These input variables *must not exceed* NR (the input number of Red pure strategies). They can, however, be left blank or input as zero--in which case the first pure stratgey in Red's list will be used as a first guess.

IPRV,IPRU	The various printout options that can be obtained with these variables are explained in Section A of Chapter V (below). In a two-period war, IPRV *must* equal 1 to obtain output. In a one-period war, IPRU must equal 1.
IDBSRC, IDRSRC	These input variables are the *first* days that the new sortie rates will be used.
BALPHA(,),RALPHA(,)	Values for these variables are needed only if IAA = 1.
BADRI(,),RADBI(,)	Values for these variables are needed only if IAA = 0.
BFRAC1,BFRAC2, RFRAC1,RFRAC2	Since these inputs are closely related to the sortie rates, care should be taken in making the inputs compatible with sortie rates.
FRFA( ),FRBD( ),FRRD( )	Abscissa breakpoint vectors should be monotone.
FRFA( )	Only force ratios greater than or equal to 1.0 need be input; inputs less than 1.0 will be ignored. (The FEBA advance function F is forced to be symmetrical in the sense that F(1/x) = -F(x), where x is the force ratio.)
PB(,),PR(,)	Though these vectors are dimensioned to hold up to 20 pure strategies, the game matrix arrays will hold only 11. The sum $\sum_{MS=1}^{3}$ PB(IBA,MS) must not exceed 1.0--and generally should equal 1.0 exactly, for all IBA; similarly for Red. If the sum is less than 1.0, some GP aircraft are not assigned to a mission; they are still vulnerable to enemy ABA.
MOE	If MOE = 4 or 5, a wide variety of different measures can be obtained by varying the 12 input weights (as described in detail in the appendix to Vol. I).
MOET	Usually equal NID (the last day of the war), it should not exceed NID. Even if MOET is less than NID, the running time of the model remains the same (i.e., the running time depends on NID, not MOET).
GVA	This should be large enough to avoid the premature stop; 10,000 or 20,000 is a good range.

C. TABLE OF UPPER AND LOWER LIMITS ON VARIABLES[1]

Variable	Lower Limit	Upper Limit
NKBD,NKRD	1	3
NKBA,NKRA	1	4
NID	1	90
NPD	1	3
IDL2,IDL3	1	
IRO,JRO,KRO	0	NR (input)
IPRV,IPRU	0	1
IREPLB,IREPLR	0	1
BDA(KBD,ID) RDA(KRD,ID)		
BAA(KBA,ID) RAA(KRA,ID)		
DBQRA,DRQRA		
PBSHEL PRSHEL		
FBD(KBD) FRD(KRD)		
FBA( ) FRA( )		
IDBSRC,IDRSRC		
SORRB1(,) SORRB2(,)		
SORRR1(,) SORRR2(,)		
IAA	0	1
XNBAA,XNRAA	1.0	
BALPHA(,)	0.0	1.0
RALPHA(,)	0.0	1.0
BIDRA(,)	0.0	1.0
BIKRA(,)	0.0	1.0
BADRI(,)	0.0	1.0
BAKRI(,)	0.0	1.0
RIDBA(,)	0.0	1.0
RIKBA(,)	0.0	1.0
RADBI(,)	0.0	1.0
RAKBI(,)	0.0	1.0
BSAMZR(,)	0.0	1.0
RSAMZB(,)	0.0	1.0

(continued on next page)

[1]If no lower limit is specified, it is zero.

Limits on dimensioned variables apply to each variable in the array.

These limits merely insure that the program will run (and not, for instance, have to divide by zero); they do not insure reasonable answers.

Variables are listed in the order input to the program, the same order as in Section A of this chapter (above).

Other restrictions on variables are described in Section B of this chapter (above).

Variable	Lower Limit	Upper Limit
IR3SH	0	1
BFRAC1,BFRAC2	0.0	1.0
RFRAC1,RFRAC2	0.0	1.0
FBSK,FRSK	0.0	1.0
BPASS( ) RPASS( )		
IBABA,IRABA	1	4
XNBAB,XNRAB	1.0	
BPARK,RPARK	1.0	
BDRS( ),BDRNS( ), BKRS( ),BKRNS( )	0.0	1.0
RDBS( ),RDBNS( ), RKBS( ),RKBNS( )	0.0	1.0
B4B		
B4AL	0.0	1.0
B4AN1,B4AN2,B4AS1, B4AS2,B4NS1,B4NS2		
B4SN1,B4SN2		
R4B		
R4AL	0.0	1.0
R4AN1,R4AN2,R4AS1, R4AS2,R4NS1,R4NS2		
R4SN1,R4SN2		
EPS4[1]		

Variable	Lower Limit	Upper Limit
NFRFA	1	15
FRFA( )		
FA( )		
NFRBD	1	15
FRBD( )		
BD( )	0.0	1.0
NFRRD	1	15
FRRD( )		
RD( )	0.0	1.0
NB,NR	1	11
PB(,)	0.0	1.0
PR(,)	0.0	1.0
MOE	1	5
MOET	1	90
BCWGT		
BSWGT( )		
BQWGT( )		
RCWGT		
RSWGT( )		
RQWGT( )		
GVA		

[1]EPS4 must be *strictly* greater than zero if mode 4 is used.

D. FACSIMILE OPTSA DATA DECK

On the following three pages appears a typescript facsimile of the data deck for a problem, to illustrate data-deck preparation. Each line of print represents one data card. The variables appearing on that card are listed in order at the left. For each card, there are eight fields, each 10 columns wide. (Real variables are not right-justified in this deck.)

Variable(s)	Data Card Card Column 1 10 20 30 40 50 60 70 80
NKBD,NKRD,NKBA,NKRA	3 3 4 4
NID	30
NPD,IDL2,IDL3	2 1 11
IRO,JRO,KRO	6 1
IPRV,IPRU	1 1
IREPLB,IREPLR	0 0
BDA(KBD,ID)[1]	24. 6.
	6.
	12.
	3.
	10.
	3.
RDA(KRD,ID)[1]	80.
	20.
	40.
	10.
	10.
	2.
BAA(KBA,ID)[1]	1500. 75.
	75.
	300.
	200.
	40.
	200.
RAA(KRA,ID)[1]	2500.

[1]The following sequence of commands is used to read the array BDA(,)—NKBD and NID have already been input:

```
      DO [a] KBD = 1,NKBD
      READ (input track, [b]) (BDA(KBD,ID),ID = 1,NID)
[a] CONTINUE
```

Therefore, NKBD sets of cards (each set containing enough fields for NID inputs) must be prepared. In the example, since NID = 30, four cards (containing 32 fields) are needed in each set. Since NKBD = 3, three sets (or 12 cards in all) are needed to input BDA. The procedures for RDA, BAA, and RAA are similar.

	1	10	20	30	40	50	60	70	80
	300.								
	400.								
	500.								
DBQRA,DRQRA	200.	200.							
PBSHEL	1000.								
PRSHEL	2000.								
FBD(KBD)	10.	8.	6.						
FRD(KRD)	6.	5.	4.						
FBA( )	.1	.15							
FRA( )	.06	.08							
IDBSRC,IDRSRC	5	4							
SORRB1(,)	2.0	2.5	2.5	2.0	3.0	1.5			
SORRB2(,)	1.0	1.5	1.0	0.7	1.0	0.6			
SORRR1(,)	3.0	2.5	2.5	3.0	2.0	2.0			
SORRR2(,)	1.7	1.5	1.5	1.7	1.0	0.8			
IAA		1							
XNBAA,XNRAA	1.0	1.0							
BALPHA(,)	0.8	0.6	0.8	0.6					
RALPHA(,)	0.5	0.4	0.5	0.4					
BIDRA(,)	.001	.001	.001	.001	.0015	.0015	.002	.002	
BIKRA(,)	.3	.3	.3	.3	.5	.5	.5	.5	
BADRI(,)	.001	.001	.001	.001	.001	.001	.001	.001	
BAKRI(,)	.1	.1	.1	.1	.1	.1	.1	.1	
RIDBA(,)	.0005	.0005	.0005	.0005	.001	.001	.001	.001	
RIKBA(,)	.2	.2	.2	.2	.3	.3	.3	.3	
RADBI(,)	.0005	.0005	.0005	.0005	.0005	.0005	.0005	.0005	
RAKBI(,)	.1	.1	.1	.1	.1	.1	.1	.1	
BSAMZR(,)	.05	.10	.05	.10					
RSAMZB(,)	.05	.10	.05	.10					
IR3SH		1							
BFRAC1,BFRAC2	.8	.9							
RFRAC1,RFRAC2	.7	.9							
FBSK,FRSK	1.0	0.5							
BPASS( )	1.0	1.0							
RPASS( )	1.0	1.0							
IBABA,IRABA		1	1						
XNBAB,NXRAB	20.	20.							
BPARK,RPARK	10000.	10000.							
BDRS( ),BDRNS( ),[2]	.01	.01	.02	.02	.4	.4	.6	.6	
BKRS( ),BKRNS( )									
RDBS( ),RDBNS( ),[2]	.01	.01	.02	.02	.2	.2	.3	.3	
RKBS( ),RKBNS( )									
B4B,B4AL,B4AN1,B4AN2,[3]	1000000.	0.0	10000.	20000.	15000.	15000.	0.	0.	
B4AS1,B4AS2,B4NS1,B4NS2									
B4SN1,B4SN2[3]	1.0	1.0							
R4B,R4AL,R4AN1,R4AN2,	1000000.	0.0	10000.	20000.	15000.	15000.	0.	0.	
R4AS1,R4AN1,R4NS1,R4NS2									
R4SN1,R4SN2	1.0	1.0							
EPS4	.0001								

[2]Four two-vectors are read in one statement and are input on one card.

[3]Ten variables for each side must be read for the area fire-attack mode. The first eight go on one card; the last two require a second.

	1	10	20	30	40	50	60	70	80
NFRFA[4]		11							
FRFA( )[4]	.10	.20	.3333	.50	.6667	1.0	1.5	2.0	
	3.0	5.0	10.0						
FA( )	-60.	-40.	-20.	-10.	-2.	0.0	2.0	10.	
	20.	40.	60.						
NFRBD[4]		11							
FRBD( )	.10	.20	.3333	.50	.6667	1.0	1.5	2.0	
	3.0	5.0	10.0						
BD( )	.020	.014	.010	.009	.008	.008	.008	.007	
	.005	.003	.002						
NFRRD[4]		11							
FRRD( )	.10	.20	.3333	.50	.6667	1.0	1.5	2.0	
	3.0	5.0	10.0						
RD( )	.002	.003	.005	.007	.008	.008	.008	.009	
	.010	.014	.020						
NB,NR[5]		6	6						
PB(,)	1.0	0.0	0.0						
	0.5	0.5	0.0						
	0.0	1.0	0.0						
	0.5	0.0	0.5						
	0.0	0.5	0.5						
	0.0	0.0	1.0						
PR(,)	1.0	0.0	0.0						
	0.5	0.5	0.0						
	0.0	1.0	0.0						
	0.5	0.0	0.5						
	0.0	0.5	0.5						
	0.0	0.0	1.0						
MOE,MOET		1	30						
BCWGT	0.0								
BSWGT( )	1.0	1.0	1.0						
BQWGT( )	1.0	0.0							
RCWGT	0.0								
RSWGT( )	0.0	0.0	0.0						
RQWGT( )	0.0	0.0							
GVA	10000.								

[4]The vector FRFA( ) is read in, element by element, up to NFRFA (the first input number). Therefore, a set of cards sufficient to contain NFRFA elements is required. Then the vector FA( ) is read in the same manner. The procedures for FRBD( ) and FRRD( ) are similar.

[5]Each card is pure strategy and contains the allocation proportions to the three missions CAS, ABA, and INT (resp.). There are NB+NR cards: the first NB form Blue's list of pure strategies; the remainder, Red's. The command sequence (NB and NR have been input) is as follows:

```
    DO [a] IBA = 1,NB
    READ (input track, [b]) (PB(IBA,MS),MS=1,3)
[a] CONTINUE

    DO [c] IRA = 1,NR
    READ (input track, [b]) (PR(IRA,MS),MS=1,3)
[c] CONTINUE
```

Chapter III

DEFINITIONS OF INDEXING AND COMPUTED VARIABLES

A. PROGRAM MAIN

Variable	Definition
IDL1	First day of first period of war (always set to 1)
IDU1	Last day of first period (set to IDL2-1; IDL2 is an input).
IDU2	Last day of second period (set to IDL3-1; IDL3 is an input).
IDU3	Last day of third period of war (always set to NID, the number of days in the war).

Note that, in a two-period war, IDL2 and IDU2 are the first and last days of the first period; IDL3 and IDU3, the first and last days of the second period.

B. SUBROUTINE READ

Variable	Definition
IBA	Blue allocation of aircraft to mission (i.e., the IBAth pure strategy in Blue's list).
IRA	Red allocation of aircraft to mission (i.e., the IRAth pure strategy in Red's list).
KAT	Kind of attacker: 1 - GP-CAS; 2 - GP-ABA; 3 - SP-CAS; 4 - SP-ABA.
TYI	Type of interceptor: 1 - GP; 2 - SP (this is declared to be an integer variable).

The following indexing variables (used in subroutines READ and CAM) are defined in the section on CAM: ID, KBA, KBD, KRA, KRD, MS, and TY.

The variables MIT and MOT (the input and output tracks) are assigned the values 5 and 6 (resp.) in the program. MOT also appears in routines SIMPL1, SIMPL2, and SIMPL3, which contain WRITE statements.

C. SUBROUTINE SIMPL1

The three game-solving subroutines (SIMPL1, SIMPL2, and SIMPL3) each follow the same procedure: "raw" payoff entries are generated by CAM and solution of games at following stages. The raw payoff entries are stored in COMMON matrices W for SIMPL1, V for SIMPL2, and U for SIMPL3. GVA is then added to each payoff entry; the results are placed in the simplex tableau matrix AS; and the game is solved as in Chapter 3 of Volume I of this paper. There is a *separate* matrix AS for each subroutine. Along with AS, there is a collection of variables for the LP right-hand side, cost row, pivot coefficient, etc., *for each subroutine*. When the game is solved, the optimal strategies are transferred to the COMMON arrays SWB and SWR (which are vectors) for SIMPL1, SVB and SVR for SIMPL2, and SUB and SUR for SIMPL3. The strategy arrays also hold the Blue and Red pure strategy played in the previous period.

While the game value and strategy arrays in COMMON are dimensioned for 11 entries, the simplex tableau arrays in each subroutine are dimensioned for 20. Thus, if the core space is available and it is desired to play up to 20 pure strategies, only the arrays in COMMON need be redimensioned.

A two-period war is considered as the last two periods of a three-period war. Second-period games are solved by SIMPL3; first-period games, by SIMPL2; one-period war, by SIMPL3.

Variables are listed in alphabetical order. Computed and indexing variables are not separated, as many integer variables are computed and later used as indices. An asterisk preceding a variable indicates storage in blank COMMON.

Variable Name, Dimension Limits, and Indices	Definition
AS(20,40) J , I	Coefficient matrix for LP (linear programming problem) for solving first stage games.
BIG	Largest element in payoff column of first Red pure strategy used.
BS(20) IROW	LP right-hand side.
CS(40) I	LP cost coefficients.
GVAL	Expected outcome (game value) for a relaxed problem plus GVA (i.e., GVAL-GVA is the two-sided optimal value of a relaxed matrix game).
IBACT(20) LB	1, if payoff row LB for Blue has been computed; 0, otherwise.
IBAS(20) IBC	Active Blue strategies in solution of current relaxed problem.
IBASIC(20) IROW	Basic variable in row IROW.
IBAS1	IBASIC(IROW), for a given value of IROW: or IBAS(IBC).
IBC	Counter for determining vector IBAS.
IBIG	Blue pure strategy producing payoff value BIG against first Red pure strategy used.
IENTER	Variable to enter basis in dual simplex method.
INDIC	Working variable used to determine IENTER.
INFEAS	0, if current solution is feasible; 1, if infeasible--used both in dual simplex method and in determining whether solution to current relaxed problem is solution to whole game.
IR	First Red pure strategy to be used (also used for each new Red pure strategy to enter tableau).
IRACT(20) I	1, if payoff column I for Red has been computed; 0, otherwise.

Variable Name, Dimension Limits, and Indices	Definition
IRAS(20) IRC	Red pure strategy corresponding to row IRC of simplex tableau.
IRAS1	IRAS(IRC).
IRC	Counter for determining vector IRAS.
IROW	Row of simplex tableau being processed (in pivoting operations, etc.).
ITCOL	Total number of columns of LP (decision plus slack variables).
JBIG	New Red pure strategy to enter LP as a new constraint.
LB	Blue pure strategy or column of LP being considered.
LEAVE1	Row whose basic variable will leave basis in dual simplex method.
LR	Red pure strategy being considered.
MS	Mission (used for setting first-period allocations).
NBC	Number of Blue pure strategies used with nonzero probability in optimal solution to current relaxed problem.
NBL	NB+NROWM1 (i.e., one less than total number of columns in tableau--NB is an input.)
NPDM1	Number of periods minus 1 (NPD-1).
NPDM2	NPD-2.
NRAS	Number of Red pure strategies being considered in current relaxed problem (essentially the same as NROWS).
NROWM1	NROWS-1.
NROWS	Number of rows of LP being solved.
PIVCO	Value of pivot term.
*PROPB(3,3) MS,1	(Defined in CAM.)

Variable Name, Dimension Limits, and Indices	Definition
*PROPR(3,3) MS,1	(Defined in CAM.)
RATIO	Ratio of cost coefficient to variable in leaving row to determine entering basic variable in dual simplex method.
RENT	Ratio of cost coefficient to variable in leaving row for entering basic variable.
SUM(20) J	Expected outcome of optimal Blue strategy for current relaxed problem against Red pure strategy J--i.e., $\sum_{LB} X(LB)*W(LB,J)$.
*SVB(11,11,11) LB,LR, L	Optimal Blue for second period (i.e., probability of Blue playing pure strategy L in period 2 when Blue and Red have played LB and LR, resp., in period 1).
*SVR(11,11,11) LB,LR, L	Optimal Red strategy for second period (i.e., probability of Red playing pure strategy L in period 2 when Blue and Red have played LB and LR, resp., in period 1).
*SWB(11) L	Optimal Blue strategy for first period (i.e., probability of Blue playing pure strategy I).
*SWR(11) IRAS1	Optimal Red strategy for first period (i.e., probability of Red playing pure strategy IRAS1).
TEST	Variable for determining feasibility of right-hand side in current dual simplex iteration.
*VALUE	Value of game (total three-stage game for three-period war.)
*W(11,11) LB, J	First-stage game-payoff matrix; W(LB,J) is the value of a second-stage game when Blue and Red pure strategies LB and J, (resp.) have been played in the first period (this value gecomes a payoff entry in the first-stage game).
X(20) IBAS1	Blue randomized strategy (vector of probabilities) optimal for current relaxed problem.
XNEC	"Northeast corner"; value of LP at any iteration, appearing at upper right corner of simplex tableau.

D. SUBROUTINE SIMPL2(IB,IR)

Variable Name, Dimension Limits, and Indices	Definition
AS(20,40) J , I	Coefficient matrix for LP for solving second-stage games.
BIG BS(20) IROW CS(40) I GVAL	(As in SIMPL1.)
IB	Blue pure strategy that was used in period 1. Set in the calling program SIMPL1.
IBACT(20) LB IBAS(20) IBC IBASIC(20) IROW IBAS1 IBC IBIG IENTER INDIC INFEAS	(As in SIMPL1.)
IR	Red pure strategy that was used in period 1. Set in the calling program SIMPL1.
IRACT(20) I IRAS(20) IRC IRC IROW ITCOL JBIG	(As in SIMPL1.)
JR	First Red pure strategy to be used; also used for each new Red pure strategy to enter tableau.
LB LEAVE1 LR	(As in SIMPL1.)

Variable Name, Dimension Limits, and Indices	Definition
MS	Mission (used for setting second-period allocations).
NBC NBL NPDM1 NRAS NROWM1 NROWS PIVCO	(As in SIMPL1.)
*PROPB(3,3) MS,2	(Defined in CAM.)
*PROPR(3,3) MS,2	(Defined in CAM.)
RATIO RENT	(As in SIMPL1.)
*SUB(11,11,11) LB,LR, L	Optimal Blue strategy for third period (i.e., probability that Blue plays pure strategy L in period 3 when Blue and Red played LB and LR in period 2 and IB and IR in period 1).
SUM(20) J	(As in SIMPL1.)
*SUR(11,11,11) LB,LR, L	Optimal Red strategy for third period (i.e., probability that Red plays pure strategy L in period 3 when Blue and Red played LB and LR in period 2 and IB and IR in period 1).
*SVB(11,11,11) IB,IR, I	Optimal Blue strategy for second period (i.e., probability that Blue plays pure strategy I in period 2 when Blue and Red played IB and IR (set in SIMPL1) in period 1).
*SVR(11,11,11) IB,IR,IRAS1	Optimal Red strategy for second period (i.e., probability that Red plays pure strategy IRAS1 in period 2 when Blue and Red played IB and IR (set in SIMPL1) in period 1).
TEST	(As in SIMPL1).
*V(11,11) LB, J	Second-stage game payoff matrix; V(LB,J) is the payoff entry when Blue and Red play pure strategies LB and J (resp.) in period 2--having played IB and IR in period 1.
*W(11,11) IB,IR	Value of second-stage game, which becomes a payoff entry in the first-stage game matrix W.

Variable Name, Dimension Limits, and Indices	Definition
X(20) IBAS1 XNEC	(As in SIMPL1.)

E. SUBROUTINE SIMPL3(JB,JR)

The final-stage payoffs found in this subroutine are actual measures of effectiveness from the assessment routine (e.g., FEBA position, cumulative Blue minus Red firepower, etc.).

Variable Name, Dimension Limits, and Indices	Definition
AS(20,40) J , I	Coefficient matrix of LP for solving third-stage games.
BA	"Blue aircraft" (working variable used in computing MOE 5).
*BAD(4,90) KA,MOET *BAI(4,90) KA,MOET	(Defined in CAM.)
BIG BS(20) IROW	(As in SIMPL1.)
*CBAF(90) MOET *CBF(90) MOET *CRAF(90) MOET *CRF(90) MOET	(Defined in CAM.)
CS(40) I	(As in SIMPL1.)
*FEBA(90) MOET	(Defined in CAM.)

Variable Name, Dimension Limits, and Indices	Definition
G	Negative of a negative payoff entry U(I,J), whose absolute value is greater than GVA--i.e., if U(I,J) + GVA < 0, G is set equal to |U(I,J)|, which is greater than GVA, and the program stops.
GVAL	(As in SIMPL1.)
IBACT(20) LB IBAS(20) IBC IBASIC(20) IROW IBAS1 IBC IBIG IENTER INDIC INFEAS IRACT(20) I IRAS(20) IRC IRC IROW ITCOL	(As in SIMPL1.)
JB	Blue pure strategy that was used in period 2 (set in the calling program SIMPL2).
JBIG	(As in SIMPL1.)
JR	Red pure strategy that was used in period 2 (set in the calling program SIMPL2).
KA	Kind of aircraft (indexing variable used in computing MOEs 4 and 5).
KR	First Red pure strategy to be used (also used for each new Red pure strategy to enter tableau).
LB LEAVE1	(As in SIMPL1.)
MS	Mission (used for setting third-period allocations; also equal to KA-1 in computing MOEs 4 and 5).

Variable Name, Dimension Limits, and Indices	Definition
NBC NBL NRAS	(As in SIMPL1.)
NROWM1 NROWS PIVCO	(As in SIMPL1.)
*PROPB(3,3) MS,3 *PROPR(3,3) MS,3	(Defined in CAM.)
RA	"Red aircraft" (working variable used in computing MOE 5).
*RAD(4,90) KA,MOET *RAI(4,90) KA,MOET	(Defined in CAM.)
RATIO RENT	(As in SIMPL1.)
*SUB(11,11,11) JB,JR, I	Optimal Blue strategy for third period (i.e., probability that Blue plays pure strategy I in period 3 when Blue and Red played JB and JR in period 2).
SUM(20) J	(As in SIMPL1.)
SUMOE	Working variable used in computing MOEs 4 and 5.
*SUR(11,11,11) JB,JR,IRAS1	Optimal Red strategy for third period (i.e., probability that Red plays pure strategy IRAS1 in period 3 when Blue and Red played JB and JR in period 2).
TEST	(As in SIMPL1.)
*U(11,11) LB, J	Third-stage game payoff matrix U(LB,J) is the payoff entry when Blue and Red play pure strategies LB and J (resp.) in period 3, having played JB and JR in period 2 (and some pure strategy pair in period 1).
*V(11,11) JB,JR	Value of a third-stage game, which becomes a payoff entry in a second-stage game matrix V.
X(20) IBAS1 XNEC	(As in SIMPL1.)

F. SUBROUTINE CAM(IDL,IDU)

Since in CAM there are many dimensioned variables whose elements are computed in large DO loops, a list of definitions of the most commonly used indexing variables of these loops is given first. The indexing variables are in alphabetical order. TY, TYB, and TYR are declared integer. Then the computed variables are defined *in the order computed in the subroutine.* They are defined alphabetically in Appendix B.

1. Indexing Variables

Variable	Definition
ID	Day of war.
IDM1	Preceding day (ID-1).
INDB	Indicator for Blue attacker in air-to-air interaction: 1 - Blue GP-CAS; 2 - Blue GP-ABA; 3 - Blue SP-CAS; 4 - Blue SP-ABA. Computed as INDB = MSB+2*(TYB-1).
INDR	Indicator for Red attacker in air-to-air interaction: 1 - Red GP-CAS; 2 - Red GP-ABA; 3 - Red SP-CAS; 4 - Red SP-ABA. Computed as INDR = MSR+2*(TYR-1).
IPD	Period of war (also a computed variable).
KBA	Kind of Blue aircraft: 1 - Blue GP; 2 - Blue SP-CAS; 3 - Blue SP-ABA; 4 - Blue SP-INT. Used in air-to-ground interaction and initial and final Blue-aircraft-inventory calculations.
KBD	Kind of Blue division (up to three kinds).
KRA	Kind of Red aircraft: 1 - Red GP; 2 - Red SP-CAS; 3 - Red SP-ABA; 4 - Red SP-INT. Used in air-to-ground interaction and initial and final Red-aircraft-inventory calculations.
KRD	Kind of Red division (up to three kinds).
MS	Aircraft mission: 1 - CAS; 2 - ABA; 3 - INT. Also used to index kind of SP aircraft, by the relation MS=KBA-1 or KRA-1.

Variable	Definition
MSB	Blue aircraft mission: 1 - CAS; 2 - ABA; 3 - INT.
MSR	Red aircraft mission: 1 - CAS: 2 - ABA; 3 - INT.
TY	Type of aircraft: 1 - GP; 2 - SP (without specifying what kind of SP aircraft; the mission is needed to do that.)
TYB	Type of Blue aircraft: 1 - GP; 2 - SP.
TYR	Type of Red aircraft: 1 - GP; 2 - SP.

2. Computed Variables

Variable Name, Dimension Limits, and Indices	Definition
IDL	First day for which assessment is to be computed in that particular call of CAM.
IDU	Last day for which assessment is to be computed in that particular call of CAM.

Forces at Beginning of Day

BDI(3,90) KBD,ID	Blue division inventory at beginning of day ID, by kind of Blue division.
RDI(3,90) KRD,ID	Red division inventory at beginning of day ID, by kind of Red division.
BGF(90) ID	Blue ground firepower delivered on day ID.
RGF(90) ID	Red ground firepower delivered on day ID.
SHELB(90) ID	Number of Blue shelters at beginning of day ID.
SHELR(90) ID	Number of Red shelters at beginning of day ID.

Variable Name, Dimension Limits, and Indices	Definition
BAI(4,90) KBA,ID	Inventory of Blue aircraft at beginning of day ID, by kind of Blue aircraft.
RAI(4,90) KRA,ID	Inventory of Red aircraft at beginning of day ID, by kind of Red aircraft.
ABQRA	Actual number of Blue QRA aircraft (GP aircraft designated as QRA).
BAAS	Blue GP aircraft assignable to missions.
ARQRA	Actual number of Red QRA aircraft (GP aircraft designated as QRA).
RAAS	Red GP aircraft assignable to missions.
IPD	Period of war.
PROPB(3,3) MS,IPD	Proportion of Blue GP aircraft assigned to mission MS in period IPD (in two-period war, IPD is 2 for the first period, 3 for the second).
PROPR(3,3) MS,IPD	Proportion of Red GP aircraft assigned to mission MS in period IPD.
BA(2,3) TY,MS	Blue aircraft on missions, by aircraft type (GP or SP) and mission.
RA(2,3) TY,MS	Red aircraft on missions, by aircraft type and mission.
SUMB,SUMR	Working variables for computing BANAS and RANAS.
BANAS	Blue GP aircraft not assigned to missions.
RANAS	Red GP aircraft not assigned to missions.
SORRB(2,3) TY,MS	Sortie rates for Blue, by aircraft type and mission.
BFRAC	Fraction of Blue aircraft on base.
SORRR(2,3) TY,MS	Sortie rates for Red, by aircraft type and mission.
RFRAC	Fraction of Red aircraft on base.

Variable Name, Dimension Limits, and Indices	Definition
BS(2,3) TY,MS	Blue sorties, by aircraft type and mission.
RS(2,3) TY,MS	Red sorties, by aircraft type and mission.
BANF(2,3) TY,MS	Blue aircraft not flying (i.e., staying on the base)--positive only if the sortie rate is less than 1.0.
RANF(2,3) TY,MS	Red aircraft not flying (i.e., staying on the base)--positive only if the sortie rate is less than 1.0.
Air-to-Air Interaction	
BITS	Blue INT sorties.
BATS	Blue attack sorties (CAS and ABA).
RITS	Red INT sorties.
RATS	Red attack sorties (CAS and ABA).
IBIRA	Check variable (the Blue-interceptor/Red-attacker attritions are zero if either side has zero sorties; IBIRA then is set to 1, and the attrition computation bypassed).
IBARI	Check variable for the Blue-attacker/Red-interceptor interaction.
VBIDRA(2)[1] TYB	Average detection parameter for Blue interceptors, by type, against Red attackers in the air-to-air interaction.
VRADBI(4)[1] INDR	Average detection parameter for Red attackers, by kind of attacker, against Blue interceptors in the air-to-air interaction.
VRIDBA(2)[1] TYR	Average detection parameter for Red interceptors, by type, against Blue attackers in the air-to-air interaction.
VBADRI(4)[1] INDB	Average detection parameter for Blue attackers, by kind of attacker, against Red interceptors in the air-to-air interaction.

[1]All air-to-air detection parameters are averaged over target type and are a function of shooter type.

Variable Name, Dimension Limits, and Indices	Definition
SUM, PROD, X1, X15	Working variables for computing attritions.
RATS1	Red attack sorties per notionalized air-to-air combat region on Blue side of FEBA (RATS1=RATS/XNBAA).
BITS1	Blue intercept sorties per notionalized air-to-air combat region on Blue side of FEBA (BITS1=BITS/XNBAA).
BATS1	Blue attack sorties per notionalized air-to-air combat region on Red side of FEBA (BATS1=BATS/XNRAA).
RITS1	Red intercept sorties per notionalized air-to-air combat region on Red side of FEBA (RITS1=RITS/XNRAA).

The following 10 variables are computed only if the second air-to-air attrition method is used:

PROD1, PROD2, X1, X15, X2, DENOM	Working variables for computing attritions in second method.
BSENG(2,3) TYB,MSB	Blue attack sorties engaged by Red interceptors, by type of Blue aircraft and *attack mission* only: 1 - CAS; 2 - ABA.
RSENG(2,2) TYR,MSR	Red attack sorties engaged by Blue interceptors, by type of Red aircraft and *attack mission* only: 1 - CAS; 2 - ABA.
BPENG(2) TYB	Proportion of Blue intercept sorties engaged that are of type TYB: 1 - GP; 2 - SP.
RPENG(2) TYR	Proportion of Red intercept sorties engaged that are of type TYR.

[End of variables for second attrition method]

BSKAA(2,3) TYB,MSB	Blue sorties killed in the air-to-air interactions, by aircraft type and mission.
RSKAA(2,3) TYR,MSR	Red sorties killed in the air-to-air interactions, by aircraft type and mission.

Variable Name, Dimension Limits, and Indices	Definition
BSFB(2,3) TY,MS	Blue sorties that fly back to Blue airbase and do not attempt to deliver ordnance (BSFB(TY,3)=0; the whole array is zero if the first air-to-air attrition method is used).
RSFB(2,3) TY,MS	Red sorties that fly back to Red airbase and do not attempt to deliver ordnance (RSFB(TY,3)=0; the whole array is zero if the first air-to-air attrition method is used).
SRB	Working variable, equal to the maximum of 1.0 and the appropriate Blue sortie rate.
SRR	Working variable, equal to the maximum of 1.0 and the appropriate Red sortie rate.
BAKAA(2,3) TY,MS	Blue aircraft killed in the air-to-air interaction, by aircraft type and mission.
RAKAA(2,3) TY,MS	Red aircraft killed in the air-to-air interaction, by aircraft type and mission.
BAFB(2,3) TY,MS	Blue aircraft that fly back to Blue airbase, by aircraft type and mission.
RAFB(2,3) TY,MS	Red aircraft that fly back to Red airbase, by aircraft type and mission.
BSL(2,3) TY,MS	Blue sorties lost to enemy SAMs (ground-to-air interaction), by aircraft type and mission.
RSL(2,3) TY,MS	Red sorties lost to enemy SAMs (ground-to-air interaction), by aircraft type and mission.
BAL(2,3) TY,MS	Blue aircraft lost to enemy SAMs (ground-to-air interaction), by aircraft type and mission.
RAL(2,3) TY,MS	Red aircraft lost to enemy SAMs (ground-to-air interaction), by aircraft type and mission.
Air-to-Ground (Airbase Attack) Interaction--Blue Airbases	
BSHEL	Number of Blue shelters (recomputed each day).
BAVUL(4) KBA	Blue aircraft vulnerable to enemy ABA, by kind of Blue aircraft, not including QRA.

Variable Name, Dimension Limits, and Indices	Definition
ABQRAS	Number of sheltered Blue QRA aircraft (QRA are given priority in sheltering).
ABQRAN	Number of nonsheltered Blue QRA aircraft.
BSHEL1	Blue shelters remaining after QRA aircraft are sheltered (zero if ABQRAN > 0.0).
BAVULT	Total Blue aircraft vulnerable to enemy ABA, not including QRA.
BPOPS(4) KBA	Population of sheltered Blue aircraft (i.e., number of aircraft), by kind of Blue aircraft, including QRA.
BPOPNS(4) KBA	Population of nonsheltered Blue aircraft.
BTOTS	Total sheltered Blue aircraft ($= \sum_{KBA}$ BPOPS(KBA)).
BTOTNS	Total nonsheltered Blue aircraft ($= \sum_{KBA}$ BPOPNS(KBA)).
BTOT	Total Blue aircraft vulnerable to ABA (=BTOTS+BTOTNS).
PRABA(2) TYR	Red ABA aircraft passes, by type of ABA aircraft: 1 - GP; 2 - SP.
RATP	Red attack total passes (=PRABA(1) + PRABA(2)).
VRDBS	Average detection parameter for Red against Blue shelters.
VRKBS	Average kill paramater for Red against Blue shelters.
VRDBNS	Average detection parameter for Red against Blue nonsheltered aircraft.
VRKBNS	Average kill parameter for Red against Blue nonsheltered aircraft.
Q	Proportion of Red passes to attack Blue shelters (the remainder attack Blue nonsheltered aircraft)--computed if IRABA=2 or 4.

The following variables are computed only if Red uses area fire (IRABA=4):

Variable Name, Dimension Limits, and Indices	Definition
B4AN	Average area covered by a Red "anti-nonsheltered" munition.
B4AS	Average area covered by a Red "anti-shelter" munition.
B4NS	Average reduction factor when Red "anti-nonsheltered" munitions are used against shelters.
B4SN	Average expansion factor when Red "anti-shelter" munitions are used against nonsheltered aircraft.
NTN	Number of iterations of Newton's method to find optimal Q.

The following working variables are used to hold intermediate results in the attrition calculations:

Red Attack Mode 1: TERMS1, XS, TERMS2, TERMN1, XNS, TERMN2.

Red Attack Mode 2: CS0, CN0, CS1, CS, CN1, CN, C1, Q0, Q, CS2.

Red Attack Mode 3: T, TERM1, TERM2, TERMS, TERMNS.

Red Attack Mode 4: X4N, X4S, X4NS, X4SN, A1N, A2N, A0B, A3, A4, A1S, A2S, A2, A5, A6, X0, X1, Q0, NTN, Q1, Q, TERMS, TERMNS, and the arithmetic statement functions F14(Q) and F24(Q).

The results in all cases are the following:

BAKS	Blue sheltered aircraft destroyed.
BSHELK(90) ID	Blue shelters destroyed on day ID.
BAKNS	Blue nonsheltered aircraft destroyed.

Airbase Attack--Red Airbases

RSHEL	Number of Red shelters (recomputed each day).
RAVUL(4) KBA	Red aircraft vulnerable to enemy ABA, by kind of Red aircraft, not including QRA.
ARQRAS	Number of sheltered Red QRA aircraft.
ARQRAN	Number of nonsheltered Red QRA aircraft.

Variable Name, Dimension Limits, and Indices	Definition
RSHEL1	Number of Red shelters remaining after QRA aircraft are sheltered.
XS	Indicator for sheltering of Red SP-ABA aircraft: 0.0 - do not shelter; 1.0 - shelter (XS=1-IR3SH)--also used later in routine.
RAVULT	Total Red aircraft vulnerable to ABA that can be sheltered, not including QRA.
RPOPS(4) KRA	Population of sheltered Red aircraft, by kind of Red aircraft.
RPOPNS(4) KRA	Population of nonsheltered Red aircraft, by kind of Red aircraft.
RTOTS	Total sheltered Red aircraft ($= \sum_{KRA}$ RPOPS(KRA)).
RTOTNS	Total nonsheltered Red aircraft ($= \sum_{KRA}$ RPOPNS(KRA)).
RTOT	Total Red aircraft vulnerable to ABA (=RTOTS+RTOTNS).
PBABA(2) TYB	Blue ABA aircraft passes by type of ABA aircraft: 1 - GP; 2 - SP.
BATP	Blue attack total passes (=PBABA(1)+PBABA(2)).
VBDRS	Average detection parameter for Blue against Red shelters.
VBKRS	Average kill parameter for Blue against Red shelters.
VBDRNS	Average detection parameter for Blue against Red nonsheltered aircraft.
VBKRNS	Average kill parameter for Blue against Red nonsheltered aircraft.
Q	Proportion of Blue passes to attack Red shelters--computed if IBABA=2 or 4.

The following variables are computed only if Blue uses area fire (IBABA=4):

Variable Name, Dimension Limits, and Indices	Definition
R4AN	Average area covered by a Blue "anti-nonsheltered" munition.
R4AS	Average area covered by a Blue "anti-shelter" munition.
R4NS	Average reduction factor when Blue "anti-nonsheltered" munitions are used against shelters.
R4SN	Average expansion factor when Blue "anti-shelter" munitions are used against nonsheltered aircraft.
NTN	Number of iterations of Newton's method to find optimal Q.

The following working variables are used to hold intermediate results in the attrition calculations:

Blue Attack Mode 1: TERMS1, XS, TERMS2, TERMN1, XNS, TERMN2.

Blue Attack Mode 2: CS0, CN0, CS1, CS, CN1, CN, C1, Q0, Q, CS2.

Blue Attack Mode 3: T, TERM1, TERM2, XS, XNS, TERMS, TERMNS.

Blue Attack Mode 4: X4N, X4SN, X4NS, X4S, A1N, A2N, A0B, A3, A4, A1S, A2S, A2, A5, A6, X0, X1, Q0, NTN, Q1, Q, TERMS, TERMNS, and the arithmetic statement functions F14(Q) and F24(Q).

The results in all cases are the following:

RAKS	Red sheltered aircraft destroyed.
RSHELK(90) ID	Red shelters destroyed on day ID.
RAKNS	Red nonsheltered aircraft destroyed.

Aircraft Destroyed and Final Measures for Day

XS	Proportion of sheltered aircraft killed in the ABA interaction--used for apportioning destroyed aircraft by kind of aircraft (redefined for Red).
XNS	Proportion of nonsheltered aircraft killed in the ABA interaction--used for apportioning destroyed aircraft by kind of aircraft (redefined for Red).

