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Technical Memorandum

A MODEL TO DETERMINE TARGET SUPPRESSIONS

RESULTING FROM RAPID FIRE HELICOPTER ARMAMENT SYSTEMS

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TABLE OF CONTENTS

NWL Technical Memorandum No. K-62/66

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WW	1
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WWY	1
WWE	1
KR	1
KRE	5
KRS	1
KRT	1
KXK	1
MAL	6
MAM	1

ABSTRACT

This technical memorandum describes a mathematical model for determining the expected number of men suppressed by a rapid fire machine gun mounted on a helicopter. Also included is a description of the computer program of the model for the IBM 7030 (STRETCH).

FOREWORD

The mathematical model and computer program described in this technical memorandum were developed as part of WEPTASK RM3773-109/210-1/F008-99-08.

The programming was done by Miss J. A. Knight under the supervision of Mr. R. O. Brancolini.

INTRODUCTION

The model described in this report determines within a specified target area the expected number of men suppressed by a rapid fire machine gun mounted on a helicopter. This model is intended to evaluate the effectiveness of various armament systems in suppressing a number of personnel targets.

For the purpose of this model, suppression is defined as the expectation of impacting a predetermined number of projectiles (or more) within a predetermined rectangular or square area around a man. Both the predetermined number of bullets for suppression and the size of the rectangle or square can be varied in the model presented below, i.e., the definition of suppression can be varied.

This model has been programmed for the IBM 7030 (STRETCH) and a listing of the computer program is presented in Appendix E. Besides the program listing, the input format and sample of the output are presented in Appendix B and Appendix C, respectively.

The problem for which the model was developed and the assumptions upon which the model is based are presented in the following sections.

PROBLEM STATEMENT

The problem for which the model was developed can be stated as follows: Given the number of rounds per burst, the dispersion (down range and cross range) of the mean point of the impacts of the machine gun bursts, the dispersion (down range and cross range) of the bullets in a burst, and the number of men in the target area, determine the expected number of men suppressed in a flat target area of specified size.

ASSUMPTIONS

The following assumptions are used in the model:

1. The target area is flat and the terrain cover is of such a nature so as not to deflect the bullets.

2. The men are randomly dispersed throughout the target area.

3. The areas of suppression of the men do not intersect.

4. The target area is rectangular or square.

5. The line of fire of the machine gun is always parallel to one of the sides of the target area.

6. The mean points of the impacts (MPIs) of the bursts have an independent bivariate normal distribution.

7. The bullets within a burst form an independent bivariate normal distribution.

8. The down range and cross range dispersions of both the bullets within a burst and the MPIs of the bursts are known.

9. The number of bullets per burst is constant and known.

MODEL DESCRIPTION

Although the following description of the model is presented in only enough detail to make it understandable, an effort has been made to keep the mathematical symbols of this presentation consistent with the symbols used in the computer program coding.

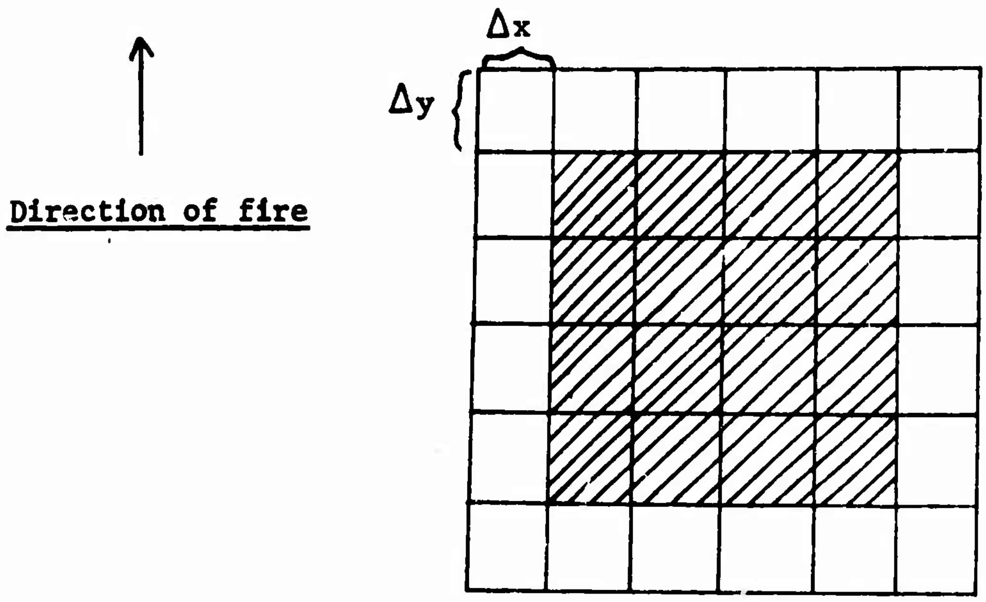
First the target area is divided into rectangular or square blocks whose dimensions are those of the area which defines suppression. (See hatched area of Figure 1.) These dimensions are Δx in the direction perpendicular to the line of fire and Δy in the direction parallel to the line of fire.

Since it is possible for the mean point of impact (MPI) of a burst to lie outside the target area and still have bullets from that burst strike within the target area, it may be necessary to add extra blocks of the same size as the target blocks around the target area. (See Figure 1 unlined blocks.) These additional impact blocks are added until the probability of having an MPI in one is small (on the order of .0005 or less). The number of blocks to be added (if any) is dependent upon the dispersion of both the bursts (MPIs) and the bullets.

