AD-A149 548 A COMPUTER SYSTEM FOR GENERATING SINGLE AND DOUBLE SAMPLING PLANS FOR ATT..(U) FLORIDA UNIV GAINESVILLE DEPT OF INDUSTRIAL AND SYSTEMS ENGIN.. 1/1

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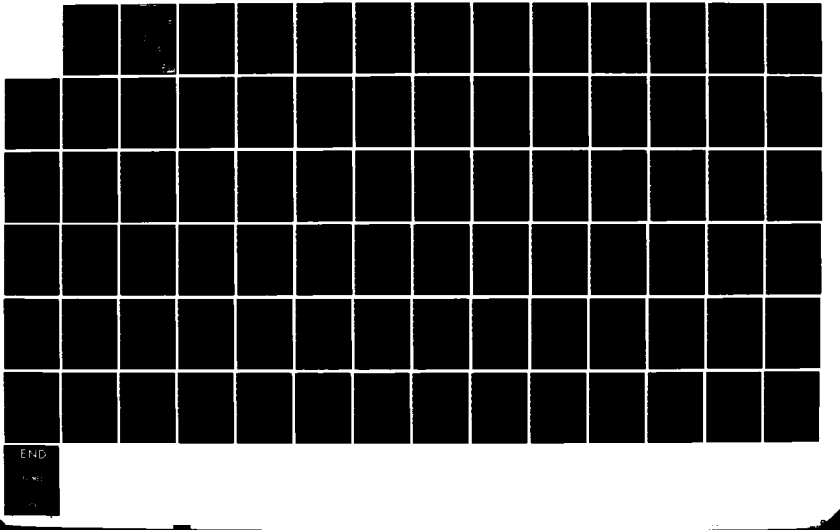

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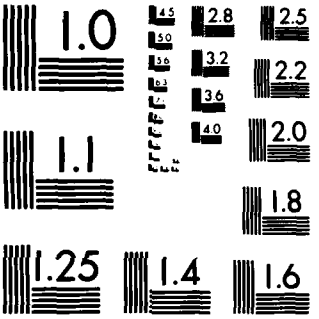

A COMPUTER SYSTEM FOR GENERATING SINGLE AND DOUBLE SAMPLING PLANS FOR ATTRIBUTES DATA

Research Report No. 84-35

by

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RESEARCH REPORT

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TABLE OF CONTENTS

ABSTRACT

This study brings together the programs developed in three previous reports into a unified sampling system. One segment contains the single and double sampling plans of MIL-STD-105D along with subroutines that evaluate the normal, tightened and reduced plans including switching rules. Output includes system OC curves, and ASN, AOQ, and AFI curves in either graphical or tabular form. Another segment derives single and double sampling plans to satisfy two points designated on the OC curve. An algorithm is employed which seeks to minimize the ASN at a designated Acceptable Quality Level (AOL). The third segment is designed for use when rectifying inspection is employed. It derives single and double sampling plans based on one point on the OC curve, either the process average or a specified AOL value, intended to not exceed a specified AOQL and minimizing the AFI at the process average or specified AQL. Programming is written in FORTRAN IV and development was on a VAX 11-750 computer.

INTRODUCTION

This report brings together the results of three previous studies dealing with acceptance sampling using attributes data. The previous studies dealt with single and double acceptance sample plans. The first involved a computerized version of MIL-STD-105D. The second dealt with the design of double sampling plans in cases where rectifying inspection is not employed. An objective function is introduced which minimizes the average amount of inspection when the process is operating at what is considered an acceptable level. The third study assumes that rectifying inspection is planned based on some specified Average Outgoiing Quality Limit and has as an objective function the minimization of inspection when the process is operating at an acceptable level. All computer programming is in ANSI FORTRAN IV and the programs were developed on a VAX 11-750 computer utilizing the VMS operating systems.

DESCRIPTION OF THE PROGRAM SEGMENTS

List of Program Segments

The programming system is composed of seven main segments. Each performs a specific activity with respect to the operation of the system or contains the code for executing the user's choice of sampling plans. These include:

1. Finding and evaluating MIL-STD-105D single and double sampling plans as a system of normal, tightened, and reduced inspection plans.
2. Deriving sampling plans to minimize the Average Sample Number (ASN), or average sample size;
3. Deriving sampling plans to minimize the Average Fraction Inspected (AFI) based on a specified Average Outgoing Quality Limit (AOQL).