Variable Name, Dimension Limits, and Indices	Definition
BAD(4,90) KBA,ID	Blue aircraft destroyed on day ID, by kind of Blue aircraft.
RAD(4,90) KRA,ID	Red aircraft destroyed on day ID, by kind of Red aircraft.
BAF(90) ID	Blue air firepower (i.e., successful CAS firepower) delivered on day ID.
RAF(90) ID	Red air firepower delivered on day ID.
BF(90) ID	Blue total firepower (ground plus successful CAS) delivered on day ID.
RF(90) ID	Red total firepower delivered on day ID.
FRBR	Force ratio of Blue to Red firepower.
FRRB	Force ratio of Red to Blue firepower (=1/FRBR).
DFEBA	FEBA advance.
DFOBA	Negative of FEBA advance.
FEBA(90) ID	FEBA position at end of day ID.
PBDID	Percept Blue divisions destroyed.
BDD(3,90) KBD,ID	Blue divisions destroyed on day ID, by kind of Blue division.
PRDID	Percent Red divisions destroyed.
RDD(3,90) KRD,ID	Red divisions destroyed on day ID, by kind of Red division
CBF(90) ID	Cumulative Blue ground plus CAS firepower delivered to date.
CRF(90) ID	Cumulative Red ground plus CAS firepower delivered to date.
CBAF(90) ID	Cumulative Blue CAS firepower delivered to date.

Variable Name, Dimension Limits, and Indices	Definition
CRAF(90) ID	Cumulative Red CAS firepower delivered to date.

Chapter IV

PROGRAM LISTING

A. PROGRAM MAIN

```
      PROGRAM MAIN(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)                MAIN    00002
C     OPTSA II                                                           MAIN    00003
CDUPBEG                                                                  MAIN    00004
      COMMON NKBD,NKRD,NKBA,NKRA                                         MAIN    00005
      COMMON NID                                                         MAIN    00006
      COMMON NPD,IDL1,IDU1,IDL2,IDU2,IDL3,IDU3                           MAIN    00007
      COMMON IRO,JRO,KRO                                                 MAIN    00008
      COMMON IPRV,IPRU                                                   MAIN    00009
      COMMON IREPLB,IREPLR                                               MAIN    00010
      COMMON BDA(3,90),RDA(3,90)                                         MAIN    00011
      COMMON BAA(4,90),RAA(4,90)                                         MAIN    00012
      COMMON DBORA,DRORA                                                 MAIN    00013
      COMMON SHELB(90),SHELR(90),PHSHEL,PHSHEL                           MAIN    00014
      COMMON BSHELK(90),RSHELK(90)                                       MAIN    00015
      COMMON FBD(3),FRD(3),FBA(2),FRA(2)                                 MAIN    00016
      COMMON IDRSRC,IDRSRC                                               MAIN    00017
      COMMON SORRB1(2,3),SORRB2(2,3),SORRR1(2,3),SORRR2(2,3)             MAIN    00018
      COMMON IAA ,XNBAA,XNRAA,BALPHA(2,2),RALPHA(2,2)                    MAIN    00019
      COMMON BIDRA(2,4),BADRI(4,2),RIDRA(2,4),RADBI(4,2)                 MAIN    00020
      COMMON BIKRA(2,4),BAKRI(4,2),RIKRA(2,4),RAKBI(4,2)                 MAIN    00021
      COMMON BSAMZR(2,2),RSAMZB(2,2)                                     MAIN    00022
      COMMON IRESH,BFRAC1,BFRAC2,RFRAC1,RFRAC2,FBSK,FRSK                 MAIN    00023
      COMMON BPASS(2),RPASS(2)                                           MAIN    00024
      COMMON IBARA,IRABA,XNBAR,XNRAB,BPARK,RPARK                         MAIN    00025
      COMMON BDRS(2),BDRNS(2),BKRS(2),BKRNS(2)                           MAIN    00026
      COMMON RDBS(2),RDBNS(2),RKBS(2),RKBNS(2)                           MAIN    00027
      COMMON   B4B,B4AL,B4AN1,B4AN2,B4AS1,B4AS2,B4NS1,B4NS2,B4SN1,B4SN2  MAIN    00028
      COMMON   R4B,R4AL,R4AN1,R4AN2,R4AS1,R4AS2,R4NS1,R4NS2,R4SN1,R4SN2  MAIN    00029
      COMMON EPS4                                                        MAIN    00030
      COMMON NFRFA,FRFA(15),FA(15)                                       MAIN    00031
      COMMON NFRBD,FRBD(15),BD(15)                                       MAIN    00032
      COMMON NFRRD,FRRD(15),RD(15)                                       MAIN    00033
      COMMON NB,NR                                                       MAIN    00034
      COMMON PB(20,3),PR(20,3)                                           MAIN    00035
      COMMON PROPB(3,3),PROPR(3,3)                                       MAIN    00036
      COMMON MOE,MOET                                                    MAIN    00037
      COMMON RCWGT,BSWGT(3),BQWGT(2),RCWGT,RSWGT(3),RQWGT(2)             MAIN    00038
      COMMON GVA                                                         MAIN    00039
C                                                                        MAIN    00040
      COMMON U(11,11),SUB(11,11,11),SUR(11,11,11)                        MAIN    00041
      COMMON V(11,11),SVB(11,11,11),SVR(11,11,11)                        MAIN    00042
      COMMON W(11,11),SWB(11),SWR(11),VALUE                              MAIN    00043
C                                                                        MAIN    00044
      COMMON BDI(3,90),RDI(3,90)                                         MAIN    00045
      COMMON BDD(3,90),RDD(3,90)                                         MAIN    00046
      COMMON BGF(90), RGF(90)                                            MAIN    00047
      COMMON BAI(4,90),RAI(4,90)                                         MAIN    00048
      COMMON BAD(4,90),RAD(4,90)                                         MAIN    00049
      COMMON BAF(90), RAF(90)                                            MAIN    00050
      COMMON BF(90), RF(90)                                              MAIN    00051
      COMMON FERA(90)                                                    MAIN    00052
      COMMON CBF(90),CRF(90)                                             MAIN    00053
      COMMON CBAF(90),CRAF(90)                                           MAIN    00054
C                                                                        MAIN    00055
CDUPEND                                                                  MAIN    00056
      CALL CLRCOM(1,1,90)                                                MAIN    00057
      CALL READ                                                          MAIN    00058
```

```
      IDL1=1                                                            MAIN    00059
      IDU1=IDL2-1                                                       MAIN    00060
      IDU2= IDL3-1                                                      MAIN    00061
      IDU3=NIO                                                          MAIN    00062
C                                                                       MAIN    00063
C     ITERATION LOOP CAN GO HERE                                        MAIN    00064
C                                                                       MAIN    00065
      CALL CLRCOM(2,1,90)                                               MAIN    00066
      IF(NPD .EQ. 1) CALL SIMPL3(1,1)                                   MAIN    00067
      IF(NPD .EQ. 2) CALL SIMPL2(1,1)                                   MAIN    00068
      IF(NPD .EQ. 3) CALL SIMPL1                                        MAIN    00069
C                                                                       MAIN    00070
C     ITERATION LOOP CAN GO HERE                                        MAIN    00071
C                                                                       MAIN    00072
C                                                                       MAIN    00073
 9999 CONTINUE                                                          MAIN    00074
      END                                                               MAIN    00075
```

B. SUBROUTINE CLRCOM

```
      SUBROUTINE CLRCOM(ICL,IDL,IDU)                                    CLRCOM  00002
CDUPDUIM
      COMMON NKRD,NKRD,NKBA,NKRA                                        MAIN
      COMMON NID                                                        MAIN
      COMMON NPD,IDL1,IDU1,IDL2,IDU2,IDL3,IDU3                          MAIN
      COMMON IR0,JR0,KR0                                                MAIN
      COMMON IPRV,IPRU                                                  MAIN
      COMMON IREPLB,IREPLR                                              MAIN
      COMMON BDA(3,90),RDA(3,90)                                        MAIN
      COMMON BAA(4,90),RAA(4,90)                                        MAIN
      COMMON DBQRA,DRQRA                                                MAIN
      COMMON SHELB(90),SHELR(90),PRSHEL,PRSHEL                          MAIN
      COMMON BSHELK(90),RSHELK(90)                                      MAIN
      COMMON FBD(3),FRD(3),FBA(2),FRA(2)                                MAIN
      COMMON IDRSRC,IDRSRC                                              MAIN
      COMMON SORRB1(2,3),SORRB2(2,3),SORRR1(2,3),SORRR2(2,3)            MAIN
      COMMON IAA ,XNBAA,XNRAA,BALPHA(2,2),RALPHA(2,2)                   MAIN
      COMMON BIDRA(2,4),BADRI(4,2),RIDBA(2,4),RADBI(4,2)                MAIN
      COMMON BIKRA(2,4),BAKRI(4,2),RIKBA(2,4),RAKBI(4,2)                MAIN
      COMMON BSAMZR(2,2),RSAMZB(2,2)                                    MAIN
      COMMON IR3SH,BFRAC1,BFRAC2,RFRAC1,RFRAC2,FBSK,FRSK                MAIN
      COMMON BPASS(2),RPASS(2)                                          MAIN
      COMMON IBABA,IRABA,XNBAR,XNRAR,BPARK,RPARK                        MAIN
      COMMON BDRS(2),BDRNS(2),BKRS(2),BKRNS(2)                          MAIN
      COMMON RDBS(2),RDBNS(2),RKBS(2),RKBNS(2)                          MAIN
      COMMON   R4B,B4AL,B4AN1,B4AN2,B4AS1,R4AS2,R4NS1,B4NS2,B4SN1,B4SN2 MAIN
      COMMON   R4B,R4AL,R4AN1,R4AN2,R4AS1,R4AS2,R4NS1,R4NS2,R4SN1,R4SN2 MAIN
      COMMON EPS4                                                       MAIN
      COMMON NFRFA,FRFA(15),FA(15)                                      MAIN
      COMMON NFRBD,FRBD(15),BD(15)                                      MAIN
      COMMON NFRRD,FRRD(15),RD(15)                                      MAIN
      COMMON N8,NR                                                      MAIN
      COMMON PB(20,3),PR(20,3)                                          MAIN
      COMMON PROPB(3,3),PROPR(3,3)                                      MAIN
      COMMON MOE,MOET                                                   MAIN
      COMMON BCWGT,BSWGT(3),BQWGT(2),RCWGT,RSWGT(3),RQWGT(2)            MAIN
      COMMON GVA                                                        MAIN
C                                                                       MAIN
      COMMON U(11,11),SUB(11,11,11),SUR(11,11,11)                       MAIN
      COMMON V(11,11),SVB(11,11,11),SVR(11,11,11)                       MAIN
      COMMON W(11,11),SWB(11),SWR(11),VALUE                             MAIN
C                                                                       MAIN
      COMMON BDI(3,90),RDI(3,90)                                        MAIN
      COMMON BDD(3,90),RDD(3,90)                                        MAIN
      COMMON BGF(90), RGF(90)                                           MAIN
      COMMON BAI(4,90),RAI(4,90)                                        MAIN
      COMMON BAD(4,90),RAD(4,90)                                        MAIN
      COMMON BAF(90), RAF(90)                                           MAIN
      COMMON BF(90), RF(90)                                             MAIN
      COMMON FERA(90)                                                   MAIN
      COMMON CBF(90),CRF(90)                                            MAIN
      COMMON CBAF(90),CRAF(90)                                          MAIN
C                                                                       MAIN
CDUPDUIM                                                                CLRCOM  00003
      IF(ICL .GT. 1) GO TO 5                                            CLRCOM  00004
      DO 100 I=1,90                                                     CLRCOM  00005
      DO 101  J=1,3                                                     CLRCOM  00006
```

```
      BDA(J,I)=RDA(J,I)=RAA(J,I)=RAA(J,I)= 0.0                          CLRCOM  00007
101   CONTINUE                                                          CLRCOM  00008
      BAA(4,I) =RAA(4,I) =0.0                                           CLRCOM  00009
100   CONTINUE                                                          CLRCOM  00010
      DO 102  J=1,3                                                     CLRCOM  00011
      FBD(J)=FRD(J)=0.0                                                 CLRCOM  00012
      DO 103  K=1,20                                                    CLRCOM  00013
      PB(K,J)=PR(K,J)=0.0                                               CLRCOM  00014
103   CONTINUE                                                          CLRCOM  00015
102   CONTINUE                                                          CLRCOM  00016
      DO 104  I=1,15                                                    CLRCOM  00017
      FRFA(I)=FA(I)=FRBD(I)=RD(I)=FRRD(I)=RD(I)=0.0                     CLRCOM  00018
104   CONTINUE                                                          CLRCOM  00019
      DO 105 K=1,2                                                      CLRCOM  00020
      BPASS(K)=RPASS(K)=FBA(K)=FRA(K)=0.0                               CLRCOM  00021
      RSAMZR(K,1)=RSAMZR(K,2)=0.0                                       CLRCOM  00022
      RSAMZB(K,1)=RSAMZB(K,2)=0.0                                       CLRCOM  00023
      DO 106  L=1,3                                                     CLRCOM  00024
      SORRB1(K,L)=SORRB2(K,L)=SORRR1(K,L)=SORRR2(K,L)=0.0               CLRCOM  00025
106   CONTINUE                                                          CLRCOM  00026
105   CONTINUE                                                          CLRCOM  00027
  5    CONTINUE                                                         CLRCOM  00028
      IF(ICL .GT. 2) GO TO 6                                            CLRCOM  00029
      DO 202  J=1,3                                                     CLRCOM  00030
      DO 203  I=1,3                                                     CLRCOM  00031
      PROPR(I,J) = PROPR(I,J) = 0.0                                     CLRCOM  00032
203   CONTINUE                                                          CLRCOM  00033
202   CONTINUE                                                          CLRCOM  00034
  6   CONTINUE                                                          CLRCOM  00035
      DO 300  I=IDL,IDU                                                 CLRCOM  00036
      DO 301  J=1,3                                                     CLRCOM  00037
      BDI(J,I)=BAI(J,I)=BDI(J,I) = RAI(J,I) = 0.0                       CLRCOM  00038
      BDD(J,I)=BAD(J,I)=BDD(J,I) = RAD(J,I) = 0.0                       CLRCOM  00039
301   CONTINUE                                                          CLRCOM  00040
      BAD(4,I) = RAI(4,I) = RAD(4,I) = RAI(4,I) = 0.0                   CLRCOM  00041
      BGF(I) =BAF(I)=RF(I)=CRF(I)=CBAF(I)=0.0                           CLRCOM  00042
      RGF(I) =RAF(I)=RF(I)=CRF(I)=CRAF(I)=0.0                           CLRCOM  00043
      SHELR(I)=SHELR(I)= 0.0                                            CLRCOM  00044
      BSHELR(I)=RSHELR(I)= .0                                           CLRCOM  00045
      FEBA(I)=0.0                                                       CLRCOM  00046
300   CONTINUE                                                          CLRCOM  00047
      RETURN                                                            CLRCOM  00048
      END                                                               CLRCOM  00049
```

C. SUBROUTINE READ

```
      SUBROUTINE READ                                                   READ    00002
C     OPTSA II                                                          READ    00003
CDUBDIM
      COMMON NKRD,NKRU,NKBA,NKRA                                        MAIN
      COMMON NID                                                        MAIN
      COMMON NPD,IDL1,IDU1,IDL2,IDU2,IDL3,IDU3                          MAIN
      COMMON IRD,JRD,KRD                                                MAIN
      COMMON IPRV,IPRU                                                  MAIN
      COMMON IREPLB,IREPLR                                              MAIN
      COMMON BDA(3,90),RDA(3,90)                                        MAIN
      COMMON BAA(4,90),RAA(4,90)                                        MAIN
      COMMON DBDRA,DRDRA                                                MAIN
      COMMON SHELB(90),SHELR(90),PRSHEL,PRSHEL                          MAIN
      COMMON BSHELK(90),RSHELK(90)                                      MAIN
      COMMON FBD(3),FRD(3),FBA(2),FRA(2)                                MAIN
      COMMON IDBSRC,IDRSRC                                              MAIN
      COMMON SORRB1(2,3),SORRB2(2,3),SORRR1(2,3),SORRR2(2,3)            MAIN
      COMMON IAA ,XNBAA,XNRAA,BALPHA(2,2),RALPHA(2,2)                   MAIN
      COMMON BIDBA(2,4),BADBI(4,2),RIDBA(2,4),RADBI(4,2)                MAIN
      COMMON BIKBA(2,4),BAKBI(4,2),RIKBA(2,4),RAKBI(4,2)                MAIN
      COMMON BSAMZB(2,2),RSAMZB(2,2)                                    MAIN
      COMMON IRBSH,BFBAC1,BFBAC2,RFBAC1,RFBAC2,FBSK,FRSK                MAIN
      COMMON BPASS(2),RPASS(2)                                          MAIN
      COMMON IBABA,IRABA,XNBAB,XNRAB,BPARK,RPARK                        MAIN
      COMMON BDBS(2),BDBNS(2),BKBS(2),BKBNS(2)                          MAIN
      COMMON RDBS(2),RDBNS(2),RKBS(2),RKBNS(2)                          MAIN
      COMMON   B4B,B4AL,B4AN1,B4AN2,B4AS1,B4AS2,B4NS1,B4NS2,B4SN1,B4SN2 MAIN
      COMMON   R4B,R4AL,R4AN1,R4AN2,R4AS1,R4AS2,R4NS1,R4NS2,R4SN1,R4SN2 MAIN
      COMMON EPS4                                                       MAIN
      COMMON NFBFA,FBFA(15),FA(15)                                      MAIN
      COMMON NFBBD,FBBD(15),BD(15)                                      MAIN
      COMMON NFBRD,FBRD(15),RD(15)                                      MAIN
      COMMON NB,NR                                                      MAIN
      COMMON PB(20,3),PR(20,3)                                          MAIN
      COMMON PROPB(3,3),PROPR(3,3)                                      MAIN
      COMMON MOE,MOET                                                   MAIN
      COMMON BCWGT,BSWGT(3),BQWGT(2),RCWGT,RSWGT(3),RQWGT(2)            MAIN
      COMMON GVA                                                        MAIN
C                                                                       MAIN
      COMMON U(11,11),SUB(11,11,11),SUR(11,11,11)                       MAIN
      COMMON V(11,11),SVB(11,11,11),SVR(11,11,11)                       MAIN
      COMMON W(11,11),SWB(11),SWR(11),VALUE                             MAIN
C                                                                       MAIN
      COMMON BDT(3,90),RDI(3,90)                                        MAIN
      COMMON BDD(3,90),RDD(3,90)                                        MAIN
      COMMON BGF(90), RGF(90)                                           MAIN
      COMMON BAI(4,90),RAI(4,90)                                        MAIN
      COMMON BAD(4,90),RAD(4,90)                                        MAIN
      COMMON BAF(90), RAF(90)                                           MAIN
      COMMON BF(90), RF(90)                                             MAIN
      COMMON FEBA(90)                                                   MAIN
      COMMON CBF(90),CRF(90)                                            MAIN
      COMMON CBAF(90),CRAF(90)                                          MAIN
C                                                                       MAIN
CDUBDIM                                                                 READ    00004
      INTEGER TY,TYI                                                    READ    00005
   10 FORMAT(8I10)                                                      READ    00006
```

```
   20 FORMAT(8F10.0)                                                    READ    00007
   21 FORMAT(8F10.1)                                                    READ    00008
   22 FORMAT(8F10.2)                                                    READ    00009
   23 FORMAT(8F10.3)                                                    READ    00010
   25 FORMAT(8F10.5)                                                    READ    00011
  301 FORMAT(1H ,4F10.5)                                                READ    00012
  302 FORMAT(1H ,2F10.5)                                                READ    00013
  303 FORMAT(1H ,3F10.4)                                                READ    00014
  304 FORMAT(1H ,2F10.4)                                                READ    00015
C                                                                       READ    00016
C                                                                       READ    00017
C --- TAPES                                                             READ    00018
C                                                                       READ    00019
      MIT = 5                                                           READ    00020
      MOT = 6                                                           READ    00021
C                                                                       READ    00022
C --- CAMPAIGN DESCRIPTION                                              READ    00023
C                                                                       READ    00024
      WRITE(MOT,1010)                                                   READ    00025
 1010 FORMAT (21H1 NKBD,NKRD,NKBA,NKRA)                                 READ    00026
      READ (MIT,10) NKBD,NKRD,NKBA,NKRA                                 READ    00027
      WRITE(MOT,10) NKBD,NKRD,NKBA,NKRA                                 READ    00028
C                                                                       READ    00029
      WRITE(MOT,1020)                                                   READ    00030
 1020 FORMAT ( 5H0 NID)                                                 READ    00031
      READ( MIT,10) NID                                                 READ    00032
      WRITE(MOT,10) NID                                                 READ    00033
C                                                                       READ    00034
      READ(MIT, 10)  NPD,IDL2,IDL3                                      READ    00035
      WRITE(MOT,1030)                                                   READ    00036
 1030 FORMAT(1H0,13HNPD,IDL2,IDL3                                       )READ    00037
      WRITE(MOT, 10)  NPD,IDL2,IDL3                                     READ    00038
C                                                                       READ    00039
      READ(MIT, 10)  IR0,JR0,KR0                                        READ    00040
      WRITE(MOT,1040)                                                   READ    00041
 1040 FORMAT(1H0,11HIR0,JR0,KR0                                         )READ    00042
      WRITE(MOT, 10)  IR0,JR0,KR0                                       READ    00043
C                                                                       READ    00044
      READ(MIT, 10)  IPRV,IPRU                                          READ    00045
      WRITE(MOT,1060)                                                   READ    00046
 1060 FORMAT(1H0, 9HIPRV,IPRU                                           )READ    00047
      WRITE(MOT, 10)  IPRV,IPRU                                         READ    00048
C                                                                       READ    00049
      READ(MIT, 10)  IREPLB,IREPLR                                      READ    00050
      WRITE(MOT,1070)                                                   READ    00051
 1070 FORMAT(1H0,13HIREPLB,IREPLR )                                     READ    00052
      WRITE(MOT, 10)  IREPLB,IREPLR                                     READ    00053
C                                                                       READ    00054
C --- FORCES                                                            READ    00055
C                                                                       READ    00056
      WRITE(MOT,2010)                                                   READ    00057
 2010 FORMAT (13H1 BDA(KBD,ID))                                         READ    00058
      DO 210 KBD=1,NKBD                                                 READ    00059
      READ (MIT,21) (BDA(KBD,ID),ID=1,NID)                              READ    00060
  210 WRITE(MOT,21) (BDA(KBD,ID),ID=1,NID)                              READ    00061
C                                                                       READ    00062
      WRITE(MOT,2020)                                                   READ    00063
 2020 FORMAT (13H0 RDA(KRD,ID))                                         READ    00064
```

```
      DO 220 KRD=1,NKRD                                                 READ  00065
      READ (MIT,21) (RDA(KRD,ID),ID=1,NID)                              READ  00066
  220 WRITE(MOT,21) (RDA(KRD,ID),ID=1,NID)                              READ  00067
C                                                                       READ  00068
      WRITE(MOT,2030)                                                   READ  00069
 2030 FORMAT( 13H0 BAA(KBA,ID))                                         READ  00070
      DO 230 KBA=1,NKBA                                                 READ  00071
      READ ( MIT,20) (BAA(KBA,ID), ID=1,NID)                            READ  00072
  230 WRITE( MOT,20) (BAA(KBA,ID), ID=1,NID)                            READ  00073
C                                                                       READ  00074
      WRITE(MOT,2040)                                                   READ  00075
 2040 FORMAT( 13H0 RAA(KRA,ID))                                         READ  00076
      DO 240 KRA=1,NKRA                                                 READ  00077
      READ ( MIT,20) (RAA(KRA,ID),ID=1,NID)                             READ  00078
  240 WRITE( MOT,20) (RAA(KRA,ID),ID=1,NID)                             READ  00079
C                                                                       READ  00080
      READ(MIT, 21)  DBQRA,DRQRA                                        READ  00081
      WRITE(MOT,2100)                                                   READ  00082
 2100  FORMAT(1H0,11HDBQRA,DRQRA                                        )READ  00083
      WRITE(MOT, 21)  DBQRA,DRQRA                                       READ  00084
C                                                                       READ  00085
      READ(MIT, 20)  PBSHEL                                             READ  00086
      WRITE(MOT,2110)                                                   READ  00087
 2110  FORMAT(1H0, 6HPBSHEL                                            )READ  00088
      WRITE(MOT, 20)  PBSHEL                                            READ  00089
C                                                                       READ  00090
      READ(MIT, 20)  PRSHEL                                             READ  00091
      WRITE(MOT,2120)                                                   READ  00092
 2120  FORMAT(1H0, 6HPRSHEL                                            )READ  00093
      WRITE(MOT, 20)  PRSHEL                                            READ  00094
C                                                                       READ  00095
C    FIREPOWER SCORES--GROUND AND AIR                                   READ  00096
C                                                                       READ  00097
      WRITE(MOT,3010)                                                   READ  00098
 3010 FORMAT(10H1 FBD(KBD))                                             READ  00099
      READ (MIT,21) (FBD(KBD),KBD=1,NKBD)                               READ  00100
      WRITE(MOT,21) (FBD(KBD),KBD=1,NKBD)                               READ  00101
C                                                                       READ  00102
      WRITE(MOT,3020)                                                   READ  00103
 3020 FORMAT(10H0 FRD(KRD))                                             READ  00104
      READ  (MIT,21) (FRD(KRD),KRD=1,NKRD)                              READ  00105
      WRITE(MOT,21)  (FRD(KRD),KRD=1,NKRD)                              READ  00106
C                                                                       READ  00107
      READ(MIT, 25)  (FBA(KBA),KBA=1,2)                                 READ  00108
      WRITE(MOT,3030)                                                   READ  00109
 3030  FORMAT(1H0,18H(FBA(KBA),KBA=1,2)                                )READ  00110
      WRITE(MOT, 25)  (FBA(KBA),KBA=1,2)                                READ  00111
C                                                                       READ  00112
      READ(MIT, 25)  (FRA(KRA),KRA=1,2)                                 READ  00113
      WRITE(MOT,3040)                                                   READ  00114
 3040  FORMAT(1H0,18H(FRA(KRA),KRA=1,2)                                )READ  00115
      WRITE(MOT, 25)  (FRA(KRA),KRA=1,2)                                READ  00116
C                                                                       READ  00117
C    SORTIE RATES                                                       READ  00118
C                                                                       READ  00119
      READ(MIT, 10)  IDBSRC,IDRSRC                                      READ  00120
      WRITE(MOT,2130)                                                   READ  00121
 2130  FORMAT(1H0,13HIDBSRC,IDRSRC                                     )READ  00122
```

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      WRITE(MOT, 10)  IDBSRC,IDRSRC                                    READ    00123
C                                                                      READ    00124
      READ(MIT, 23)  ((SORRR1(TY,MS),MS=1,3),TY=1,2)                   READ    00125
      WRITE(MOT,2140)                                                  READ    00126
 2140 FORMAT(1H0,31H((SORRR1(TY,MS),MS=1,3),TY=1,2)                    )READ    00127
      WRITE(MOT,303)  ((SORRB1(TY,MS),MS=1,3),TY=1,2)                  READ    00128
C                                                                      READ    00129
      READ(MIT, 23)  ((SORRR2(TY,MS),MS=1,3),TY=1,2)                   READ    00130
      WRITE(MOT,2150)                                                  READ    00131
 2150 FORMAT(1H0,31H((SORRB2(TY,MS),MS=1,3),TY=1,2)                    )READ    00132
      WRITE(MOT,303)  ((SORRB2(TY,MS),MS=1,3),TY=1,2)                  READ    00133
C                                                                      READ    00134
      READ(MIT, 23)  ((SORRR1(TY,MS),MS=1,3),TY=1,2)                   READ    00135
      WRITE(MOT,2160)                                                  READ    00136
 2160 FORMAT(1H0,31H((SORRR1(TY,MS),MS=1,3),TY=1,2)                    )READ    00137
      WRITE(MOT,303)  ((SORRR1(TY,MS),MS=1,3),TY=1,2)                  READ    00138
C                                                                      READ    00139
      READ(MIT, 23)  ((SORRR2(TY,MS),MS=1,3),TY=1,2)                   READ    00140
      WRITE(MOT,2170)                                                  READ    00141
 2170 FORMAT(1H0,31H((SORRR2(TY,MS),MS=1,3),TY=1,2)                    )READ    00142
      WRITE(MOT,303)  ((SORRR2(TY,MS),MS=1,3),TY=1,2)                  READ    00143
C                                                                      READ    00144
C     AIR TO AIR PARAMETERS                                            READ    00145
C                                                                      READ    00146
      READ(MIT, 10)  IAA                                               READ    00147
      WRITE(MOT,2200)                                                  READ    00148
 2200 FORMAT(1H0, 3HIAA                                                )READ    00149
      WRITE(MOT, 10)  IAA                                              READ    00150
C                                                                      READ    00151
      READ(MIT, 21)  XNBAA,XNRAA                                       READ    00152
      WRITE(MOT,2210)                                                  READ    00153
 2210 FORMAT(1H0,11HXNBAA,XNRAA                                        )READ    00154
      WRITE(MOT, 21)  XNBAA,XNRAA                                      READ    00155
C                                                                      READ    00156
      READ(MIT, 23)  ((BALPHA(TY,MS),MS=1,2),TY=1,2)                   READ    00157
      WRITE(MOT,2220)                                                  READ    00158
 2220 FORMAT(1H0,31H((BALPHA(TY,MS),MS=1,2),TY=1,2)                    )READ    00159
      WRITE(MOT,302)  ((BALPHA(TY,MS),MS=1,2),TY=1,2)                  READ    00160
C                                                                      READ    00161
      READ(MIT, 23)  ((RALPHA(TY,MS),MS=1,2),TY=1,2)                   READ    00162
      WRITE(MOT,2230)                                                  READ    00163
 2230 FORMAT(1H0,31H((RALPHA(TY,MS),MS=1,2),TY=1,2)                    )READ    00164
      WRITE(MOT,302)  ((RALPHA(TY,MS),MS=1,2),TY=1,2)                  READ    00165
C                                                                      READ    00166
      READ(MIT, 25)  ((BIDRA(TYI,KAT),KAT=1,4),TYI=1,2)                READ    00167
      WRITE(MOT,2310)                                                  READ    00168
 2310 FORMAT(1H0,34H((BIDRA(TYI,KAT),KAT=1,4),TYI=1,2)                 )READ    00169
      WRITE(MOT,301)  ((BIDRA(TYI,KAT),KAT=1,4),TYI=1,2)               READ    00170
C                                                                      READ    00171
      READ(MIT, 25)  ((BIKRA(TYI,KAT),KAT=1,4),TYI=1,2)                READ    00172
      WRITE(MOT,2320)                                                  READ    00173
 2320 FORMAT(1H0,34H((BIKRA(TYI,KAT),KAT=1,4),TYI=1,2)                 )READ    00174
      WRITE(MOT,301)  ((BIKRA(TYI,KAT),KAT=1,4),TYI=1,2)               READ    00175
C                                                                      READ    00176
      READ(MIT, 25)  ((BADRI(KAT,TYI),TYI=1,2),KAT=1,4)                READ    00177
      WRITE(MOT,2330)                                                  READ    00178
 2330 FORMAT(1H0,34H((BADRI(KAT,TYI),TYI=1,2),KAT=1,4)                 )READ    00179
      WRITE(MOT,302)  ((BADRI(KAT,TYI),TYI=1,2),KAT=1,4)               READ    00180
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C                                                                       READ    00181
      READ(MIT, 25)  ((BAKRI(KAT,TYI),TYI=1,2),KAT=1,4)                 READ    00182
      WRITE(MOT,2340)                                                   READ    00183
 2340 FORMAT(1H0,34H((BAKRI(KAT,TYI),TYI=1,2),KAT=1,4)      )           READ    00184
      WRITE(MOT,302)  ((BAKRI(KAT,TYI),TYI=1,2),KAT=1,4)                READ    00185
C                                                                       READ    00186
      READ(MIT, 25)  ((RIDBA(TYI,KAT),KAT=1,4),TYI=1,2)                 READ    00187
      WRITE(MOT,2350)                                                   READ    00188
 2350 FORMAT(1H0,34H((RIDBA(TYI,KAT),KAT=1,4),TYI=1,2)      )           READ    00189
      WRITE(MOT,301)  ((RIDBA(TYI,KAT),KAT=1,4),TYI=1,2)                READ    00190
C                                                                       READ    00191
      READ(MIT, 25)  ((RIKBA(TYI,KAT),KAT=1,4),TYI=1,2)                 READ    00192
      WRITE(MOT,2360)                                                   READ    00193
 2360 FORMAT(1H0,34H((RIKBA(TYI,KAT),KAT=1,4),TYI=1,2)      )           READ    00194
      WRITE(MOT,301)  ((RIKBA(TYI,KAT),KAT=1,4),TYI=1,2)                READ    00195
C                                                                       READ    00196
      READ(MIT, 25)  ((RADBI(KAT,TYI),TYI=1,2),KAT=1,4)                 READ    00197
      WRITE(MOT,2370)                                                   READ    00198
 2370 FORMAT(1H0,34H((RADBI(KAT,TYI),TYI=1,2),KAT=1,4)      )           READ    00199
      WRITE(MOT,302)  ((RADBI(KAT,TYI),TYI=1,2),KAT=1,4)                READ    00200
C                                                                       READ    00201
      READ(MIT, 25)  ((RAKBI(KAT,TYI),TYI=1,2),KAT=1,4)                 READ    00202
      WRITE(MOT,2380)                                                   READ    00203
 2380 FORMAT(1H0,34H((RAKBI(KAT,TYI),TYI=1,2),KAT=1,4)      )           READ    00204
      WRITE(MOT,302)  ((RAKBI(KAT,TYI),TYI=1,2),KAT=1,4)                READ    00205
C                                                                       READ    00206
C   SAM PARAMETERS                                                      READ    00207
C                                                                       READ    00208
      READ(MIT,23)   ((BSAMZR(TY,MS),MS=1,2),TY=1,2)                    READ    00209
      WRITE(MOT,2410)                                                   READ    00210
 2410 FORMAT(1H0, 31H((BSAMZR(TY,MS),MS=1,2),TY=1,2)      )             READ    00211
      WRITE(MOT,304)  ((BSAMZR(TY,MS),MS=1,2),TY=1,2)                   READ    00212
C                                                                       READ    00213
      READ(MIT,23)   ((RSAMZB(TY,MS),MS=1,2),TY=1,2)                    READ    00214
      WRITE(MOT,2420)                                                   READ    00215
 2420 FORMAT(1H0, 31H((RSAMZB(TY,MS),MS=1,2),TY=1,2)      )             READ    00216
      WRITE(MOT,304)  ((RSAMZB(TY,MS),MS=1,2),TY=1,2)                   READ    00217
C                                                                       READ    00218
C   ABA   PARAMETERS                                                    READ    00219
C                                                                       READ    00220
      READ(MIT,10)   IR3SH                                              READ    00221
      WRITE(MOT,2440)                                                   READ    00222
 2440 FORMAT(1H0,5HIR3SH)                                               READ    00223
      WRITE(MOT,10)   IR3SH                                             READ    00224
C                                                                       READ    00225
      READ(MIT, 23)  BFRAC1,BFRAC2                                      READ    00226
      WRITE(MOT,2450)                                                   READ    00227
 2450 FORMAT(1H0,13HBFRAC1,BFRAC2                           )           READ    00228
      WRITE(MOT, 23)  BFRAC1,BFRAC2                                     READ    00229
C                                                                       READ    00230
      READ(MIT, 23)  RFRAC1,RFRAC2                                      READ    00231
      WRITE(MOT,2455)                                                   READ    00232
 2455 FORMAT(1H0,13HRFRAC1,RFRAC2                           )           READ    00233
      WRITE(MOT, 23)  RFRAC1,RFRAC2                                     READ    00234
C                                                                       READ    00235
      READ(MIT, 23)  FBSK,FRSK                                          READ    00236
      WRITE(MOT,2460)                                                   READ    00237
 2460 FORMAT(1H0, 9HFBSK,FRSK                               )           READ    00238
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      WRITE(MOT, 23)  FBSK,FRSK                                          READ   00239
C                                                                        READ   00240
      READ(MIT, 22)  (BPASS(TY),TY=1,2)                                  READ   00241
      WRITE(MOT,2470)                                                    READ   00242
 2470 FORMAT(1H0,18H(BPASS(TY),TY=1,2)                    )              READ   00243
      WRITE(MOT, 22)  (BPASS(TY),TY=1,2)                                 READ   00244
C                                                                        READ   00245
      READ(MIT, 22)  (RPASS(TY),TY=1,2)                                  READ   00246
      WRITE(MOT,2475)                                                    READ   00247
 2475 FORMAT(1H0,18H(RPASS(TY),TY=1,2)                    )              READ   00248
      WRITE(MOT, 22)  (RPASS(TY),TY=1,2)                                 READ   00249
C                                                                        READ   00250
      READ(MIT,10)  IBABA,IRABA                                          READ   00251
      WRITE(MOT,2476)   IBABA                                            READ   00252
      WRITE(MOT,2477)       IRABA                                        READ   00253
 2476 FORMAT(1H0,42HIBABA--BLUE ATTACKS RED AIRBASE USING MODE,I5)        READ   00254
 2477 FORMAT(1H0,42HIRABA--RED ATTACKS BLUE AIRBASE USING MODE,I5)        READ   00255
C                                                                        READ   00256
      READ(MIT, 21)  XNBAB,XNRAB                                         READ   00257
      WRITE(MOT,2480)                                                    READ   00258
 2480 FORMAT(1H0,11HXNBAB,XNRAB                           )              READ   00259
      WRITE(MOT, 21)  XNBAB,XNRAB                                        READ   00260
C                                                                        READ   00261
      READ(MIT, 21)  BPARK,RPARK                                         READ   00262
      WRITE(MOT,2490)                                                    READ   00263
 2490 FORMAT(1H0,11HBPARK,RPARK                           )              READ   00264
      WRITE(MOT, 21)  BPARK,RPARK                                        READ   00265
C                                                                        READ   00266
      READ(MIT,25)  BDRS,BDRNS,BKRS,BKRNS                                READ   00267
      WRITE(MOT,2524)                                                    READ   00268
      WRITE(MOT,2525)   BDRS                                             READ   00269
      WRITE(MOT,2526)  BDRNS                                             READ   00270
      WRITE(MOT,2527)   BKRS                                             READ   00271
      WRITE(MOT,2528)     BKRNS                                          READ   00272
 2524 FORMAT(1H0,5X,6X,4HB GP ,2X,8HB SP ABA  )                          READ   00273
 2525 FORMAT(1H ,5HBDRS ,2F10.5)                                         READ   00274
 2526 FORMAT(1H ,5HBDRNS,2F10.5)                                         READ   00275
 2527 FORMAT(1H ,5HBKRS ,2F10.5)                                         READ   00276
 2528 FORMAT(1H ,5HBKRNS,2F10.5)                                         READ   00277
C                                                                        READ   00278
      READ(MIT,25)   RDBS,RDBNS,RKBS,RKRNS                               READ   00279
      WRITE(MOT,2529)                                                    READ   00280
      WRITE(MOT,2530)        RDBS                                        READ   00281
      WRITE(MOT,2531)       RDBNS                                        READ   00282
      WRITE(MOT,2532)     RKBS                                           READ   00283
      WRITE(MOT,2533)     RKBNS                                          READ   00284
 2529 FORMAT(1H0,5X,6X,4HR GP ,2X,8HR SP ABA  )                          READ   00285
 2530 FORMAT(1H ,5HRDBS ,2F10.5)                                         READ   00286
 2531 FORMAT(1H ,5HRDBNS,2F10.5)                                         READ   00287
 2532 FORMAT(1H ,5HRKBS ,2F10.5)                                         READ   00288
 2533 FORMAT(1H ,5HRKBNS,2F10.5)                                         READ   00289
C                                                                        READ   00290
C    AREA FIRE PARAMETERS                                                READ   00291
C                                                                        READ   00292
      READ(MIT,21)                                                       READ   00293
     1       B4B,B4AL,B4AN1,B4AN2,B4AS1,B4AS2,B4NS1,B4NS2,B4SN1,B4SN2    READ   00294
      WRITE(MOT,2610)                                                    READ   00295
 2610 FORMAT(1H0,                                                        READ   00296
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     1       56HB4B,B4AL,B4AN1,B4AN2,B4AS1,B4AS2,B4NS1,B4NS2,B4SN1,B4SN2)  READ  00297
      WRITE(MOT,2615)                                                     READ  00298
     1       R4B,R4AL,R4AN1,R4AN2,R4AS1,R4AS2,R4NS1,R4NS2,R4SN1,R4SN2     READ  00299
 2615 FORMAT(1H ,F15.1,F10.4,4F10.1,4F10.4)                               READ  00300
C                                                                         READ  00301
      READ(MIT,21)                                                        READ  00302
     1       R4B,R4AL,R4AN1,R4AN2,R4AS1,R4AS2,R4NS1,R4NS2,R4SN1,R4SN2     READ  00303
      WRITE(MOT,2620)                                                     READ  00304
 2620 FORMAT(1H0,                                                         READ  00305
     1       56HR4B,R4AL,R4AN1,R4AN2,R4AS1,R4AS2,R4NS1,R4NS2,R4SN1,R4SN2) READ  00306
      WRITE(MOT,2615)                                                     READ  00307
     1       R4B,R4AL,R4AN1,R4AN2,R4AS1,R4AS2,R4NS1,R4NS2,R4SN1,R4SN2     READ  00308
C                                                                         READ  00309
      READ(MIT,25) EPS4                                                   READ  00310
      WRITE(MOT,2630)                                                     READ  00311
 2630 FORMAT(1H0,4HEPS4)                                                  READ  00312
      WRITE(MOT,25) EPS4                                                  READ  00313
C                                                                         READ  00314
C     FUNCTIONS FOR FEBA ADVANCE AND DIVISION DESTRUCTION                 READ  00315
C                                                                         READ  00316
      WRITE(MOT,3410)                                                     READ  00317
 3410 FORMAT(21H0 NFRFA,FRFA(I),FA(I))                                    READ  00318
      READ (MIT,10) NFRFA                                                 READ  00319
      WRITE(MOT,10) NFRFA                                                 READ  00320
      READ (MIT,22) (FRFA(I),I=1,NFRFA)                                   READ  00321
      WRITE(MOT,22) (FRFA(I),I=1,NFRFA)                                   READ  00322
      READ (MIT,21) (FA(I),I=1,NFRFA)                                     READ  00323
      WRITE(MOT,21) (FA(I),I=1,NFRFA)                                     READ  00324
C                                                                         READ  00325
      WRITE(MOT,3420)                                                     READ  00326
 3420 FORMAT(21H0 NFRBD,FRBD(I),BD(I))                                    READ  00327
      READ (MIT,10) NFRBD                                                 READ  00328
      WRITE(MOT,10) NFRBD                                                 READ  00329
      READ (MIT,22) (FRBD(I),I=1,NFRBD)                                   READ  00330
      WRITE(MOT,22) (FRBD(I),I=1,NFRBD)                                   READ  00331
      READ(MIT,23)  (BD(I),I=1,NFRBD)                                     READ  00332
      WRITE(MOT,23) (BD(I),I=1,NFRBD)                                     READ  00333
C                                                                         READ  00334
      WRITE(MOT,3430)                                                     READ  00335
 3430 FORMAT(21H0 NFRRD,FRRD(I),RD(I))                                    READ  00336
      READ (MIT,10) NFRRD                                                 READ  00337
      WRITE(MOT,10) NFRRD                                                 READ  00338
      READ (MIT,22) (FRRD(I),I=1,NFRRD)                                   READ  00339
      WRITE(MOT,22) (FRRD(I),I=1,NFRRD)                                   READ  00340
      READ (MIT,23) (RD(I),I=1,NFRRD)                                     READ  00341
      WRITE(MOT,23) (RD(I),I=1,NFRRD)                                     READ  00342
C                                                                         READ  00343
C --- STRATEGIES BY ALLOCATION BY MISSION                                 READ  00344
C                                                                         READ  00345
      WRITE(MOT,4005)                                                     READ  00346
 4005 FORMAT( 7H1 NB,NR)                                                  READ  00347
      READ (MIT,10) NB,NR                                                 READ  00348
      WRITE(MOT,10) NB,NR                                                 READ  00349
C                                                                         READ  00350
      WRITE(MOT,4010)                                                     READ  00351
 4010 FORMAT(22H0 PB(IBA, MS), MS=1,3))                                   READ  00352
      DO 410 IBA=1,NB                                                     READ  00353
      READ (MIT,23) (PB(IBA, MS), MS=1,3)                                 READ  00354
```