The impact area consists of these additional blocks plus the target blocks. If the dispersions of the MPIs are such that the probability of getting an MPI outside the target area is less than .0005, the target area and the impact area are identical. The impact area is always square or rectangular, and the number of additional impact blocks (if any) in the x- and y-directions are predetermined and are inputs to the computer program.

Next, labeling of the blocks begins with the lower lefthand corner. This first block is labeled (1,1). The first coordinate indicates the i^{th} row, and the second coordinate indicates the j^{th} column of the impact area. All impact blocks are labeled in this way. The target blocks are labeled by the coordinate pair of the impact block they represent

***Target Area and Impact Area**



* The hatched area is the target area, and the blocks within it are target blocks.

The total area -- lined and clear -- is the impact area, and the blocks within it (including the lined blocks) are impact blocks.

Figure 1.

(the impact area is always at least as large as the target area). To avoid confusion when referring to target blocks, k will designate the column of the target block, and l will designate the row.

Let

σ_{x_w} = standard deviation of the MPI of the weapon burst cross range

σ_{y_w} = standard deviation of the MPI of the weapon burst down range

It is assumed that a cartesian coordinate system with its origin at the centroid of the impact area is overlayed on the impact area. The x-direction is cross range; the y-direction is down range. Using this coordinate system, let

m_x = mean of the distribution of MPIs cross range

m_y = mean of the distribution of MPIs down range

P(i,j) = probability that the MPI of a given burst is in impact block (i,j).

Then:

$$P(i,j) = \frac{1}{2\pi\sigma_{x_w}\sigma_{y_w}} \int_s^t \int_v^u e^{-1/2\left[\left(\frac{x-m_x}{\sigma_{x_y}}\right)^2 + \left(\frac{y-m_y}{\sigma_{x_w}}\right)^2\right]} dxdy$$

since x and y are assumed independent.

$|u-v| = \Delta x$

$|t-s| = \Delta y$, i.e., u and v are the cross range and s and t are the down range distances from the mean to the side of impact block (i,j).

The method of determining the values of u, v, s, and t adds nothing to the presentation of the model, and it is not included. However, the method can be found in the program listing of Appendix E.

Let

σ_{x_b} = cross range standard deviation of the bullets for any MPI

σ_{y_b} = down range standard deviation of the bullets for any MPI

The mean of the distribution of bullets is assumed to be at the centroid of the impact block for each impact block. That is, the mean of the bullets is assumed to be (0,0) in a cartesian coordinate system whose origin is the center of the impact block.

Let

$P\left[(k,l)/(i,j)\right]$ = probability that a bullet hits a target block (k,l) given an impact in impact block (i,j)

Then

$$P\left[(k,l)/(i,j)\right] = \frac{1}{2\pi\sigma_{x_b}\sigma_{y_b}} \int_c^d \int_f^g e^{-1/2\left(\frac{x^2}{\sigma^2_{x_b}} + \frac{y^2}{\sigma^2_{y_b}}\right)} dxdy$$

$|g-f| = \Delta x$

$|d-c| = \Delta y$, i.e., g and f are the cross range and c and d are the down range distances from the center of impact block (i,j) to the sides of target block (k,l).

Again the method of determining g, f, and d, c adds nothing to the presentation and is not given. It too can be determined from the program listing of Appendix E.

Let

N = the number of bullets per weapon burst

$B\left[(k,l)/(i,j)\right]$ = expected number of bullets in target block (k,l) given the MPI in impact block (i,j)

$$B\left[(k,l)/(i,j)\right] = N\cdot P\left[(k,l)/(i,j)\right]$$

Since suppression can occur only in those blocks receiving an expected number of bullets equal to or greater than some tolerance q, it is necessary to count and record for each impact block (i,j) the number of target blocks (k,l) for which $B\left[(k,l)/(i,j)\right] \geq q$. For each impact block (i,j) call this quantity T(i,j).

$T(i,j)$ = number of blocks in which suppression can occur given an impact in impact block (i,j)

K = number of targets in the target area

B = number of target blocks into which the target area is divided

$\frac{K}{B}$ = probability that a target is in any given target block

$E(i,j)$ = expected number of targets suppressed by an MPI in impact block (i,j)

$$E(i,j) = \frac{K}{B} \cdot T(i,j)$$

E = expected number of targets suppressed by a single machine gun

$$E = \sum_{\text{all } j} \sum_{\text{all } i} \left\{E(i,j) \cdot P(i,j)\right\}$$

$$= \sum_{\text{all } j} \sum_{\text{all } i} \left\{\frac{K}{B} \cdot T(i,j) \cdot P(i,j)\right\}$$

$$= \frac{K}{B} \cdot \sum_{\text{all } j} \sum_{\text{all } i} T(i,j) \cdot P(i,j)$$

In the case where the tolerance q=1 the following option can be used:

Determine the expected number of bullets striking the target area but not accounted for in the target blocks which form T(i,j) for each impact block (i,j). Call this expected number of bullets w'(i,j).

$$w'(i,j) = \sum B\left[(k,l)/i,j)\right], \text{ for all } B\left[(k,l)/i,j)\right] < q$$

Let

$w(i,j)$ = integer portion of $w'(i,j)$

$$T'(i,j) = T(i,j) + w(i,j)$$

Let

$E'(i,j)$ = expected number of targets suppressed by an MPI in impact block (i,j) using the option

$$E'(i,j) = \frac{K}{B} \cdot T'(i,j)$$

E' = expected number of targets suppressed using the option by a single machine gun burst

$$E' = \frac{K}{B} \cdot \sum_{\text{all } j} \sum_{\text{all } i} T'(i,j) \cdot P(i,j)$$

This option is reasonably accurate only when $q = 1$. For other values of q it is not usable.