```
  410 WRITE(MOT,23) (PR(IRA, MS), MS=1,3)                                READ    00355
C                                                                        READ    00356
      WRITE (MOT,4020)                                                   READ    00357
 4020 FORMAT(22H0 PR(IRA, MS), MS=1,3))                                  READ    00358
      DO 420 IRA=1,NR                                                    READ    00359
      READ (MIT,23) (PR(IRA, MS), MS=1,3)                                READ    00360
  420 WRITE(MOT,23) (PR(IRA, MS), MS=1,3)                                READ    00361
C                                                                        READ    00362
C --- MEASURE OF EFFECTIVENESS                                           READ    00363
C                                                                        READ    00364
      WRITE (MOT,5010)                                                   READ    00365
 5010 FORMAT(10H1 MOE,MOET)                                              READ    00366
      READ  (MIT,10) MOE,MOET                                            READ    00367
      WRITE(MOT,10) MOE,MOET                                             READ    00368
C                                                                        READ    00369
C      WEIGHTS FOR MOE 4 AND MOE 5                                       READ    00370
C                                                                        READ    00371
      READ(MIT, 23)  BCWGT                                               READ    00372
      WRITE(MOT,5110)                                                    READ    00373
 5110  FORMAT(1H0, 5HBCWGT                                    )          READ    00374
      WRITE(MOT, 23)  BCWGT                                              READ    00375
C                                                                        READ    00376
      READ(MIT, 23)  (BSWGT(MS),MS=1,3)                                  READ    00377
      WRITE(MOT,5120)                                                    READ    00378
 5120  FORMAT(1H0,18H(BSWGT(MS),MS=1,3)                       )          READ    00379
      WRITE(MOT, 23)  (BSWGT(MS),MS=1,3)                                 READ    00380
C                                                                        READ    00381
      READ(MIT, 23)  (BQWGT(I),I=1,2)                                    READ    00382
      WRITE(MOT,5130)                                                    READ    00383
 5130  FORMAT(1H0,16H(BQWGT(I),I=1,2)                         )          READ    00384
      WRITE(MOT, 23)  (BQWGT(I),I=1,2)                                   READ    00385
C                                                                        READ    00386
      READ(MIT, 23)  RCWGT                                               READ    00387
      WRITE(MOT,5160)                                                    READ    00388
 5160  FORMAT(1H0, 5HRCWGT                                    )          READ    00389
      WRITE(MOT, 23)  RCWGT                                              READ    00390
C                                                                        READ    00391
      READ(MIT, 23)  (RSWGT(MS),MS=1,3)                                  READ    00392
      WRITE(MOT,5170)                                                    READ    00393
 5170  FORMAT(1H0,18H(RSWGT(MS),MS=1,3)                       )          READ    00394
      WRITE(MOT, 23)  (RSWGT(MS),MS=1,3)                                 READ    00395
C                                                                        READ    00396
      READ(MIT, 23)  (RQWGT(I),I=1,2)                                    READ    00397
      WRITE(MOT,5180)                                                    READ    00398
 5180  FORMAT(1H0,16H(RQWGT(I),I=1,2)                         )          READ    00399
      WRITE(MOT, 23)  (RQWGT(I),I=1,2)                                   READ    00400
C                                                                        READ    00401
      READ(MIT, 20)  GVA                                                 READ    00402
      WRITE(MOT,5300)                                                    READ    00403
 5300  FORMAT(1H0, 3HGVA                                      )          READ    00404
      WRITE(MOT, 20)  GVA                                                READ    00405
C                                                                        READ    00406
C                                                                        READ    00407
 9999 CONTINUE                                                           READ    00408
      RETURN                                                             READ    00409
      END                                                                READ    00410
```

D. SUBROUTINE SIMPL1

```
      SUBROUTINE SIMPL1                                                  SIMPL1  00002
CDUBDIM
      COMMON NKBD,NKBU,NKBA,NKBA                                         MAIN
      COMMON NID                                                         MAIN
      COMMON NPD,IDL1,IDU1,IDL2,IDU2,IDL3,IDU3                           MAIN
      COMMON IRD,JRD,KRD                                                 MAIN
      COMMON IPRV,IPRU                                                   MAIN
      COMMON IREPLR,IHEPLR                                               MAIN
      COMMON BDA(3,90),RDA(3,90)                                         MAIN
      COMMON BAA(4,90),RAA(4,90)                                         MAIN
      COMMON DBDRA,DRDRA                                                 MAIN
      COMMON SHELB(90),SHELR(90),PRSHEL,PKSHEL                           MAIN
      COMMON BSHELK(90),RSHELK(90)                                       MAIN
      COMMON FBD(3),FRD(3),FBA(2),FRA(2)                                 MAIN
      COMMON IDRSRC,IDRSRC                                               MAIN
      COMMON SORRB1(2,3),SORRA2(2,3),SORRR1(2,3),SORRR2(2,3)             MAIN
      COMMON IAA ,XNRAA,XNRAA,BALPHA(2,2),RALPHA(2,2)                    MAIN
      COMMON BIDRA(2,4),BADRI(4,2),RIDBA(2,4),RADBI(4,2)                 MAIN
      COMMON BIKRA(2,4),BAKRI(4,2),RIKRA(2,4),RAKBI(4,2)                 MAIN
      COMMON BSAMZR(2,2),RSAMZB(2,2)                                     MAIN
      COMMON IR3SH,BFRAC1,BFRAC2,RFRAC1,RFRAC2,FRSK,FRSK                 MAIN
      COMMON BPASS(2),RPASS(2)                                           MAIN
      COMMON IBABA,IRARA,XNRAB,XNRAR,BPARK,RPARK                         MAIN
      COMMON BDRS(2),BDRNS(2),BKRS(2),RKRNS(2)                           MAIN
      COMMON RDRS(2),RDBNS(2),RKBS(2),RKRNS(2)                           MAIN
      COMMON   R4B,B4AL,B4AN1,B4AN2,B4AS1,B4AS2,B4NS1,B4NS2,R4SN1,R4SN2  MAIN
      COMMON   R4B,R4AL,R4AN1,R4AN2,R4AS1,R4AS2,R4NS1,R4NS2,R4SN1,R4SN2  MAIN
      COMMON EPS4                                                        MAIN
      COMMON NFRFA,FRFA(15),FA(15)                                       MAIN
      COMMON NFRBD,FRBD(15),BD(15)                                       MAIN
      COMMON NFRRD,FRRD(15),RD(15)                                       MAIN
      COMMON NB,NR                                                       MAIN
      COMMON PB(20,3),PR(20,3)                                           MAIN
      COMMON PROPB(3,3),PROPR(3,3)                                       MAIN
      COMMON MOE,MOET                                                    MAIN
      COMMON BCWGT,BSWGT(3),BOWGT(2),RCWGT,RSWGT(3),ROWGT(2)             MAIN
      COMMON GVA                                                         MAIN
C                                                                        MAIN
      COMMON U(11,11),SUB(11,11,11),SUR(11,11,11)                        MAIN
      COMMON V(11,11),SVB(11,11,11),SVR(11,11,11)                        MAIN
      COMMON W(11,11),SWB(11),SWR(11),VALUE                              MAIN
C                                                                        MAIN
      COMMON BDI(3,90),RDI(3,90)                                         MAIN
      COMMON BDD(3,90),RDD(3,90)                                         MAIN
      COMMON BGF(90), RGF(90)                                            MAIN
      COMMON BAI(4,90),RAI(4,90)                                         MAIN
      COMMON BAD(4,90),RAD(4,90)                                         MAIN
      COMMON BAF(90), RAF(90)                                            MAIN
      COMMON BF(90), RF(90)                                              MAIN
      COMMON FERA(90)                                                    MAIN
      COMMON CBF(90),CRF(90)                                             MAIN
      COMMON CBAF(90),CRAF(90)                                           MAIN
C                                                                        MAIN
CDUBDIM                                                                  SIMPL1  00003
      DIMENSION IBAS(20),IRAS(20),IBASIC(20),AS(20,40),CS(40),BS(20)     SIMPL1  00004
      DIMENSION X(20),SUM(20),TBACT(20),IRACT(20)                        SIMPL1  00005
      MOT=6                                                              SIMPL1  00006
```

```
      IF(IPRV .EQ. 1)  WRITE(MOT,1)                                     SIMPL1  00007
    1 FORMAT(1H1/)                                                      SIMPL1  00008
      DO 723  I=1,20                                                    SIMPL1  00009
      IBACT(I)  = IRACT(I) =  0                                         SIMPL1  00010
      BS(I) =0.0                                                        SIMPL1  00011
      IBAS(I)  =IRAS(I) = IBASIC(I) =0                                  SIMPL1  00012
      DO 721   J=1,40                                                   SIMPL1  00013
      CS(J) = 0.0                                                       SIMPL1  00014
      AS(I,J) = 0.0                                                     SIMPL1  00015
  721  CONTINUE                                                         SIMPL1  00016
  723 CONTINUE                                                          SIMPL1  00017
      DO 731  I=1,11                                                    SIMPL1  00018
      DO 732  J=1,11                                                    SIMPL1  00019
      W(I,J)=0.                                                         SIMPL1  00020
  732 CONTINUE                                                          SIMPL1  00021
  731 CONTINUE                                                          SIMPL1  00022
C     FIRST SETUP OF MATRIX  W                                          SIMPL1  00023
      IR=IR0                                                            SIMPL1  00024
      IF(IR0 .EQ. 0) IR=1                                               SIMPL1  00025
       IBIG=1                                                           SIMPL1  00026
      IRACT(IR)=1                                                       SIMPL1  00027
      DO 725  LB=1,NB                                                   SIMPL1  00028
C  COMPUTE PAYOFF ENTRY (LB,IR)                                         SIMPL1  00029
C  SET ALLOCATION                                                       SIMPL1  00030
      DO  730   MS= 1,3                                                 SIMPL1  00031
      PROPB(MS,1) = PB(LB,MS)                                           SIMPL1  00032
      PROPR(MS,1) =  PR(IR,MS)                                          SIMPL1  00033
  730 CONTINUE                                                          SIMPL1  00034
      CALL CAM(IDL1,IDU1)                                               SIMPL1  00035
      CALL SIMPL2(LB,IR)                                                SIMPL1  00036
      IF(LB .EQ. 1) BIG= W(1,IR)                                        SIMPL1  00037
      IF(W(LB,IR) .LE. BIG) GO TO 725                                   SIMPL1  00038
  726   IBIG= LB                                                        SIMPL1  00039
      BIG= W(LB,IR)                                                     SIMPL1  00040
  725 CONTINUE                                                          SIMPL1  00041
C   FIRST TIME SIMPLEX MATRIX SETUP                                     SIMPL1  00042
      DO 790    I=1,NB                                                  SIMPL1  00043
     PIVCO= W(IBIG,IR)+ GVA                                             SIMPL1  00044
      AS(1,I)= (W(I,IR) + GVA)/PIVCO                                    SIMPL1  00045
      CS(I) = 1. -AS(1,I)                                               SIMPL1  00046
  790 CONTINUE                                                          SIMPL1  00047
      AS(1,NB+1) =      -1.0/PIVCO                                      SIMPL1  00048
      CS(NB+1)  =  1.0/PIVCO                                            SIMPL1  00049
      XNEC=-1.0/PIVCO                                                   SIMPL1  00050
      BS(1)= -XNEC                                                      SIMPL1  00051
C                                                                       SIMPL1  00052
C     SET ACTIVE BLUE AND RED STRATEGIES  FIRST TIME                    SIMPL1  00053
C                                                                       SIMPL1  00054
      DO 750  I=1,NB                                                    SIMPL1  00055
      IBAS(I)= 0                                                        SIMPL1  00056
  750 X(I) = 0.0                                                        SIMPL1  00057
      IBAS(1)=IBIG                                                      SIMPL1  00058
      IBASIC(1) =  IBIG                                                 SIMPL1  00059
      X(IBIG)= 1.0                                                      SIMPL1  00060
      IRAS(1)=IR                                                        SIMPL1  00061
      DO 751  I=2,NR                                                    SIMPL1  00062
      IRAS(I)=0                                                         SIMPL1  00063
  751  CONTINUE                                                         SIMPL1  00064
```

```
      GVAL=PIVCO                                                        SIMPL1  00065
      NROWS=NRAS=NBC=1                                                  SIMPL1  00066
C                                                                       SIMPL1  00067
C  GENERAL LOOP FOR TESTING TOTAL FEASIBILITY                           SIMPL1  00068
C  DETERMINE IF CONSTRAINT IS VIOLATED   FIND MOST VIOLATED ONE         SIMPL1  00069
C                                                                       SIMPL1  00070
 2600  CONTINUE                                                         SIMPL1  00071
      IR=JBIG=IRAS(1)                                                   SIMPL1  00072
      INFEAS=0                                                          SIMPL1  00073
      DO 270  J=1,NR                                                    SIMPL1  00074
      SUM(J)= 0.0                                                       SIMPL1  00075
      SUM(IR)=GVAL-GVA                                                  SIMPL1  00076
      IF(IRACT(J) .EQ.  1) GO TO  270                                   SIMPL1  00077
      DO 260  I=1,NBC                                                   SIMPL1  00078
C                                                                       SIMPL1  00079
C    GROUP ACTIVE STRATEGIES TOGETHER                                   SIMPL1  00080
C   IF ROW ALREADY HAS BEEN COMPUTED, NEED NOT RECOMPUTE ENTRIES        SIMPL1  00081
C                                                                       SIMPL1  00082
      LB=IRAS(I)                                                        SIMPL1  00083
      IF(IRACT(LB) .EQ. 1)  GO TO 259                                   SIMPL1  00084
C                                                                       SIMPL1  00085
C   FIND ENTRY,SET ALLOCATION, CALL CAM, ASSIGN TO W                    SIMPL1  00086
C                                                                       SIMPL1  00087
      DO  255  MS= 1,3                                                  SIMPL1  00088
      PROPR(MS,1) = PR(LB,MS)                                           SIMPL1  00089
      PROPR(MS,1) =  PR( J,MS)                                          SIMPL1  00090
  255 CONTINUE                                                          SIMPL1  00091
      CALL CAM(IDL1,IDU1)                                               SIMPL1  00092
      CALL SIMPL2(LB, J)                                                SIMPL1  00093
  259 SUM(J) =  SUM(J) +  X(LB)*W(LB,J)                                 SIMPL1  00094
  260 CONTINUE                                                          SIMPL1  00095
  261 IF(SUM(J) .GE. GVAL-GVA) GO TO 270                                SIMPL1  00096
      INFEAS=1                                                          SIMPL1  00097
      IF(SUM(J) .LT. SUM(JBIG)) JBIG=J                                  SIMPL1  00098
  270 CONTINUE                                                          SIMPL1  00099
      DO 268  I=1,NBC                                                   SIMPL1  00100
      LB=IRAS(I)                                                        SIMPL1  00101
      IBACT(LB) =1                                                      SIMPL1  00102
  268 CONTINUE                                                          SIMPL1  00103
      IF(INFEAS-1)  271,272,272                                         SIMPL1  00104
  271  CONTINUE                                                         SIMPL1  00105
C                                                                       SIMPL1  00106
C   WHOLE GAME HAS BEEN SOLVED                                          SIMPL1  00107
C    FIND AND ASSIGN OPTIMAL BLUE AND RED STRATEGIES                    SIMPL1  00108
C   IF DESIRED PRINT STRATEGY AND VALUE                                 SIMPL1  00109
C                                                                       SIMPL1  00110
      VALUE =  GVAL-GVA                                                 SIMPL1  00111
      DO 2701  J=1,NR                                                   SIMPL1  00112
 2701   SWR(J)= 0.0                                                     SIMPL1  00113
      DO 2711  IRC= 1, NRAS                                             SIMPL1  00114
      IRAS1=IRAS(IRC)                                                   SIMPL1  00115
      SWR(IRAS1) =  CS(NB,IRC)*GVAL                                     SIMPL1  00116
 2711 CONTINUE                                                          SIMPL1  00117
      DO 2712  I=1,NB                                                   SIMPL1  00118
 2712  SWB(I) =X(I)                                                     SIMPL1  00119
      WRITE(MOT,407 )                                                   SIMPL1  00120
  407 FORMAT(1H1,33HPAYOFF MATRIX FOR GAME AT STAGE 1 )                 SIMPL1  00121
      WRITE(MOT,408) (IRACT(I),I=1,NR)                                  SIMPL1  00122
```

```
  408  FORMAT(1H ,4X,11I1))
       DO 410  I=1,NB
      WRITE(MOT,409) IBACT(I),(W(I,J),J=1,NR)
  409  FORMAT(1H ,I2,2X,11F11.3)
  410  CONTINUE
       WRITE(MOT,419)  VALUE
  419  FORMAT(1H0,13HGAME VALUE      ,F15.4)
       NPDM2=NPD-2
       WRITE(MOT,423) NPDM2
  423  FORMAT(1H0,34HBLUE AND RED STRATEGIES FOR PERIOD, I3)
       WRITE(MOT,30)   (SWB(I),I=1,NB)
       WRITE(MOT,30)   (SWR(I),I=1,NR)
   30  FORMAT(1H ,4X,11F11.3)
       NPDM1=NPD-1
       WRITE(MOT,423)   NPDM1
       DO 3100  LB=1,NB
       DO 3100  LR=1,NR
       IF(SWB(LB) .LE. 0.0 .OR. SWR(LR) .LE. 0.0) GO TO 3100
       WRITE(MOT,11)   LB,LR
   11  FORMAT(1H0,2I11)
       WRITE(MOT,30)   (SVR(LB,LR,L),L=1,NR)
       WRITE(MOT,30)   (SVB(LB,LR,L),L=1,NR)
 3100  CONTINUE
       RETURN
  272  CONTINUE
C
C  NEED MORE RED STRATEGIES
C    ENTER JBIG FOR RED
C
       NBAS=NBAS+1
       IR =  JBIG
       IBACT(JBIG)=1
       IBAS(NBAS)=JBIG
       DO 280  LB=1,NB
C
C     COMPUTE PAYOFF ENTRY (LB,IR)
C    SET ALLOCATION
C
       IF(IBACT(LB) .EQ. 1) GO TO 280
       DO  278   MS= 1,3
       PROPB(MS,1) = PB(LB,MS)
       PROPR(MS,1) =  PR(IR,MS)
  278  CONTINUE
       CALL CAM(IDL1,IDU1)
       CALL SIMPL2(LB,IR)
  280  CONTINUE
C
C   ASSIGN PAYOFFS TO SIMPLEX MATRIX  PIVOT IN NEW CONSTRAINT
C    PIVOTING IN A ROW
C
       NROWS=NROWS+1
       DO 300   K=1,NB
C   GIVEN JBIG
       AS(NROWS,K)= -( W(K,JBIG)+GVA)
  300  CONTINUE
      NROWM1=NROWS-1
       DO 302  K=1,NROWM1
       AS(NROWS,NB+K) =0.0
```

```
SIMPL1  00123
SIMPL1  00124
SIMPL1  00125
SIMPL1  00126
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SIMPL1  00178
SIMPL1  00179
SIMPL1  00180
```

```
      AS(K,NB+NROWS) = 0.0                                              SIMPL1  00181
  302 CONTINUE                                                          SIMPL1  00182
      BS(NROWS)= -1.0                                                   SIMPL1  00183
      AS(NROWS,NB+NROWS)   =1.0                                         SIMPL1  00184
      IBASIC(NROWS)  =  NB + NROWS                                      SIMPL1  00185
      DO 301  J=1,NROWM1                                                SIMPL1  00186
C                                                                       SIMPL1  00188
C     PIVOT OUT VARIABLE FROM CONSTRAINT                                SIMPL1  00189
C                                                                       SIMPL1  00190
      IF(IBASIC(J) .GT. NB) GO TO 301                                   SIMPL1  00187
      IBAS1=  IBASIC(J)                                                 SIMPL1  00191
      PIVCO =  W(IBAS1,JBIG) + GVA                                      SIMPL1  00192
      NBL= NB+NROWM1                                                    SIMPL1  00193
      DO 304  I=1,NBL                                                   SIMPL1  00194
      AS(NROWS,I) =  AS(NROWS,I)+PIVCO*AS(J,I)                          SIMPL1  00195
  304  CONTINUE                                                         SIMPL1  00196
      BS(NROWS)=BS(NROWS) +  PIVCO*BS(J)                                SIMPL1  00197
  301    CONTINUE                                                       SIMPL1  00198
C                                                                       SIMPL1  00199
C    NOW PIVOT TO RE-SOLVE PROBLEM   USE DUAL SIMPLEX METHOD            SIMPL1  00200
C   TO START  LET SLACK IN LAST ROW LEAVE BASIS                         SIMPL1  00201
C    SLACK VARIABLE IS NEGATIVE                                         SIMPL1  00202
C                                                                       SIMPL1  00203
      LEAVE1=NROWS                                                      SIMPL1  00204
  800 CONTINUE                                                          SIMPL1  00205
C    FIND ENTERING     BASIC VARIABLE                                   SIMPL1  00206
      ITCOL=NB+NROWS                                                    SIMPL1  00207
      INDIC=0                                                           SIMPL1  00208
      DO 801  I=1,ITCOL                                                 SIMPL1  00209
      IF(AS(LEAVE1,I) .GE. 0.0)  GO TO 801                              SIMPL1  00210
      IF(INDIC .EQ. 1) GO TO 802                                        SIMPL1  00211
      RENT=  CS(I)/AS(LEAVE1,I)                                         SIMPL1  00212
      IENTER =I                                                         SIMPL1  00213
      INDIC=1                                                           SIMPL1  00214
  802 CONTINUE                                                          SIMPL1  00215
      RATIO=  CS(I)/AS(LEAVE1,I)                                        SIMPL1  00216
      IF(RATIO .LE. RENT)  GO TO 801                                    SIMPL1  00217
      IENTER =I                                                         SIMPL1  00218
      RENT =  RATIO                                                     SIMPL1  00219
  801 CONTINUE                                                          SIMPL1  00220
C   IENTER IS THE VARIABLE TO ENTER THE BASIS                           SIMPL1  00221
      IBASIC(LEAVE1) =  IENTER                                          SIMPL1  00222
C   PIVOT                                                             SIMPL1  00223
      PIVCO=  AS(LEAVE1,IENTER)                                         SIMPL1  00224
      DO 805   I=1,ITCOL                                                SIMPL1  00225
      AS(LEAVE1,I)=  AS(LEAVE1,I)/PIVCO                                 SIMPL1  00226
      IF(I .EQ. IENTER) GO TO 805                                       SIMPL1  00227
      CS(I) =CS(I) - AS(LEAVE1,I)*CS(IENTER)                            SIMPL1  00228
  805  CONTINUE                                                         SIMPL1  00229
      BS(LEAVE1) =  BS(LEAVE1)/PIVCO                                    SIMPL1  00230
      DO 803  J=1,NROWS                                                 SIMPL1  00231
      IF(J .EQ. LEAVE1)  GO TO 803                                      SIMPL1  00232
      DO 804    I=1,ITCOL                                               SIMPL1  00233
      IF(I .EQ. IENTER) GO TO 804                                       SIMPL1  00234
      AS(J,I) =   AS(J,I)-AS(LEAVE1,I)*AS(J,IENTER)                     SIMPL1  00235
  804 CONTINUE                                                          SIMPL1  00236
      BS(J)= BS(J) - BS(LEAVE1)*AS(J,IENTER)                            SIMPL1  00237
  803 CONTINUE                                                          SIMPL1  00238
```

```
      XNEC=XNEC-BS(LEAVE1)*CS(IENTER)                                   SIMPL1  00239
      CS(IENTER )  =0.0                                                 SIMPL1  00240
      DO 806   J=1,NROWS                                                SIMPL1  00241
       AS(J,IENTER) = 0.0                                               SIMPL1  00242
  806 CONTINUE                                                          SIMPL1  00243
      AS(LEAVE1,IENTER) = 1.0                                           SIMPL1  00244
C                                                                       SIMPL1  00245
C   TEST RHS FOR FEASIBILITY    FIND MOST NEGATIVE ENTRY TO LEAVE BASIS SIMPL1  00246
C                                                                       SIMPL1  00247
  810    INFEAS=0                                                       SIMPL1  00248
      TEST= 0.0                                                         SIMPL1  00249
      DO 811    J=1,NROWS                                               SIMPL1  00250
      IF(BS(J) .GE. 0.0)   GO TO 811                                    SIMPL1  00251
      INFEAS=1                                                          SIMPL1  00252
      IF(BS(J)  .GE. TEST)   GO TO 811                                  SIMPL1  00253
      TEST =  BS(J)                                                     SIMPL1  00254
      LEAVE1=J                                                          SIMPL1  00255
  811 CONTINUE                                                          SIMPL1  00256
      IF(INFEAS-1)   840,800,800                                        SIMPL1  00257
C                                                                       SIMPL1  00258
C     FEASIBLE SOLUTION FOUND                                           SIMPL1  00259
C    FIND ACTIVE BLUE STRATEGIES                                        SIMPL1  00260
C                                                                       SIMPL1  00261
  840  CONTINUE                                                         SIMPL1  00262
      GVAL=    =1.0/XNEC                                                SIMPL1  00263
      IBC=0                                                             SIMPL1  00264
      DO 849   I=1,NB                                                   SIMPL1  00265
  849 X(I) = 0.0                                                        SIMPL1  00266
      DO 850       IROW=1,NROWS                                         SIMPL1  00267
C   SEE IF A SLACK VARIABLE IS BASIC                                    SIMPL1  00268
      IF(IBASIC(IROW)  .GT. NB)  GO TO 850                              SIMPL1  00269
       IBC=IBC+1                                                        SIMPL1  00270
      IBAS1=IBAS(IBC)=IBASIC(IROW)                                      SIMPL1  00271
      X(IBAS1)=    BS(IROW)*  GVAL                                      SIMPL1  00272
  850  CONTINUE                                                         SIMPL1  00273
      NBC=IBC                                                           SIMPL1  00274
      GO TO 2600                                                        SIMPL1  00275
      END                                                               SIMPL1  00276
```

E. SUBROUTINE SIMPL2

```
      SUBROUTINE SIMPL2(IB,IR)                                          SIMPL2  00002
CDUPDIM
      COMMON NKBD,NKRD,NKBA,NKRA                                        MAIN
      COMMON NID                                                        MAIN
      COMMON NPD,IDL1,IDU1,IDL2,IDU2,IDL3,IDU3                          MAIN
      COMMON IR0,JR0,KR0                                                MAIN
      COMMON IPRV,IPRU                                                  MAIN
      COMMON IREPLB,IREPLR                                              MAIN
      COMMON BDA(3,90),RDA(3,90)                                        MAIN
      COMMON BAA(4,90),RAA(4,90)                                        MAIN
      COMMON DBQRA,DRQRA                                                MAIN
      COMMON SHELB(90),SHELR(90),PBSHEL,PRSHEL                          MAIN
      COMMON BSHELK(90),RSHELK(90)                                      MAIN
      COMMON FBD(3),FRD(3),FBA(2),FRA(2)                                MAIN
      COMMON IDBSRC,IURSRC                                              MAIN
      COMMON SORRB1(2,3),SORRB2(2,3),SORRR1(2,3),SORRR2(2,3)            MAIN
      COMMON IAA ,XNBAA,XNRAA,BALPHA(2,2),RALPHA(2,2)                   MAIN
      COMMON BIDRA(2,4),RADRI(4,2),RIDBA(2,4),RADBI(4,2)                MAIN
      COMMON BIKRA(2,4),BAKRI(4,2),RIKBA(2,4),RAKBI(4,2)                MAIN
      COMMON BSAMZR(2,2),RSAMZB(2,2)                                    MAIN
      COMMON IRBSH,BFRAC1,BFRAC2,RFRAC1,RFRAC2,FBSK,FRSK                MAIN
      COMMON BPASS(2),RPASS(2)                                          MAIN
      COMMON IBABA,IRABA,XNBAB,XNRAB,BPARK,RPARK                        MAIN
      COMMON BDRS(2),BDRNS(2),BKRS(2),BKRNS(2)                          MAIN
      COMMON RDBS(2),RDBNS(2),RKBS(2),RKBNS(2)                          MAIN
      COMMON   B4R,B4AL,B4AN1,B4AN2,B4AS1,B4AS2,B4NS1,B4NS2,B4SN1,B4SN2 MAIN
      COMMON   R4B,R4AL,R4AN1,R4AN2,R4AS1,R4AS2,R4NS1,R4NS2,R4SN1,R4SN2 MAIN
      COMMON EPS4                                                       MAIN
      COMMON NFRFA,FRFA(15),FA(15)                                      MAIN
      COMMON NFRBD,FRBD(15),BD(15)                                      MAIN
      COMMON NFRRD,FRRD(15),RD(15)                                      MAIN
      COMMON NB,NR                                                      MAIN
      COMMON PB(20,3),PR(20,3)                                          MAIN
      COMMON PROPB(3,3),PROPR(3,3)                                      MAIN
      COMMON MOE,MOET                                                   MAIN
      COMMON BCWGT,BSWGT(3),BQWGT(2),RCWGT,RSWGT(3),RQWGT(2)            MAIN
      COMMON GVA                                                        MAIN
C                                                                       MAIN
      COMMON U(11,11),SUB(11,11,11),SUR(11,11,11)                       MAIN
      COMMON V(11,11),SVB(11,11,11),SVR(11,11,11)                       MAIN
      COMMON W(11,11),SWB(11),SWR(11),VALUE                             MAIN
C                                                                       MAIN
      COMMON BDI(3,90),RDI(3,90)                                        MAIN
      COMMON BDO(3,90),RDO(3,90)                                        MAIN
      COMMON BGF(90), RGF(90)                                           MAIN
      COMMON BAI(4,90),RAI(4,90)                                        MAIN
      COMMON BAD(4,90),RAD(4,90)                                        MAIN
      COMMON BAF(90), RAF(90)                                           MAIN
      COMMON BF(90), RF(90)                                             MAIN
      COMMON FERA(90)                                                   MAIN
      COMMON CBF(90),CRF(90)                                            MAIN
      COMMON CBAF(90),CRAF(90)                                          MAIN
C                                                                       MAIN
CDUPDIM                                                                 SIMPL2  00003
      DIMENSION IBAS(20),IRAS(20),IBASIC(20),AS(20,40),CS(40),BS(20)    SIMPL2  00004
      DIMENSION X(20),SUM(20),IBACT(20),IRACT(20)                       SIMPL2  00005
      MOT=6                                                             SIMPL2  00006
```

```
      IF(NPO .EQ. 2  .AND.  IPRU .EQ. 1)  WRITE(MOT,1)                  SIMPL2  00007
    1 FORMAT(1H1/)                                                      SIMPL2  00008
      DO 723  I=1,20                                                    SIMPL2  00009
      IBACT(I)  = IRACT(I) =  0                                         SIMPL2  00010
      BS(I) =0.0                                                        SIMPL2  00011
      IBAS(I)  =IRAS(I) = IBASIC(I) =0                                  SIMPL2  00012
      DO 721   J=1,40                                                   SIMPL2  00013
      CS(J) = 0.0                                                       SIMPL2  00014
      AS(I,J) = 0.0                                                     SIMPL2  00015
  721  CONTINUE                                                         SIMPL2  00016
  723 CONTINUE                                                          SIMPL2  00017
      DO 731  I=1,11                                                    SIMPL2  00018
      DO 732  J=1,11                                                    SIMPL2  00019
      V(I,J)=0.                                                         SIMPL2  00020
  732 CONTINUE                                                          SIMPL2  00021
  731 CONTINUE                                                          SIMPL2  00022
C     FIRST SETUP OF MATRIX  V                                          SIMPL2  00023
      JR= JR0                                                           SIMPL2  00024
      IF( JR0 .EQ. 0) JR=1                                              SIMPL2  00025
       IBIG=1                                                           SIMPL2  00026
      IRACT(JR)=1                                                       SIMPL2  00027
      DO 725  LB=1,NB                                                   SIMPL2  00028
C     COMPUTE PAYOFF ENTRY (LB,JR)                                      SIMPL2  00029
C  SET ALLOCATION                                                       SIMPL2  00030
      DO 730    MS=1,3                                                  SIMPL2  00031
      PROPB(MS,2) = PB(LB,MS)                                           SIMPL2  00032
      PROPR(MS,2) = PR(JR,MS)                                           SIMPL2  00033
  730 CONTINUE                                                          SIMPL2  00034
      CALL CAM(IDL2,IDU2)                                               SIMPL2  00035
      CALL SIMPL3(LB,JR)                                                SIMPL2  00036
      IF(LB .EQ. 1)  BIG=V(1,JR)                                        SIMPL2  00037
      IF(V(LB,JR) .LE. BIG) GO TO 725                                   SIMPL2  00038
  726   IBIG= LB                                                        SIMPL2  00039
      BIG=V(LB,JR)                                                      SIMPL2  00040
  725 CONTINUE                                                          SIMPL2  00041
C   FIRST TIME SIMPLEX MATRIX SETUP                                     SIMPL2  00042
      DO 790    I=1,NB                                                  SIMPL2  00043
      PIVCO= V(IBIG,JR) + GVA                                           SIMPL2  00044
      AS(1,I)= ( V(I,JR)+ GVA)/PIVCO                                    SIMPL2  00045
      CS(I) = 1. -AS(1,I)                                               SIMPL2  00046
  790 CONTINUE                                                          SIMPL2  00047
      AS(1,NB+1) =      -1.0/PIVCO                                      SIMPL2  00048
      CS(NB+1)  =  1.0/PIVCO                                            SIMPL2  00049
      XNEC=-1.0/PIVCO                                                   SIMPL2  00050
      BS(1)= -XNEC                                                      SIMPL2  00051
C                                                                       SIMPL2  00052
C    SET ACTIVE BLUE AND RED STRATEGIES  FIRST TIME                     SIMPL2  00053
C                                                                       SIMPL2  00054
      DO 750  I=1,NB                                                    SIMPL2  00055
      IBAS(I)= 0                                                        SIMPL2  00056
  750 X(I) = 0.0                                                        SIMPL2  00057
      IBAS(1)=IBIG                                                      SIMPL2  00058
      IBASIC(1) =  IBIG                                                 SIMPL2  00059
      X(IBIG)= 1.0                                                      SIMPL2  00060
      IRAS(1)= JR                                                       SIMPL2  00061
      DO 751  I=2,NR                                                    SIMPL2  00062
      IRAS(I)=0                                                         SIMPL2  00063
  751  CONTINUE                                                         SIMPL2  00064
```

```
      GVAL=PIVCO                                                        SIMPL2  00065
      NROWS=NRAS=NBC=1                                                  SIMPL2  00066
C                                                                       SIMPL2  00067
C  GENERAL LOOP FOR TESTING TOTAL FEASIBILITY                           SIMPL2  00068
C  DETERMINE IF CONSTRAINT IS VIOLATED   FIND MOST VIOLATED ONE         SIMPL2  00069
C                                                                       SIMPL2  00070
 2600  CONTINUE                                                         SIMPL2  00071
      JR=JBIG=IRAS(1)                                                   SIMPL2  00072
      INFEAS=0                                                          SIMPL2  00073
      DO 270  J=1,NR                                                    SIMPL2  00074
      SUM(J)= 0.0                                                       SIMPL2  00075
      SUM(JR)=GVAL-GVA                                                  SIMPL2  00076
      IF(IBACT(J) .EQ.  1) GO TO  270                                   SIMPL2  00077
      DO 260  I=1,NBC                                                   SIMPL2  00078
C                                                                       SIMPL2  00079
C    GROUP ACTIVE STRATEGIES TOGETHER                                   SIMPL2  00080
C   IF ROW ALREADY HAS BEEN COMPUTED, NEED NOT RECOMPUTE ENTRIES        SIMPL2  00081
C                                                                       SIMPL2  00082
      LB=IBAS(I)                                                        SIMPL2  00083
      IF(IBACT(LB) .EQ. 1)  GO TO 259                                   SIMPL2  00084
C                                                                       SIMPL2  00085
C   FIND ENTRY,SET ALLOCATION, CALL CAM, ASSIGN TO V                    SIMPL2  00086
C                                                                       SIMPL2  00087
      DO 255  MS=1,3                                                    SIMPL2  00088
      PROPR(MS,2) = PR(LB,MS)                                           SIMPL2  00089
      PROPR(MS,2) = PR( J,MS)                                           SIMPL2  00090
 255  CONTINUE                                                          SIMPL2  00091
      CALL CAM(IDL2,IDU2)                                               SIMPL2  00092
      CALL SIMPL3(LB, J)                                                SIMPL2  00093
 259  SUM(J) =  SUM(J) +  X(LB) * V(LB,J)                               SIMPL2  00094
 260  CONTINUE                                                          SIMPL2  00095
 261  IF(SUM(J) .GE. GVAL-GVA) GO TO 270                                SIMPL2  00096
      INFEAS=1                                                          SIMPL2  00097
      IF(SUM(J) .LT. SUM(JBIG)) JBIG=J                                  SIMPL2  00098
 270  CONTINUE                                                          SIMPL2  00099
      DO 268  I=1,NBC                                                   SIMPL2  00100
      LB=IBAS(I)                                                        SIMPL2  00101
      IBACT(LB) =1                                                      SIMPL2  00102
 268  CONTINUE                                                          SIMPL2  00103
      IF(INFEAS-1)  271,272,272                                         SIMPL2  00104
 271  CONTINUE                                                          SIMPL2  00105
C                                                                       SIMPL2  00106
C    MATRIX GAME SOLUTION HAS BEEN FOUND          ASSIGN W(IB,IR)       SIMPL2  00107
C    FIND AND ASSIGN OPTIMAL BLUE AND RED STRATEGIES                    SIMPL2  00108
C   IF DESIRED PRINT STRATEGY AND VALUE                                 SIMPL2  00109
C                                                                       SIMPL2  00110
      W(IB,IR)=  GVAL-GVA                                               SIMPL2  00111
      DO 2701  J=1,NR                                                   SIMPL2  00112
2701  SVR(IB,IR,J) = 0.0                                                SIMPL2  00113
      DO 2711  IRC= 1, NRAS                                             SIMPL2  00114
      IRAS1=IRAS(IRC)                                                   SIMPL2  00115
      SVR(IB,IR,IRAS1)= CS(NB*IRC)*GVAL                                 SIMPL2  00116
2711  CONTINUE                                                          SIMPL2  00117
      DO 2712  I=1,NB                                                   SIMPL2  00118
2712  SVB(IB,IR,I) = X(I)                                               SIMPL2  00119
      IF(IPRV .EQ. 0) RETURN                                            SIMPL2  00120
      IF(NPD .EQ. 2 .OR. IPRU .EQ. 1) WRITE(MOT,1)                      SIMPL2  00121
      NPDM1=NPD-1                                                       SIMPL2  00122
```

```
      WRITE(MOT,407)  NPDM1                                              SIMPL2  00123
  407 FORMAT(////1H , 31HPAYOFF MATRIX FOR GAME AT STAGE    ,I3  )       SIMPL2  00124
      WRITE(MOT,408)       (IRACT(I),I=1,NR)                             SIMPL2  00125
  408 FORMAT(1H ,4X,11I11)                                               SIMPL2  00126
      DO 410  I=1,NB                                                     SIMPL2  00127
      WRITE(MOT,409) IBACT(I),(V(I,J),J=1,NR)                            SIMPL2  00128
  409 FORMAT(1H ,I2,2X,11F11.3)                                          SIMPL2  00129
  410 CONTINUE                                                           SIMPL2  00130
      IF(NPD .EQ. 2) GO TO 420                                           SIMPL2  00131
      WRITE(MOT,418) IB,IR                                               SIMPL2  00132
  418 FORMAT(1H0,3HIB=,I5,7H     IR=,I5)                                 SIMPL2  00133
      WRITE(MOT,419) W(IB,IR)                                            SIMPL2  00134
  419 FORMAT(1H0,10HW(IB,IR)    =,F15.4)                                 SIMPL2  00135
      GO TO 422                                                          SIMPL2  00136
  420 WRITE(MOT,421)  W(IB,IR)                                           SIMPL2  00137
  421 FORMAT(1H0,13HGAME VALUE      =,F15.4)                             SIMPL2  00138
  422 CONTINUE                                                           SIMPL2  00139
      WRITE(MOT,423)  NPDM1                                              SIMPL2  00140
  423 FORMAT(1H0,34HBLUE AND RED STRATEGIES FOR PERIOD ,I3)              SIMPL2  00141
      WRITE(MOT,30)  (SVB(IB,IR,I),I=1,NB)                              SIMPL2  00142
      WRITE(MOT,30)  (SVR(IB,IR,I),I=1,NR)                              SIMPL2  00143
   30 FORMAT(1H ,4X,11F11.3)                                             SIMPL2  00144
      WRITE(MOT,423)   NPD                                               SIMPL2  00145
      DO 3100 LB=1,NB                                                    SIMPL2  00146
      DO 3100  LR=1,NR                                                   SIMPL2  00147
      IF(SVB(IB,IR,LB).LE.0. .OR. SVR(IB,IR,LR).LE. 0.) GO TO 3100       SIMPL2  00148
      WRITE(MOT,11) LB,LR                                                SIMPL2  00149
   11 FORMAT(1H0,2I11)                                                   SIMPL2  00150
      WRITE(MOT,30)  (SUB(LB,LR,L),L=1,NB)                              SIMPL2  00151
      WRITE(MOT,30)  (SUR(LB,LR,L),L=1,NR)                              SIMPL2  00152
 3100 CONTINUE                                                          SIMPL2  00153
      IF(IPRO .EQ. 1 .AND.  NPD .EQ. 3)  WRITE(MOT,1)                    SIMPL2  00154
      RETURN                                                             SIMPL2  00155
  272 CONTINUE                                                           SIMPL2  00156
C                                                                        SIMPL2  00157
C  NEED MORE RED STRATEGIES                                              SIMPL2  00158
C    ENTER JRIG FOR RED                                                  SIMPL2  00159
C                                                                        SIMPL2  00160
      NRAS=NRAS+1                                                        SIMPL2  00161
      JR =  JRIG                                                         SIMPL2  00162
      IRACT(JRIG)=1                                                      SIMPL2  00163
      IRAS(NRAS)=JRIG                                                    SIMPL2  00164
      DO 280  LB=1,NB                                                    SIMPL2  00165
C                                                                        SIMPL2  00166
C     COMPUTE PAYOFF ENTRY (LB,JR)                                       SIMPL2  00167
C    SET ALLOCATION                                                      SIMPL2  00168
C                                                                        SIMPL2  00169
      IF(IBACT(LB) .EQ. 1) GO TO 280                                     SIMPL2  00170
      DO 278     MS=1,3                                                  SIMPL2  00171
      PROPR(MS,2) = PR(LR,MS)                                            SIMPL2  00172
      PROPB(MS,2) = PB(JR,MS)                                            SIMPL2  00173
  278 CONTINUE                                                           SIMPL2  00174
      CALL CAM(IDL2,IDU2)                                                SIMPL2  00175
      CALL SIMPL3(LB,JR)                                                 SIMPL2  00176
  280 CONTINUE                                                           SIMPL2  00177
C                                                                        SIMPL2  00178
C   ASSIGN PAYOFFS TO SIMPLEX MATRIX  PIVOT IN NEW CONSTRAINT            SIMPL2  00179
C    PIVOTING IN A ROW                                                   SIMPL2  00180
```

```
C                                                                       SIMPL2  00181
      NROWS=NROWS+1                                                     SIMPL2  00182
      DO 300   K=1,NB                                                   SIMPL2  00183
C   GIVEN JBIG                                                          SIMPL2  00184
      AS(NROWS,K)= -( V(K,JBIG)+GVA)                                    SIMPL2  00185
  300 CONTINUE                                                          SIMPL2  00186
      NROWM1=NROWS-1                                                    SIMPL2  00187
      DO 302  K=1,NROWM1                                                SIMPL2  00188
      AS(NROWS,NB+K) =0.0                                               SIMPL2  00189
      AS(K,NB+NROWS) = 0.0                                              SIMPL2  00190
  302 CONTINUE                                                          SIMPL2  00191
      BS(NROWS)=  -1.0                                                  SIMPL2  00192
      AS(NROWS,NB+NROWS)    =1.0                                        SIMPL2  00193
      IBASIC(NROWS)  =  NB + NROWS                                      SIMPL2  00194
      DO 301  J=1,NROWM1                                                SIMPL2  00195
C                                                                       SIMPL2  00197
C    PIVOT OUT VARIABLE FROM CONSTRAINT                                 SIMPL2  00198
C                                                                       SIMPL2  00199
      IF(IBASIC(J) .GT. NB) GO TO 301                                   SIMPL2  00196
      IBAS1=  IBASIC(J)                                                 SIMPL2  00200
      PIVCO =  V(IBAS1,JBIG) + GVA                                      SIMPL2  00201
      NBL= NB+NROWM1                                                    SIMPL2  00202
      DO 304  I=1,NBL                                                   SIMPL2  00203
      AS(NROWS,I) =  AS(NROWS,I)+PIVCO*AS(J,I)                          SIMPL2  00204
  304  CONTINUE                                                         SIMPL2  00205
      BS(NROWS)=BS(NROWS) +  PIVCO*BS(J)                                SIMPL2  00206
  301    CONTINUE                                                       SIMPL2  00207
C                                                                       SIMPL2  00208
C    NOW PIVOT TO RE-SOLVE PROBLEM   USE DUAL SIMPLEX METHOD            SIMPL2  00209
C   TO START  LET SLACK IN LAST ROW LEAVE BASIS                         SIMPL2  00210
C      SLACK VARIABLE IS NEGATIVE                                       SIMPL2  00211
C                                                                       SIMPL2  00212
      LEAVE1=NROWS                                                      SIMPL2  00213
  800 CONTINUE                                                          SIMPL2  00214
C    FIND ENTERING     BASIC VARIABLE                                   SIMPL2  00215
      ITCOL=NB+NROWS                                                    SIMPL2  00216
      INDIC=0                                                           SIMPL2  00217
      DO 801  I=1,ITCOL                                                 SIMPL2  00218
      IF(AS(LEAVE1,I) .GE. 0.0)  GO TO 801                              SIMPL2  00219
      IF(INDIC .EQ. 1) GO TO 802                                        SIMPL2  00220
      RENT=  CS(I)/AS(LEAVE1,I)                                         SIMPL2  00221
      IENTER =I                                                         SIMPL2  00222
      INDIC=1                                                           SIMPL2  00223
  802 CONTINUE                                                          SIMPL2  00224
      RATIO=  CS(I)/AS(LEAVE1,I)                                        SIMPL2  00225
      IF(RATIO .LE. RENT)  GO TO 801                                    SIMPL2  00226
      IENTER =I                                                         SIMPL2  00227
      RENT =  RATIO                                                     SIMPL2  00228
  801 CONTINUE                                                          SIMPL2  00229
C   IENTER IS THE VARIABLE TO ENTER THE BASIS                           SIMPL2  00230
      IBASIC(LEAVE1) =  IENTER                                          SIMPL2  00231
C   PIVOT                                                               SIMPL2  00232
      PIVCO=  AS(LEAVE1,IENTER)                                         SIMPL2  00233
      DO 805   I=1,ITCOL                                                SIMPL2  00234
      AS(LEAVE1,I)=  AS(LEAVE1,I)/PIVCO                                 SIMPL2  00235
      IF(I .EQ. IENTER) GO TO 805                                       SIMPL2  00236
      CS(I) =CS(I) - AS(LEAVE1,I)*CS(IENTER)                            SIMPL2  00237
  805  CONTINUE                                                         SIMPL2  00238
```

```
      BS(LEAVE1) = BS(LEAVE1)/PIVCO                                    SIMPL2  00239
      DO 803  J=1,NROWS                                                SIMPL2  00240
      IF(J .EQ. LEAVE1)  GO TO 803                                     SIMPL2  00241
      DO 804    I=1,ITCOL                                              SIMPL2  00242
      IF(I .EQ. IENTER) GO TO 804                                      SIMPL2  00243
      AS(J,I) =   AS(J,I)-AS(LEAVE1,I)*AS(J,IENTER)                    SIMPL2  00244
  804 CONTINUE                                                         SIMPL2  00245
      BS(J)= BS(J) - BS(LEAVE1)*AS(J,IENTER)                           SIMPL2  00246
  803 CONTINUE                                                         SIMPL2  00247
      XNEC=XNEC-BS(LEAVE1)*CS(IENTER)                                  SIMPL2  00248
      CS(IENTER )  =0.0                                                SIMPL2  00249
      DO 806   J=1,NROWS                                               SIMPL2  00250
       AS(J,IENTER) = 0.0                                              SIMPL2  00251
  806 CONTINUE                                                         SIMPL2  00252
      AS(LEAVE1,IENTER) = 1.0                                          SIMPL2  00253
C                                                                      SIMPL2  00254
C   TEST RHS FOR FEASIBILITY    FIND MOST NEGATIVE ENTRY TO LEAVE BASIS SIMPL2  00255
C                                                                      SIMPL2  00256
  810    INFEAS=0                                                      SIMPL2  00257
      TEST= 0.0                                                        SIMPL2  00258
      DO 811    J=1,NROWS                                              SIMPL2  00259
      IF(BS(J) .GE. 0.0)   GO TO 811                                   SIMPL2  00260
      INFEAS=1                                                         SIMPL2  00261
      IF(BS(J)  .GE. TEST)   GO TO 811                                 SIMPL2  00262
      TEST = BS(J)                                                     SIMPL2  00263
      LEAVE1=J                                                         SIMPL2  00264
  811 CONTINUE                                                         SIMPL2  00265
      IF(INFEAS-1)   840,800,800                                       SIMPL2  00266
C                                                                      SIMPL2  00267
C     FEASIBLE SOLUTION FOUND                                          SIMPL2  00268
C   FIND ACTIVE BLUE STRATEGIES                                        SIMPL2  00269
C                                                                      SIMPL2  00270
  840  CONTINUE                                                        SIMPL2  00271
      GVAL=   =1.0/XNEC                                                SIMPL2  00272
      IBC=0                                                            SIMPL2  00273
      DO 849  I=1,NB                                                   SIMPL2  00274
  849 X(I) = 0.0                                                       SIMPL2  00275
      DO 850     IROW=1,NROWS                                          SIMPL2  00276
C   SEE IF A SLACK VARIABLE IS BASIC                                   SIMPL2  00277
      IF(IBASIC(IROW)  .GT. NB)  GO TO 850                             SIMPL2  00278
       IBC=IBC+1                                                       SIMPL2  00279
      IBAS1=IBAS(IBC)=IBASIC(IROW)                                     SIMPL2  00280
      X(IBAS1)=    BS(IROW)*  GVAL                                     SIMPL2  00281
  850  CONTINUE                                                        SIMPL2  00282
      NBC=IBC                                                          SIMPL2  00283
      GO TO 2600                                                       SIMPL2  00284
      END                                                              SIMPL2  00285
```

F. SUBROUTINE SIMPL3

```
      SUBROUTINE SIMPL3(JB,JR)                                          SIMPL3  00002
CDUPDIM
      COMMON NKRD,NKRD,NKBA,NKRA                                        MAIN
      COMMON NID                                                        MAIN
      COMMON NPD,IDL1,IDU1,IDL2,IDU2,IDL3,IDU3                          MAIN
      COMMON IR0,JR0,KR0                                                MAIN
      COMMON IPRV,IPRU                                                  MAIN
      COMMON IREPLB,IREPLR                                              MAIN
      COMMON BDA(3,90),RDA(3,90)                                        MAIN
      COMMON BAA(4,90),RAA(4,90)                                        MAIN
      COMMON DBQRA,DRQRA                                                MAIN
      COMMON SHELB(90),SHELR(90),PBSHEL,PRSHEL                          MAIN
      COMMON BSHELK(90),RSHELK(90)                                      MAIN
      COMMON FBD(3),FRD(3),FBA(2),FRA(2)                                MAIN
      COMMON IDBSRC,IDRSRC                                              MAIN
      COMMON SORRB1(2,3),SORRB2(2,3),SORRR1(2,3),SORRR2(2,3)            MAIN
      COMMON IAA ,XNRAA,XNRAA,BALPHA(2,2),RALPHA(2,2)                   MAIN
      COMMON BIDRA(2,4),BADRI(4,2),RIDBA(2,4),RADBI(4,2)                MAIN
      COMMON BIKRA(2,4),BAKRI(4,2),RIKBA(2,4),RAKBI(4,2)                MAIN
      COMMON BSAMZR(2,2),RSAMZB(2,2)                                    MAIN
      COMMON IRJSH,BFRAC1,BFRAC2,RFRAC1,RFRAC2,FBSK,FRSK                MAIN
      COMMON BPASS(2),RPASS(2)                                          MAIN
      COMMON IBABA,IRABA,XNBAB,XNRAB,BPARK,RPARK                        MAIN
      COMMON BDRS(2),BDRNS(2),BKRS(2),BKRNS(2)                          MAIN
      COMMON RDBS(2),RDBNS(2),RKBS(2),RKRNS(2)                          MAIN
      COMMON   B4B,B4AL,B4AN1,B4AN2,B4AS1,B4AS2,B4NS1,B4NS2,B4SN1,B4SN2 MAIN
      COMMON   R4B,R4AL,R4AN1,R4AN2,R4AS1,R4AS2,R4NS1,R4NS2,R4SN1,R4SN2 MAIN
      COMMON EPS4                                                       MAIN
      COMMON NFRFA,FRFA(15),FA(15)                                      MAIN
      COMMON NFRBD,FRBD(15),BD(15)                                      MAIN
      COMMON NFRRD,FRRD(15),RD(15)                                      MAIN
      COMMON NB,NR                                                      MAIN
      COMMON PB(20,3),PR(20,3)                                          MAIN
      COMMON PROPB(3,3),PROPR(3,3)                                      MAIN
      COMMON MOE,MOET                                                   MAIN
      COMMON BCWGT,BSWGT(3),BQWGT(2),RCWGT,RSWGT(3),RQWGT(2)            MAIN
      COMMON GVA                                                        MAIN
C                                                                       MAIN
      COMMON U(11,11),SUB(11,11,11),SUR(11,11,11)                       MAIN
      COMMON V(11,11),SVB(11,11,11),SVR(11,11,11)                       MAIN
      COMMON W(11,11),SWB(11),SWR(11),VALUE                             MAIN
C                                                                       MAIN
      COMMON BDI(3,90),RDI(3,90)                                        MAIN
      COMMON BDD(3,90),RDD(3,90)                                        MAIN
      COMMON BGF(90), RGF(90)                                           MAIN
      COMMON BAI(4,90),RAI(4,90)                                        MAIN
      COMMON BAD(4,90),RAD(4,90)                                        MAIN
      COMMON BAF(90), RAF(90)                                           MAIN
      COMMON BF(90), RF(90)                                             MAIN
      COMMON FEBA(90)                                                   MAIN
      COMMON CBF(90),CRF(90)                                            MAIN
      COMMON CBAF(90),CRAF(90)                                          MAIN
C                                                                       MAIN
CDUPDIM                                                                 SIMPL3  00003
      DIMENSION IBAS(20),IRAS(20),IBASIC(20),AS(20,40),CS(40),BS(20)    SIMPL3  00004
      DIMENSION X(20),SUM(20),IBACT(20),IRACT(20)                       SIMPL3  00005
      MOT=6                                                             SIMPL3  00006
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```
    1  FORMAT(1H1/)                                                    SIMPL3  00007
       DO 723  I=1,20                                                  SIMPL3  00008
       IBACT(I)  = IRACT(I) = 0                                        SIMPL3  00009
       BS(I) =0.0                                                      SIMPL3  00010
       IBAS(I)  =IRAS(I) = IBASIC(I) =0                                SIMPL3  00011
       DO 721  J=1,40                                                  SIMPL3  00012
       CS(J) = 0.0                                                     SIMPL3  00013
       AS(I,J) = 0.0                                                   SIMPL3  00014
  721  CONTINUE                                                        SIMPL3  00015
  723  CONTINUE                                                        SIMPL3  00016
       DO 731  I=1,11                                                  SIMPL3  00017
       DO 732  J=1,11                                                  SIMPL3  00018
       U(I,J)=0.                                                       SIMPL3  00019
  732  CONTINUE                                                        SIMPL3  00020
  731  CONTINUE                                                        SIMPL3  00021
C      FIRST SETUP OF MATRIX  U                                        SIMPL3  00022
       KR=KR0                                                          SIMPL3  00023
       IF(KR0 .EQ. 0) KR=1                                             SIMPL3  00024
        IBIG=1                                                         SIMPL3  00025
       IRACT(KR)=1                                                     SIMPL3  00026
       DO 725  LB=1,NB                                                 SIMPL3  00027
C  COMPUTE PAYOFF OF ENTRY (LB,KR)                                     SIMPL3  00028
C  SET ALLOCATION                                                      SIMPL3  00029
       DO 740     MS=1,3                                               SIMPL3  00030
       PROPB(MS,3) = PB(LB,MS)                                         SIMPL3  00031
       PROPR(MS,3) = PR(KR,MS)                                         SIMPL3  00032
  740  CONTINUE                                                        SIMPL3  00033
       CALL CAM(IDL3,IDU3)                                             SIMPL3  00034
       GO TO (511,512,513,514,515),MOE                                 SIMPL3  00035
  511  U(LB,KR)= FEBA(MOET)                                            SIMPL3  00036
       GO TO 519                                                       SIMPL3  00037
  512  U(LB,KR) = CBF(MOET)-CRF(MOET)                                  SIMPL3  00038
       GO TO 519                                                       SIMPL3  00039
  513  U(LB,KR) = CBAF(MOET)-CRAF(MOET)                                SIMPL3  00040
       GO TO 519                                                       SIMPL3  00041
C      SURVIVING AIRCRAFT MOE IS MOE 4                                 SIMPL3  00042
  514  CONTINUE                                                        SIMPL3  00043
       SUMOE=BQWGT(1)*(BAI(1,MOET)-BAD(1,MOET))-                       SIMPL3  00044
     1       RQWGT(1)*(RAI(1,MOET)-RAD(1,MOET))                        SIMPL3  00045
       DO 5141  KA=2,4                                                 SIMPL3  00046
       MS=KA- 1                                                        SIMPL3  00047
       SUMOE=SUMOE+BSWGT(MS)*(BAI(KA,MOET)-BAD(KA,MOET))               SIMPL3  00048
     1     -          RSWGT(MS)*(RAI(KA,MOET)-RAD(KA,MOET))           SIMPL3  00049
 5141  CONTINUE                                                        SIMPL3  00050
       U(LB,KR)=SUMOE                                                  SIMPL3  00051
       GO TO 519                                                       SIMPL3  00052
C      QRA PENALTY MOE IS MOE 5                                        SIMPL3  00053
  515  CONTINUE                                                        SIMPL3  00054
       BA=BAI(1,MOET)-BAD(1,MOET)-DBQRA                                SIMPL3  00055
       RA=RAI(1,MOET)-RAD(1,MOET)-DRQRA                                SIMPL3  00056
       SUMOE=BCWGT*CBAF(MOET)-RCWGT*CRAF(MOET)                         SIMPL3  00057
       SUMOE=SUMOE+BQWGT(1)*AMAX1(0.0,BA)*BQWGT(2)*AMIN1(0.0,BA)       SIMPL3  00058
       SUMOE=SUMOE-RQWGT(1)*AMAX1(0.0,RA)-RQWGT(2)*AMIN1(0.0,RA)       SIMPL3  00059
       DO 5151  KA=2,4                                                 SIMPL3  00060
       MS=KA-1                                                         SIMPL3  00061
       SUMOE=SUMOE+BSWGT(MS)*(BAI(KA,MOET)-BAD(KA,MOET))               SIMPL3  00062
     1     -          RSWGT(MS)*(RAI(KA,MOET)-RAD(KA,MOET))           SIMPL3  00063
 5151  CONTINUE                                                        SIMPL3  00064
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      U(LB,KR)=SUMOE                                                    SIMPL3  00065
      GO TO 519                                                         SIMPL3  00066
  519 CONTINUE                                                          SIMPL3  00067
      IF(U(LB,KR) + GVA  .LE.  0.0)  GO TO 5191                         SIMPL3  00068
      GO TO 5192                                                        SIMPL3  00069
 5191     G= -U(LB,KR)                                                  SIMPL3  00070
      GO TO 1100                                                        SIMPL3  00071
 5192   CONTINUE                                                       SIMPL3  00072
      IF( LB .EQ. 1) BIG=U(1,KR)                                        SIMPL3  00073
      IF(U(LB,KR).LE. BIG)  GO TO 725                                   SIMPL3  00074
  726   IBIG= LB                                                        SIMPL3  00075
      BIG=U(LB,KR)                                                      SIMPL3  00076
  725 CONTINUE                                                          SIMPL3  00077
C   FIRST TIME SIMPLEX MATRIX SETUP                                     SIMPL3  00078
      DO 790    I=1,NB                                                  SIMPL3  00079
      PIVCO= U(IBIG,KR) + GVA                                           SIMPL3  00080
      AS(I,I)= ( U(I,KR) + GVA) /PIVCO                                  SIMPL3  00081
      CS(I) = 1. -AS(1,I)                                               SIMPL3  00082
  790 CONTINUE                                                          SIMPL3  00083
      AS(1,NB+1) =      -1.0/PIVCO                                      SIMPL3  00084
      CS(NB+1)  =  1.0/PIVCO                                            SIMPL3  00085
      XNEC=-1.0/PIVCO                                                   SIMPL3  00086
      BS(1)= -XNEC                                                      SIMPL3  00087
C                                                                       SIMPL3  00088
C    SET ACTIVE BLUE AND RED STRATEGIES  FIRST TIME                     SIMPL3  00089
C                                                                       SIMPL3  00090
      DO 750  I=1,NB                                                    SIMPL3  00091
      IBAS(I)= 0                                                        SIMPL3  00092
  750 X(I) = 0.0                                                        SIMPL3  00093
      IBAS(1)=IBIG                                                      SIMPL3  00094
      IBASIC(1) =  IBIG                                                 SIMPL3  00095
      X(IBIG)= 1.0                                                      SIMPL3  00096
      IRAS(1)= KR                                                       SIMPL3  00097
      DO 751  I=2,NR                                                    SIMPL3  00098
      IRAS(I)=0                                                         SIMPL3  00099
  751  CONTINUE                                                         SIMPL3  00100
      GVAL=PIVCO                                                        SIMPL3  00101
      NROWS=NRAS=NBC=1                                                  SIMPL3  00102
C                                                                       SIMPL3  00103
C  GENERAL LOOP FOR TESTING TOTAL FEASIBILITY                           SIMPL3  00104
C  DETERMINE IF CONSTRAINT IS VIOLATED   FIND MOST VIOLATED ONE         SIMPL3  00105
C                                                                       SIMPL3  00106
 2600   CONTINUE                                                        SIMPL3  00107
      KR=JBIG=IRAS(1)                                                   SIMPL3  00108
      INFEAS=0                                                          SIMPL3  00109
      DO 270   J=1,NR                                                   SIMPL3  00110
      SUM(J)= 0.0                                                       SIMPL3  00111
      SUM(KR)=GVAL-GVA                                                  SIMPL3  00112
      IF(IRACT(J) .EQ.  1) GO TO  270                                   SIMPL3  00113
      DO 260   I=1,NBC                                                  SIMPL3  00114
C                                                                       SIMPL3  00115
C    GROUP ACTIVE STRATEGIES TOGETHER                                   SIMPL3  00116
C   IF ROW ALREADY HAS BEEN COMPUTED, NEED NOT RECOMPUTE ENTRIES        SIMPL3  00117
C        JUST USE THEM                                                  SIMPL3  00118
C                                                                       SIMPL3  00119
      LB=IBAS(I)                                                        SIMPL3  00120
      IF(IRACT(LB) .EQ. 1)   GO TO 259                                  SIMPL3  00121
C                                                                       SIMPL3  00122
```

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C   FIND ENTRY    SET ALLOCATION,CALL CAM, ASSIGN TO U                    SIMPL3  00123
C                                                                         SIMPL3  00124
      DO 255    MS=1,3                                                    SIMPL3  00125
      PROPB(MS,3) = PB(LB,MS)                                             SIMPL3  00126
      PROPR(MS,3) = PR( J,MS)                                             SIMPL3  00127
  255 CONTINUE                                                            SIMPL3  00128
      CALL CAM(IDL3,IDU3)                                                 SIMPL3  00129
      GO TO (521,522,523,524,525),MOE                                     SIMPL3  00130
  521 U(LB, J)= FEBA(MOET)                                                SIMPL3  00131
      GO TO 529                                                           SIMPL3  00132
  522 U(LB, J) = CBF(MOET)-CRF(MOET)                                      SIMPL3  00133
      GO TO 529                                                           SIMPL3  00134
  523 U(LB, J) = CBAF(MOET)-CRAF(MOET)                                    SIMPL3  00135
      GO TO 529                                                           SIMPL3  00136
C     SURVIVING AIRCRAFT MOE IS MOE 4                                     SIMPL3  00137
  524 CONTINUE                                                            SIMPL3  00138
      SUMOE=BQWGT(1)*(BAI(1,MOET)-BAD(1,MOET))-                           SIMPL3  00139
     1       RQWGT(1)*(RAI(1,MOET)-RAD(1,MOET))                           SIMPL3  00140
      DO 5241  KA=2,4                                                     SIMPL3  00141
      MS=KA-1                                                             SIMPL3  00142
      SUMOE=SUMOE+BSWGT(MS)*(BAI(KA,MOET)-BAD(KA,MOET))                   SIMPL3  00143
     1    -         RSWGT(MS)*(RAI(KA,MOET)-RAD(KA,MOET))                 SIMPL3  00144
 5241 CONTINUE                                                            SIMPL3  00145
      U(LB, J)=SUMOE                                                      SIMPL3  00146
      GO TO 529                                                           SIMPL3  00147
C     QRA PENALTY MOE IS MOE 5                                            SIMPL3  00148
  525 CONTINUE                                                            SIMPL3  00149
      BA=BAI(1,MOET)-BAD(1,MOET)-DBQRA                                    SIMPL3  00150
      RA=RAI(1,MOET)-RAD(1,MOET)-DRQRA                                    SIMPL3  00151
      SUMOE=BCWGT*CBAF(MOET)-RCWGT*CRAF(MOET)                             SIMPL3  00152
      SUMOE=SUMOE+BQWGT(1)*AMAX1(0.0,BA)+BQWGT(2)*AMIN1(0.0,BA)           SIMPL3  00153
      SUMOE=SUMOE-RQWGT(1)*AMAX1(0.0,RA)-RQWGT(2)*AMIN1(0.0,RA)           SIMPL3  00154
      DO 5251  KA=2,4                                                     SIMPL3  00155
      MS=KA-1                                                             SIMPL3  00156
      SUMOE=SUMOE+BSWGT(MS)*(BAI(KA,MOET)-BAD(KA,MOET))                   SIMPL3  00157
     1    -         RSWGT(MS)*(RAI(KA,MOET)-RAD(KA,MOET))                 SIMPL3  00158
 5251 CONTINUE                                                            SIMPL3  00159
      U(LB, J)=SUMOE                                                      SIMPL3  00160
      GO TO 529                                                           SIMPL3  00161
  529 CONTINUE                                                            SIMPL3  00162
      IF(U(LB, J) + GVA  .LE.  0.0)   GO TO 5291                          SIMPL3  00163
      GO TO 5292                                                          SIMPL3  00164
 5291      G= -U(LB, J)                                                   SIMPL3  00165
      GO TO 1100                                                          SIMPL3  00166
 5292   CONTINUE                                                          SIMPL3  00167
  259 SUM(J) =  SUM(J) +  X(LB)*U(LB,J)                                   SIMPL3  00168
  260 CONTINUE                                                            SIMPL3  00169
  261 IF(SUM(J) .GE. GVAL-GVA) GO TO 270                                  SIMPL3  00170
  266 INFEAS=1                                                            SIMPL3  00171
      IF(SUM(J) .LT. SUM(JBIG)) JBIG=J                                    SIMPL3  00172
  270 CONTINUE                                                            SIMPL3  00173
      DO 268  I=1,NBC                                                     SIMPL3  00174
      LB=IBAS(I)                                                          SIMPL3  00175
      IBACT(LB) =1                                                        SIMPL3  00176
  268 CONTINUE                                                            SIMPL3  00177
      IF(INFEAS-1)  271,272,272                                           SIMPL3  00178
  271  CONTINUE                                                           SIMPL3  00179
C                                                                         SIMPL3  00180
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C     MATRIX GAME SOLUTION HAS BEEN FOUND          ASSIGN V(JB,JR)          SIMPL3  00181
C     FIND AND ASSIGN OPTIMAL BLUE AND RED STRATEGIES                       SIMPL3  00182
C   .IF DESIRED PRINT STRATEGY AND VALUE                                    SIMPL3  00183
C                                                                           SIMPL3  00184
      V(JB,JR) =  GVAL-GVA                                                  SIMPL3  00185
      DO 2701  J=1,NR                                                       SIMPL3  00186
 2701 SUR(JR,JR,J)= 0.0                                                     SIMPL3  00187
      DO 2711  IRC= 1, NRAS                                                 SIMPL3  00188
      IRAS1=IRAS(IRC)                                                       SIMPL3  00189
      SUR(JR,JR,IRAS1)= CS(NB+IRC)*GVAL                                     SIMPL3  00190
 2711 CONTINUE                                                              SIMPL3  00191
      DO 2712  I=1,NB                                                       SIMPL3  00192
 2712 SUB(JB,JR,1)=X(I)                                                     SIMPL3  00193
      IF(IPRO .EQ. 0) RETURN                                                SIMPL3  00194
      IF(NPO .EQ. 1)  WRITE(MOT,1)                                          SIMPL3  00195
      WRITE(MOT,407)  NPO                                                   SIMPL3  00196
  407 FORMAT(////1H , 31HPAYOFF MATRIX FOR GAME AT STAGE    ,I3  )          SIMPL3  00197
      WRITE(MOT,408)  (IRACT(I),I=1,NR)                                     SIMPL3  00198
  408 FORMAT(1H ,4X,11111)                                                  SIMPL3  00199
      DO 411  I=1,NB                                                        SIMPL3  00200
      WRITE(MOT,409)  IBACT(I), (U(I,J),J=1,NR)                             SIMPL3  00201
  409 FORMAT(1H ,I2,2X,11F11.3)                                             SIMPL3  00202
  410 CONTINUE                                                              SIMPL3  00203
      IF(NPO .EQ. 1)  GO TO 420                                             SIMPL3  00204
      WRITE(MOT,418)  JB,JR                                                 SIMPL3  00205
  418 FORMAT(1HO,3HJB=,I5,7H    JR=,I5)                                     SIMPL3  00206
      WRITE(MOT,419)   V(JB,JR)                                             SIMPL3  00207
  419 FORMAT(1HO,10HV(JB,JR)   ,F15.4)                                      SIMPL3  00208
      GO TO 422                                                             SIMPL3  00209
  420 WRITE(MOT,421)   V(JB,JR)                                             SIMPL3  00210
  421 FORMAT(1HO,13HGAME VALUE      ,F15.4)                                 SIMPL3  00211
  422 CONTINUE                                                              SIMPL3  00212
      WRITE(MOT, 423)  NPO                                                  SIMPL3  00213
  423 FORMAT(1HO,34HBLUE AND RED STRATEGIES FOR PERIOD ,I3)                 SIMPL3  00214
      WRITE(MOT,30)   (SUR(JB,JR,I),I=1,NR)                                 SIMPL3  00215
      WRITE(MOT,30)   (SUR(JB,JR,I),I=1,NB)                                 SIMPL3  00216
   30 FORMAT(1H ,4X,11F11.3)                                                SIMPL3  00217
      RETURN                                                                SIMPL3  00218
  272 CONTINUE                                                              SIMPL3  00219
C                                                                           SIMPL3  00220
C  NEED MORE RED STRATEGIES                                                 SIMPL3  00221
C    ENTER JBIG FOR RED                                                     SIMPL3  00222
C                                                                           SIMPL3  00223
      NRAS=NRAS+1                                                           SIMPL3  00224
      KR=JBIG                                                               SIMPL3  00225
      IRACT(JBIG)=1                                                         SIMPL3  00226
      IRAS(NRAS)=JBIG                                                       SIMPL3  00227
      DO 280  LR=1,NB                                                       SIMPL3  00228
C                                                                           SIMPL3  00229
C    COMPUTE PAYOFF ENTRY (LB,KR)                                           SIMPL3  00230
C    SET ALLOCATION                                                         SIMPL3  00231
C                                                                           SIMPL3  00232
      IF(IBACT(LB) .EQ. 1) GO TO 280                                        SIMPL3  00233
      DO 278     MS=1,3                                                     SIMPL3  00234
      PROPB(MS,3) = PB(LB,MS)                                               SIMPL3  00235
      PROPR(MS,3) = PR(KR,MS)                                               SIMPL3  00236
  278 CONTINUE                                                              SIMPL3  00237
      CALL CAM(IDL3,1003)                                                   SIMPL3  00238
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      GO TO (531,532,533,534,535),MOE                                   SIMPL3  00239
  531 U(LB,KR)= FEBA(MOET)                                              SIMPL3  00240
      GO TO 539                                                         SIMPL3  00241
  532 U(LB,KR) = CBF(MOET)-CRF(MOET)                                    SIMPL3  00242
      GO TO 539                                                         SIMPL3  00243
  533 U(LB,KR) = CBAF(MOET)-CRAF(MOET)                                  SIMPL3  00244
      GO TO 539                                                         SIMPL3  00245
C     SURVIVING AIRCRAFT MOE IS MOE 4                                   SIMPL3  00246
  534 CONTINUE                                                          SIMPL3  00247
      SUMOE=BQWGT(1)*(BAI(1,MOET)-BAD(1,MOET))-                         SIMPL3  00248
     1        RQWGT(1)*(RAI(1,MOET)-RAD(1,MOET))                        SIMPL3  00249
      DO 5341  KA=2,4                                                   SIMPL3  00250
      MS=KA-1                                                           SIMPL3  00251
      SUMOE=SUMOE+BSWGT(MS)*(BAI(KA,MOET)-BAD(KA,MOET))                 SIMPL3  00252
     1     -          RSWGT(MS)*(RAI(KA,MOET)-RAD(KA,MOET))             SIMPL3  00253
 5341 CONTINUE                                                          SIMPL3  00254
      U(LB,KR)=SUMOE                                                    SIMPL3  00255
      GO TO 539                                                         SIMPL3  00256
C     QRA PENALTY MOE IS MOE 5                                          SIMPL3  00257
  535 CONTINUE                                                          SIMPL3  00258
      BA=BAI(1,MOET)-BAD(1,MOET)-DBQRA                                  SIMPL3  00259
      RA=RAI(1,MOET)-RAD(1,MOET)-DRQRA                                  SIMPL3  00260
      SUMOE=BCWGT*CBAF(MOET)-RCWGT*CRAF(MOET)                           SIMPL3  00261
      SUMOE=SUMOE+BQWGT(1)*AMAX1(0.0,BA)+BQWGT(2)*AMIN1(0.0,BA)         SIMPL3  00262
      SUMOE=SUMOE-RQWGT(1)*AMAX1(0.0,RA)-RQWGT(2)*AMIN1(0.0,RA)         SIMPL3  00263
      DO 5351  KA=2,4                                                   SIMPL3  00264
      MS=KA- 1                                                          SIMPL3  00265
      SUMOE=SUMOE+BSWGT(MS)*(BAI(KA,MOET)-BAD(KA,MOET))                 SIMPL3  00266
     1     -          RSWGT(MS)*(RAI(KA,MOET)-RAD(KA,MOET))             SIMPL3  00267
 5351 CONTINUE                                                          SIMPL3  00268
      U(LB,KR)=SUMOE                                                    SIMPL3  00269
      GO TO 539                                                         SIMPL3  00270
  539 CONTINUE                                                          SIMPL3  00271
      IF(U(LB,KR) + GVA  .LE.  0.0)   GO TO 5391                        SIMPL3  00272
      GO TO 5392                                                        SIMPL3  00273
 5391      G= -U(LB,KR)                                                 SIMPL3  00274
      GO TO 1100                                                        SIMPL3  00275
 5392   CONTINUE                                                        SIMPL3  00276
  280 CONTINUE                                                          SIMPL3  00277
C                                                                       SIMPL3  00278
C   ASSIGN PAYOFFS TO SIMPLEX MATRIX  PIVOT IN NEW CONSTRAINT           SIMPL3  00279
C    PIVOTING IN A ROW                                                  SIMPL3  00280
C                                                                       SIMPL3  00281
      NROWS=NROWS+1                                                     SIMPL3  00282
      DO 300   K=1,NB                                                   SIMPL3  00283
C   GIVEN JBIG                                                          SIMPL3  00284
      AS(NROWS,K) =  -(U(K,JBIG)+GVA)                                   SIMPL3  00285
  300 CONTINUE                                                          SIMPL3  00286
      NROWM1=NROWS-1                                                    SIMPL3  00287
      DO 302  K=1,NROWM1                                                SIMPL3  00288
      AS(NROWS,NB+K) =0.0                                               SIMPL3  00289
      AS(K,NB+NROWS) = 0.0                                              SIMPL3  00290
  302 CONTINUE                                                          SIMPL3  00291
      BS(NROWS)=  -1.0                                                  SIMPL3  00292
      AS(NROWS,NB+NROWS)   =1.0                                         SIMPL3  00293
      IBASIC(NROWS)  =  NB +  NROWS                                     SIMPL3  00294
      DO 301  J=1,NROWM1                                                SIMPL3  00295
C                                                                       SIMPL3  00297
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C     PIVOT OUT VARIABLE FROM CONSTRAINT                                SIMPL3  00298
C     NEEDNT WORRY ABOUT SLACKS                                         SIMPL3  00299
C                                                                       SIMPL3  00300
      IF(IBASIC(J) .GT. NB) GO TO 301                                   SIMPL3  00296
      IBAS1= IBASIC(J)                                                  SIMPL3  00301
      PIVCO=U(IBAS1,JBIG)+GVA                                           SIMPL3  00302
      NBL= NB+NROWM1                                                    SIMPL3  00303
      DO 304 I=1,NBL                                                    SIMPL3  00304
      AS(NROWS,I) = AS(NROWS,I)+PIVCO*AS(J,I)                           SIMPL3  00305
  304 CONTINUE                                                          SIMPL3  00306
      BS(NROWS)=BS(NROWS) + PIVCO*BS(J)                                 SIMPL3  00307
  301 CONTINUE                                                          SIMPL3  00308
C                                                                       SIMPL3  00309
C     NOW PIVOT TO RE-SOLVE PROBLEM  USE DUAL SIMPLEX METHOD            SIMPL3  00310
C     TO START  LET SLACK IN LAST ROW LEAVE BASIS                       SIMPL3  00311
C          SLACK VARIABLE IS NEGATIVE                                   SIMPL3  00312
C                                                                       SIMPL3  00313
      LEAVE1=NROWS                                                      SIMPL3  00314
  800 CONTINUE                                                          SIMPL3  00315
C     FIND ENTERING     BASIC VARIABLE                                  SIMPL3  00316
      ITCOL=NB+NROWS                                                    SIMPL3  00317
      INDIC=0                                                           SIMPL3  00318
      DO 801 I=1,ITCOL                                                  SIMPL3  00319
      IF(AS(LEAVE1,I) .GE. 0.0) GO TO 801                               SIMPL3  00320
      IF(INDIC .EQ. 1) GO TO 802                                        SIMPL3  00321
      RENT= CS(I)/AS(LEAVE1,I)                                          SIMPL3  00322
      IENTER =I                                                         SIMPL3  00323
      INDIC=1                                                           SIMPL3  00324
  802 CONTINUE                                                          SIMPL3  00325
      RATIO= CS(I)/AS(LEAVE1,I)                                         SIMPL3  00326
      IF(RATIO .LE. RENT) GO TO 801                                     SIMPL3  00327
      IENTER =I                                                         SIMPL3  00328
      RENT = RATIO                                                      SIMPL3  00329
  801 CONTINUE                                                          SIMPL3  00330
C     IENTER IS THE VARIABLE TO ENTER THE BASIS                         SIMPL3  00331
      IBASIC(LEAVE1) = IENTER                                           SIMPL3  00332
C     PIVOT                                                             SIMPL3  00333
      PIVCO= AS(LEAVE1,IENTER)                                          SIMPL3  00334
      DO 805 I=1,ITCOL                                                  SIMPL3  00335
      AS(LEAVE1,I)= AS(LEAVE1,I)/PIVCO                                  SIMPL3  00336
      IF(I .EQ. IENTER) GO TO 805                                       SIMPL3  00337
      CS(I) =CS(I) - AS(LEAVE1,I)*CS(IENTER)                            SIMPL3  00338
  805 CONTINUE                                                          SIMPL3  00339
      BS(LEAVE1) = BS(LEAVE1)/PIVCO                                     SIMPL3  00340
      DO 803 J=1,NROWS                                                  SIMPL3  00341
      IF(J .EQ. LEAVE1) GO TO 803                                       SIMPL3  00342
      DO 804 I=1,ITCOL                                                  SIMPL3  00343
      IF(I .EQ. IENTER) GO TO 804                                       SIMPL3  00344
      AS(J,I) = AS(J,I)-AS(LEAVE1,I)*AS(J,IENTER)                       SIMPL3  00345
  804 CONTINUE                                                          SIMPL3  00346
      BS(J)= BS(J) - BS(LEAVE1)*AS(J,IENTER)                            SIMPL3  00347
  803 CONTINUE                                                          SIMPL3  00348
      XNEC=XNEC-BS(LEAVE1)*CS(IENTER)                                   SIMPL3  00349
      CS(IENTER ) =0.0                                                  SIMPL3  00350
      DO 806 J=1,NROWS                                                  SIMPL3  00351
      AS(J,IENTER) = 0.0                                                SIMPL3  00352
  806 CONTINUE                                                          SIMPL3  00353
      AS(LEAVE1,IENTER) = 1.0                                           SIMPL3  00354
```

```
C                                                                       SIMPL3  00355
C   TEST RHS FOR FEASIBILITY    FIND MOST NEGATIVE ENTRY TO LEAVE BASIS SIMPL3  00356
C                                                                       SIMPL3  00357
  810     INFEAS=0                                                      SIMPL3  00358
          TEST= 0.0                                                     SIMPL3  00359
          DO 811    J=1,NROWS                                           SIMPL3  00360
          IF(BS(J) .GE. 0.0)   GO TO 811                                SIMPL3  00361
          INFEAS=1                                                      SIMPL3  00362
          IF(BS(J)  .GE. TEST)   GO TO 811                              SIMPL3  00363
          TEST =  BS(J)                                                 SIMPL3  00364
          LEAVE1=J                                                      SIMPL3  00365
  811     CONTINUE                                                      SIMPL3  00366
          IF(INFEAS-1)   840,800,800                                    SIMPL3  00367
C                                                                       SIMPL3  00368
C     FEASIBLE SOLUTION FOUND                                           SIMPL3  00369
C    FIND ACTIVE BLUE STRATEGIES                                        SIMPL3  00370
C                                                                       SIMPL3  00371
  840   CONTINUE                                                        SIMPL3  00372
          GVAL=   =1.0/XNEC                                             SIMPL3  00373
          IBC=0                                                         SIMPL3  00374
          DO 849   I=1,NB                                               SIMPL3  00375
  849   X(I) = 0.0                                                      SIMPL3  00376
          DO 850      IROW=1,NROWS                                      SIMPL3  00377
C   SEE IF A SLACK VARIABLE IS BASIC                                    SIMPL3  00378
          IF(IBASIC(IROW)  .GT. NB)  GO TO 850                          SIMPL3  00379
           IBC=IBC+1                                                    SIMPL3  00380
          IBAS1=IBAS(IBC)=IBASIC(IROW)                                  SIMPL3  00381
          X(IBAS1)=    BS(IROW)*  GVAL                                  SIMPL3  00382
  850   CONTINUE                                                        SIMPL3  00383
          NBC=IBC                                                       SIMPL3  00384
          GO TO 2600                                                    SIMPL3  00385
 1100   CONTINUE                                                        SIMPL3  00386
          WRITE(MOT,1101)   G                                           SIMPL3  00387
 1101   FORMAT(1H0, 34HGVA TOO SMALL, SHOULD BE AT LEAST  ,F10.2)       SIMPL3  00388
          STOP 223                                                      SIMPL3  00389
          END                                                           SIMPL3  00390
```