COMPUTER PROGRAM

The mathematical model described in the previous section has been programmed for the IBM 7030 (STRETCH). The programming language is FORTRAN IV.

The symbols used in the computer program are defined in Appendix A, and the inputs to the program are indicated. Appendix B presents a sample input sheet; Appendix C gives an example of the output from the program. Appendix D is a flow chart of the computer program, and Appendix E is a listing of the program.

Some of the input data such as angle (angle of descent), velocity, altitude, and range from target are not actually used in the computer program, but they are included in the output for identification in those cases where these data are used to compute the various dispersions. If for a particular theoretical study these data are not applicable, zeroes can be used in the input.

RESULTS AVAILABLE FROM THE MODEL

This section describes how the model can be used.

The parameters that can vary are:

(1) σ_{x_w} and σ_{y_w} = cross range and down range dispersions, respectively, of each weapon burst

(2) σ_{x_b} and σ_{y_b} = cross range and down range dispersions, respectively, of each weapon burst

(3) Δx and Δy = dimensions of target and impact blocks and also area of suppressions

(4) q = expected number of bullets needed in target block to suppress a man

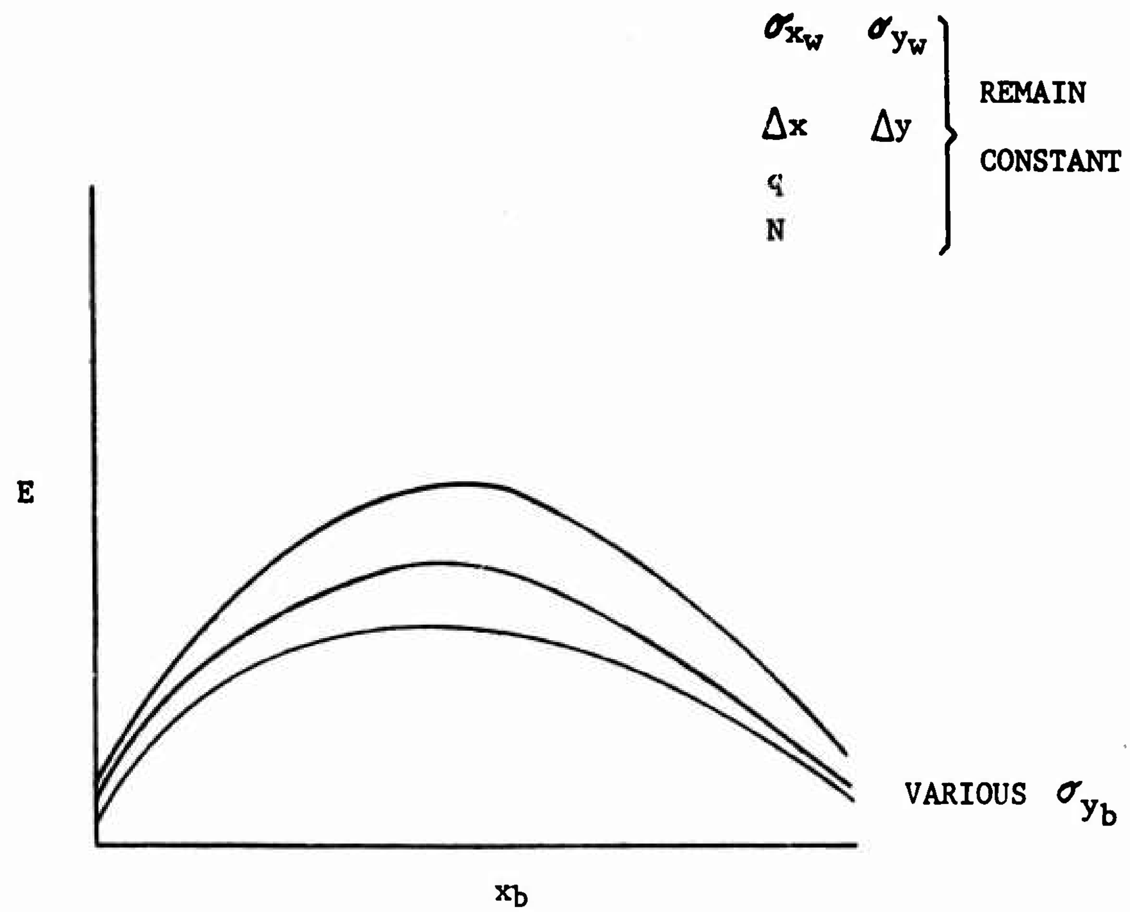
(5) N = number of bullets per weapon burst

A change in any of these parameters will produce a change in E, the expected number of men suppressed.

A study can be performed on the effect of changing any two parameters by determining E for each value of the changing parameters and holding all other parameters constant. Figure 2 shows a possible family of curves for changes in σ_{x_w} and σ_{y_w}. (These curves are presented only for the purpose of illustration, and their form has no relation to those an actual study would produce.)