G. SUBROUTINE CAM

```
      SUBROUTINE CAM(IDL,IDU)                                          CAM    00002
C     OPTSA 11                                                         CAM    00003
COUPDIM
      COMMON NKBD,NKRD,NKBA,NKRA                                       MAIN
      COMMON NID                                                       MAIN
      COMMON NPD,IDL1,IDU1,IDL2,IDU2,IDL3,IDU3                         MAIN
      COMMON IRU,JRU,KRU                                               MAIN
      COMMON IPRV,IPRU                                                 MAIN
      COMMON IREPLR,IREPLR                                             MAIN
      COMMON BDA(3,90),RDA(3,90)                                       MAIN
      COMMON BAA(4,90),RAA(4,90)                                       MAIN
      COMMON DBURA,DRURA                                               MAIN
      COMMON SHELB(90),SHELR(90),PBSHEL,PRSHEL                         MAIN
      COMMON BSHELK(90),RSHELK(90)                                     MAIN
      COMMON FBD(3),FRD(3),FBA(2),FRA(2)                               MAIN
      COMMON IDBSRC,IDRSRC                                             MAIN
      COMMON SORRB1(2,3),SORRB2(2,3),SORRR1(2,3),SORRR2(2,3)           MAIN
      COMMON IAA ,XNBAA,XNRAA,BALPHA(2,2),RALPHA(2,2)                  MAIN
      COMMON BIDRA(2,4),BADRI(4,2),RIDBA(2,4),RADBI(4,2)               MAIN
      COMMON BIKRA(2,4),BAKRI(4,2),RIKBA(2,4),RAKBI(4,2)               MAIN
      COMMON BSAMZR(2,2),RSAMZB(2,2)                                   MAIN
      COMMON IR3SM,BFRAC1,BFRAC2,RFRAC1,RFRAC2,FBSK,FRSK               MAIN
      COMMON BPASS(2),RPASS(2)                                         MAIN
      COMMON IBABA,IRABA,XNBAB,XNRAB,BPARK,RPARK                       MAIN
      COMMON BDRS(2),BDRNS(2),BKRS(2),BKRNS(2)                         MAIN
      COMMON RDBS(2),RDBNS(2),RKBS(2),RKBNS(2)                         MAIN
      COMMON   B4B,B4AL,B4AN1,B4AN2,B4AS1,B4AS2,B4NS1,B4NS2,B4SN1,B4SN2 MAIN
      COMMON   R4B,R4AL,R4AN1,R4AN2,R4AS1,R4AS2,R4NS1,R4NS2,R4SN1,R4SN2 MAIN
      COMMON EPS4                                                      MAIN
      COMMON NFRFA,FRFA(15),FA(15)                                     MAIN
      COMMON NFRBD,FRBD(15),BD(15)                                     MAIN
      COMMON NFRRD,FRRD(15),RD(15)                                     MAIN
      COMMON NB,NR                                                     MAIN
      COMMON PB(20,3),PR(20,3)                                         MAIN
      COMMON PROPB(3,3),PROPR(3,3)                                     MAIN
      COMMON MOE,MOEI                                                  MAIN
      COMMON BCWGT,BSWGT(3),BGWGT(2),RCWGT,RSWGT(3),RGWGT(2)           MAIN
      COMMON GVA                                                       MAIN
C                                                                      MAIN
      COMMON U(11,11),SUB(11,11,11),SUR(11,11,11)                      MAIN
      COMMON V(11,11),SVB(11,11,11),SVR(11,11,11)                      MAIN
      COMMON W(11,11),SWB(11),SWR(11),VALUE                            MAIN
C                                                                      MAIN
      COMMON BDI(3,90),RDI(3,90)                                       MAIN
      COMMON BDD(3,90),RDD(3,90)                                       MAIN
      COMMON BGF(90), RGF(90)                                          MAIN
      COMMON BAI(4,90),RAI(4,90)                                       MAIN
      COMMON BAD(4,90),RAD(4,90)                                       MAIN
      COMMON BAF(90), RAF(90)                                          MAIN
      COMMON BF(90), RF(90)                                            MAIN
      COMMON FEBA(90)                                                  MAIN
      COMMON CBF(90),CRF(90)                                           MAIN
      COMMON CBAF(90),CRAF(90)                                         MAIN
C                                                                      MAIN
COUPDIM                                                                CAM    00004
C                                                                      CAM    00005
      COMMON/CAMVAR/  SURRB(2,3),SURRR(2,3)                            CAM    00006
```

```
      COMMON/CAMVAR/  BA(2,3),RA(2,3),BS(2,3),RS(2,3)                    CAM   00007
      COMMON/CAMVAR/ BANAA(2,3),RAKAA(2,3),BSKAA(2,3),RSKAA(2,3)         CAM   00008
      COMMON/CAMVAR/ BAL(2,3),RAL(2,3),BSL(2,3),RSL(2,3)                 CAM   00009
      COMMON/CAMVAR/  VBIDRA(2),VBADRI(4),VRIDBA(2),VRADBI(4)            CAM   00010
      COMMON/CAMVAR/  BSENG(2,2),RSENG(2,2)                              CAM   00011
      COMMON/CAMVAR/ BPENG(2),RPENG(2)                                   CAM   00012
      COMMON/CAMVAR/ BSFB(2,3),BAFB(2,3),RSFB(2,3),RAFB(2,3)             CAM   00013
      COMMON/CAMVAR/ BAVUL(4),RAVUL(4),PBABA(2),PRABA(2)                 CAM   00014
      COMMON/CAMVAR/ BPOPS(4),BPOPNS(4),RPOPS(4),RPOPNS(4)               CAM   00015
      COMMON/CAMVAR/ VBURS,VBURNS,VBKRS,VBKRNS                           CAM   00016
      COMMON/CAMVAR/ VRUBS,VRUBNS,VRKBS,VRKBNS                           CAM   00017
      INTEGER TY,TYB,TYR                                                 CAM   00018
      DIMENSION BANF(2,3),RANF(2,3)                                      CAM   00019
      F14(Q)= A2-A3*ALOG(A4)*A4**Q-A5*ALOG(A6)*A6**Q                     CAM   00020
      F24(Q)= -A3*(ALOG(A4)**2)*A4**Q-A5*(ALOG(A6)**2)*A6**Q             CAM   00021
       CALL CLRCOM(3,IDL,IDU)                                            CAM   00022
C                                                                        CAM   00023
C --- DO LOOP ON ID                                                      CAM   00024
C                                                                        CAM   00025
      DO 3000 ID=IDL,IDU                                                 CAM   00026
      CALL CAMCLR                                                        CAM   00027
C                                                                        CAM   00028
C --- STARTING DIVISION INVENTORY FOR ID -- B AND R                      CAM   00029
C                                                                        CAM   00030
      IF(ID-1) 1510,1510,1520                                            CAM   00031
 1510 DO 1512 KBD=1,NKBD                                                 CAM   00032
 1512 BDI(KBD,ID) = BDA(KBD,ID)                                          CAM   00033
      DO 1514 KRD=1,NKRD                                                 CAM   00034
 1514 RDI(KRD,ID) = RDA(KRD,ID)                                          CAM   00035
      GO TO 1600                                                         CAM   00036
 1520 IDM1 = ID-1                                                        CAM   00037
      DO 1522 KBD=1,NKBD                                                 CAM   00038
 1522 BDI(KBD,ID) = BDI(KBD,IDM1) - BDD(KBD,IDM1) + BDA(KBD,ID)          CAM   00039
      DO 1524 KRD=1,NKRD                                                 CAM   00040
      RDI(KRD,ID)=RDI(KRD,IDM1)-RDD(KRD,IDM1) + RDA(KRD,ID)              CAM   00041
 1524 CONTINUE                                                           CAM   00042
C                                                                        CAM   00043
C --- GROUND FIREPOWER FOR ID -- B AND R                                 CAM   00044
C                                                                        CAM   00045
 1600 BGF(ID) = 0.                                                       CAM   00046
      DO 1610 KBD=1,NKBD                                                 CAM   00047
 1610 BGF(ID) = BDI(KBD,ID)* FBD(KBD)                                    CAM   00048
      RGF(ID) = 0.                                                       CAM   00049
      DO 1620 KRD=1,NKRD                                                 CAM   00050
      RGF(ID)=  RDI(KRD,ID)*FRD(KRD)                                     CAM   00051
 1620 CONTINUE                                                           CAM   00052
C                                                                        CAM   00053
C     SHELTER INVENTORY FOR ID--B AND R                                  CAM   00054
C                                                                        CAM   00055
      IF(ID-1) 1621,1621,1622                                            CAM   00056
 1622 CONTINUE                                                           CAM   00057
      SHELB(ID) = SHELB(IDM1) - BSHELK(IDM1)                             CAM   00058
      SHELR(ID) = SHELR(IDM1) - RSHELK(IDM1)                             CAM   00059
      GO TO 1623                                                         CAM   00060
 1621 CONTINUE                                                           CAM   00061
      SHELB(1) = PBSHEL                                                  CAM   00062
      SHELR(1) = PRSHEL                                                  CAM   00063
 1623 CONTINUE                                                           CAM   00064
```

```
C
C     STARTING AIRCRAFT INVENTORY FOR ID-- B AND R                    CAM  00065
C                                                                     CAM  00066
      IF(ID-1)2010,2010,2020                                          CAM  00067
 2010 DO 2012 KBA=1,NKBA                                              CAM  00068
 2012 BAI(KBA,ID)=BAA(KBA,ID)                                         CAM  00069
      DO 2014 KRA=1,NKRA                                              CAM  00070
 2014 RAI(KRA,ID)=RAA(KRA,ID)                                         CAM  00071
      GO TO 2050                                                      CAM  00072
 2020 IDM1=ID-1                                                       CAM  00073
      DO 2022 KBA=1,NKBA                                              CAM  00074
 2022 BAI(KBA,ID)=BAI(KBA,IDM1)-BAD(KBA,IDM1)+BAA(KBA,ID)             CAM  00075
      DO 2024 KRA=1,NKRA                                              CAM  00076
      RAI(KRA,ID)=RAI(KRA,IDM1)-RAD(KRA,IDM1)+RAA(KRA,ID)             CAM  00077
 2024 CONTINUE                                                        CAM  00078
C                                                                     CAM  00079
C     DETERMINATION OF BRA AND                                        CAM  00080
C             AIRCRAFT ASSIGNMENTS--BLUE AND RED                      CAM  00081
C                                                                     CAM  00082
 2050 CONTINUE                                                        CAM  00083
      IF(BAI(1,ID)-DBQRA) 2051,2052,2052                              CAM  00084
 2051 ABQRA=BAI(1,ID)                                                 CAM  00085
      BAAS=0.0                                                        CAM  00086
      GO TO 2053                                                      CAM  00087
 2052 ABQRA=DBQRA                                                     CAM  00088
      BAAS= BAI(1,ID)-DBQRA                                           CAM  00089
 2053 IF(RAI(1,ID)-DRQRA) 2054,2055,2055                              CAM  00090
 2054 ARQRA=RAI(1,ID)                                                 CAM  00091
      RAAS=0.0                                                        CAM  00092
      GO TO 2056                                                      CAM  00093
 2055 ARQRA=DRQRA                                                     CAM  00094
      RAAS= RAI(1,ID)-DRQRA                                           CAM  00095
 2056 CONTINUE                                                        CAM  00096
 2060 CONTINUE                                                        CAM  00097
      IPD=1                                                           CAM  00098
      IF(ID .GE. IDL2) IPD=2                                          CAM  00099
      IF(ID .GE. IDL3) IPD=3                                          CAM  00100
      SUMB=SUMR =0.0                                                  CAM  00101
      DO 2061  MS= 1,3                                                CAM  00102
      BA(1,MS)=PROPB(MS,IPD)*BAAS                                     CAM  00103
      RA(1,MS)=PROPR(MS,IPD)*RAAS                                     CAM  00104
      BA(2,MS) = BAI(MS+1,ID)                                         CAM  00105
      RA(2,MS) = RAI(MS+1,ID)                                         CAM  00106
      SUMB=SUMB+ BA(1,MS)                                             CAM  00107
      SUMR=SUMR+ RA(1,MS)                                             CAM  00108
 2061 CONTINUE                                                        CAM  00109
      BANAS= BAAS-SUMB                                                CAM  00110
      RANAS= RAAS-SUMR                                                CAM  00111
C                                                                     CAM  00112
C     SORTIE RATES FOR BLUE AND RED                                   CAM  00113
C                                                                     CAM  00114
      IF(ID-IDBSRC) 2080,2085,2085                                    CAM  00115
 2080 CONTINUE                                                        CAM  00116
      DO 2081  IY=1,2                                                 CAM  00117
      DO 2081  MS=1,3                                                 CAM  00118
      SORRB(IY,MS) = SURRB1(IY,MS)                                    CAM  00119
 2081 CONTINUE                                                        CAM  00120
      BFRBC=BFRBC1                                                    CAM  00121
                                                                      CAM  00122
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      GO TO 2089                                                        CAM  00123
 2085 CONTINUE                                                          CAM  00124
      DO 2086  IY=1,2                                                   CAM  00125
      DO 2086  MS=1,3                                                   CAM  00126
      SORRB(IY,MS) = SORRB2(IY,MS)                                      CAM  00127
 2086 CONTINUE                                                          CAM  00128
      BFRAC=BFRAC2                                                      CAM  00129
 2089 CONTINUE                                                          CAM  00130
      IF(ID-IDRSRC) 2090,2095,2095                                      CAM  00131
 2090 CONTINUE                                                          CAM  00132
      DO 2091  IY=1,2                                                   CAM  00133
      DO 2091  MS=1,3                                                   CAM  00134
      SORRR(IY,MS) = SORRR1(IY,MS)                                      CAM  00135
 2091 CONTINUE                                                          CAM  00136
      RFRAC=RFRAC1                                                      CAM  00137
      GO TO 2100                                                        CAM  00138
 2095 CONTINUE                                                          CAM  00139
      DO 2096 IY=1,2                                                    CAM  00140
      DO 2096  MS=1,3                                                   CAM  00141
      SORRR(IY,MS) = SORRR2(IY,MS)                                      CAM  00142
 2096 CONTINUE                                                          CAM  00143
      RFRAC=RFRAC2                                                      CAM  00144
C                                                                       CAM  00145
C                                                                       CAM  00146
C   AIRCRAFT DESTRUCTION -- AIR TO AIR INTERACTION                      CAM  00147
C                                                                       CAM  00148
C                                                                       CAM  00149
 2100 CONTINUE                                                          CAM  00150
C                                                                       CAM  00151
C  SORTIES FOR BLUE AND RED                                             CAM  00152
C                                                                       CAM  00153
      DO 2101  IY=1,2                                                   CAM  00154
      DO 2101  MS=1,3                                                   CAM  00155
      BS(IY,MS) = BA(IY,MS)*SORRB(IY,MS)                                CAM  00156
      RS(IY,MS) = RA(IY,MS)*SORRR(IY,MS)                                CAM  00157
      BANF(IY,MS)=RANF(IY,MS)= 0.0                                      CAM  00158
      IF(SORRB(IY,MS) .LT. 1.0) BANF(IY,MS)=BA(IY,MS)*(1.-SORRB(IY,MS)) CAM  00159
      IF(SORRR(IY,MS) .LT. 1.0) RANF(IY,MS)=RA(IY,MS)*(1.-SORRR(IY,MS)) CAM  00160
 2101 CONTINUE                                                          CAM  00161
      BITS=  BS(1,3) + BS(2,3)                                          CAM  00162
      BATS= BS(1,1) + BS(1,2) +BS(2,1) + BS(2,2)                        CAM  00163
      RITS=RS(1,3) + RS(2,3)                                            CAM  00164
      RATS= RS(1,1)+RS(1,2)+RS(2,1)+RS(2,2)                             CAM  00165
C                                                                       CAM  00166
C    CHECKS                                                             CAM  00167
C                                                                       CAM  00168
      IBIRA=IBARI=0                                                     CAM  00169
      IF(RATS .LT. 1. .OR. BITS .LT. 1. )    IBIRA=1                    CAM  00170
      IF(RITS .LT. 1. .OR. BATS .LT. 1. )    IBARI=1                    CAM  00171
C                                                                       CAM  00172
C    COMPUTING AVERAGE DETECTION PARAMETERS                             CAM  00173
C                                                                       CAM  00174
 2180 CONTINUE                                                          CAM  00175
      IF(IBIRA .EQ. 1) GO TO 2185                                       CAM  00176
       DO      2181       TYB     =1,2                                  CAM  00177
      SUM= 0.0                                                          CAM  00178
       DO      2182       TYR     =1,2                                  CAM  00179
       DO      2182       MSR     =1,2                                  CAM  00180
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```
      INDR= MSR+ 2*(IYR-1)                                              CAM  00181
      SUM= SUM+    BIDRA(TYB,INDR)*RS(TYR,MSR)                          CAM  00182
2182   CONTINUE                                                         CAM  00183
      VRIDRA(TYB)=  SUM/RATS                                            CAM  00184
2181   CONTINUE                                                         CAM  00185
      IF( IAA .EQ. 1) GO TO 2185                                        CAM  00186
      DO 2183  IYR=1,2                                                  CAM  00187
      DO 2183  MSR=1,2                                                  CAM  00188
      INDR= MSR+ 2*(IYR-1)                                              CAM  00189
      SUM= 0.0                                                          CAM  00190
      DO 2184  IYB=1,2                                                  CAM  00191
      SUM= SUM+    RADBI(INDR,TYB)*BS(TYB,3)                            CAM  00192
2184  CONTINUE                                                          CAM  00193
      VRADBI(INDR)= SUM/RIIS                                            CAM  00194
2183  CONTINUE                                                          CAM  00195
2185  CONTINUE                                                          CAM  00196
      IF(IBARI .EQ. 1) GO TO 2200                                       CAM  00197
       DO      2186        IYR    =1,2                                  CAM  00198
      SUM= 0.0                                                          CAM  00199
       DO      2187        TYB    =1,2                                  CAM  00200
       DO      2187        MSB    =1,2                                  CAM  00201
      INDB= MSB+ 2*(IYB-1)                                              CAM  00202
      SUM= SUM+    RIDBA(TYR,INDB)*BS(TYB,MSB)                          CAM  00203
2187   CONTINUE                                                         CAM  00204
      VRIDBA(TYR)=SUM/BATS                                              CAM  00205
2186   CONTINUE                                                         CAM  00206
      IF( IAA .EQ. 1) GO TO 2200                                        CAM  00207
      DO 2188  IYB=1,2                                                  CAM  00208
      DO 2188  MSB=1,2                                                  CAM  00209
      INDB= MSB+ 2*(IYB-1)                                              CAM  00210
      SUM= 0.0                                                          CAM  00211
       DO 2189  IYR=1,2                                                 CAM  00212
      SUM= SUM+    BADRI(INDB,TYR)*RS(TYR,3)                            CAM  00213
2189  CONTINUE                                                          CAM  00214
      VBADRI(INDB)=SUM/RITS                                             CAM  00215
2188  CONTINUE                                                          CAM  00216
2200  CONTINUE                                                          CAM  00217
C                                                                       CAM  00218
C    CHOOSE DESIRED METHOD OF ATTRITION                                 CAM  00219
C       STATEMENT NUMBERS IN 2200S FOR FIRST METHOD                     CAM  00220
C       STATEMENT NUMBERS IN 2300S FOR SECOND METHOD                    CAM  00221
C                                                                       CAM  00222
      IF( IAA .EQ. 1) GO TO 2300                                        CAM  00223
C                                                                       CAM  00224
C    BLUE INTERCEPTORS,  RED ATTACKERS                                  CAM  00225
C                                                                       CAM  00226
      IF(IBIRA .EQ. 1) GO TO 2249                                       CAM  00227
C                                                                       CAM  00228
C  BLUE INTERCEPTORS KILL RED ATTACKERS                                 CAM  00229
C                                                                       CAM  00230
      RATS1=RATS/XNBAA                                                  CAM  00231
       DO      2210        TYR    =1,2                                  CAM  00232
       DO      2210        MSR    =1,2                                  CAM  00233
      INDR= MSR+ 2*(IYR-1)                                              CAM  00234
      PROD=1.0                                                          CAM  00235
       DO      2220        TYB    =1,2                                  CAM  00236
      X1= (1.-(1.-VBIDRA(TYB))**RATS1)/RATS1                            CAM  00237
      X15=AMAX1(0.0, 1.-RIKRA(TYB,INDR)*X1)                             CAM  00238
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```
      PROD= PROD* X15**(BS(TYB,3)/XNBAA)                                CAM  00239
 2220  CONTINUE                                                         CAM  00240
      RSKAA(TYR,MSR)=RS(TYR,MSR)*(1.-PROD)                              CAM  00241
 2210  CONTINUE                                                         CAM  00242
C                                                                       CAM  00243
C     RED ATTACKERS KILL BLUE INTERCEPTORS                              CAM  00244
C                                                                       CAM  00245
      BITS1=BITS/XNBAA                                                  CAM  00246
       DO      2230          TYB     =1,2                             CAM  00247
      PROD=1.0                                                          CAM  00248
       DO      2240          TYR     =1,2                             CAM  00249
       DO      2240          MSR     =1,2                             CAM  00250
      INDR= MSR+ 2*(TYR-1)                                              CAM  00251
      X1=(1.-(1.-VRADBI(INDR))**BITS1)/BITS1                            CAM  00252
      X15=AMAX1(0.0, 1.-RAKBI(INDR,TYB)*X1)                             CAM  00253
      PROD=PROD*  X15**(RS(TYR,MSR)/XNBAA)                              CAM  00254
 2240  CONTINUE                                                         CAM  00255
      BSKAA(TYB,3)=  BS(TYB,3)*(1.-PROD)                                CAM  00256
 2230  CONTINUE                                                         CAM  00257
       GO TO 2250                                                       CAM  00258
 2299 RAKAA(1,1) =RAKAA(1,2)=RAKAA(2,1)=RAKAA(2,2)=0.0                  CAM  00259
      RSKAA(1,1)=RSKAA(1,2)=RSKAA(2,1)=RSKAA(2,2) = 0.0                 CAM  00260
      BSKAA(1,3) = BSKAA(2,3) = 0.0                                     CAM  00261
      BAKAA(1,3) =BAKAA(2,3)=0.0                                        CAM  00262
 2250  CONTINUE                                                         CAM  00263
C                                                                       CAM  00264
C     RED INTERCEPTORS, BLUE ATTACKERS                                  CAM  00265
C                                                                       CAM  00266
      IF(IBARI .EQ. 1) GO TO 2299                                       CAM  00267
C                                                                       CAM  00268
C     RED INTERCEPTORS KILL BLUE ATTACKERS                              CAM  00269
C                                                                       CAM  00270
      BATS1=BATS/XNRAA                                                  CAM  00271
       DO      2260          TYB     =1,2                             CAM  00272
       DO      2260          MSB     =1,2                             CAM  00273
      INDB= MSB+ 2*(TYB-1)                                              CAM  00274
      PROD=1.0                                                          CAM  00275
       DO      2270          TYR     =1,2                             CAM  00276
      X1= (1.-(1.-VRIDBA(TYR))**BATS1)/BATS1                            CAM  00277
      X15=AMAX1(0.0, 1.-RIKBA(TYR,INDB)*X1)                             CAM  00278
      PROD =PROD *X15**(RS(TYR,3)/XNRAA)                                CAM  00279
 2270  CONTINUE                                                         CAM  00280
      BSKAA(TYB,MSB)=BS(TYB,MSB)*(1.-PROD)                              CAM  00281
 2260  CONTINUE                                                         CAM  00282
C                                                                       CAM  00283
C   BLUE ATTACKERS KILL RED INTERCEPTORS                                CAM  00284
C                                                                       CAM  00285
      RITS1=RITS/XNRAA                                                  CAM  00286
       DO      2280          TYR     =1,2                             CAM  00287
      PROD=1.0                                                          CAM  00288
      DO 2290  TYB=1,2                                                  CAM  00289
      DO 2290  MSB=1,2                                                  CAM  00290
      INDB= MSB+ 2*(TYB-1)                                              CAM  00291
      X1=(1.-(1.-VBADRI(INDB))**RITS1)/RITS1                            CAM  00292
      X15=AMAX1(0.0, 1.-BAKRI(INDB,TYR)*X1)                             CAM  00293
      PROD=PROD*  X15**(BS(TYB,MSB)/XNRAA)                              CAM  00294
 2290  CONTINUE                                                         CAM  00295
      RSKAA(TYR,3)=RS(TYR,3)*(1.-PROD)                                  CAM  00296
```

```
 2280   CONTINUE                                                          CAM  00297
        GO TO 2400                                                        CAM  00298
 2299   BSKAA(1,1) =BSKAA(1,2) = BSKAA(2,1) = BSKAA(2,2) = 0.0            CAM  00299
        BAKAA(1,1) =BAKAA(1,2) = BAKAA(2,1) = BAKAA(2,2) = 0.0            CAM  00300
        RSKAA(1,3) = RSKAA(2,3) = 0.0                                     CAM  00301
        RAKAA(1,3) = RAKAA(2,3) = 0.0                                     CAM  00302
        GO TO 2400                                                        CAM  00303
 2300   CONTINUE                                                          CAM  00304
C                                                                         CAM  00305
C  ALTERNATE ATTRITION SCHEME                                             CAM  00306
C    IN THIS ATTRITION METHOD ATTACKERS SHOOT AT INTERCEPTORS ONLY IF      CAM  00307
C              ENGAGED BY THEM AND THEN ONLY (1.-ALPHA) OF THE TIME       CAM  00308
C                                                                         CAM  00309
C    BLUE INTERCEPTORS,  RED ATTACKERS                                    CAM  00310
C                                                                         CAM  00311
       IF(IBIRA .EQ. 1) GO TO 2349                                        CAM  00312
C                                                                         CAM  00313
C   RED ATTACKERS KILLED                                                  CAM  00314
C                                                                         CAM  00315
       RATS1=RATS/XNBAA                                                   CAM  00316
        DO       2310        TYR     =1,2                                 CAM  00317
        DO       2310        MSR     =1,2                                 CAM  00318
       INDR= MSR+ 2*(TYR-1)                                               CAM  00319
       PROD1=PROD2=1.0                                                    CAM  00320
        DO       2311        TYB     =1,2                                 CAM  00321
       X1= (1.-(1.-VBIDRA(TYB))**RATS1)/RATS1                             CAM  00322
       X15=AMAX1(0.0, 1.-BIKRA(TYB,INDR)*X1)                              CAM  00323
       X2 =AMAX1(0.0, 1.-X1)                                              CAM  00324
       PROD1=PROD1*X15**(BS(TYB,3)/XNBAA)                                 CAM  00325
       PROD2=PROD2*X2 **(BS(TYB,3)/XNBAA)                                 CAM  00326
 2311   CONTINUE                                                          CAM  00327
       RSKAA(TYR,MSR)=RS(TYR,MSR)*(1.-PROD1)                              CAM  00328
       RSENG(TYR,MSR)=RS(TYR,MSR)*(1.-PROD2)                              CAM  00329
 2310   CONTINUE                                                          CAM  00330
C                                                                         CAM  00331
C        BLUE INTERCEPTORS KILLED                                         CAM  00332
C                                                                         CAM  00333
       DENOM= BS(1,3)*VBIDRA(1) + BS(2,3)*VBIDRA(2)                       CAM  00334
       BPENG(1)=(BS(1,3)*VBIDRA(1))/DENOM                                 CAM  00335
       BPENG(2)=(BS(2,3)*VBIDRA(2))/DENOM                                 CAM  00336
        DO       2320        TYB     =1,2                                 CAM  00337
       SUM= 0.0                                                           CAM  00338
        DO       2321        TYR     =1,2                                 CAM  00339
        DO       2321        MSR     =1,2                                 CAM  00340
       INDR= MSR+ 2*(TYR-1)                                               CAM  00341
       SUM=SUM+  RSENG(TYR,MSR) *RAKBI(INDR,TYB)*BPENG(TYB)*              CAM  00342
     1 (1.-RALPHA(TYR,MSR))                                               CAM  00343
 2321   CONTINUE                                                          CAM  00344
       BSKAA(TYB,3)=SUM                                                   CAM  00345
 2320   CONTINUE                                                          CAM  00346
        GO TO 2350                                                        CAM  00347
 2349  RAKAA(1,1) =RAKAA(1,2)=RAKAA(2,1)=RAKAA(2,2)=0.0                   CAM  00348
       RSKAA(1,1)=RSKAA(1,2)=RSKAA(2,1)=RSKAA(2,2) = 0.0                  CAM  00349
       BSKAA(1,3) = BSKAA(2,3) = 0.0                                      CAM  00350
       BAKAA(1,3) =BAKAA(2,3)=0.0                                         CAM  00351
 2350   CONTINUE                                                          CAM  00352
C                                                                         CAM  00353
C    RED INTERCEPTORS, BLUE ATTACKERS                                     CAM  00354
```

```
C
      IF(IBARI .EQ. 1) GO TO 2399
C
C  BLUE ATTACKERS KILLED
C
       BATS1=BATS/XNRAA
       DO      2360        TYB     =1,2
       DO      2360        MSB     =1,6
      INDB= MSB+ 2*(TYB-1)
      PROD1=PROD2=1.0
       DO      2361        TYR     =1,2
      X1= (1.-(1.-VRIDBA(TYR))**BATS1)/BATS1
      X15=AMAX1(0.0, 1.-RIKBA(TYR,INDB)*X1)
      X2 =AMAX1(0.0, 1.-X1)
      PROD1=PROD1*X15**(RS(TYR,3)/XNRAA)
      PROD2=PROD2*X2 **(RS(TYR,3)/XNRAA)
 2361  CONTINUE
      BSKAA(TYB,MSB)=BS(TYB,MSB)*(1.-PROD1)
      BSENG(TYB,MSB)=BS(TYB,MSB)*(1.-PROD2)
 2360  CONTINUE
C
C         RED INTERCEPTORS KILLED
C
      DENOM= RS(1,3)*VRIDBA(1)+RS(2,3)*VRIDBA(2)
      RPENG(1)=(RS(1,3)*VRIDBA(1))/DENOM
      RPENG(2)=(RS(2,3)*VRIDBA(2))/DENOM
       DO      2370        TYR     =1,2
      SUM= 0.0
       DO      2371        TYB     =1,2
       DO      2371        MSB     =1,2
      INDB= MSB+ 2*(TYB-1)
      SUM=SUM+ BSENG(TYB,MSB)*BAKRI(INDB,TYR)*RPENG(TYR)*
     1 (1.-BALPHA(TYB,MSB))
 2371  CONTINUE
      RSKAA(TYR,3)=  SUM
 2370  CONTINUE
      GO TO 2400
 2399 BSKAA(1,1) =BSKAA(1,2) = BSKAA(2,1) = BSKAA(2,2) = 0.0
      BAKAA(1,1) =BAKAA(1,2) = BAKAA(2,1) = BAKAA(2,2) = 0.0
      RSKAA(1,3) = RSKAA(2,3) = 0.0
      BAKAA(1,3) = BAKAA(2,3) = 0.0
 2400  CONTINUE
C
C    FIRST REVISED ATTACK-- SUBTRACT OUT AIRCRAFT LOSSES
C                IN AIR TO AIR INTERACTION
C
C     COMPUTE AND SUBTRACT OUT SORTIES LOST
C
      IF(IAA) 2401,2401,2403
 2401 DO 2402  TY=1,2
      DO 2402  MS=1,3
      BS(TY,MS)= BS(TY,MS)-BSKAA(TY,MS)
      RS(TY,MS)= RS(TY,MS)-RSKAA(TY,MS)
 2402 CONTINUE
      GO TO 2407
 2403 CONTINUE
      DO 2405  TY=1,2
      BS(TY,3)=BS(TY,3)-BSKAA(TY,3)
```