Illustration of Parametric Study

(σ_{x_b} and σ_{y_b} vary)



It is possible to get a family of such families by giving those parameters that remain constant new values.

Figure 2.

DEFINITION OF SYMBOLS USED IN COMPUTER PROGRAM

* IRUN	= Run Indicator	0 = Another run to follow 1 = Last run
* NHAA	= Helicopter's Angle of Descent	
* NHVK	= Helicopter's Velocity	
* NHAF	= Helicopter's Altitude	
* NHRF	= Helicopter's Range from Target	
* NTX	= Number of Target Cells in x-direction	
* NTY	= Number of Target Cells in y-direction	
* NAX	= Number of additional cells in x-direction	
* NAY	= Number of additional cells in y-direction	
* XDEL	= Cell dimension in x-direction	
* YDEL	= Cell dimension in y-direction	
* TØL	= Expected number of bullets needed in each cell for suppression	
* N	= Number of bullets in each machine gun burst	
* K	= Number of targets	
* XMI	= Mean of MPIs of distribution in x-direction	
* YMI	= Mean of MPIs of distribution in y-direction	
* SIGIX	= Standard deviation of MPIs of distribution in x-direction	
* SIGIY	= Standard deviation of MPIs of distribution in y-direction	
* SIGBX	= Standard deviation of bullets of distribution in x-direction	
* SIGBY	= Standard deviation of bullets of distribution in y-direction	
* IØP	= Option	0 = Don't include option 1 = Include option

* These quantities are program inputs.

NRUN = Run number

NIX = Number of impact cells in x-direction

NIY = Number of impact cells in y-direction

LMAX = Index number of last target block in y-direction

KMAX = Index number of last target block in x-direction

XTAR = x-dimension of target area

YTAR = y-dimension of target area

XIMP = x-dimension of impact area

YIMP = y-dimension of impact area

CONST 1 = $\sqrt{2}\,\sigma_{w_x}$

2 = $\sqrt{2}\,\sigma_{w_y}$

3 = $\sqrt{2}\,\sigma_{b_x}$

4 = $\sqrt{2}\,\sigma_{b_y}$

(1–4: Constants needed in transforming the normal distribution to ERF*)

** 5 = $\frac{K}{B}$

NAXP1 = Index number in x-direction of target block in lower left-hand corner

NAYP1 = Index number in y-direction of target block in lower left-hand corner

TOLDN = Cutoff point in terms of probabilities

HX = Distance in x-direction from (0,0) of coordinate system at center of impact area to the edge of the impact area

HY = Distance in y-direction from (0,0) of coordinate system at center of impact area to the edge of the impact area

$$*ERF(T) = \frac{2}{\sqrt{\pi}} \int_0^T e^{-z^2}\,dz$$

**See text, Model Description, for definition of symbols.

BX = Number of blocks in x-direction excluding the center block for the bullets in a burst. If 3X is not an integer, then IX makes it an integer.

BY = Number of blocks in y-direction excluding the center block for the bullets in a burst. If BY is not an integer, then IY makes it an integer.

IXP1 = Number of blocks in x-direction including the center block for the bullets in a burst.

IYP1 = Number of blocks in y-direction including the center block for the bullets in a burst.

PX = Probability that an MPI occurs along a given line segment in the x-direction.

PY = Probability that an MPI occurs along a given line segment in the y-direction.

PXP = Probability that a bullet strikes along a given line segment in the x-direction.

PYP = Probability that a bullet strikes along a given line segment in the y-direction.

T(I,J) = Number of target blocks which meet suppression requirement given an impact in impact block (I,J)

TP(I,J) = Number of target blocks for the option which meets the suppression requirement given an impact in impact block (I,J)

IW = Integer portion of those bullets expected to strike the target area in target blocks which do not meet the suppression requirement.

E = Expected number of targets suppressed

EP = For option expected number of targets suppressed

DATA CARD LAYOUT
NUMBER ONE
NDW-NWL-19462/60-Rev. 3-64

PAGE

INPUT FORMAT

DATA CARD LAYOUT

PROG. IDEN. (73–75) | CARD NUMBER (76–80)

CARD TYPE 1

IRUN	NHAA	NHVK	NHAF	NHRP	NTX	NTY	NAX	NAY	XDEL	YDEL	TOL	N

CARD TYPE 2

K	XMI	YMI	SIGIX	SIGIY	SIGEX	SIGEY	IOP

HELICOPTER ARMAMENT STUDY

RUN NUMBER 1

ANGLE = 45 DEGREES
ALTITUDE = 9000 FEET
VELOCITY = 120 KNOTS
RANGE = 1000 FEET

TARGET AREA IS 40.00 FEET BY 42.00 FEET
NUMBER OF TARGETS IS 14
TARGET DIMENSIONS ARE 10.00 FEET BY 6.00 FEET

MEAN OF MEAN POINTS OF IMPACT IN X-DIRECTION IS -8. FEET
MEAN OF MEAN POINTS OF IMPACT IN Y-DIRECTION IS 11. FEET

STANDARD DEVIATION OF MEAN POINTS OF IMPACT IN X-DIRECTION IS 10.000 FEET
STANDARD DEVIATION OF MEAN POINTS OF IMPACT IN Y-DIRECTION IS 8.000 FEET