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CAM     00355
CAM     00356
CAM     00357
CAM     00358
CAM     00359
CAM     00360
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CAM     00362
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CAM     00407
CAM     00408
CAM     00409
CAM     00410
CAM     00411
CAM     00412
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      RS(IY,3)=RS(IY,3)-RSKAA(TY,3)                                    CAM  00413
      BSFB(IY,3)=RSFB(IY,3)=0.0                                        CAM  00414
      DO 2405  MS=1,2                                                  CAM  00415
      BSFB(TY,MS)=(1.-BALPHA(TY,MS))*(BSENG(TY,MS)-BSKAA(TY,MS))       CAM  00416
      RSFB(IY,MS)=(1.-RALPHA(TY,MS))*(RSENG(TY,MS)-RSKAA(TY,MS))       CAM  00417
      BS(TY,MS)=BS(IY,MS)-BSKAA(TY,MS)-BSFB(TY,MS)                     CAM  00418
      RS(TY,MS)=RS(IY,MS)-RSKAA(TY,MS)-RSFB(IY,MS)                     CAM  00419
 2405 CONTINUE                                                         CAM  00420
 2407 CONTINUE                                                         CAM  00421
C                                                                      CAM  00422
C     CONVERT SORTIES LOST TO AIRCRAFT LOST                            CAM  00423
C       FIND REMAINING NUMBER OF AIRCRAFT                              CAM  00424
C                                                                      CAM  00425
      DO 2410  IY=1,2                                                  CAM  00426
      DO 2410  MS=1,3                                                  CAM  00427
      SRB=AMAX1(1.0,SORRB(TY,MS) )                                     CAM  00428
      SRR= AMAX1(1.0,SORRR(TY,MS))                                     CAM  00429
      BAFB(IY,MS)=BSFB(TY,MS)/SRB                                      CAM  00430
      RAFB(IY,MS)=RSFB(TY,MS)/SRR                                      CAM  00431
      BAKAA(TY,MS)=BSKAA(TY,MS)/SRB                                    CAM  00432
      RAKAA(TY,MS)=RSKAA(TY,MS)/SRR                                    CAM  00433
      BA(TY,MS)=BA(IY,MS)-BANF(TY,MS)-BAFB(TY,MS)-BAKAA(TY,MS)         CAM  00434
      RA(TY,MS)=RA(IY,MS)-RANF(TY,MS)-RAFB(TY,MS)-RAKAA(TY,MS)         CAM  00435
 2410 CONTINUE                                                         CAM  00436
C                                                                      CAM  00437
C   BLUE AND RED SAMS AND SECOND REVISED ATTACK                        CAM  00438
C    FIND AND SUBTRACT OUT SORTIES AND AIRCRAFT KILLED BY SAMS         CAM  00439
C                                                                      CAM  00440
      DO 2415  IY=1,2                                                  CAM  00441
      BSL(TY,3)=RSL(TY,3)= 0.0                                         CAM  00442
      DO 2416  MS=1,2                                                  CAM  00443
      BSL(TY,MS)= BSAMZB(TY,MS)*BS(TY,MS)                              CAM  00444
      RSL(TY,MS)= BSAMZR(TY,MS)*RS(IY,MS)                              CAM  00445
 2416 CONTINUE                                                         CAM  00446
 2415 CONTINUE                                                         CAM  00447
      DO 2420  IY=1,2                                                  CAM  00448
      DO 2420  MS=1,3                                                  CAM  00449
      SRB=AMAX1(1.0,SORRB(TY,MS))                                      CAM  00450
      SRR=AMAX1(1.0,SORRR(TY,MS))                                      CAM  00451
      BAL(TY,MS)= BSL(TY,MS)/SRB                                       CAM  00452
      RAL(TY,MS)= RSL(TY,MS)/SRR                                       CAM  00453
      BS(TY,MS)=BS(IY,MS)-BSL(TY,MS)                                   CAM  00454
      BA(TY,MS)=BA(IY,MS)-BAL(TY,MS)                                   CAM  00455
      RS(TY,MS)=RS(IY,MS)-RSL(TY,MS)                                   CAM  00456
      RA(TY,MS)=RA(IY,MS)-RAL(TY,MS)                                   CAM  00457
 2420 CONTINUE                                                         CAM  00458
C                                                                      CAM  00459
C                                                                      CAM  00460
C     AIRCRAFT DESTRUCTION--AIRBASE ATTACK                             CAM  00461
C                                                                      CAM  00462
C                                                                      CAM  00463
C     BLUE AIRBASES                                                    CAM  00464
C                                                                      CAM  00465
C                                                                      CAM  00466
C     COMPUTE NUMBER OF BLUE AIRCRAFT VULNERABLE TO ABA BY RED         CAM  00467
C                                                                      CAM  00468
      BSHEL=SHELB(1D)                                                  CAM  00469
      IF(SHELB(1D) .LT. 1.)  BSHEL=0.                                  CAM  00470
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      BAVUL(1)= BANAS                                                    CAM  00471
      DO 2501  MS=1,3                                                    CAM  00472
      BAVUL(1)=BAVUL(1)+BA(1,MS)+BANF(1,MS)+BAFB(1,MS)                   CAM  00473
 2501 CONTINUE                                                           CAM  00474
      DO 2502  KBA=2,4                                                   CAM  00475
      MS=KBA-1                                                           CAM  00476
      BAVUL(KBA)=BA(2,MS)+BAFB(2,MS)+BANF(2,MS)                          CAM  00477
 2502 CONTINUE                                                           CAM  00478
      ABQRAS=AMIN1(ABQRA,BSHEL)                                          CAM  00479
      BSHEL1= BSHEL-ABQRAS                                               CAM  00480
      ABQRAN=ABQRA-ABQRAS                                                CAM  00481
      BAVULT=BAVUL(1)+BAVUL(2)+BAVUL(3)+BAVUL(4)                         CAM  00482
      BSHEL1=AMIN1(BSHEL1,BAVULT)                                        CAM  00483
      IF(BAVULT .EQ. 0.0) GO TO 2505                                     CAM  00484
      DO 2504  KBA=1,NKBA                                                CAM  00485
      BPOPS(KBA)= BSHEL1*(BAVUL(KBA)/BAVULT)                             CAM  00486
 2504 CONTINUE                                                           CAM  00487
 2505 CONTINUE                                                           CAM  00488
      DO 2506  KBA=1,NKBA                                                CAM  00489
      BPOPNS(KBA)=BFRAC*(BAVUL(KBA)-BPOPS(KBA))                          CAM  00490
      BPOPS(KBA)=BFRAC*BPOPS(KBA)                                        CAM  00491
 2506 CONTINUE                                                           CAM  00492
      BPOPS(1)=BPOPS(1)+ABQRAS                                           CAM  00493
      BPOPNS(1)=BPOPNS(1)+ABQRAN                                         CAM  00494
      BTOTS=BTOTNS=0.0                                                   CAM  00495
      DO 2507  KBA=1,4                                                   CAM  00496
      BTOTS= BTOTS+BPOPS(KBA)                                            CAM  00497
      BTOTNS=BTOTNS+BPOPNS(KBA)                                          CAM  00498
 2507 CONTINUE                                                           CAM  00499
      BTOT=BTOTS+BTOTNS                                                  CAM  00500
C                                                                        CAM  00501
C     RED ATTACKERS--COMPUTE NUMBER OF RED ATTACK PASSES                 CAM  00502
C                                                                        CAM  00503
      DO 2509  TYR=1,2                                                   CAM  00504
      PRABA(TYR)= RS(TYR,2)*RPASS(TYR)                                   CAM  00505
 2509 CONTINUE                                                           CAM  00506
      RATP=PRABA(1)+PRABA(2)                                             CAM  00507
C                                                                        CAM  00508
C     CHECKS                                                             CAM  00509
C                                                                        CAM  00510
      IF(RATP .LT. 1.0 .OR. BTOT .LT. 1.0)  GO TO 2598                   CAM  00511
C                                                                        CAM  00512
C     AVERAGE RED EFFECTIVENESS PARAMETERS                               CAM  00513
C                                                                        CAM  00514
      VRDBS  =  ( RDBS(1)*PRABA(1)+ RDBS(2)*PRABA(2))/RATP               CAM  00515
      VRKBS  =  ( RKBS(1)*PRABA(1)+ RKBS(2)*PRABA(2))/RATP               CAM  00516
      VRDBNS =  (RDBNS(1)*PRABA(1)+RDBNS(2)*PRABA(2))/RATP               CAM  00517
      VRKBNS =  (RKBNS(1)*PRABA(1)+RKBNS(2)*PRABA(2))/RATP               CAM  00518
C                                                                        CAM  00519
C   USING APPROPRIATE RED ATTACK MODE, COMPUTE NUMBER OF BLUE AIRCRAFT   CAM  00520
C         KILLED                                                         CAM  00521
C                                                                        CAM  00522
      GO TO (2510,2520,2530,2540), IRABA                                 CAM  00523
 2510 CONTINUE                                                           CAM  00524
      TERMS1=0.0                                                         CAM  00525
      IF(BSHEL .NE. 0.0) TERMS1=                                         CAM  00526
     1  VRKBS* (1.-(1.-VRDBS)**(BSHEL/XNBAB))/(BSHEL/XNBAB)             CAM  00527
      XS=AMAX1(0.0, 1.-TERMS1*(1.-VRDBNS)**(BTOTNS/XNBAB) )              CAM  00528
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      TERMS2= 1.-  AS**(RATP/ANBAB)                                      CAM  00529
      BAKS=BTOTS*TERMS2                                                  CAM  00530
      BSHELA(ID)=FBSK*BSHEL*TERMS2                                       CAM  00531
      TERMN1=0.0                                                         CAM  00532
      IF(BTOTNS .GE.  1.0)  TERMN1=                                      CAM  00533
     1 VRKBNS*(1.-(1.-VRDBNS)**(BTOTNS/ANBAB))/AMIN1(BPARK,BTOTNS/ANBAB) CAM  00534
      ANS= AMAX1(0.0, 1.-TERMN1)                                         CAM  00535
      TERMN2=  1.-  ANS**(RATP/ANBAB)                                    CAM  00536
      BAKNS= BTOTNS*TERMN2                                               CAM  00537
      GO TO 2600                                                         CAM  00538
2520  CONTINUE                                                           CAM  00539
      IF(BTOTS .LT. 1.0)    GO TO 2521                                   CAM  00540
      IF(BTOTNS.LT. 1.0)    GO TO 2522                                   CAM  00541
      CS0=BSHEL/ANBAB                                                    CAM  00542
      CN0= BTOTNS/ANBAB                                                  CAM  00543
      CS1= 1.-(VRKBS/CS0)*(1.-(1.-VRDBS)**CS0)                           CAM  00544
      CS1= AMAX1(0.0,CS1)                                                CAM  00545
      CS=CS1**(RATP/ANBAB)                                               CAM  00546
      CN1= 1.-(VRKBNS/AMIN1(BPARK,CN0))*(1.-(1.-VRDBNS)**CN0)            CAM  00547
      CN1= AMAX1(0.0, CN1)                                               CAM  00548
      CN=CN1**(RATP/ANBAB)                                               CAM  00549
      IF( CS .NE. 0.0)  GO TO 2523                                       CAM  00550
      W= .0001                                                           CAM  00551
      GO TO 2525                                                         CAM  00552
2523  IF(CN .NE. 0.0)  GO TO 2524                                        CAM  00553
      W= .9999                                                           CAM  00554
      GO TO 2525                                                         CAM  00555
2524  CONTINUE                                                           CAM  00556
      C1=BTOTNS*CN*ALOG(CN)/(BTOTS*ALOG(CS))                             CAM  00557
      W0=ALOG(C1)/(ALOG(CS)+ALOG(CN))                                    CAM  00558
      W= W0                                                              CAM  00559
      IF(W0 .LE. 0.0) W= 0.0                                             CAM  00560
      IF(W0 .GE. 1.0) W= 1.0                                             CAM  00561
2525  CONTINUE                                                           CAM  00562
      CS2= 1.-CS**W                                                      CAM  00563
      BAKS=BTOTS*CS2                                                     CAM  00564
      BSHELA(ID)=FBSK*BSHEL*CS2                                          CAM  00565
       BAKNS=BTOTNS*(1.-CN**(1.-W))                                      CAM  00566
      GO TO 2600                                                         CAM  00567
2521  BAKS=BSHELA(ID)=0.0                                                CAM  00568
      CN1= 1.-(VRKBNS/AMIN1(BPARK,CN0))*(1.-(1.-VRDBNS)**CN0)            CAM  00569
      CN1= AMAX1(0.0, CN1)                                               CAM  00570
      CN=CN1**(RATP/ANBAB)                                               CAM  00571
      BAKNS=BTOTNS*(1.-CN)                                               CAM  00572
      GO TO 2600                                                         CAM  00573
2522  BAKNS= 0.0                                                         CAM  00574
      CS1= 1.-(VRKBS/CS0)*(1.-(1.-VRDBS)**CS0)                           CAM  00575
      CS1= AMAX1(0.0,CS1)                                                CAM  00576
      CS=CS1**(RATP/ANBAB)                                               CAM  00577
      BAKS=BTOTS*(1.-CS)                                                 CAM  00578
      BSHELA(ID)= FBSK*BSHEL*(1.-CS)                                     CAM  00579
      GO TO 2600                                                         CAM  00580
2530  CONTINUE                                                           CAM  00581
      T=BTOTNS*BSHEL                                                     CAM  00582
      TERM1=(VRDBS*BSHEL+VRDBNS*BTOTNS)/T                                CAM  00583
      TERM2=(1.-(1.-TERM1)**(T/XNBAB))/AMIN1(BPARK,(T/XNBAB))            CAM  00584
      AS= AMAX1(0.0, 1.-VRKBS*TERM2)                                     CAM  00585
      ANS= AMAX1(0.0, 1.-VRKBNS*TERM2)                                   CAM  00586
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      TERMS= 1. -  AS**(RATP/XNBAB)                                     CAM   00587
      TERMNS=1. - ANS**(RATP/XNBAB)                                     CAM   00588
      BAKS= BTOTS*TERMS                                                 CAM   00589
      BSHELK(ID)= FOSK*BSHEL*TERMS                                      CAM   00590
      BAKNS= BTOTNS*TERMNS                                              CAM   00591
      GO TO 2600                                                        CAM   00592
 2540 CONTINUE                                                          CAM   00593
      B4AN=(B4AN1*PRABA(1)+B4AN2*PRABA(2))/RATP                         CAM   00594
      B4AS=(B4AS1*PRABA(1)+B4AS2*PRABA(2))/RATP                         CAM   00595
      B4NS=(B4NS1*PRABA(1)+B4NS2*PRABA(2))/RATP                         CAM   00596
      B4SN=(B4SN1*PRABA(1)+B4SN2*PRABA(2))/RATP                         CAM   00597
      X4N= (1.-B4AL)*B4AN/B4B                                           CAM   00598
      X4SN=(1.-B4AL)*B4AS*B4SN/B4B                                      CAM   00599
      X4NS=(1.-B4AL)*B4AN*B4NS/B4B                                      CAM   00600
      X4S=(1.-B4AL)*B4AS/B4B                                            CAM   00601
      X4N= AMIN1(1.0,X4N )                                              CAM   00602
      X4SN=AMIN1(1.0,X4SN)                                              CAM   00603
      X4NS=AMIN1(1.0,X4NS)                                              CAM   00604
      X4S =AMIN1(1.0,X4S )                                              CAM   00605
      X4N =AMAX1(0.0,X4N )                                              CAM   00606
      X4NS=AMAX1(0.0,X4NS)                                              CAM   00607
      X4SN=AMAX1(0.0,X4SN)                                              CAM   00608
      X4S =AMAX1(0.0,X4S )                                              CAM   00609
      A1N= 1.+B4AL*B4AN*RATP/(B4B*XNBAB)                                CAM   00610
      A2N= (B4AL*RATP/(B4B*XNBAB))*(B4AS*B4SN-B4AN)                     CAM   00611
      AOB= RATP/XNBAB                                                   CAM   00612
      A3= (1.-X4N)**AOB                                                 CAM   00613
      A4=((1.-X4SN)/(1.-X4N))**AOB                                      CAM   00614
        A1S= B4AL*B4AN*RATP*B4NS/(B4B*XNBAB)+1.                         CAM   00615
      A2S=(B4AL*RATP/(B4B*XNBAB))*(B4AS-B4AN*B4NS)                      CAM   00616
      A2=A2S+A2N                                                        CAM   00617
      A5=(1.-X4NS)**AOB                                                 CAM   00618
      A6= ((1.-X4S)/(1.-X4NS))**AOB                                     CAM   00619
      IF(BTOTS .LT. .0001)   GO TO 2548                                 CAM   00620
      IF(BTOTNS .LT. .0001 )  GO TO  2549                               CAM   00621
      X0=F14(0.)                                                        CAM   00622
      X1=F14(1.)                                                        CAM   00623
      IF(X0 .GE. 0. .AND. X1 .GE. 0.)  GO TO 2547                       CAM   00624
      IF(X0 .LE. 0. .AND. X1 .LE. 0.)  GO TO 2546                       CAM   00625
 2541 CONTINUE                                                          CAM   00626
C                                                                       CAM   00627
C     USE NEWTONS METHOD                                                CAM   00628
C                                                                       CAM   00629
      Q0= .5                                                            CAM   00630
      NTN=0                                                             CAM   00631
 2542    Q1=Q0-F14(Q0)/F24(Q0)                                          CAM   00632
      IF(ABS(Q1-Q0) .LT. EPS4)  GO TO 2543                              CAM   00633
      IF(NTN .GT. 100) STOP 445                                         CAM   00634
      Q0 =Q1                                                            CAM   00635
      NTN= NTN+1                                                        CAM   00636
      GO TO 2542                                                        CAM   00637
 2543  Q= Q1                                                          CAM   00638
      TERMS= A1S+A2S*Q-A5*A6**Q                                         CAM   00639
      TERMNS=A1N +A2N*Q-A3*A4**Q                                        CAM   00640
      TERMS=AMIN1(1.0,TERMS)                                            CAM   00641
      BAKS= BTOTS*TERMS                                                 CAM   00642
      BSHELK(ID)=  FOSK*BSHEL*TERMS                                     CAM   00643
      BAKNS= BTOTNS*AMIN1(1.0,TERMNS)                                   CAM   00644
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      GO TO 2600                                                        CAM  00645
 2548  CONTINUE                                                         CAM  00646
C                                                                       CAM  00647
C     USE ONLY  ANTI-NONSHELTERED-AIRCRAFT MUNITIONS                    CAM  00648
C                                                                       CAM  00649
      TERMS= B4AL*B4AN*RATP*B4NS/(B4B*XNBAB)+1.-(1.-X4NS)**(RATP/XNBAB) CAM  00650
      TERMS= AMIN1(1.0,TERMS)                                           CAM  00651
      TERMNS=B4AL*B4AN*RATP/(B4B*XNBAB) +1.-(1.-X4N)**(RATP/XNBAB)      CAM  00652
      BAKS=BTOTS*TERMS                                                  CAM  00653
      BSHELK(ID)= FBSK*BSHEL*TERMS                                      CAM  00654
      BAKNS=BTOINS*AMIN1(1.0,TERMNS)                                    CAM  00655
      GO TO 2600                                                        CAM  00656
 2549 CONTINUE                                                          CAM  00657
C                                                                       CAM  00658
C     USE ONLY  ANTI-SHELTER MUNITIONS                                  CAM  00659
C                                                                       CAM  00660
      TERMS=   (B4AL)*B4AS*RATP/(B4B*XNBAB)+1.-(1.-X4S)**(RATP/XNBAB)   CAM  00661
      TERMS=AMIN1(1.0,TERMS)                                            CAM  00662
      TERMNS=B4AL*B4AS*RATP*B4SN/(B4B*XNBAB)+1.-(1.-X4SN)**(RATP/XNBAB) CAM  00663
      BAKS=BTOTS*TERMS                                                  CAM  00664
      BSHELK(ID)=FBSK*BSHEL*TERMS                                       CAM  00665
      BAKNS=BTOINS*AMIN1(1.0,TERMNS)                                    CAM  00666
      GO TO 2600                                                        CAM  00667
 2598 CONTINUE                                                          CAM  00668
      BAKS=BAKNS=BSHELK(ID)=0.0                                         CAM  00669
 2600 CONTINUE                                                          CAM  00670
C                                                                       CAM  00671
C   RED AIRBASES                                                        CAM  00672
C                                                                       CAM  00673
C                                                                       CAM  00674
C  COMPUTE NUMBER OF RED AIRCRAFT VULNERABLE TO ABA BY BLUE             CAM  00675
C     IF IR3SM=1, DO NOT SHELTER RED SP ABA AIRCRAFT                    CAM  00676
C                                                                       CAM  00677
      RSHEL=SHELK(ID)                                                   CAM  00678
      IF(SHELK(ID) .LT. 1.)  RSHEL=0.                                   CAM  00679
      RAVUL(1)= RANAS                                                   CAM  00680
      DO 2601  MS=1,3                                                   CAM  00681
      RAVUL(1)=RAVUL(1)+RA(1,MS)+RANF(1,MS)+RAFB(1,MS)                  CAM  00682
 2601 CONTINUE                                                          CAM  00683
      DO 2602  KRA=2,4                                                  CAM  00684
      MS=KRA-1                                                          CAM  00685
      RAVUL(KRA)=RA(2,MS)+RAFB(2,MS)+RANF(2,MS)                         CAM  00686
 2602 CONTINUE                                                          CAM  00687
      ARGRAS=AMIN1(ARGRA,RSHEL)                                         CAM  00688
      RSHEL1=RSHEL-ARGRAS                                               CAM  00689
      ARGRAN=ARGRA      -ARGRAS                                         CAM  00690
     XS= 1-IR3SM                                                        CAM  00691
      RAVULT=RAVUL(1) + RAVUL(2)+RAVUL(3)*XS + RAVUL(4)                 CAM  00692
      RSHEL1=AMIN1(RSHEL1,RAVULT)                                       CAM  00693
      IF(RAVULT .EQ. 0.0) GO TO 2605                                    CAM  00694
      DO 2604  KRA=1,NKRA                                               CAM  00695
      RPUPS(KRA)= RSHEL1*(RAVUL(KRA)/RAVULT)                            CAM  00696
 2604 CONTINUE                                                          CAM  00697
      RPUPS(3)=  XS*RPUPS(3)                                            CAM  00698
 2605 CONTINUE                                                          CAM  00699
      DO 2606  KRA=1,NKRA                                               CAM  00700
      RPUPNS(KRA)=RFRAC*(RAVUL(KRA)-RPUPS(KRA))                         CAM  00701
      RPUPS(KRA)=RFRAC*RPUPS(KRA)                                       CAM  00702
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 2609  CONTINUE                                                          CAM  00703
       RPOPS(1)=RPOPS(1)*ARGRAS                                          CAM  00704
       RPOPNS(1)=RPOPNS(1)*ARGRAN                                        CAM  00705
       RTOTS=RTOTNS=0.0                                                  CAM  00706
       DO 2607  KRA=1,4                                                  CAM  00707
       RTOTS= RTOTS+RPOPS(KRA)                                           CAM  00708
       RTOTNS=RTOTNS+RPOPNS(KRA)                                         CAM  00709
 2607  CONTINUE                                                          CAM  00710
       RTOT=RTOTS+RTOTNS                                                 CAM  00711
C                                                                        CAM  00712
C      BLUE ATTACKERS--COMPUTE NUMBER OF BLUE ATTACK PASSES              CAM  00713
C                                                                        CAM  00714
       DO 2609  TYB=1,2                                                  CAM  00715
       PBABA(TYB)= BS(TYB,2)*BPASS(TYB)                                  CAM  00716
 2609  CONTINUE                                                          CAM  00717
       BATP=PBABA(1)+PBABA(2)                                            CAM  00718
C                                                                        CAM  00719
C     CHECKS                                                             CAM  00720
C                                                                        CAM  00721
       IF(BATP .LT. 1.0 .OR. RTOT .LT. 1.0)  GO TO 2698                  CAM  00722
C                                                                        CAM  00723
C     AVERAGE BLUE EFFECTIVENESS PARAMETERS                              CAM  00724
C                                                                        CAM  00725
       VBDRS  =  ( BDRS(1)*PBABA(1)+ BDRS(2)*PBABA(2))/BATP              CAM  00726
       VBKRS  =  ( BKRS(1)*PBABA(1)+ BKRS(2)*PBABA(2))/BATP              CAM  00727
       VBDRNS =  (BDRNS(1)*PBABA(1)+BDRNS(2)*PBABA(2))/BATP              CAM  00728
       VBKRNS =  (BKRNS(1)*PBABA(1)+BKRNS(2)*PBABA(2))/BATP              CAM  00729
C                                                                        CAM  00730
C  USING APPROPRIATE BLUE ATTACK MODE, COMPUTE NUMBER OF RED AIRCRAFT    CAM  00731
C       KILLED                                                           CAM  00732
C                                                                        CAM  00733
      GO TO (2610,2620,2630,2640), IBABA                                 CAM  00734
 2610  CONTINUE                                                          CAM  00735
       TERMS1=0.0                                                        CAM  00736
       IF(RSHEL .NE. 0.0) TERMS1=                                        CAM  00737
     1  VBKRS* (1.-(1.-VBDRS)**(RSHEL/XNRAB))/(RSHEL/XNRAB)              CAM  00738
       XS=AMAX1(0.0, 1.-TERMS1*(1.-VBDRNS)**(RTOTNS/XNRAB) )             CAM  00739
       TERMS2= 1.-  XS**(BATP/XNRAB)                                     CAM  00740
       RAKS=RTOTS*TERMS2                                                 CAM  00741
       RSHELK(ID)=FRSK*RSHEL*TERMS2                                      CAM  00742
       TERMN1=0.0                                                        CAM  00743
       IF(RTOTNS .GE. 1.0)  TERMN1=                                      CAM  00744
     1 VBKRNS*(1.-(1.-VBDRNS)**(RTOTNS/XNRAB))/AMIN1(RPARK,RTOTNS/XNRAB) CAM  00745
       XNS= AMAX1(0.0, 1.-TERMN1)                                        CAM  00746
       TERMN2= 1.-  XNS**(BATP/XNRAB)                                    CAM  00747
       RAKNS= RTOTNS*TERMN2                                              CAM  00748
       GO TO 2700                                                        CAM  00749
 2620  CONTINUE                                                          CAM  00750
       IF(RTOTS .LT. 1.0)   GO TO 2621                                   CAM  00751
       IF(RTOTNS.LT. 1.0)   GO TO 2622                                   CAM  00752
       CS0=RSHEL/XNRAB                                                   CAM  00753
       CN0= RTOTNS/XNRAB                                                 CAM  00754
       CS1= 1.-(VBKRS/CS0)*(1.-(1.-VBDRS)**CS0)                          CAM  00755
       CS1= AMAX1(0.0,CS1)                                               CAM  00756
       CS=CS1**(BATP/XNRAB)                                              CAM  00757
       CN1= 1.-(VBKRNS/AMIN1(RPARK,CN0))*(1.-(1.-VBDRNS)**CN0)           CAM  00758
       CN1= AMAX1(0.0, CN1)                                              CAM  00759
       CN=CN1**(BATP/XNRAB)                                              CAM  00760
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      IF( CS .NE. 0.0)  GO TO 2623                                      CAM  00761
      Q= .0001                                                          CAM  00762
      GO TO 2625                                                        CAM  00763
2623  IF(CN .NE. 0.0)  GO TO 2624                                       CAM  00764
      Q= .9999                                                          CAM  00765
      GO TO 2625                                                        CAM  00766
2624  CONTINUE                                                          CAM  00767
      C1=RTOTNS*CN*ALOG(CN)/(RTOTS*ALOG(CS))                            CAM  00768
      Q0=ALOG(C1)/(ALOG(CS)+ALOG(CN))                                   CAM  00769
      Q= Q0                                                             CAM  00770
      IF(Q0 .LE. 0.0) Q= 0.0                                            CAM  00771
      IF(Q0 .GE. 1.0) Q= 1.0                                            CAM  00772
2625  CONTINUE                                                          CAM  00773
      CS2= 1.-CS**Q                                                     CAM  00774
      RAKS=RTOTS*CS2                                                    CAM  00775
      RSHELK(ID)=FRSK*RSHEL*CS2                                         CAM  00776
      RAKNS=RTOTNS*(1.-CN**(1.-Q))                                      CAM  00777
      GO TO 2700                                                        CAM  00778
2621  RAKS=RSHELK(ID)=0.0                                               CAM  00779
      CN1= 1.-(VBKRNS/AMIN1(RPARK,CN0))*(1.-(1.-VBORNS)**CN0)           CAM  00780
      CN1= AMAX1(0.0, CN1)                                              CAM  00781
      CN=CN1**(RATP/XNRAB)                                              CAM  00782
      RAKNS=RTOTNS*(1.-CN)                                              CAM  00783
      GO TO 2700                                                        CAM  00784
2622  RAKNS= 0.0                                                        CAM  00785
      CS1= 1.-(VBKRS/CS0)*(1.-(1.-VBORS)**CS0)                          CAM  00786
      CS1= AMAX1(0.0,CS1)                                               CAM  00787
      CS=CS1**(RATP/XNRAB)                                              CAM  00788
      RAKS=RTOTS*(1.-CS)                                                CAM  00789
      RSHELK(ID)= FRSK*RSHEL*(1.-CS)                                    CAM  00790
      GO TO 2700                                                        CAM  00791
2630  CONTINUE                                                          CAM  00792
      T=RTOTNS+RSHEL                                                    CAM  00793
      TERM1=(VBORS*RSHEL+VBORNS*RTOTNS)/T                               CAM  00794
      TERM2=(1.-(1.-TERM1)**(T/XNRAB))/AMIN1(RPARK,(T/XNRAB))           CAM  00795
      XS= AMAX1(0.0, 1.-VBKRNS*TERM2)                                   CAM  00796
      XNS= AMAX1(0.0, 1.-VBKRNS*TERM2)                                  CAM  00797
      TERMS =1. - XS **(RATP/XNRAB)                                     CAM  00798
      TERMNS=1. - XNS**(RATP/XNRAB)                                     CAM  00799
      RAKS= RTOTS*TERMS                                                 CAM  00800
      RSHELK(ID)= FRSK*RSHEL*TERMS                                      CAM  00801
      RAKNS= RTOTNS*TERMNS                                              CAM  00802
      GO TO 2700                                                        CAM  00803
2640  CONTINUE                                                          CAM  00804
      R4AN=(R4AN1*PBABA(1))+R4AN2*PBABA(2))/BATP                        CAM  00805
      R4AS=(R4AS1*PBABA(1))+R4AS2*PBABA(2))/BATP                        CAM  00806
      R4NS=(R4NS1*PBABA(1))+R4NS2*PBABA(2))/BATP                        CAM  00807
      R4SN=(R4SN1*PBABA(1))+R4SN2*PBABA(2))/BATP                        CAM  00808
      X4N= (1.-R4AL)*R4AN/R4B                                           CAM  00809
      X4SN=(1.-R4AL)*R4AS*R4SN/R4B                                      CAM  00810
      X4NS=(1.-R4AL)*R4AN*R4NS/R4B                                      CAM  00811
      X4S=(1.-R4AL)*R4AS/R4B                                            CAM  00812
      X4N= AMIN1(1.0,X4N )                                              CAM  00813
      X4SN=AMIN1(1.0,X4SN)                                              CAM  00814
      X4NS=AMIN1(1.0,X4NS)                                              CAM  00815
      X4S =AMIN1(1.0,X4S )                                              CAM  00816
      X4N  = AMAX1(0.0, X4N  )                                          CAM  00817
      X4NS = AMAX1(0.0, X4NS )                                          CAM  00818
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      X4SN = AMAX1(0.0, X4SN )                                          CAM  00819
      X4S  = AMAX1(0.0, X4S  )                                          CAM  00820
      A1N= 1.+R4AL*R4AN*BATP/(R4B*XNRAB)                                CAM  00821
      A2N= (R4AL*BATP/(R4B*XNRAB))*(R4AS*R4SN-R4AN)                     CAM  00822
      AOB= BATP/XNRAB                                                   CAM  00823
      A3= (1.-X4N)**AOB                                                 CAM  00824
      A4=((1.-X4SN)/(1.-X4N))**AOB                                      CAM  00825
        A1S= R4AL*R4AN*BATP*R4NS/(R4B*XNRAB)+1.                         CAM  00826
      A2S=(R4AL*BATP/(R4B*XNRAB))*(R4AS-R4AN*R4NS)                      CAM  00827
      A2=A2S+A2N                                                        CAM  00828
      A5=(1.-X4NS)**AOB                                                 CAM  00829
      A6= ((1.-X4S)/(1.-X4NS))**AOB                                     CAM  00830
      IF(RTOTS .LT. .0001)   GO TO 2648                                 CAM  00831
      IF(RTOTNS .LT. .0001 )  GO TO  2649                               CAM  00832
      X0=F14(0.)                                                        CAM  00833
      X1=F14(1.)                                                        CAM  00834
      IF(X0 .GE. 0. .AND. X1 .GE. 0.)  GO TO 2649                       CAM  00835
      IF(X0 .LE. 0. .AND. X1 .LE. 0.)  GO TO 2648                       CAM  00836
 2641 CONTINUE                                                          CAM  00837
C                                                                       CAM  00838
C     USE NEWTONS METHOD                                                CAM  00839
C                                                                       CAM  00840
      Q0= .5                                                            CAM  00841
      NTN=0                                                             CAM  00842
 2642    Q1=Q0-F14(Q0)/F24(Q0)                                          CAM  00843
      IF(ABS(Q1-Q0) .LT. EPS4)  GO TO 2643                              CAM  00844
      IF(NTN .GT. 100)  STOP 446                                        CAM  00845
      Q0 =Q1                                                            CAM  00846
      NTN= NTN+1                                                        CAM  00847
      GO TO 2642                                                        CAM  00848
 2643  Q= Q1                                                            CAM  00849
      TERMS= A1S+A2S*Q-A5*A6**Q                                         CAM  00850
      TERMNS=A1N +A2N*Q-A3*A4**Q                                        CAM  00851
      TERMS=AMIN1(1.0,TERMS)                                            CAM  00852
      RAKS= RTOTS*TERMS                                                 CAM  00853
      RSHELK(ID)= FRSK*RSHEL*TERMS                                      CAM  00854
      RAKNS=RTOTNS*AMIN1(1.0,TERMNS)                                    CAM  00855
      GO TO 2700                                                        CAM  00856
 2648  CONTINUE                                                         CAM  00857
C                                                                       CAM  00858
C     USE ONLY  ANTI-NONSHELTERED-AIRCRAFT MUNITIONS                    CAM  00859
C                                                                       CAM  00860
      TERMS= R4AL*R4AN*BATP*R4NS/(R4B*XNRAB)+1.-(1.-X4NS)**(BATP/XNRAB) CAM  00861
      TERMS= AMIN1(1.0,TERMS)                                           CAM  00862
      TERMNS=R4AL*R4AN*BATP/(R4B*XNRAB) +1.-(1.-X4N)**(BATP/XNRAB)      CAM  00863
      RAKS= RTOTS*TERMS                                                 CAM  00864
      RSHELK(ID)= FRSK*RSHEL*TERMS                                      CAM  00865
      RAKNS=RTOTNS*AMIN1(1.0,TERMNS)                                    CAM  00866
      GO TO 2700                                                        CAM  00867
 2649 CONTINUE                                                          CAM  00868
C                                                                       CAM  00869
C     USE ONLY  ANTI-SHELTER MUNITIONS                                  CAM  00870
C                                                                       CAM  00871
      TERMS=   (R4AL)*R4AS*BATP/(R4B*XNRAB)+1.-(1.-X4S)**(BATP/XNRAB)   CAM  00872
      TERMS=AMIN1(1.0,TERMS)                                            CAM  00873
      TERMNS=R4AL*R4AS*BATP*R4SN/(R4B*XNRAB)+1.-(1.-X4SN)**(BATP/XNRAB) CAM  00874
      RAKS=RTOTS*TERMS                                                  CAM  00875
      RSHELK(ID)=FRSK*RSHEL*TERMS                                       CAM  00876
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      RAKNS=RTOTNS*AMIN1(1.0,TERMNS)                                    CAM  00877
      GO TO 2700                                                        CAM  00878
 2698 CONTINUE                                                          CAM  00879.
      RAKS=RAKNS=RSMELR(ID)=0.0                                         CAM  00880
 2709 CONTINUE                                                          CAM  00881
C                                                                       CAM  00882
C     TOTAL AIRCRAFT DESTRUCTION                                        CAM  00883
C                                                                       CAM  00884
      XS= 0.0                                                           CAM  00885
      IF(BTOTS .GT. .0001)  XS=BAKS/BTOTS                               CAM  00886
      XNS= 0.0                                                          CAM  00887
      IF(BTOTNS .GT. .0001)        XNS=BAKNS/BTOTNS                     CAM  00888
      BAD(1,ID)=XS*BPOPS(1)+ XNS*BPOPNS(1)                              CAM  00889
      DO 2701  MS=1,3                                                   CAM  00890
      BAD(1,ID)=BAD(1,ID)+BAKAA(1,MS)+BAL(1,MS)                         CAM  00891
 2701 CONTINUE                                                          CAM  00892
      IF(NKBA .EQ. 1) GO TO 2703                                        CAM  00893
      DO 2702  KBA=2,4                                                  CAM  00894
      MS=KBA-1                                                          CAM  00895
      BAD(KBA,ID)=XS*BPOPS(KBA)+XNS*BPOPNS(KBA)+BAKAA(2,MS)+BAL(2,MS)   CAM  00896
 2702 CONTINUE                                                          CAM  00897
 2703 CONTINUE                                                          CAM  00898
      XS= 0.0                                                           CAM  00899
      IF(RTOTS .GT. .0001)  XS=RAKS/RTOTS                               CAM  00900
      XNS= 0.0                                                          CAM  00901
      IF(RTOTNS .GT. .0001)        XNS=RAKNS/RTOTNS                     CAM  00902
      RAD(1,ID)= XS*RPOPS(1)+XNS*RPOPNS(1)                              CAM  00903
      DO 2706  MS=1,3                                                   CAM  00904
      RAD(1,ID)=RAD(1,ID)+RAKAA(1,MS)+RAL(1,MS)                         CAM  00905
 2706 CONTINUE                                                          CAM  00906
      IF(NKRA .EQ. 1) GO TO 2708                                        CAM  00907
      DO 2707  KRA=2,4                                                  CAM  00908
      MS= KRA-1                                                         CAM  00909
      RAD(KRA,ID)=XS*RPOPS(KRA)+XNS*RPOPNS(KRA)+RAKAA(2,MS)+RAL(2,MS)   CAM  00910
 2707 CONTINUE                                                          CAM  00911
 2708 CONTINUE                                                          CAM  00912
C                                                                       CAM  00913
C --- AIR FIREPOWER FOR ID -- B AND R                                   CAM  00914
C                                                                       CAM  00915
      BAF(ID) = 0.0                                                     CAM  00916
      RAF(ID) = 0.0                                                     CAM  00917
      DO 2801  TY=1,2                                                   CAM  00918
      BAF(ID) = BAF(ID) + BS(TY,1)*FBA(TY)                              CAM  00919
      RAF(ID) = RAF(ID) + RS(TY,1)*FRA(TY)                              CAM  00920
 2801  CONTINUE                                                         CAM  00921
C                                                                       CAM  00922
C     TOTAL FIREPOWER FOR ID--B AND R                                   CAM  00923
C                                                                       CAM  00924
      BF(ID)=BGF(ID)+BAF(ID)                                            CAM  00925
      RF(ID)=RGF(ID)+RAF(ID)                                            CAM  00926
C                                                                       CAM  00927
C     FEBA FOR ID                                                       CAM  00928
C                                                                       CAM  00929
      FRBR=  RF(ID)/BF(ID)                                              CAM  00930
      IF(BF(ID) .LT. RF(ID) )  GO TO 2802                               CAM  00931
      CALL CVFX ( NFRBA, FRBA, FA, FRBR, DFEBA)                         CAM  00932
      GO TO 2805                                                        CAM  00933
 2802 CONTINUE                                                          CAM  00934
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      FRRB=  RF(ID)/BF(ID)                                              CAM  00935
      CALL CVFX(NFRFA,FRFA,FA,FRRB,DFOBA)                               CAM  00936
      DFEBA=-DFOBA                                                      CAM  00937
 2805 CONTINUE                                                          CAM  00938
      IF(ID-1) 2810,2810,2820                                           CAM  00939
 2810  FEBA(ID)=DFEBA                                                   CAM  00940
      GO TO 2850                                                        CAM  00941
 2820 IDM1=ID-1                                                         CAM  00942
      FEBA(ID)=FEBA(IDM1)+DFEBA                                         CAM  00943
C                                                                       CAM  00944
C --- DIVISION DESTRUCTION FOR ID                                       CAM  00945
C                                                                       CAM  00946
 2850 CONTINUE                                                          CAM  00947
      IF(IREPLB .EQ. 0) GO TO 2851                                      CAM  00948
      BDD(1,ID)=BDD(2,ID)=BDD(3,ID)=BDD(4,ID)=0.0                       CAM  00949
      GO TO 2855                                                        CAM  00950
 2851 CALL CVFX(NFRBD,FRBD,BD,FRBR,PBDID)                               CAM  00951
      DO 2852  KBD=1,NKBD                                               CAM  00952
 2852 BDD(KBD,ID)=BDI(KBD,ID)*PBDID                                     CAM  00953
 2855 IF(IREPLR .EQ. 0) GO TO 2856                                      CAM  00954
      RDD(1,ID)=RDD(2,ID)=RDD(3,ID)=RDD(4,ID)=0.0                       CAM  00955
      GO TO 2860                                                        CAM  00956
 2856 CALL CVFX(NFRRD,FRFD,RD,FRBR,PRDID)                               CAM  00957
      DO 2857  KRD=1,NKRD                                               CAM  00958
 2857 RDD(KRD,ID) = RDI(KRD,ID)*PRDID                                   CAM  00959
 2860 CONTINUE                                                          CAM  00960
C                                                                       CAM  00961
C --- CUMULATIVE TOTAL AND AIR FIREPOWER -- B AND R                     CAM  00962
C                                                                       CAM  00963
 2870   IF(ID-1) 2875,2875,2880                                         CAM  00964
 2875   CBF(ID)=BF(ID)                                                  CAM  00965
      CRF(ID) = RF(ID)                                                  CAM  00966
      CBAF(ID) = BAF(ID)                                                CAM  00967
      CRAF(ID) = RAF(ID)                                                CAM  00968
      GO TO 2900                                                        CAM  00969
C                                                                       CAM  00970
 2880   IDM1=ID-1                                                       CAM  00971
      CBF(ID) = CBF(IDM1) + BF(ID)                                      CAM  00972
      CRF(ID) = CRF(IDM1) + RF(ID)                                      CAM  00973
      CBAF(ID) = CBAF(IDM1) + BAF(ID)                                   CAM  00974
      CRAF(ID) = CRAF(IDM1) + RAF(ID)                                   CAM  00975
 2900 CONTINUE                                                          CAM  00976
C                                                                       CAM  00977
C --- END OF DO LOOP ON ID                                              CAM  00978
C                                                                       CAM  00979
 3000 CONTINUE                                                          CAM  00980
C                                                                       CAM  00981
 9999 CONTINUE                                                          CAM  00982
      RETURN                                                            CAM  00983
      END                                                               CAM  00984
```

H. SUBROUTINE CVFX

```
      SUBROUTINE CVFX(M,X,FX,VX,VFX)                                    CVFX    00002
C     OPTSA II                                                          CVFX    00003
C     SUBROUTINE CALCULATE VFX=FUNCTION(VX)                             CVFX    00004
C                                                                       CVFX    00005
      DIMENSION X(8),FX(8)                                              CVFX    00006
C                                                                       CVFX    00007
      I=1                                                               CVFX    00008
      IF( VX-X(1))30,20,10                                              CVFX    00009
C                                                                       CVFX    00010
   10 DO 12 I=2,M                                                       CVFX    00011
      IF( VX-X(I))15,20,12                                              CVFX    00012
   12 CONTINUE                                                          CVFX    00013
      XDIF = VX-X(M)                                                    CVFX    00014
      FRAC =  XDIF / ( X(M)-X(M-1) )                                    CVFX    00015
      VFX  =  FX(M)  +  FRAC * ( FX(M)-FX(M-1) )                        CVFX    00016
      GO TO 99                                                          CVFX    00017
   15 XDIF = VX-X(I-1)                                                  CVFX    00018
      FRAC =  XDIF / ( X(I)-X(I-1) )                                    CVFX    00019
      VFX  =  FX(I-1) + FRAC * ( FX(I)-FX(I-1) )                        CVFX    00020
      GO TO 99                                                          CVFX    00021
C                                                                       CVFX    00022
   20 VFX = FX(I)                                                       CVFX    00023
      GO TO 99                                                          CVFX    00024
C                                                                       CVFX    00025
   30 XDIF = X(1)- VX                                                   CVFX    00026
      FRAC = XDIF/ ( X(2)-X(1) )                                        CVFX    00027
      VFX = FX(1) - FRAC * ( FX(2)-FX(1) )                              CVFX    00028
      GO TO 99                                                          CVFX    00029
C                                                                       CVFX    00030
   99 CONTINUE                                                          CVFX    00031
      RETURN                                                            CVFX    00032
      END                                                               CVFX    00033
```

I. SUBROUTINE CAMCLR