STANDARD DEVIATION OF BULLETS IN EACH BURST IN X-DIRECTION IS 8.000 FEET
STANDARD DEVIATION OF BULLETS IN EACH BURST IN Y-DIRECTION IS 6.000 FEET

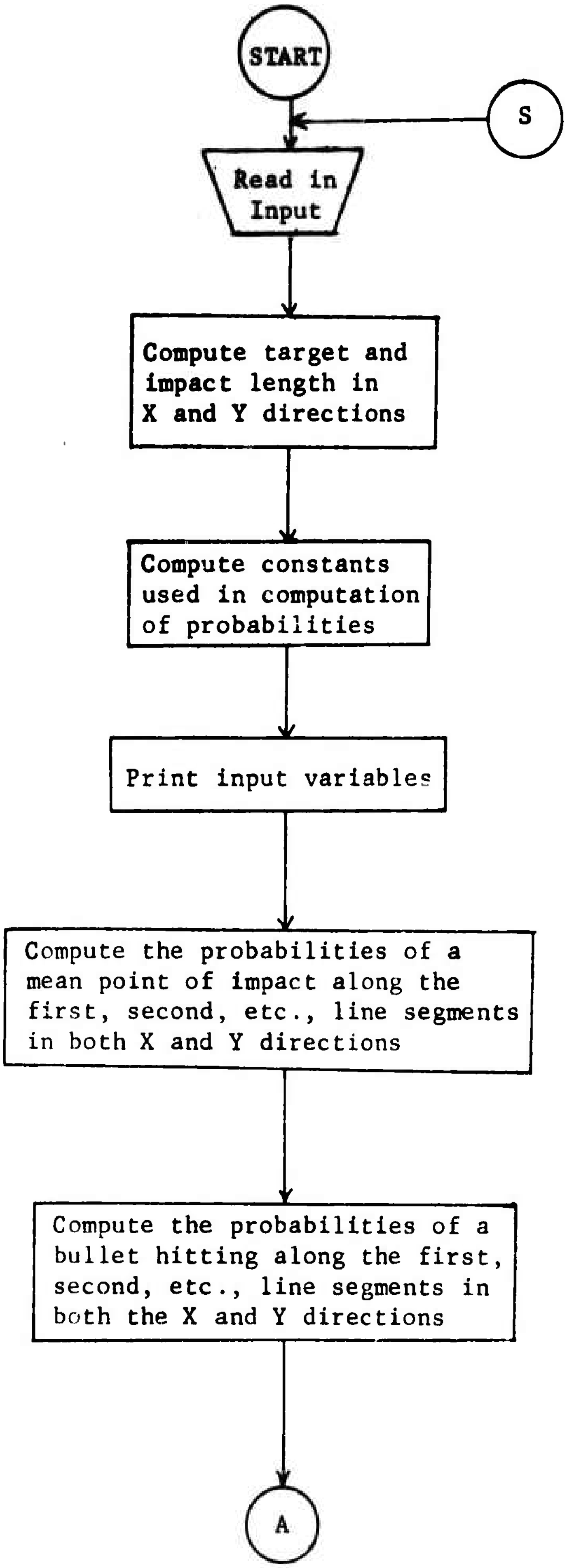
NUMBER OF BULLETS PER BURST IS 45

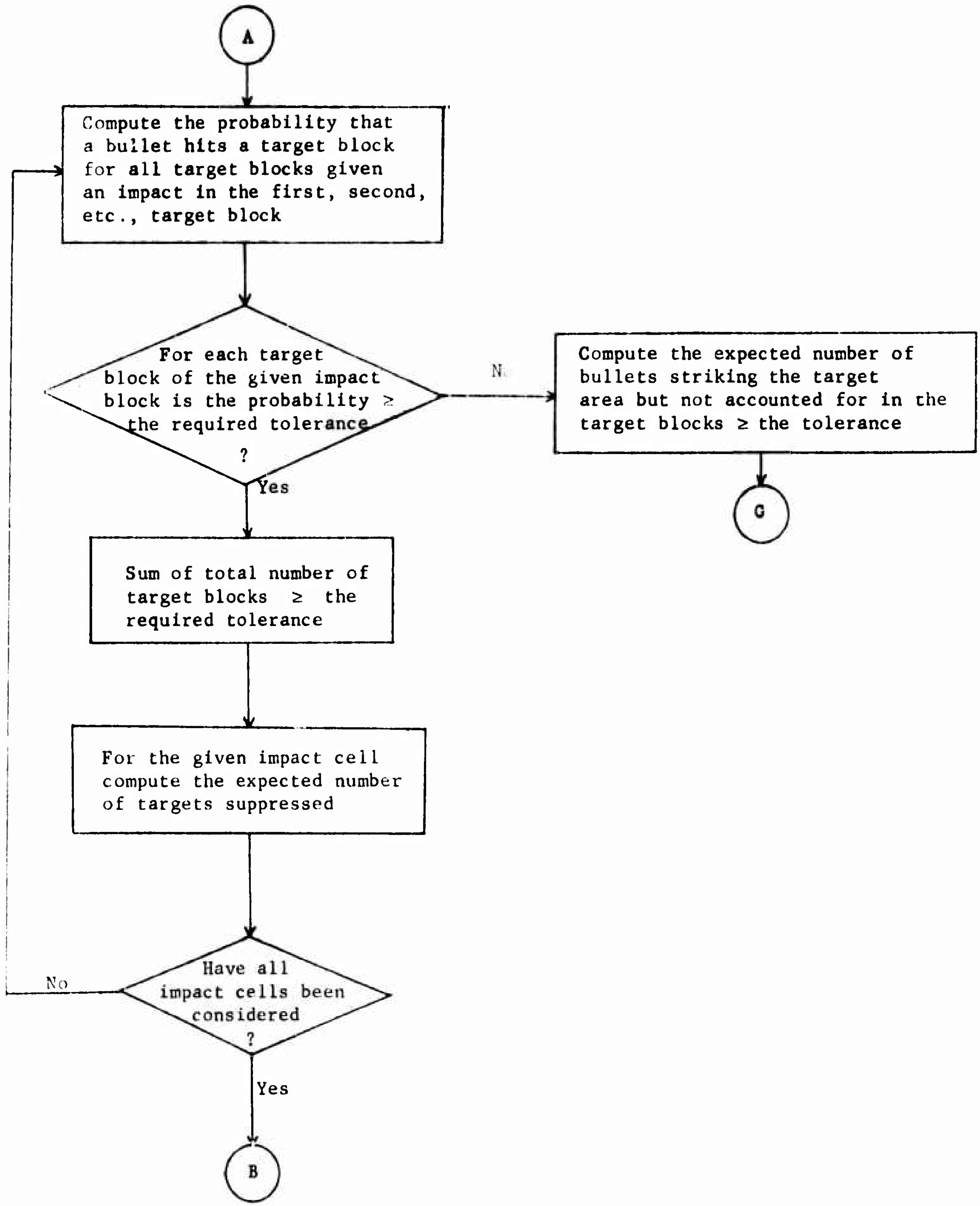
EXPECTED NUMBER OF SUPPRESSIONS IS = 3.7

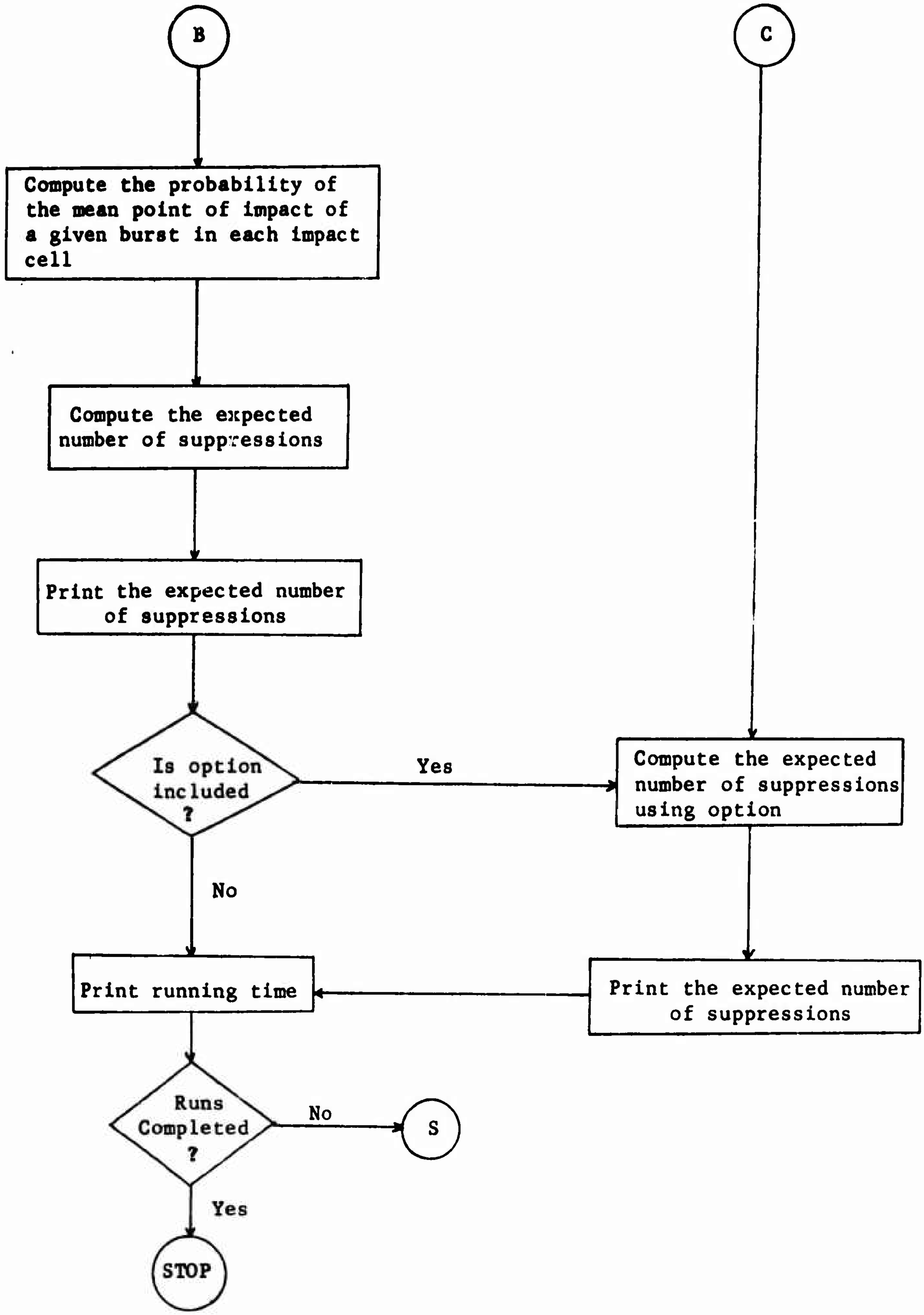
OPTION

EXPECTED NUMBER OF SUPPRESSIONS IS = 4.8

RUNNING TIME IN SECONDS = 0.757


START
S
Read in Input
Compute target and impact length in X and Y directions
Compute constants used in computation of probabilities
Print input variables
Compute the probabilities of a mean point of impact along the first, second, etc., line segments in both X and Y directions
Compute the probabilities of a bullet hitting along the first, second, etc., line segments in both the X and Y directions
A