```
      SUBROUTINE CAMCLR                                                 CAMCLR  00002
      COMMON/CAMVAR/  SORRB(2,3),SORRR(2,3)                             CAMCLR  00003
      COMMON/CAMVAR/  BA(2,3),RA(2,3),BS(2,3),RS(2,3)                   CAMCLR  00004
      COMMON/CAMVAR/ BAKAA(2,3),RAKAA(2,3),BSKAA(2,3),RSKAA(2,3)        CAMCLR  00005
      COMMON/CAMVAR/ BAL(2,3),RAL(2,3),BSL(2,3),RSL(2,3)                CAMCLR  00006
      COMMON/CAMVAR/  VBIDRA(2),VBADRI(4),VRIDBA(2),VRADBI(4)           CAMCLR  00007
      COMMON/CAMVAR/  BSENG(2,2),RSENG(2,2)                             CAMCLR  00008
      COMMON/CAMVAR/ BPENG(2),RPENG(2)                                  CAMCLR  00009
      COMMON/CAMVAR/ BSFB(2,3),BAFB(2,3),RSFB(2,3),RAFB(2,3)            CAMCLR  00010
      COMMON/CAMVAR/ BAVUL(4),RAVUL(4),PBARA(2),PRARA(2)                CAMCLR  00011
      COMMON/CAMVAR/ BPOPS(4),BPOPNS(4),RPOPS(4),RPOPNS(4)              CAMCLR  00012
      COMMON/CAMVAR/ VBDRS,VBDRNS,VBKRS,VBKRNS                          CAMCLR  00013
      COMMON/CAMVAR/ VRDBS,VRDBNS,VRKBS,VRKBNS                          CAMCLR  00014
      DO 3  I=1,2                                                       CAMCLR  00015
      DO 4  J=1,3                                                       CAMCLR  00016
        BA(I,J)=   RA(I,J)=   BS(I,J)=   RS(I,J)=0.0                   CAMCLR  00017
        BAL(I,J)=  RAL(I,J)=  BSL(I,J)=  RSL(I,J)=0.0                  CAMCLR  00018
      BAKAA(I,J)=RAKAA(I,J)=BSKAA(I,J)=RSKAA(I,J)=0.0                   CAMCLR  00019
      BSFB(I,J)=BAFB(I,J)=RSFB(I,J)=RAFB(I,J)=0.0                       CAMCLR  00020
      SORRB(I,J)=SORRR(I,J)=0.                                          CAMCLR  00021
    4 CONTINUE                                                          CAMCLR  00022
      VBIDRA(I)=VRIDBA(I)=0.                                            CAMCLR  00023
      PBABA(I)=PRABA(I)=0.                                              CAMCLR  00024
      BPENG(I)=RPENG(I)=0.0                                             CAMCLR  00025
      BSENG(1,I)=BSENG(2,I)=0.0                                         CAMCLR  00026
      RSENG(1,I)=RSENG(2,I)=0.0                                         CAMCLR  00027
    3 CONTINUE                                                          CAMCLR  00028
      DO 5  K=1,4                                                       CAMCLR  00029
      VBADRI(K)=VRADBI(K)=0.                                            CAMCLR  00030
      BAVUL(K)=RAVUL(K)=0.                                              CAMCLR  00031
      BPOPS(K)=BPOPNS(K)=RPOPS(K)=RPOPNS(K)=0.                          CAMCLR  00032
    5 CONTINUE                                                          CAMCLR  00033
      RETURN                                                            CAMCLR  00034
      END                                                               CAMCLR  00035
```

Chapter V

OUTPUT

There are two parts to the output. First, input variables are printed out by subroutine READ as they are read in. This output is exhibited in Section B of this chapter (below). Second are the payoff matrices, game values, and optimal strategies for the various stages. The output of the original program was very long and, thus, cumbersome to read. Though some of this lengthiness is unavoidable due to the backwards induction procedure used to solve the game, a "strategy recall" process has been introduced to shorten the output somewhat. There are now several output options of various lengths and detail, which are explained in Section A (below). Examples of output, using the sample data from Chapter II with the various output options, appear in Section C.

A. READING THE OUTPUT - EXPLANATION OF OUTPUT OPTIONS

The output listing is generated as the program progresses, and some of the payoff matrices and strategy arrays are covered up with new information. However, the "strategy recall" feature prints optimal Blue and Red strategies for period k+1 *immediately after* printing the strategies for period k. A period k+1 strategy pair is printed for each possible realization of a randomized period-k strategy. This feature makes it possible to avoid printing the space-consuming payoff matrices yet to retain the important strategy information.

The output option is controlled by the two input variables IPRV and IPRU. The number of periods in the war (variable NPD)

also affects the output. Table 1 describes the options: Option 3A does not give strategies for all periods; option 3C is quite long. The overall best options seem to be 2A for a two-period war and 3B for a three-period war; they give all the strategy information with a minimum of payoff matrices.

Table 1. OUTPUT OPTIONS

Output Option	Number of Periods (NPD)	Print Inputs		Output		Output Length (Pages)*
		IPRV	IPRU	Strategies for Period(s)	Partial Payoff Matrices for Period(s)	
1	1	1	1	1	1	1
2A	2	1	0	1,2	1	1
2B	2	1	1	1,2	1,2	4 or 5
3A	3	0	0	1,2	1	1
3B	3	1	0	1,2,3	1,2	7 or 8
3C	3	1	1	1,2,3	1,2,3	100 to 200

*This is somewhat dependent on NB and NR, the number of pure strategies input .

A "unit" of printout contains the following, in order:

- The notation "Payoff Matrix for Game at Stage" and the stage (period).
- The payoff matrix. Not all the entries in a payoff matrix are necessarily computed; at the left-hand side and top of the matrix are zero-one indicators (vectors IBACT( ) and IRACT( )) that show whether the corresponding row or column of payoff entries has not or has been computed.
- Except in a stage-one game, the Blue and Red pure strategies played in the preceding period; these are marked JB and JR or IB and IR.
- The value for this game, given the preceding period pure strategies. This is marked "game value" for a stage-one

game; otherwise, it is marked V(JB,JR) or W(IR,IR) as the game value becomes a payoff entry in a game at the preceding stage. This value assumes optimal play in all following periods. (*All* payoff entries and game values represent values of the selected MOE *on day MOET, not* at the end of intermediate periods.)

- The notation "Blue and Red Strategies for Period" and the current period.
- The optimal strategies. These are output as two rows--the first for Blue, the second for Red. Each row gives probabilities for choosing the input pure strategies for that side, in order. Of course, strategies in preceding periods have been played.
- Except for final-stage games, the optimal strategies for the following period. There is output a strategy pair for each possible realization of the randomized strategy for the current period. (The strategies for the following period might, however, all be the same, regardless of the randomization outcome.) This is preceded by the notation "Blue and Red Strategies for Period" and the following period.

There is a lot of manipulation of variable names, and the number of periods in the war affects which variable names are used for which output. Table 2 shows which variables hold which elements of a unit of output, for a given stage and number of periods.

Following is a brief guide for reading the output for other than one-page options:

- The last page of output contains the payoff matrix of the overall game to be solved (the first-stage game), the optimal first-period strategies, and the optimal second-period strategies for each active pair of Blue and Red first-period pure strategies.
- To find the second-period payoff matrices for a given active pair of first-period strategies, look for the output unit where IB and IR (or JB and JR for a two-period war) are equal to the particular pair. The second-period strategies will be the same as those on the last page of output. For a three-period war, the optimal third-period strategies will also be given. (In option 3C, be careful not to confuse third- and second-period printout units.)
- If option 3C is being used, the third-period payoff matrices for a particular *second-period* active pure-strategy pair

Table 2. VARIABLES OUTPUT

Number of Periods	Stage/ Current Period	Variable for-- Payoff Matrix	Pure Strategy Pair (Preceding Period)	Value of Game	Optimal Blue and Red Strategies (Current Period)	Optimal Blue and Red Strategies (Following Period)
1	1	U(KB,KR)	[1,1]	[V(1,1)]	SUB(1,1,KB) KB=1,NB SUR(1,1,KR) KR=1,NR	n/a
2	1	V(JB,JR)	[1,1]	[W(1,1)]	SVB(1,1,JB) JB=1,NB SVR(1,1,JR) JR=1,NR	SUB(JB,JR,·) SUR(JB,JR,·)
2	2	U(KB,KR)	JB,JR	V(JB,JR)	SUB(JB,JR,KB) KB=1,NB SUR(JB,JR,KR) KR=1,NR	n/a
3	1	W(IB,IR)	n/a	VALUE	SWB(IB) IB=1,NB SWR(IR) IR=1,NR	SVB(IB,IR,·) SVR(IB,IR,·)
3	2	V(JB,JR)	IB,IR	W(IB,IR)	SVB(IB,IR,JB) JB=1,NB SVR(IB,IR,JR) JR=1,NR	SUB(JB,JR,·) SUR(JB,JR,·)
3	3	U(KB,KR)	JB,JR	V(JB,JR)	SUB(JB,JR,KB) KB=1,NB SUR(JB,JR,KR) KR=1,NR	n/a

(JB,JR) are found by leafing back from the second-period payoff matrix.

This guide will be made clear by the examples.

Changing the number of periods is a real data change; hence, different optimal strategies and game values are to be expected for the examples for options 2A and 2B and the examples for options 3A, 3B, and 3C--and, indeed, do occur. However, given the number of periods and decision days, the output option naturally does not affect the game values or strategies at all. The examples for options 2A and 2B, for instance, have *exactly* the same game solution.

B. SAMPLE OUTPUT OF INPUT VARIABLES (using output option 2B)

NK_{RD}, NKR_D, NK_{BA}, NKR_A			
3	3	4	4

NID
30

NPD, IDL2, IDL3		
2	1	11

IRO, JRO, KRO		
-0	6	1

IPRV, IPRU	
1	1

IREPLB, IREPLR	
0	0

BDA(KBD,ID)

24.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
-0.0	6.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	6.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	-0.0	-0.0	-0.0		
12.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	3.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	-0.0	-0.0	-0.0		
10.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	3.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	-0.0	-0.0	-0.0		

RDA(KRD,ID)

80.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	20.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	-0.0	-0.0	-0.0		
40.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	10.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	-0.0	-0.0	-0.0		
10.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	2.0	-0.0	-0.0	-0.0	-0.0
-0.0	-0.0	-0.0	-0.0	-0.0	-0.0		

BAA(KBA,ID)

1500	-0	-0	-0	75	-0	-0	-0
-0	-0	-0	-0	-0	-0	-0	-0
-0	75	-0	-0	-0	-0	-0	-0
-0	-0	-0	75	-0	-0		
300	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0		
200	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	40	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0		
200	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0		

RAA(KRA,ID)

2300	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0		
300	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0		
400	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0		
500	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0	-0	-0
-0	-0	-0	-0	-0	-0		

DBURA;URURA

200.0	200.0

PRSHEL

1000

PRSHEL

2000

```
FBD(KBD)
    10.0        8.0        6.0

FHD(KHD)
     6.0        5.0        4.0

(FBA(KBA),KBA=1,2)
   .10000     .15000

(FHA(KHA),KRA=1,2)
   .09000     .08000

IDBSRC,IDHSRC
       5          4

((SOKHB1(TY,MS),MS=1,3),TY=1,2)
   2.0000     2.5000     2.5000
   2.0000     3.0000     1.5000

((SOKHB2(TY,MS),MS=1,3),TY=1,2)
   1.0000     1.5000     1.0000
    .7000     1.0000      .6000

((SOKHH1(TY,MS),MS=1,3),TY=1,2)
   3.0000     2.5000     2.5000
   3.0000     2.0000     2.0000

((SOKHH2(TY,MS),MS=1,3),TY=1,2)
   1.7000     1.5000     1.5000
   1.7000     1.0000      .8000

IAA
      1

XNBAA,XNRAA
     1.0        1.0

((BALPHA(TY,MS),MS=1,2),TY=1,2)
   .80000     .60000
   .80000     .60000

((RALPHA(TY,MS),MS=1,2),TY=1,2)
   .50000     .40000
   .50000     .40000

((BIDHA(TYI,KAI),KAI=1,4),TYI=1,2)
   .00100     .00100     .00100     .00100
   .00150     .00150     .00200     .00200

((BIHHA(TYI,KAI),KAI=1,4),TYI=1,2)
   .30000     .30000     .30000     .30000
   .50000     .50000     .50000     .50000

((BADHI(KAI,TYI),TYI=1,2),KAI=1,4)
   .00100     .00100
   .00100     .00100
   .00100     .00100
   .00100     .00100

((BAHHI(KAI,TYI),TYI=1,2),KAI=1,4)
   .10000     .10000
   .10000     .10000
   .10000     .10000
   .10000     .10000
```

((RIDBA(TY1,KA1),KA1=1,4),TY1=1,2)

.00050	.00050	.00050	.00050
.00100	.00100	.00100	.00100

((RINBA(TY1,KA1),KA1=1,4),TY1=1,2)

.20000	.20000	.20000	.20000
.30000	.30000	.30000	.30000

((RADB1(KA1,TY1),TY1=1,2),KA1=1,4)

.00050	.00050
.00050	.00050
.00050	.00050
.00050	.00050

((RANB1(KA1,TY1),TY1=1,2),KA1=1,4)

.10000	.10000
.10000	.10000
.10000	.10000
.10000	.10000

((BSAM2R(TY,MS),MS=1,2),TY=1,2)

.0500	.1000
.0500	.1000

((RSAM2B(TY,MS),MS=1,2),TY=1,2)

.0500	.1000
.0500	.1000

IR3SM

1

BFRAC1,BFRAC2

.800 .900

RFRAC1,RFRAC2

.700 .900

FBSK,FRSK

1.000 .500

(BPASS(TY),TY=1,2)

1.00 1.00

(RPASS(TY),TY=1,2)

1.00 1.00

IBABA--BLUE ATTACKS RED AIRBASE USING MODE 1

IRABA--RED ATTACKS BLUE AIRBASE USING MODE 1

XNBAB,XNRAB

20.0 20.0

BPARK,RPARK

10000.0 10000.0

	B GP	B SP ABA
BDRS	.01000	.01000
BDRNS	.02000	.02000
BKRS	.40000	.40000
BKRNS	.60000	.60000

	R GP	R SP ABA
RDBS	.01000	.01000
RDBNS	.02000	.02000

```
RKBS      .20000     .20000
RKBNS     .30000     .30000

B4B,B4AL,B4AN1,B4AN2,B4AS1,R4AS2,B4NS1,B4NS2,B4SN1,B4SN2
      1000000.0     0.0000    10000.0    20000.0    15000.0    15000.0     0.0000     0.0000     1.0000     1.0000

R4B,R4AL,R4AN1,R4AN2,R4AS1,R4AS2,R4NS1,R4NS2,R4SN1,R4SN2
      1000000.0     0.0000    10000.0    20000.0    15000.0    15000.0     0.0000     0.0000     1.0000     1.0000

EPS4
   .00010

 NFRFA,FRFA(I),FA(I)
        11
      .10        .20        .33        .50        .67       1.00       1.50       2.00
     3.00       5.00      10.00
   -60.0      -40.0      -20.0      -10.0       -5.0        0.0        2.0       10.0
    20.0       40.0       60.0

 NFRBD,FRBD(I),BD(I)
        11
      .10        .20        .33        .50        .67       1.00       1.50       2.00
     3.00       5.00      10.00
     .020       .014       .010       .009       .008       .008       .008       .007
     .005       .003       .002

 NFRRD,FRRD(I),RD(I)
        11
      .10        .20        .33        .50        .67       1.00       1.50       2.00
     3.00       5.00      10.00
     .002       .003       .005       .007       .008       .008       .008       .009
     .010       .014       .020
```

NB,NK

6	6	

PB(IBA, MS), MS=1,3)

1.000	0.000	0.000
.500	.500	0.000
0.000	1.000	0.000
.500	0.000	.500
0.000	.500	.500
0.000	0.000	1.000

PR(IRA, MS), MS=1,3)

1.000	0.000	0.000
.500	.500	0.000
0.000	1.000	0.000
.500	0.000	.500
0.000	.500	.500
0.000	0.000	1.000

```
MOE,MOET
     1          30

BCWG!
     0.000

(BSWG!(MS),MS=1,3)
     1.000      1.000      1.000

(BQWG!(I),I=1,2)
     1.000      0.000

RCWG!
     0.000

(RSWG!(MS),MS=1,3)
     0.000      0.000      0.000

(RQWG!(I),I=1,2)
     0.000      0.000

GVA
     10000
```

C. SAMPLE OUTPUT OF GAME SOLUTIONS

1. Option 2A

PAYOFF MATRIX FOR GAME AT STAGE 1

	0	0	0	0	0	1
0	0.000	0.000	0.000	0.000	0.000	-259.816
0	0.000	0.000	0.000	0.000	0.000	-137.352
0	0.000	0.000	0.000	0.000	0.000	-50.268
0	0.000	0.000	0.000	0.000	0.000	-190.940
0	0.000	0.000	0.000	0.000	0.000	-53.733
1	212.618	39.621	24.456	134.052	46.768	4.617

GAME VALUE 4.6171

BLUE AND RED STRATEGIES FOR PERIOD 1

0.000	0.000	0.000	0.000	0.000	1.000
0.000	0.000	0.000	0.000	0.000	1.000

BLUE AND RED STRATEGIES FOR PERIOD 2

6	6				
0.000	1.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

2. Option 2B

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	0	0	0
1	-259.816	-53.888	102.782	-98.673	105.823	133.783
0	-264.448	0.000	0.000	0.000	0.000	0.000
0	-269.600	0.000	0.000	0.000	0.000	0.000
0	-266.791	0.000	0.000	0.000	0.000	0.000
0	-267.381	0.000	0.000	0.000	0.000	0.000
0	-263.838	0.000	0.000	0.000	0.000	0.000

JR= 1 JR= 6

V(JR,JR) -259.8161

BLUE AND RED STRATEGIES FOR PERIOD 2

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	0	0	0
1	-137.352	-6.815	106.530	-37.054	109.448	136.242
0	-143.377	0.000	0.000	0.000	0.000	0.000
0	-149.252	0.000	0.000	0.000	0.000	0.000
0	-146.119	0.000	0.000	0.000	0.000	0.000
0	-147.474	0.000	0.000	0.000	0.000	0.000
0	-144.589	0.000	0.000	0.000	0.000	0.000

JR= 2 JR= 6

V(JR,JR) -137.3520

BLUE AND RED STRATEGIES FOR PERIOD 2

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	0	0	0
1	-60.268	24.495	110.616	4.802	117.742	139.345
0	-66.875	0.000	0.000	0.000	0.000	0.000
0	-73.488	0.000	0.000	0.000	0.000	0.000
0	-69.073	0.000	0.000	0.000	0.000	0.000
0	-71.445	0.000	0.000	0.000	0.000	0.000
0	-68.203	0.000	0.000	0.000	0.000	0.000

JR= 3 JR= 6

V(JR,JR) -60.2677

BLUE AND RED STRATEGIES FOR PERIOD 2

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	0	0	0
0	-162.009	0.000	0.000	0.000	0.000	0.000
0	-167.674	0.000	0.000	0.000	0.000	0.000
0	-177.454	0.000	0.000	0.000	0.000	0.000
1	-160.940	3.271	178.847	-34.951	181.922	203.629
0	-175.444	0.000	0.000	0.000	0.000	0.000
0	-168.495	0.000	0.000	0.000	0.000	0.000

JR= 4 JR= 6

V(JR,JR) -160.9397

BLUE AND RED STRATEGIES FOR PERIOD 2

0.000	0.000	0.000	1.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	0	0	0
1	-53.733	31.172	164.931	10.650	170.188	180.594
0	-66.723	0.000	0.000	0.000	0.000	0.000
0	-81.803	0.000	0.000	0.000	0.000	0.000
0	-57.328	0.000	0.000	0.000	0.000	0.000
0	-76.986	0.000	0.000	0.000	0.000	0.000
0	-67.765	0.000	0.000	0.000	0.000	0.000

JR= 5 JR= 6

V(JR,JR) -53.7326

BLUE AND RED STRATEGIES FOR PERIOD 2

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	0	0	0
0	-5.110	0.000	0.000	0.000	0.000	0.000
1	4.617	44.161	228.567	20.987	223.133	216.404
0	-25.926	0.000	0.000	0.000	0.000	0.000
0	1.188	0.000	0.000	0.000	0.000	0.000
0	-25.024	0.000	0.000	0.000	0.000	0.000
0	-8.178	0.000	0.000	0.000	0.000	0.000

JR= 6 JR= 6

V(JR,JR) 4.6171

BLUE AND RED STRATEGIES FOR PERIOD 2

0.000	1.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	0	0	0
1	212.618	248.930	282.677	226.629	278.994	273.679

0	175.778	0.000	0.000	0.000	0.000	0.000
0	74.035	0.000	0.000	0.000	0.000	0.000
0	207.477	0.000	0.000	0.000	0.000	0.000
0	72.192	0.000	0.000	0.000	0.000	0.000
0	64.579	0.000	0.000	0.000	0.000	0.000

JR= 6 JR= 1

V(JR,JR) 212.6182

BLUE AND RED STRATEGIES FOR PERIOD 2

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	0	0	0
0	11.565	0.000	0.000	0.000	0.000	0.000
0	16.151	0.000	0.000	0.000	0.000	0.000
0	18.223	0.000	0.000	0.000	0.000	0.000
1	39.821	77.385	134.148	43.612	135.967	141.225
0	27.555	0.000	0.000	0.000	0.000	0.000
0	38.318	0.000	0.000	0.000	0.000	0.000

JR= 6 JR= 2

V(JR,JR) 39.8207

BLUE AND RED STRATEGIES FOR PERIOD 2

0.000	0.000	0.000	1.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	0	0	0
0	18.582	0.000	0.000	0.000	0.000	0.000
0	16.860	0.000	0.000	0.000	0.000	0.000
0	15.038	0.000	0.000	0.000	0.000	0.000
0	21.639	0.000	0.000	0.000	0.000	0.000
0	17.683	0.000	0.000	0.000	0.000	0.000
1	24.456	50.712	82.743	31.474	85.386	91.314

JR= 6 JR= 3

V(JR,JR) 24.4562

BLUE AND RED STRATEGIES FOR PERIOD 2

0.000	0.000	0.000	0.000	0.000	1.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	0	0	0
0	65.516	0.000	0.000	0.000	0.000	0.000
0	90.487	0.000	0.000	0.000	0.000	0.000
0	63.862	0.000	0.000	0.000	0.000	0.000
1	134.052	184.574	240.970	135.527	238.781	232.951
0	65.001	0.000	0.000	0.000	0.000	0.000
0	65.997	0.000	0.000	0.000	0.000	0.000

JH= 6 JR= 4

V(JR,JR) 134.0521

BLUE AND RED STRATEGIES FOR PERIOD 2

0.000	0.000	0.000	1.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	1	0	0
0	22.363	0.000	0.000	34.980	0.000	0.000
0	21.794	0.000	0.000	33.276	0.000	0.000
0	16.421	0.000	0.000	30.877	0.000	0.000
0	35.206	0.000	0.000	41.137	0.000	0.000
0	27.983	0.000	0.000	35.045	0.000	0.000
1	49.623	79.177	122.066	46.768	124.227	128.286

JH= 6 JR= 5

V(JR,JR) 46.7683

BLUE AND RED STRATEGIES FOR PERIOD 2

0.000	0.000	0.000	0.000	0.000	1.000
0.000	0.000	0.000	1.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 1

	0	0	0	0	0	1
0	0.000	0.000	0.000	0.000	0.000	-259.816
0	0.000	0.000	0.000	0.000	0.000	-137.352
0	0.000	0.000	0.000	0.000	0.000	-60.268
0	0.000	0.000	0.000	0.000	0.000	-160.940
0	0.000	0.000	0.000	0.000	0.000	-53.733
1	212.618	39.821	24.456	134.052	46.768	4.617

GAME VALUE 4.6171

BLUE AND RED STRATEGIES FOR PERIOD 1

	0.000	0.000	0.000	0.000	0.000	1.000
	0.000	0.000	0.000	0.000	0.000	1.000

BLUE AND RED STRATEGIES FOR PERIOD 2

	6	6				
	0.000	1.000	0.000	0.000	0.000	0.000
	1.000	0.000	0.000	0.000	0.000	0.000

3. Option 3A

PAYOFF MATRIX FOR GAME AT STAGE 1

	1	0	1	0	0	0
0	-13.708	0.000	-34.617	0.000	0.000	0.000
0	96.944	0.000	10.139	0.000	0.000	0.000
0	209.360	0.000	25.209	0.000	0.000	0.000
0	59.810	0.000	-7.705	0.000	0.000	0.000
0	209.227	0.000	26.195	0.000	0.000	0.000
1	220.841	64.633	32.487	141.546	69.116	83.694

GAME VALUE 32.4866

BLUE AND RED STRATEGIES FOR PERIOD 1

0.000	0.000	0.000	0.000	0.000	1.000
0.000	0.000	1.000	0.000	0.000	0.000

BLUE AND RED STRATEGIES FOR PERIOD 2

6	3				
0.000	0.000	0.000	0.000	0.000	1.000
0.000	0.000	0.000	1.000	0.000	0.000

4. Option 3B

```
PAYOFF MATRIX FOR GAME AT STAGE  2
          1          0          0          1          0          0
 0    -34.900     0.000     0.000   -26.743     0.000     0.000
 0    -45.769     0.000     0.000   -25.265     0.000     0.000
 0    -59.986     0.000     0.000   -26.901     0.000     0.000
 0    -35.242     0.000     0.000   -21.625     0.000     0.000
 0    -47.189     0.000     0.000   -22.940     0.000     0.000
 1    -10.769    17.066    46.956   -13.708    33.273    34.216

IH=   1    IR=   1

W(IR,IR)          -13.7077

BLUE AND RED STRATEGIES FOR PERIOD  2
          0.000     0.000     0.000     0.000     0.000     1.000
          0.000     0.000     0.000     1.000     0.000     0.000

BLUE AND RED STRATEGIES FOR PERIOD  3

          6         4
          1.000     0.000     0.000     0.000     0.000     0.000
          1.000     0.000     0.000     0.000     0.000     0.000


PAYOFF MATRIX FOR GAME AT STAGE  2
          1          0          0          1          0          0
 0     76.959     0.000     0.000    73.988     0.000     0.000
 0     85.001     0.000     0.000    73.625     0.000     0.000
 0     86.972     0.000     0.000    75.477     0.000     0.000
 0    105.893     0.000     0.000    92.832     0.000     0.000
 0     97.390     0.000     0.000    92.780     0.000     0.000
 1    116.661   130.867   151.931    96.944   148.544   100.805

IH=   2    IR=   1

W(IR,IR)           96.9436

BLUE AND RED STRATEGIES FOR PERIOD  2
          0.000     0.000     0.000     0.000     0.000     1.000
          0.000     0.000     0.000     1.000     0.000     0.000

BLUE AND RED STRATEGIES FOR PERIOD  3

          6         4
          1.000     0.000     0.000     0.000     0.000     0.000
          1.000     0.000     0.000     0.000     0.000     0.000


PAYOFF MATRIX FOR GAME AT STAGE  2
          1          0          0          0          0          0
 1    209.340   227.733   244.000   211.499   237.509   222.970
 0    174.699     0.000     0.000     0.000     0.000     0.000
 0    127.582     0.000     0.000     0.000     0.000     0.000
 0    196.486     0.000     0.000     0.000     0.000     0.000
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 0      136.961       0.000       0.000       0.000       0.000       0.000
 0      154.055       0.000       0.000       0.000       0.000       0.000

IH=    3     IR=    1

V(IB,IR)            209.3601

BLUE AND RED STRATEGIES FOR PERIOD  2
          1.000       0.000       0.000       0.000       0.000       0.000
          1.000       0.000       0.000       0.000       0.000       0.000

BLUE AND RED STRATEGIES FOR PERIOD  3

          1           1
          1.000       0.000       0.000       0.000       0.000       0.000
          1.000       0.000       0.000       0.000       0.000       0.000


PAYOFF MATRIX FOR GAME AT STAGE  2
                1           0           0           1           0           1
 0        -1.052       0.000       0.000       -.814       0.000     104.540
 0        14.467       0.000       0.000        .976       0.000      74.578
 0        27.334       0.000       0.000      10.257       0.000      39.811
 1        41.297      72.424     144.475      15.031     119.119     106.493
 0        47.548       0.000       0.000      27.065       0.000      44.820
 1        86.869      98.931     122.277      42.733     107.578      56.761

IH=    4     IR=    1

V(IB,IR)            53.8097

BLUE AND RED STRATEGIES FOR PERIOD  2
          0.000       0.000       0.000        .061       0.000        .939
          0.000       0.000       1.000        .511       0.000        .489

BLUE AND RED STRATEGIES FOR PERIOD  3

          4           4
          1.000       0.000       0.000       0.000       0.000       0.000
          1.000       0.000       0.000       0.000       0.000       0.000

          4           6
          1.000       0.000       0.000       0.000       0.000       0.000
          1.000       0.000       0.000       0.000       0.000       0.000

          4           4
          1.000       0.000       0.000       0.000       0.000       0.000
          1.000       0.000       0.000       0.000       0.000       0.000

          6           6
          1.000       0.000       0.000       0.000       0.000       0.000
          1.000       0.000       0.000       0.000       0.000       0.000


PAYOFF MATRIX FOR GAME AT STAGE  2
                1           0           0           0           0           0
 1      209.227     234.839     262.842     213.406     252.873     231.156
 0      176.770       0.000       0.000       0.000       0.000       0.000
 0      114.475       0.000       0.000       0.000       0.000       0.000
 0      205.852       0.000       0.000       0.000       0.000       0.000
 0      129.579       0.000       0.000       0.000       0.000       0.000
 0      156.292       0.000       0.000       0.000       0.000       0.000
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IH= 5 IR= 1

W(IR,IR) 209.2276

BLUE AND RED STRATEGIES FOR PERIOD 2

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

BLUE AND RED STRATEGIES FOR PERIOD 3

1	1				
1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	1	0	0
0	212.658	0.000	0.000	220.620	0.000	0.000
0	187.861	0.000	0.000	193.770	0.000	0.000
0	97.351	0.000	0.000	98.998	0.000	0.000
1	226.355	240.999	255.859	220.841	248.126	221.719
0	117.661	0.000	0.000	118.394	0.000	0.000
0	169.915	0.000	0.000	164.464	0.000	0.000

IH= 6 IR= 1

W(IR,IR) 220.8412

BLUE AND RED STRATEGIES FOR PERIOD 2

0.000	0.000	0.000	1.000	0.000	0.000
0.000	0.000	0.000	1.000	0.000	0.000

BLUE AND RED STRATEGIES FOR PERIOD 3

4	4				
1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	1	0	1
0	11.565	0.000	0.000	15.323	0.000	102.519
0	22.836	0.000	0.000	18.190	0.000	68.391
0	31.582	0.000	0.000	24.409	0.000	38.885
1	49.619	79.387	133.421	36.426	116.472	95.743
0	49.397	0.000	0.000	39.141	0.000	45.783
1	81.990	93.565	116.551	67.800	100.140	61.141

IH= 6 IR= 2

W(IR,IR) 64.6334

BLUE AND RED STRATEGIES FOR PERIOD 2

0.000	1.000	0.000	.101	0.000	.899
1.000	0.000	0.000	.524	0.000	.476

BLUE AND RED STRATEGIES FOR PERIOD 3

4	4				
1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

4	6				
1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000
6	4				
1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000
6	6				
1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	1	0	0
0	18.582	0.000	0.000	24.814	0.000	0.000
0	18.698	0.000	0.000	23.975	0.000	0.000
0	19.444	0.000	0.000	23.130	0.000	0.000
0	24.741	0.000	0.000	26.760	0.000	0.000
0	25.245	0.000	0.000	25.157	0.000	0.000
1	42.485	58.079	83.461	32.487	67.844	59.391

IB= 6 IR= 3

W(IB,IR) 32.4866

BLUE AND RED STRATEGIES FOR PERIOD 2

0.000	0.000	0.000	0.000	0.000	1.000
0.000	0.000	0.000	1.000	0.000	0.000

BLUE AND RED STRATEGIES FOR PERIOD 3

6	4				
1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	1	0	1
0	65.516	0.000	0.000	85.354	0.000	203.161
0	100.538	0.000	0.000	94.624	0.000	155.555
0	88.646	0.000	0.000	86.678	0.000	97.990
1	149.151	195.197	248.871	135.971	227.788	176.828
0	110.659	0.000	0.000	101.922	0.000	98.349
1	169.603	170.976	185.566	148.406	174.801	98.907

IB= 6 IR= 4

W(IB,IR) 141.5464

BLUE AND RED STRATEGIES FOR PERIOD 2

0.000	0.000	0.000	.547	0.000	.453
0.000	0.000	0.000	.861	0.000	.139

BLUE AND RED STRATEGIES FOR PERIOD 3

4	4				
1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000
4	6				

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

6	4				
1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

6	6				
1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	1	0	0
0	22.343	0.000	0.000	29.214	0.000	0.000
0	25.433	0.000	0.000	29.021	0.000	0.000
0	26.133	0.000	0.000	28.167	0.000	0.000
0	41.557	0.000	0.000	34.965	0.000	0.000
0	48.054	0.000	0.000	34.520	0.000	0.000
1	89.391	107.042	140.722	69.116	119.676	89.691

IH= 6 IR= 5

W(IR,IR) 69.115=

BLUE AND RED STRATEGIES FOR PERIOD 2

0.000	0.000	0.000	0.000	0.000	1.000
0.000	0.000	0.000	1.000	0.000	0.000

BLUE AND RED STRATEGIES FOR PERIOD 3

6	4				
1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	1	0	0	0	0
0	-5.110	23.229	0.000	0.000	0.000	0.000
0	15.652	36.860	0.000	0.000	0.000	0.000
0	4.726	35.703	0.000	0.000	0.000	0.000
0	5.854	34.583	0.000	0.000	0.000	0.000
0	23.342	47.083	0.000	0.000	0.000	0.000
1	91.175	83.694	139.385	96.300	122.063	106.287

IH= 6 IR= 6

W(IR,IR) 83.694=

BLUE AND RED STRATEGIES FOR PERIOD 2

0.000	0.000	0.000	0.000	0.000	1.000
0.000	1.000	0.000	0.000	0.000	0.000

BLUE AND RED STRATEGIES FOR PERIOD 3

6	2				
1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	0	0	0
1	-34.617	32.119	58.143	18.948	52.976	43.211
0	-34.632	0.000	0.000	0.000	0.000	0.000
0	-34.639	0.000	0.000	0.000	0.000	0.000
0	-34.636	0.000	0.000	0.000	0.000	0.000
0	-34.642	0.000	0.000	0.000	0.000	0.000
0	-34.636	0.000	0.000	0.000	0.000	0.000

IH= 1 IR= 3

W(IR,IR) -34.6169

BLUE AND RED STRATEGIES FOR PERIOD 2

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

BLUE AND RED STRATEGIES FOR PERIOD 3

1	1				
1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	0	0	0
0	9.511	0.000	0.000	0.000	0.000	0.000
0	9.142	0.000	0.000	0.000	0.000	0.000
0	8.780	0.000	0.000	0.000	0.000	0.000
0	9.784	0.000	0.000	0.000	0.000	0.000
0	9.358	0.000	0.000	0.000	0.000	0.000
1	10.139	34.868	57.173	24.729	53.213	50.627

IH= 2 IR= 3

W(IR,IR) 10.1392

BLUE AND RED STRATEGIES FOR PERIOD 2

0.000	0.000	0.000	0.000	0.000	1.000
1.000	0.000	0.000	0.000	0.000	0.000

BLUE AND RED STRATEGIES FOR PERIOD 3

6	1				
1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	1	0	0
0	20.235	0.000	0.000	24.803	0.000	0.000
0	20.560	0.000	0.000	24.108	0.000	0.000
0	20.768	0.000	0.000	23.491	0.000	0.000
0	22.657	0.000	0.000	25.020	0.000	0.000
0	22.751	0.000	0.000	24.136	0.000	0.000
1	25.892	41.911	67.867	25.209	56.769	52.366

IH= 3 IR= 3

W(IR,IR) 25.2493

BLUE AND RED STRATEGIES FOR PERIOD 2

	0.000	0.000	0.000	0.000	0.000	1.000
	0.000	0.000	0.000	1.000	0.000	0.000

BLUE AND RED STRATEGIES FOR PERIOD 3

	6	4				
	1.000	0.000	0.000	0.000	0.000	0.000
	1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	0	0	0
0	-8.393	0.000	0.000	0.000	0.000	0.000
0	-8.778	0.000	0.000	0.000	0.000	0.000
0	-9.177	0.000	0.000	0.000	0.000	0.000
0	-8.094	0.000	0.000	0.000	0.000	0.000
0	-8.667	0.000	0.000	0.000	0.000	0.000
1	-7.735	29.933	53.134	19.196	48.753	45.284

IH= 4 IR= 3

W(IR,IH) -7.7053

BLUE AND RED STRATEGIES FOR PERIOD 2

	0.000	0.000	0.000	0.000	0.000	1.000
	1.000	0.000	0.000	0.000	0.000	0.000

BLUE AND RED STRATEGIES FOR PERIOD 3

	6	1				
	1.000	0.000	0.000	0.000	0.000	0.000
	1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	0	0	1	0	0
0	18.588	0.000	0.000	24.525	0.000	0.000
0	19.006	0.000	0.000	23.757	0.000	0.000
0	19.440	0.000	0.000	23.059	0.000	0.000
0	22.562	0.000	0.000	25.274	0.000	0.000
0	22.667	0.000	0.000	24.138	0.000	0.000
1	29.560	45.440	71.293	26.195	59.439	54.499

IH= 5 IR= 3

W(IR,IH) 26.1952

BLUE AND RED STRATEGIES FOR PERIOD 2

	0.000	0.000	0.000	0.000	0.000	1.000
	0.000	0.000	0.000	1.000	0.000	0.000

BLUE AND RED STRATEGIES FOR PERIOD 3

	6	4				
	1.000	0.000	0.000	0.000	0.000	0.000
	1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 1

1	0	1	0	0	0
0	-13.728	0.000	-34.617	0.000	0.000	0.000
0	96.944	0.000	10.139	0.000	0.000	0.000
0	209.360	0.000	25.209	0.000	0.000	0.000
0	59.810	0.000	-7.705	0.000	0.000	0.000
0	209.257	0.000	26.195	0.000	0.000	0.000
1	220.841	84.633	32.487	141.546	69.116	83.694

GAME VALUE 32.4866

BLUE AND RED STRATEGIES FOR PERIOD 1

0.000	0.000	0.000	0.000	0.000	1.000
0.000	0.000	1.000	0.000	0.000	0.000

BLUE AND RED STRATEGIES FOR PERIOD 2

6	3				
0.000	0.000	0.000	0.000	0.000	1.000
0.000	0.000	0.000	1.000	0.000	0.000

5. Option 3C

The full output using option 3C consists of about 20 four- or five-page sections, one for each first-period payoff entry computed. The sections appear in the order that the first-period payoff entries are computed, which depends on the input data. Shown below are the sections for the first and last payoff entries computed, which are elements (1,1) and (5,3) of the first-period payoff matrix. (To avoid undue length of this volume, the rest of the pages of output 3C have been omitted.) Each section has a second-period payoff matrix and game solution *at the end*, preceded by a series of third-period payoff matrices and game solutions.