A
Compute the probability that a bullet hits a target block for all target blocks given an impact in the first, second, etc., target block
For each target block of the given impact block is the probability ≥ the required tolerance ?
No
Compute the expected number of bullets striking the target area but not accounted for in the target blocks ≥ the tolerance
C
Yes
Sum of total number of target blocks ≥ the required tolerance
For the given impact cell compute the expected number of targets suppressed
Have all impact cells been considered ?
No
Yes
B



B
C
Compute the probability of the mean point of impact of a given burst in each impact cell
Compute the expected number of suppressions
Print the expected number of suppressions
Is option included ?
Yes
Compute the expected number of suppressions using option
No
Print running time
Print the expected number of suppressions
Runs Completed ?
No
S
Yes
STOP

```
B          TYPE,COMPILGO,FORTRAN,PM
T          SUBTYPE,FORTRAN,LMAP,PUNCH
      DIMENSION T(2500), TP(2500)
      COMMON IRUN,NHAA,NHVK,NHAF,NHRF,NTX,NTY,NAX,NAY,XDEL,YDEL,TOL,
     1        N,K,XMI,YMI,SIGIX,SIGIY,SIGBX,SIGBY,IOP,NRUN
      NRUN=0
    1 READ 3, IRUN,NHAA,NHVK,NHAF,NHRF,NTX,NTY,NAX,NAY,XDEL,YDEL,TOL,
     1        N,K,XMI,YMI,SIGIX,SIGIY,SIGBX,SIGBY,IOP
      NRUN=NRUN+1
    3 FORMAT(I2,3X,I3,3X,I4,2X,I4,2X,I4,3X,I3,2X,I3,2X,I3,2X,I3,2X,
     1        F5.2,2X,F5.2,3X,F6.3,3X,I3/
     2        I3,2X,F10.0,3X,F10.0,2X,F7.3,2X,F7.3,2X,F7.3,2X,F7.3,
     3        3X,I1,3X,F4.2)
      CALL SETIT
      NIX= NTX+2*NAX
      NIY= NTY+2*NAY
      IF((NIX*NIY).GT.2500) STOP
      CALL HAS(T,TP,NIX,NIY)
      IF(IRUN.LT.1) GO TO 1
      RETURN
      END
-         SUBTYPE,FORTRAN,LMAP,PUNCH
      SUBROUTINE   HAS(T,TP,NIX,NIY)
      DIMENSION T(NIX,NIY),TP(NIX,NIY),PX(500),PY(500),PXP(500),PYP(500)
      COMMON IRUN,NHAA,NHVK,NHAF,NHRF,NTX,NTY,NAX,NAY,XDEL,YDEL,TOL,
     1        N,K,XMI,YMI,SIGIX,SIGIY,SIGBX,SIGBY,IOP,NRUN
```

```
      LMAX=NTY + NAY
      KMAX=NTX + NAX
      XTAR = XDEL*FLOAT(NTX)
      YTAR = YDEL*FLOAT(NTY)
      XIMP = XTAR+2.*FLOAT(NAX)*XDEL
      YIMP = YTAR+2.*FLOAT(NAY)*YDEL
      FN=N
      CONST1=1.4142135623731*SIGIX
      CONST2=1.4142135623731*SIGIY
      CONST3=1.4142135623731*SIGBX
      CONST4=1.4142135623731*SIGBY
      CONST5=(FLOAT(K))/(FLOAT(NTX*NTY))
      NAXP1=NAX+1
      TOLDN=TOL/FLOAT(N)
      HX=XIMP/2.
      HY=YIMP/2.
      BX=(3.5*SIGBX)/XDEL-.5
      BY=(3.5*SIGBY)/YDEL-.5
      NAYP1=NAY+1
      PRINT 21,NRUN,NHAA,NHAF,NHVK,NHRF,XTAR,YTAR,K,XDEL,YDEL,XMI,YMI
   21 FORMAT(1H2,26X, 25HHELICOPTER ARMAMENT STUDY//
     1        12HORUN NUMBER ,I1/
     2 1H0,6X,8HANGLE = I3,8H DEGREES,14X,11HALTITUDE = I4,5H FEET/
     3      7X,11HVELOCITY = I4,6H KNOTS,12X,8HRANGE = I4,5H FEET//
     4 1H0,6X,15HTARGET AREA IS F8.2,9H FEET BY F8.2,5H FEET/
     5      7X,21HNUMBER OF TARGETS IS I3/
```

```
 6     7X,22HTARGET DIMENSIONS ARE F5.2,9H FEET BY F5.2,5H FEET//
 7 1HO,6X,48HMEAN OF MEAN POINTS OF IMPACT IN X-DIRECTION IS F10.0,
 8    5H FEET/7X,44HMEAN OF MEAN POINTS OF IMPACT IN Y-DIRECTION,
 9    4H IS F10.0,5H FEET//)
  PRINT 22,SIGIX,SIGIY,SIGBX,SIGBY,N
22 FORMAT(1HO,6X,46HSTANDARD DEVIATION OF MEAN POINTS OF IMPACT IN,
 1    16H X-DIRECTION IS F7.3,5H FEET/
 2    7X,46HSTANDARD DEVIATION OF MEAN POINTS OF IMPACT IN,
 3    16H Y-DIRECTION IS F7.3,5H FEET//
 4 1HO,6X,46HSTANDARD DEVIATION OF BULLETS IN EACH BURST IN,
 5   16H X-DIRECTION IS F7.3,5H FEET/7X,18HSTANDARD DEVIATION,
 6 43H OF BULLETS IN EACH BURST IN Y-DIRECTION IS F8.3,5H FEET//
 7 1HO,6X,31HNUMBER OF BULLETS PER BURST IS I3)
  X=-HX-XMI
  P1=.5*ERF(ABS(X/CONST1))
  DO 5 I=1,NIX
  X=X+XDEL
  P2=.5*ERF(ABS(X/CONST1))
  IF(X) 4,4,2
2 IF(X-XDEL) 3,3,4
3 PX(I)=P1+P2
  P1=P2
  GO TO 5
4 PX(I)=ABS(P1-P2)
  P1=P2
5 CONTINUE
```

```
      Y=-HY-YMI
      P1=.5*ERF(ABS(Y/CONST2))
      DO10 I=1,NIY
      Y=Y+YDEL
      P2= .5*ERF(ABS(Y/CONST2))
      IF(Y) 9,9,7
    7 IF(Y-YDEL) 8,8,9
    8 PY(I)=P1+P2
      P1=P2
      GO TO 10
    9 PY(I)=ABS(P1-P2)
      P1=P2
   10 CONTINUE
      IX =BX+.999
      IY =BY+.999
      YI = IY
      XI = IX
      DX =-(XI+.5)*XDEL
      DY =-(YI+.5)*YDEL
      X = DX
      L= 2*IX+2
      P1=.5*ERF(ABS(X/CONST3))
      IXP1 =IX+1
      DO15 I=1,IXP1
      X=X+XDEL
      P2=.5*ERF(ABS(X/CONST3))
```

```
      PXP(I) = ABS(P1-P2)
      P1=P2
      L=L-1
      PXP(L)=PXP(I)
   15 CONTINUE
      PXP(IXP1)=2.*P2
      Y=DY
      L=2*IY+2
      P1=.5*ERF(ABS (Y/CONST4))
      IYP1=IY+1
      DO20 I=1,IYP1
      Y=Y+YDEL
      P2 =.5*ERF(ABS(Y/CONST4))
      PYP(I)=ABS(P1-P2)
      P1=P2
      L=L-1
      PYP(L)=PYP(I)
   20 CONTINUE
      PYP(IYP1)=2.*P2
      DO60 J=1,NIY
      DO60 I=1,NIX
      T(I,J)= 0
      SUM = 0
      TP(I,J)=0
      DO 50 L=NAYP1,LMAX
      IF((IABS(L-J)-IYP1).GE.0) GO TO 25
```

```
      L1 = IYP1+IABS(J-L)
      P2 =PYP(L1)
      GO TO 30
   25 P2 = 0
   30 DO 50  K=NAXP1,KMAX
      IF((IABS(K-I)-IXP1).GE.0) GO TO 35
      L1=IXP1+IABS(K-I)
      P1=PXP(L1)
      GO TO 40
   35 P1=0
   40 P =P1*P2
      IF(P.LT.TOLDN) GO TO 45
      T(I,J) =T(I,J)+1.
      GO TO 50
   45 SUM = SUM+P
   50 CONTINUE
      IW= SUM*FN
      W = IW
      TF(I,J)=T(I,J)+W
   60 CONTINUE
      F=0
      DO 65 J=1,NIY
      P2=PY(J)
      DO 65 I=1,NIX
      P1=PX(I)
      F=F+T(I,J)*P1*P2
```

```
65 CONTINUE
   E= E*CONST5
   PRINT 66,E
   IF(IOP.EQ.0) GO TO 75
66 FORMAT (37H0EXPECTED NUMBER OF SUPPRESSIONS IS = F6.1)
   EP=0
   DO 70 J=1,NIY
   P2=PY(J)
   DO 70 I=1,NIX
   P1=PX(I)
   EP=EP+TP(I,J)*P1*P2
70 CONTINUE
   EP=EP*CONST5
   PRINT 71,EP
71 FORMAT (7H0OPTION/ 37H0EXPECTED NUMBER OF SUPPRESSIONS IS = F6.1)
75 CALL INTVL(TSEC)
   PRINT 80,TSEC
80 FORMAT(27H0RUNNING TIME IN SECONDS = ,F7.3)
   RETURN
   END
T         SUBTYPE,DATA
```

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13. ABSTRACT

This technical memorandum describes a mathematical model for determining the expected number of men suppressed by a rapid fire machine gun mounted on a helicopter. Also included is a description of the computer program of the model for the IBM 7030 (STRETCH).