PAYOFF MATRIX FOR GAME AT STAGE 3

1	0	0	0	0	0
1 -34.996	-28.356	3.252	-39.917	3.567	4.271
0 -36.116	0.000	0.000	0.000	0.000	0.000
0 -37.195	0.000	0.000	0.000	0.000	0.000
0 -35.707	0.000	0.000	0.000	0.000	0.000
0 -36.946	0.000	0.000	0.000	0.000	0.000
0 -36.640	0.000	0.000	0.000	0.000	0.000

J_B= 1 I_R= 1

V(JB,JR) -34.9957

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

1	0	0	0	0	0
1 -45.769	-35.004	-6.899	-37.579	-6.488	-6.256
0 -46.993	0.000	0.000	0.000	0.000	0.000
0 -48.143	0.000	0.000	0.000	0.000	0.000
0 -46.619	0.000	0.000	0.000	0.000	0.000
0 -47.938	0.000	0.000	0.000	0.000	0.000
0 -47.689	0.000	0.000	0.000	0.000	0.000

J_B= 2 I_R= 1

V(JB,JR) -45.7688

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

1	0	0	0	0	0
1 -59.956	-45.570	-22.629	-47.998	-22.503	-22.184
0 -61.888	0.000	0.000	0.000	0.000	0.000
0 -63.063	0.000	0.000	0.000	0.000	0.000
0 -61.567	0.000	0.000	0.000	0.000	0.000
0 -62.882	0.000	0.000	0.000	0.000	0.000
0 -62.718	0.000	0.000	0.000	0.000	0.000

J_B= 3 I_R= 1

V(JB,JR) -59.9565

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	-35.242	-18.209	10.486	-21.418	10.421	10.518
0	-37.177	0.000	0.000	0.000	0.000	0.000
0	-39.051	0.000	0.000	0.000	0.000	0.000
0	-36.529	0.000	0.000	0.000	0.000	0.000
0	-38.697	0.000	0.000	0.000	0.000	0.000
0	-38.256	0.000	0.000	0.000	0.000	0.000

JH= 4 JR= 1

V(JR,JR) -35.2421

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	-47.189	-28.934	-8.901	-31.546	-8.925	-8.823
0	-53.276	0.000	0.000	0.000	0.000	0.000
0	-56.524	0.000	0.000	0.000	0.000	0.000
0	-51.530	0.000	0.000	0.000	0.000	0.000
0	-56.281	0.000	0.000	0.000	0.000	0.000
0	-55.943	0.000	0.000	0.000	0.000	0.000

JH= 5 JR= 1

V(JR,JR) -47.1890

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	-10.749	3.224	17.089	1.389	16.798	16.568
0	-27.551	0.000	0.000	0.000	0.000	0.000
0	-42.010	0.000	0.000	0.000	0.000	0.000
0	-23.449	0.000	0.000	0.000	0.000	0.000
0	-41.439	0.000	0.000	0.000	0.000	0.000
0	-40.498	0.000	0.000	0.000	0.000	0.000

JB= 6 JR= 1

V(JB,JR) -10.7488

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	17.046	32.547	45.138	30.845	45.068	45.066
0	5.521	0.000	0.000	0.000	0.000	0.000

0	-3.404	0.000	0.000	0.000	0.000	0.000
0	8.306	0.000	0.000	0.000	0.000	0.000
0	-3.019	0.000	0.000	0.000	0.000	0.000
0	-2.215	0.000	0.000	0.000	0.000	0.000

J_H= 6 IR= 2

V(JR,JR) 17.0663

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	46.956	59.784	72.193	58.274	72.227	72.330
0	39.894	0.000	0.000	0.000	0.000	0.000
0	32.715	0.000	0.000	0.000	0.000	0.000
0	40.608	0.000	0.000	0.000	0.000	0.000
0	33.061	0.000	0.000	0.000	0.000	0.000
0	33.619	0.000	0.000	0.000	0.000	0.000

J_H= 6 IR= 3

V(JR,JR) 46.9562

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	-13.708	14.601	49.800	9.340	49.832	48.275
0	-16.938	0.000	0.000	0.000	0.000	0.000
0	-20.062	0.000	0.000	0.000	0.000	0.000
0	-15.649	0.000	0.000	0.000	0.000	0.000
0	-19.491	0.000	0.000	0.000	0.000	0.000
0	-18.500	0.000	0.000	0.000	0.000	0.000

J_H= 6 IR= 4

V(JR,JR) -13.7077

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	33.273	53.996	83.604	47.413	83.497	83.461
0	31.233	0.000	0.000	0.000	0.000	0.000
0	29.248	0.000	0.000	0.000	0.000	0.000
0	31.977	0.000	0.000	0.000	0.000	0.000
0	29.649	0.000	0.000	0.000	0.000	0.000
0	30.152	0.000	0.000	0.000	0.000	0.000

J_H= 6 IR= 5

V(JR,JR) 33.2729

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	34.216	43.365	114.280	41.597	111.984	109.495
0	30.903	0.000	0.000	0.000	0.000	0.000
0	19.337	0.000	0.000	0.000	0.000	0.000
0	32.347	0.000	0.000	0.000	0.000	0.000
0	23.779	0.000	0.000	0.000	0.000	0.000
0	25.708	0.000	0.000	0.000	0.000	0.000

J_H= 6 IR= 6

V(JR,JR) 34.2159

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	-26.743	-19.908	11.075	-20.713	11.947	13.307
0	-27.574	0.000	0.000	0.000	0.000	0.000
0	-28.444	0.000	0.000	0.000	0.000	0.000
0	-27.273	0.000	0.000	0.000	0.000	0.000
0	-28.234	0.000	0.000	0.000	0.000	0.000
0	-27.965	0.000	0.000	0.000	0.000	0.000

J_H= 1 IR= 4

V(JR,JR) -26.7429

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	-26.205	-19.770	12.555	-20.573	13.276	14.417
0	-26.976	0.000	0.000	0.000	0.000	0.000
0	-27.766	0.000	0.000	0.000	0.000	0.000
0	-26.757	0.000	0.000	0.000	0.000	0.000
0	-27.575	0.000	0.000	0.000	0.000	0.000
0	-27.362	0.000	0.000	0.000	0.000	0.000

J_H= 2 IR= 4

V(JR,JR) -26.2051

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	-26.951	-20.757	12.381	-21.539	12.983	13.948
0	-27.694	0.000	0.000	0.000	0.000	0.000
0	-28.457	0.000	0.000	0.000	0.000	0.000
0	-27.461	0.000	0.000	0.000	0.000	0.000
0	-28.331	0.000	0.000	0.000	0.000	0.000
0	-28.117	0.000	0.000	0.000	0.000	0.000

J_H= 3 J_R= 4

V(JR,JR) -24.9008

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	-21.625	-14.744	24.641	-15.719	24.673	24.927
0	-22.937	0.000	0.000	0.000	0.000	0.000
0	-24.266	0.000	0.000	0.000	0.000	0.000
0	-22.405	0.000	0.000	0.000	0.000	0.000
0	-23.916	0.000	0.000	0.000	0.000	0.000
0	-23.405	0.000	0.000	0.000	0.000	0.000

J_H= 4 J_R= 4

V(JR,JR) -21.6256

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	-22.940	-13.459	24.391	-16.826	24.405	24.617
0	-24.296	0.000	0.000	0.000	0.000	0.000
0	-25.585	0.000	0.000	0.000	0.000	0.000
0	-23.822	0.000	0.000	0.000	0.000	0.000
0	-25.339	0.000	0.000	0.000	0.000	0.000
0	-24.971	0.000	0.000	0.000	0.000	0.000

J_H= 5 J_R= 4

V(JR,JR) -22.9404

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

```
PAYOFF MATRIX FOR GAME AT STAGE  2
          1          0          0          1          0          0
 0   -34.996     0.000     0.000   -26.743     0.000     0.000
 0   -45.769     0.000     0.000   -26.205     0.000     0.000
 0   -59.956     0.000     0.000   -26.901     0.000     0.000
 0   -35.282     0.000     0.000   -21.625     0.000     0.000
 0   -47.109     0.000     0.000   -22.940     0.000     0.000
 1   -10.769    17.066    46.056   -13.708    33.273    34.216

IH=   1    IR=   1

V(IB,IR)          -13.7177

BLUE AND RED STRATEGIES FOR PERIOD  2
          0.000     0.000     0.000     0.000     0.000     1.000
          0.000     0.000     0.000     1.000     0.000     0.000

BLUE AND RED STRATEGIES FOR PERIOD  3

          6         4
          1.000     0.000     0.000     0.000     0.000     0.000
          1.000     0.000     0.000     0.000     0.000     0.000
```

[DELETED OUTPUT SECTIONS OCCUR HERE.]

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	18.588	29.990	48.302	28.364	48.586	48.945
0	17.102	0.000	0.000	0.000	0.000	0.000
0	16.166	0.000	0.000	0.000	0.000	0.000
0	17.445	0.000	0.000	0.000	0.000	0.000
0	16.202	0.000	0.000	0.000	0.000	0.000
0	16.445	0.000	0.000	0.000	0.000	0.000

JB= 1 JR= 1

V(JB,JR) 18.5883

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	19.006	31.268	47.004	28.766	47.275	47.618
0	16.593	0.000	0.000	0.000	0.000	0.000
0	15.532	0.000	0.000	0.000	0.000	0.000
0	16.934	0.000	0.000	0.000	0.000	0.000
0	15.637	0.000	0.000	0.000	0.000	0.000
0	15.746	0.000	0.000	0.000	0.000	0.000

JB= 2 JR= 1

V(JB,JR) 19.0962

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	19.480	30.369	45.774	28.976	46.031	46.360
0	16.190	0.000	0.000	0.000	0.000	0.000
0	14.909	0.000	0.000	0.000	0.000	0.000
0	16.788	0.000	0.000	0.000	0.000	0.000
0	14.939	0.000	0.000	0.000	0.000	0.000
0	15.157	0.000	0.000	0.000	0.000	0.000

JB= 3 JR= 1

V(JB,JR) 19.4797

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	22.532	35.419	52.835	33.807	53.047	53.316
0	18.432	0.000	0.000	0.000	0.000	0.000
0	16.869	0.000	0.000	0.000	0.000	0.000
0	19.258	0.000	0.000	0.000	0.000	0.000
0	17.021	0.000	0.000	0.000	0.000	0.000
0	17.179	0.000	0.000	0.000	0.000	0.000

JH= 4 IR= 1

V(JR,JR) 22.5324

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	22.687	35.033	52.568	33.583	52.776	53.041
0	18.354	0.000	0.000	0.000	0.000	0.000
0	15.887	0.000	0.000	0.000	0.000	0.000
0	19.205	0.000	0.000	0.000	0.000	0.000
0	15.998	0.000	0.000	0.000	0.000	0.000
0	16.102	0.000	0.000	0.000	0.000	0.000

JH= 5 IR= 1

V(JR,JR) 22.6873

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	29.530	43.795	58.510	42.225	58.572	58.668
0	22.629	0.000	0.000	0.000	0.000	0.000
0	17.847	0.000	0.000	0.000	0.000	0.000
0	24.029	0.000	0.000	0.000	0.000	0.000
0	19.025	0.000	0.000	0.000	0.000	0.000
0	19.308	0.000	0.000	0.000	0.000	0.000

JH= 6 IR= 1

V(JR,JR) 29.5300

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	45.440	56.243	67.635	55.170	67.798	67.968
0	39.494	0.000	0.000	0.000	0.000	0.000

0	34.502	0.000	0.000	0.000	0.000	0.000
0	40.472	0.000	0.000	0.000	0.000	0.000
0	34.819	0.000	0.000	0.000	0.000	0.000
0	35.148	0.000	0.000	0.000	0.000	0.000

J_H= 6 IR= 2

V(JR,JR) 45.4426

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	71.293	79.154	87.125	78.434	87.288	87.487
0	66.335	0.000	0.000	0.000	0.000	0.000
0	61.506	0.000	0.000	0.000	0.000	0.000
0	67.003	0.000	0.000	0.000	0.000	0.000
0	61.776	0.000	0.000	0.000	0.000	0.000
0	62.054	0.000	0.000	0.000	0.000	0.000

J_H= 6 IR= 3

V(JR,JR) 71.2924

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	26.105	42.363	67.644	39.997	67.746	67.886
0	24.481	0.000	0.000	0.000	0.000	0.000
0	22.864	0.000	0.000	0.000	0.000	0.000
0	24.983	0.000	0.000	0.000	0.000	0.000
0	23.180	0.000	0.000	0.000	0.000	0.000
0	23.485	0.000	0.000	0.000	0.000	0.000

J_H= 6 IR= 4

V(JR,JR) 26.1052

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	59.439	72.496	91.391	70.871	91.707	92.081
0	54.308	0.000	0.000	0.000	0.000	0.000
0	55.175	0.000	0.000	0.000	0.000	0.000
0	54.903	0.000	0.000	0.000	0.000	0.000
0	55.317	0.000	0.000	0.000	0.000	0.000
0	55.402	0.000	0.000	0.000	0.000	0.000

J_H= 6 IR= 5

V(JB,JR) 59.4385

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

1	0	0	0	0	0
1 54.409	63.162	102.132	59.366	102.311	102.519
0 53.058	0.000	0.000	0.000	0.000	0.000
0 51.657	0.000	0.000	0.000	0.000	0.000
0 53.593	0.000	0.000	0.000	0.000	0.000
0 51.946	0.000	0.000	0.000	0.000	0.000
0 52.345	0.000	0.000	0.000	0.000	0.000

J_B= 6 J_R= 6

V(JB,JR) 54.4985

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

1	0	0	0	0	0
1 24.535	32.549	56.631	31.559	57.093	57.642
0 23.638	0.000	0.000	0.000	0.000	0.000
0 22.730	0.000	0.000	0.000	0.000	0.000
0 23.894	0.000	0.000	0.000	0.000	0.000
0 22.934	0.000	0.000	0.000	0.000	0.000
0 23.126	0.000	0.000	0.000	0.000	0.000

J_B= 1 J_R= 4

V(JB,JR) 24.525

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

1	0	0	0	0	0
1 23.757	32.480	55.405	30.586	56.845	56.378
0 22.888	0.000	0.000	0.000	0.000	0.000
0 22.056	0.000	0.000	0.000	0.000	0.000
0 23.173	0.000	0.000	0.000	0.000	0.000
0 22.185	0.000	0.000	0.000	0.000	0.000
0 22.339	0.000	0.000	0.000	0.000	0.000

J_B= 2 J_R= 4

V(JB,JR) 23.7574

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	23.059	32.363	54.268	30.557	54.691	55.207
0	22.217	0.000	0.000	0.000	0.000	0.000
0	21.392	0.000	0.000	0.000	0.000	0.000
0	22.413	0.000	0.000	0.000	0.000	0.000
0	21.569	0.000	0.000	0.000	0.000	0.000
0	21.647	0.000	0.000	0.000	0.000	0.000

J_B= 3 J_R= 4

V(JB,JR) 23.0586

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	25.274	35.467	61.147	33.416	61.505	61.936
0	24.139	0.000	0.000	0.000	0.000	0.000
0	22.965	0.000	0.000	0.000	0.000	0.000
0	24.442	0.000	0.000	0.000	0.000	0.000
0	23.178	0.000	0.000	0.000	0.000	0.000
0	23.462	0.000	0.000	0.000	0.000	0.000

J_B= 4 J_R= 4

V(JB,JR) 25.2737

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 3

	1	0	0	0	0	0
1	24.138	34.999	58.961	33.085	59.311	59.734
0	23.018	0.000	0.000	0.000	0.000	0.000
0	21.929	0.000	0.000	0.000	0.000	0.000
0	23.351	0.000	0.000	0.000	0.000	0.000
0	22.186	0.000	0.000	0.000	0.000	0.000
0	22.266	0.000	0.000	0.000	0.000	0.000

J_B= 5 J_R= 4

V(JB,JR) 24.1378

BLUE AND RED STRATEGIES FOR PERIOD 3

1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

PAYOFF MATRIX FOR GAME AT STAGE 2

	1	2	3	1	2	3
0	18.588	0.000	0.000	24.525	0.000	0.000
0	19.006	0.000	0.000	23.757	0.000	0.000
0	19.480	0.000	0.000	23.059	0.000	0.000
0	22.532	0.000	0.000	25.274	0.000	0.000
0	22.697	0.000	0.000	24.138	0.000	0.000
1	29.520	45.440	71.293	26.195	59.439	54.499

IH= 5 . IR= 3

W(I$_B$,I$_R$) 26.1952

BLUE AND RED STRATEGIES FOR PERIOD 2

0.000	0.000	0.000	0.000	0.000	1.000
0.000	0.000	0.000	1.000	0.000	0.000

BLUE AND RED STRATEGIES FOR PERIOD 3

6	4				
1.000	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000

[AFTER A BLANK PAGE, OCCURS THE FOLLOWING:]

PAYOFF MATRIX FOR GAME AT STAGE 1

	1	0	1	0	0	0
0	-13.788	0.000	-34.617	0.000	0.000	0.000
0	96.944	0.000	10.139	0.000	0.000	0.000
0	209.360	0.000	25.209	0.000	0.000	0.000
0	59.810	0.000	-7.705	0.000	0.000	0.000
0	209.237	0.000	26.195	0.000	0.000	0.000
1	220.841	64.633	32.487	141.546	69.116	93.696

GAME VALUE 32.4865

BLUE AND RED STRATEGIES FOR PERIOD 1

0.000	0.000	0.000	0.000	0.000	1.000
0.000	0.000	1.000	0.000	0.000	0.000

BLUE AND RED STRATEGIES FOR PERIOD 2

6	3				
0.000	0.000	0.000	0.000	0.000	1.000
0.000	0.000	0.000	1.000	0.000	0.000

APPENDIX A

ALPHABETICAL LISTING AND DEFINITIONS OF INPUT VARIABLES

Variable Name	Definition
BAA(KBA,ID)	Blue aircraft added, by kind of Blue aircraft and day (including day 1).
BADRI(INDB,TYR)	Air-to-air detection parameter for Blue attackers detecting Red interceptors.
BAKRI(INDB,TYR)	Air-to-air kill parameter for Blue attackers: 1 - GP-CAS; 2 - GP-ABA; 3 - SP-CAS; 4 - SP-ABA killing Red interceptors: 1 - GP; 2 - SP.
BALPHA(TYB,MSB)	Fraction of Blue attackers that do *not* jettison their ordnance and fly back but continue on, by Blue attacker type: 1 - GP; 2 - SP and attack mission: 1 - CAS; 2 - ABA.
BCWGT	Weight for cumulative Blue CAS firepower delivered (must be zero if MOE=4).
BD(15)	Proportion of Blue divisions destroyed--vector of breakpoint ordinates for interpolation.
BDA(KBD,ID)	Blue divisions added, by kind of Blue division and day (including day 1).
BDRNS(2)	Parameter for Blue detecting Red nonsheltered aircraft: 1 - Blue GP aircraft; 2 - Blue SP-ABA aircraft.
BDRS(TYB)	Parameter for Blue detecting Red shelters: 1 - Blue GP aircraft; 2 - Blue SP-ABA aircraft.
BFRAC1	Fraction of Blue aircraft on base before change in sortie rate.
BFRAC2	Fraction of Blue aircraft on base after change in sortie rate.
BIDRA(TYB,INDR)	Air-to-air detection parameter for Blue interceptors detecting Red attackers (subscripted as for BIKRA, below).
BIKRA(TYB,INDR)	Air-to-air kill parameter for Blue interceptors: 1 - GP; 2 - SP killing Red attackers: 1 - GP-CAS; 2 - GP-ABA; 3 - SP-CAS; 4 - SP-ABA.
BKRNS(2)	Parameter for Blue killing Red nonsheltered aircraft: 1 - Blue GP aircraft; 2 - Blue SP-ABA aircraft.

Variable Name	Definition
BKRS(2)	Parameter for Blue killing Red shelters: 1 - Blue GP aircraft; 2 - Blue SP-ABA aircraft.
BPARK	Number of Blue parking areas for aircraft on each Blue airbase.
BPASS(TYB)	Number of passes per Blue ABA sortie by 1 - GP-ABA aircraft; 2 - SP-ABA aircraft.
BQWGT(2)	If MOE=4, BQWGT(1) is weight for surviving Blue general-purpose aircraft; BQWGT(2) is not used. If MOE=5, BQWGT(1) is weight for Blue GP surviving aircraft minus desired Blue QRA; BQWGT(2) is weight for desired minus actual Blue QRA.
BSAMZR(TYR,MSR)	Proportion of Red attack sorties by type: 1 - GP; 2 - SP and by mission: 1 - CAS; 2 - ABA destroyed by Blue ground-to-air weapons.
BSWGT(MS)	Weights for surviving SP aircraft (KBA=2,3,4), by kind of aircraft: 1 - SP-CAS; 2 - SP-ABA; 3 - SP-INT.
B4AL	Overlap factor (between 0 and 1) for Red munitions at the Blue airbase.
B4AN1,B4AN2	Lethal area covered by one pass of a Red GP- or SP-ABA aircraft (resp.) dropping "anti-nonsheltered" munitions against nonsheltered aircraft.
B4AS1,B4AS2	Lethal area covered by one pass of a Red GP- or SP-ABA aircraft (resp.) dropping "anti-shelter" munitions against shelters.
B4B	Area (in square meters) of a typical airbase on which Blue aircraft might be located.
B4NS1,B4NS2	A reduction factor applied to B4AN1 or B4AN2 (resp.) when "anti-nonsheltered" munitions are dropped on shelters.
B4SN1,B4SN2	An expansion (or reduction) factor applied to B4AS1 or B4AS2 (resp.) when "anti-shelter" munitions are dropped on nonsheltered aircraft.
DBQRA	Desired Blue Quick Reaction Alert aircraft level (number of aircraft).

Variable Name	Definition
DRQRA	Desired Red Quick Reaction Alert aircraft level (number of aircraft).
FA(15)	FEBA advance--vector of breakpoint ordinates for interpolation.
FBA(KBA)	Firepower per successful Blue CAS sortie: 1 - by a GP plane on CAS; 2 - by a SP-CAS plane.
FBD(KBD)	Firepower per Blue division.
FBSK	Fraction of Blue aircraft shelters hit by Red that are destroyed.
FRA(KRA)	Firepower per successful Red CAS sortie: 1 - by a GP plane on CAS; 2 - by a SP-CAS plane.
FRBD(15)	Force ratio for Blue division destruction--vector of breakpoint abscissas for interpolation.
FRD(KRD)	Firepower per Red division.
FRFA(15)	Force ratios for FEBA advance--vector of breakpoint abscissas for interpolation.
FRRD(15)	Force ratios for Red division destruction.
FRSK	Fraction of Red aircraft shelters hit by Blue that are destroyed.
GVA	Game value added (i.e., value added to each payoff entry to make it positive for the game-solving procedure).
IAA	Indicator for air-to-air combat mode: 0 - basic method; 1 - method where some attackers drop their ordnance, then shoot back at enemy interceptors.
IBABA	Indicator for Blue ABA attack mode of Red airbases (1, 2, 3, or 4).
IDBSRC	Day for Blue sortie rates to change.
IDL2	First day of second period; if two periods, first day of first period (i.e., day 1).
IDL3	First day of third period; if two periods, first day of second period.

Variable Name	Definition
IDRSRC	Day for Red sortie rates to change.
IPRU	Indicator for printing third-period game results.
IPRV	Indicator for printing second-period game results: 0 - do not print; 1 - print.
IRABA	Indicator for Red ABA attack mode of Blue airbases (1, 2, 3, or 4).
IREPLB	Indicator for casualty replacement of Blue ground forces: 0 - no Blue ground casualties are replaced; 1 - all Blue ground casualties are replaced.
IREPLR	Indicator for casualty replacement of Red ground forces.
IR0	First Red allocation to use in solving first-period games (must not exceed NR).
IR3SH	Indicator for Red SP-ABA aircraft to be sheltered: 0 - *do* shelter them; 1 - do *not* shelter them.
JR0	First Red allocation to use in solving second-period games (must not exceed NR).
KR0	First Red allocation to use in solving third-period games (must not exceed NR).
MOE	Measure of effectiveness to be optimized: 1 - FEBA; 2 - firepower difference; 3 - air firepower difference; 4 - surviving aircraft, weighted by type; 5 - generalized air measure, including QRA.
MOET	Day on which MOE is to be found.
NB	Number of Blue pure strategies (all pure strategies are available in each period).
NFRBD	Number (up to 15) of force ratios for Blue division destruction.
NFRFA	Number (up to 15) of force ratios for FEBA advance.
NFRRD	Number (up to 15) of force ratios for Red division destruction.
NID	Number (up to 90) of days in war.

Variable Name	Definition
NKBA	Number of kinds of Blue aircraft.
NKBD	Number (up to 3) of kinds of Blue divisions.
NKRA	Number of kinds of Red aircraft.
NKRD	Number (up to 3) of kinds of Red divisions.
NPD	Number (up to 3) of periods in war.
NR	Number of Red pure strategies (all pure strategies are available in each period).
RAA(KRA,ID)	Red aircraft added, by kind of Red aircraft and day (including day 1).
RADBI(INDR,TYB)	Air-to-air detection parameter--Red attackers detect Blue interceptors.
RAKBI(INDR,TYB)	Air-to-air kill parameter; Red attackers-- 1 - CAS; 2 - ABA; 3 - CAS; 4 - ABA kill Blue interceptors: 1 - GP; 2 - SP.
RALPHA(TYR,MSR)	Fraction of Red attackers that do not jettison their ordnance but continue on, by Red attacker type and mission.
RCWGT	Weight for cumulative Red CAS firepower delivered (must be zero if MOE=4).
RD(15)	Proportion of Red divisions destroyed.
RDA(KRD,ID)	Red divisions added by kind of Red division and day (including day 1).
RDBNS(2)	Parameter for Red detecting Blue nonsheltered aircraft: 1 - Red GP aircraft; 2 - Red SP-ABA aircraft.
RDBS(TYR)	Parameter for Red detecting Blue shelters: 1 - Red GP aircraft; 2 - Red SP-ABA aircraft.
RFRAC1	Fraction of Red aircraft on base before change in sortie rate.
RFRAC2	Fraction of Red aircraft on base after change in sortie rate.

Variable Name	Definition
RIDBA(TYR,INDB)	Air-to-air detection parameter; Red interceptors detect Blue attackers.
RIKBA(TYR,INDB)	Air-to-air kill parameter; Red interceptors-- 1 - GP; 2 - SP kill Blue attackers: 1 - GP-CAS; 2 - GP-ABA; 3 - SP-CAS; 4 - SP-ABA.
RKBNS(2)	Parameter for Red killing Blue nonsheltered aircraft: 1 - Red GP aircraft; 2 - Red SP-ABA aircraft.
RKBS(2)	Parameter for Red killing Blue shelters: 1 - Red GP aircraft; 2 - Red SP-ABA aircraft.
RPARK	Number of Red parking areas for aircraft on each Red airbase.
RPASS(TYR)	Number of passes per Red ABA sortie by-- 1 - Red GP-ABA aircraft; 2 - Red SP-ABA aircraft.
RQWGT(2)	Weights for Red surviving GP aircraft and/or QRA (analogous to BQWFT(•)).
RSAMZB(TYB,MSB)	Proportion of Blue attack sorties by type and mission destroyed by Red ground-to-air weapons.
RSWGT(MS)	Weights for surviving SP Red aircraft, by kind of aircraft.
R4AL	Overlap factor (between 0 and 1) for Blue munitions at Red airbase.
R4AN1,R4AN2	Lethal area covered by one pass of a Blue GP- or SP-ABA aircraft (resp.) dropping "anti-nonsheltered" munitions against nonsheltered aircraft.
R4AS1,R4AS2	Lethal area covered by one pass of a Blue GP- or SP-ABA aircraft (resp.) dropping "anti-shelter" munitions against shelters.
R4B	Area of a typical airbase on which Red aircraft might be located.
R4NS1,R4NS2	A reduction factor applied to R4AN1 or R4AN2 (resp.) when "anti-nonsheltered" munitions are dropped on shelters.
R4SN1,R4SN2	An expansion (or reduction) factor applied to R4AS1 or R4AS2 (resp.) when "anti-shelter" munitions are dropped on nonsheltered aircraft.

Variable Name	Definition
SORRB1(TYB,MSB)	Sortie rates for Blue before day IDBSRC, by type of aircraft: 1 - GP; 2 - SP and by mission: 1 - CAS; 2 - ABA; 3 - INT.
SORRB2(TYB,MSB)	Sortie rates for Blue on and after day IDBSRC, by type of aircraft: 1 - GP; 2 - SP and by mission: 1 - CAS; 2 - ABA; 3 - INT.
SORRR1(TYR,MSR)	Sortie rates for Red before day IDRSRC, by type of aircraft: 1 - GP; 2 - SP and by mission: 1 - CAS; 2 - ABA; 3 - INT.
SORRR2(TYR,MSR)	Sortie rates for Red on and after day IDRSRC, by type of aircraft: 1 - GP; 2 - SP and by mission: 1 - CAS; 2 - ABA; 3 - INT.
XNBAA	Number of notionalized Blue air-to-air combat regions (on Blue side of FEBA).
XNBAB	Number of notionalized (identical) Blue airbases.
XNRAA	Number of notionalized Red air-to-air combat regions (on Red side of FEBA).
XNRAB	Number of notionalized (identical) Red airbases.

APPENDIX B

ALPHABETICAL LISTING AND DEFINITIONS OF COMPUTED VARIABLES OF SUBROUTINE CAM

Variable Name	Definition
ABQRA	Actual number of Blue QRA aircraft (GP aircraft designated as QRA).
ABQRAN	Number of nonsheltered Blue QRA aircraft.
ABQRAS	Number of sheltered Blue QRA aircraft (QRA are given priority in sheltering).
ARQRA	Actual number of Red QRA aircraft (GP aircraft designated as QRA).
ARQRAN	Number of nonsheltered Red QRA aircraft.
ARQRAS	Number of sheltered Red QRA aircraft.
BA(TY,MS)	Blue aircraft on missions, by aircraft type (GP or SP) and mission.
BAAS	Blue GP aircraft assignable to missions.
BAD(KBA,ID)	Blue aircraft destroyed on day ID, by kind of Blue aircraft.
BAF(ID)	Blue air firepower (i.e., successful CAS firepower) delivered on day ID.
BAFB(TY,MS)	Blue aircraft that fly back to Blue airbase, by aircraft type and mission.
BAI(KBA,ID)	Inventory of Blue aircraft at beginning of day ID, by kind of Blue aircraft.
BAKAA(TY,MS)	Blue aircraft killed in the air-to-air interaction, by aircraft type and mission.
BAKNS	Blue nonsheltered aircraft destroyed.
BAKS	Blue sheltered aircraft destroyed.
BAL(TY,MS)	Blue aircraft lost to enemy SAMs (ground-to-air interaction), by aircraft type and mission.
BANAS	Blue GP aircraft not assigned to missions.
BANF(TY,MS)	Blue aircraft not flying (i.e., staying on the base): positive only if the sortie rate is less than 1.0.
BATP	Blue attack total passes (=PBABA(1)+PBABA(2)).

Variable Name	Definition
BATS	Blue attack sorties (CAS and ABA).
BATS1	Blue attack sorties per notionalized air-to-air combat region on Red side of FEBA (BATS1=BATS/XNRAA).
BAVUL(KBA)	Blue aircraft vulnerable to enemy ABA, by kind of Blue aircraft (not including QRA).
BAVULT	Total Blue aircraft vulnerable to enemy ABA (not including QRA).
BDD(KBD,ID)	Blue divisions destroyed on day ID, by kind of Blue division.
BDI(KBD,ID)	Blue division inventory at beginning of day ID, by kind of Blue division.
BF(ID)	Blue total firepower (ground plus successful CAS) delivered on day ID.
BFRAC	Fraction of Blue aircraft on base.
BGF(ID)	Blue ground firepower delivered on day ID.
BITS	Blue intercept sorties.
BITS1	Blue intercept sorties per notionalized air-to-air combat region on Blue side of FEBA (BITSI=BITS/XNBAA).
BPENG(TYB)	Proportion of Blue intercept sorties engaged that are of type TYB: 1 - GP; 2 - SP.
BPOPNS(KBA)	Population of nonsheltered Blue aircraft.
BPOPS(KBA)	Population of sheltered Blue aircraft (i.e., number of aircraft), by kind of Blue aircraft (including QRA).
BS(TY,MS)	Blue sorties, by aircraft type and mission.
BSENG(TYB,MSB)	Blue attack sorties engaged by Red interceptors, by type of Blue aircraft and *attack* mission only: 1 - CAS; 2 - ABA.
BSFB(TY,MS)	Blue sorties that fly back to Blue airbase and do not attempt to deliver ordnance (BSFB(TY,3)=0; the whole array is zero if the first air-to-air attrition method is used).

Variable Name	Definition
BSHEL	Number of Blue shelters (recomputed each day).
BSHEL1	Blue shelters remaining after QRA aircraft are sheltered (zero if ABQRAN > 0.0).
BSHELK(ID)	Blue shelters destroyed on day ID.
BSKAA(TYB,MSB)	Blue sorties killed in the air-to-air interactions, by aircraft type and mission.
BSL(TY,MS)	Blue sorties lost to enemy SAMs (ground-to-air interaction), by aircraft type and mission.
BTOT	Total Blue aircraft vulnerable to ABA (=BTOTS+BTOTNS).
BTOTNS	Total nonsheltered Blue aircraft ($= \sum_{KBA}$ BPOPNS(KBA)).
BTOTS	Total sheltered Blue aircraft ($= \sum_{KBA}$ BPOPS(KBA)).
B4AN	Average area covered by a Red "anti-nonsheltered" munition.
B4AS	Average area covered by a Red "anti-shelter" munition.
B4NS	Average reduction factor when Red "anti-nonsheltered" munitions are used against shelters.
B4SN	Average expansion factor when Red "anti-shelter" munitions are used against nonsheltered aircraft.
CBAF(ID)	Cumulative Blue CAS firepower delivered to date.
CBF(ID)	Cumulative Blue ground plus CAS firepower delivered to date.
CRAF(ID)	Cumulative Red CAS firepower delivered to date.
CRF(ID)	Cumulative Red ground plus CAS firepower delivered to date.
DFEBA	FEBA advance.
DFOBA	Negative of FEBA advance.
FEBA(ID)	FEBA position at end of day ID.
FRBR	Force ratio of Blue to Red firepower.

Variable Name	Definition
FRRB	Force ratio of Red to Blue firepower (=1/FRBR).
IBARI	Check variable for the Blue attacker-Red interceptor interaction.
IBIRA	Check variable (the Blue interceptor-Red attacker attritions are zero if either side has zero sorties; IBIRA then is set to 1, and the attrition computation is bypassed).
IDL	First day for which assessment is to be computed in that particular call of CAM.
IDU	Last day for which assessment is to be computed in that particular call of CAM.
IPD	Period of war.
NTN	Number of iterations of Newton's method to find optimal Q.
PBABA(TYB)	Blue ABA aircraft passes by type of ABA aircraft: 1 - GP; 2 - SP.
PBDID	Percent Blue divisions destroyed.
PRABA(TYR)	Red ABA aircraft passes by type of ABA aircraft: 1 - GP; 2 - SP.
PRDID	Percent of Red divisions destroyed.
PROD1, PROD2, X1, X15, X2, DENOM	Working variables for computing attritions in second method (air-to-air).
PROPB(MS,IPD)	Proportion of Blue GP aircraft assigned to mission MS in period IPD (in two-period war, IPD is 2 for the first period and 3 for the second).
PROPR(MS,IPD)	Proportion of Red GP aircraft assigned to mission MS in period IPD.
Q	Proportion of Blue passes to attack Red shelters--computed if IBABA=2 or 4. Or proportion of Red passes to attack Blue shelters (the remainder attack Blue nonsheltered aircraft)--computed if IRABA=2 or 4.
RA(TY,MS)	Red aircraft on missions, by aircraft type and mission.
RAAS	Red GP aircraft assignable to missions.

Variable Name	Definition
RAD(KRA,ID)	Red aircraft destroyed on day ID, by kind of Red aircraft.
RAF(ID)	Red air firepower delivered on day ID.
RAFB(TY,MS)	Red aircraft that fly back to Red airbase, by aircraft type and mission.
RAI(KRA,ID)	Red aircraft inventory at beginning of day ID, by kind of Red aircraft.
RAKAA(TY,MS)	Red aircraft killed in the air-to-air interaction, by aircraft type and mission.
RAKNS	Red nonsheltered aircraft destroyed.
RAKS	Red sheltered aircraft destroyed.
RAL(TY,MS)	Red aircraft lost to enemy SAMs (ground-to-air interaction), by aircraft type and mission.
RANAS	Red GP aircraft not assigned to missions.
RANF(TY,MS)	Red aircraft not flying (i.e., staying on the base; this is positive only if the sortie rate is less than 1.0).
RATP	Red attack total passes (=PRABA(1)+PRABA(2)).
RATS	Red attack sorties (CAS and ABA).
RATS1	Red attack sorties per notionalized air-to-air combat region on Blue side of FEBA (RATS1=RATS/XNBAA).
RAVUL(KBA)	Red aircraft vulnerable to enemy ABA, by kind of Red aircraft (not including QRA).
RAVULT	Total Red aircraft vulnerable to ABA that can be sheltered (not including QRA).
RDD(KRD,ID)	Red divisions destroyed on day ID, by kind of Red division.
RDI(KRD,ID)	Red division inventory at beginning of day ID, by kind of Red division.
RF(ID)	Red total firepower delivered on day ID.
RFRAC	Fraction of Red aircraft on base.
RGF(ID)	Red ground firepower delivered on day ID.

Variable Name	Definition
RITS	Red intercept sorties.
RITS1	Red intercept sorties per notionalized air-to-air combat region on Red side of FEBA (RITS1=RITS/XNRAA).
RPENG(TYR)	Proportion of Red intercept sorties engaged that are of type TYR.
RPOPNS(KRA)	Population of nonsheltered Red aircraft, by kind of Red aircraft.
RPOPS(KRA)	Population of sheltered Red aircraft, by kind of Red aircraft.
RS(TY,MS)	Red sorties, by aircraft type and mission.
RSENG(TYR,MSR)	Red attack sorties engaged by Blue interceptors, by type of Red aircraft and *attack* mission only: 1 - CAS; 2 - ABA.
RSFB(TY,MS)	Red sorties that fly back to Red airbase and do not attempt to deliver ordnance (RSFB(TY,3)=0; the whole array is zero if the first air-to-air attrition method is used).
RSHEL	Number of Red shelters (recomputed each day).
RSHEL1	Number of Red shelters remaining after QRA aircraft are sheltered.
RSHELK(ID)	Red shelters destroyed on day ID.
RSKAA(TYR,MSR)	Red sorties killed in the air-to-air interactions, by aircraft type and mission.
RSL(TY,MS)	Red sorties lost to enemy SAMs (ground-to-air interaction), by aircraft type and mission.
RTOT	Total Red aircraft vulnerable to ABA (=RTOTS+RTOTNS).
RTOTNS	Total nonsheltered Red aircraft ($= \sum_{KRA}$ RPOPNS(KRA)).
RTOTS	Total sheltered Red aircraft ($= \sum_{KRA}$ RPOPS(KRA)).

Variable Name	Definition
R4AN	Average area covered by a Blue "anti-nonsheltered" munition.
R4AS	Average area covered by a Blue "anti-shelter" munition.
R4NS	Average reduction factor when Blue "anti-nonsheltered" munitions are used against shelters.
R4SN	Average expansion factor when Blue "anti-shelter" munitions are used against nonsheltered aircraft.
SHELB(ID)	Number of Blue shelters at beginning of day ID.
SHELR(ID)	Number of Red shelters at beginning of day ID.
SORRB(TY,MS)	Sortie rates for Blue, by aircraft type and mission.
SORRR(TY,MS)	Sortie rates for Red, by aircraft type and mission.
SRB	Working variable, equal to the maximum of 1.0 and the appropriate Blue sortie rate.
SRR	Working variable, equal to the maximum of 1.0 and the appropriate Red sortie rate.
SUM, PROD, X1, X15	Working variables for computing attritions (air-to-air).
SUMB, SUMR	Working variables for computing BANAS and RANAS.
VBADRI(INDB)	Average detection parameter for Blue attackers, by kind of attacker, against Red interceptors in the air-to-air interaction.
VBDRNS	Average detection parameter for Blue against Red nonsheltered aircraft.
VBDRS	Average detection parameter for Blue against Red shelters.
VBIDRA(TYB)	Average detection parameter for Blue interceptors, by type, against Red attackers in the air-to-air interaction.
VBKRNS	Average kill parameter for Blue against Red nonsheltered aircraft.
VBKRS	Average kill parameter for Blue against Red shelters.

Variable Name	Definition
VRADBI(INDR)	Average detection parameter for Red attackers, by kind of attacker, against Blue interceptors in the air-to-air interaction.
VRDBNS	Average detection parameters for Red against Blue nonsheltered aircraft.
VRDBS	Average detection parameter for Red against Blue shelters.
VRIDBA(TYR)	Average detection parameter for Red interceptors, by type, against Blue attackers in the air-to-air interaction.
VRKBNS	Average kill parameters for Red against Blue nonsheltered aircraft.
VRKBS	Average kill parameter for Red against Blue shelters.
XNS	Proportion of nonsheltered aircraft killed in the ABA interaction--used for apportioning destroyed aircraft by kind of aircraft (redefined for Red).
XS	Indicator for sheltering of Red SP-ABA aircraft: 0.0 - do not shelter; 1.0 - shelter (XS=1-IR3SH)-- also used later in routine as proportion of sheltered aircraft killed in the ABA interaction--used for apportioning destroyed aircraft by kind of aircraft (redefined for Red).

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