The program segments are:

QUALITY.COM A command file that complies and links the program files into an executable file, QMAIN.EXE.

QMAIN.FOR The main program control file from which are called the three sampling plan programs.

QMIL.FOR The program containing MIL-STD-105D sampling plans and the analysis package.

QASN.FOR The program for finding single and double sampling plans based on minimizing the ASN.

QAFI.FOR The program for finding single and double rectifying inspection sampling plans based on minimizing the AFI.

PROBS1.FOR A program for calculating probabilities, binomial or Poisson, for single sampling plans. It is used by QASN.FOR and QAFI.FOR.

PROBD1.FOR A program for calculating probabilities, binomial or Poisson, for double sampling plans. It is used by QASN.FOR and QAFI.FOR.

Program Segment QMIL.FOR

The program QMIL.FOR contains all of the single and double sampling acceptance plans from MIL-STD-105D for normal, tightened, and reduced inspection. They are organized such that the user goes through identically the same procedure as if the Standard were being used. First, an Inspection Level is entered (Special Levels S-1 through S-4 or General Levels I, II, or III) followed by lot or batch size. This leads the program to the selection of the appropriate sample size code letter. The required AQL (Acceptable Quality Level) is entered next. This value must be one of the prescribed values in the Standard. Any other value will lead to extraneous and undesired results. Those values are, expressed in percent defective or defects per 100 units:

0.010, 0.015, 0.025, 0.040, 0.065, 0.10, 0.15, 0.25, 0.40, 0.65,
1.0, 1.5, 2.5, 4.0, 6.5, 10, 25, 40, 65, 100, 150, 250, 400, 650, 1000.

Once a system of sampling plans has been obtained, the user is given the option of having the system analyzed. Output of the analysis may be either in tabular or graphical form. In tabular form, a range of values of p for which the calcuations are to be made must be entered. If the user has no idea of the range of p required, it may be desirable to first obtain graphical output and then select the values of p for which accurate results are to be obtained. One caution with respect to graphical output is necessary at this point. In order to obtain clear, easily readable graphical output, the printer unit must be capable of and set on condensed printing. Graphical output uses more space than the standard 80 column pica type font allows. Hence, when restricted to 80 columns, two lines are used for each actual line of output.

Output of the analysis in tabular form appears as follows:

1. The value of p for which the calculation was made.
2. The probability of acceptance.
3. The average sample size (ASN).
4. The average outgoing quality (AOQ).
5. The average fraction inspected (AFI).

Item 3 applies only to those items in samples. Items 4 and 5 apply only if rectifying inspection is being employed; i.e., that all rejected lots are screened of defective units (defects) and are repaired/replaced in the lot in acceptable condition.

The graphical output provides the same information except that curves of the characteristics are plotted rather than numerical values printed. Because of limitations on the type of graphical output, the tabular output will be more accurate.

Analytical results of the program will not correspond exactly with those shown in MIL-STD-105D because the program treats the normal, tightened, and reduced inspection plans, along with the switching rules for changing from one

to the other, as a system of plans and analyzes the entire system rather than each plan individually. The system is analyzed as a Markov chain. Steady state probabilities of being in each of a series of states under normal, tightened and reduced inspection are calculated for each value of p in the effective range of the OC curve. These probabilities are then combined to give probabilities of being in normal, tightened and reduced inspection. From these values are calculated the probabilities of acceptance of lots or batches, the OC curve points, the ASN, AFI, and AOQ. As is the case in the Standard itself, each calculation assumes that lots are being formed from a process generating a constant value of p, i.e., a process in statistical control.

Details of the models and procedures are contained in reference (1).

Program Segment QASN.FOR

This program segment enables the user to design custom double sampling plans to minimize the average sample size based on two points on the operating characteristic curve. In the process, it also specifies the minimum single sampling plan that meets the OC curve requirements. The selection of plans based on ASN minimization are intended for use when rectifying inspection either is not or can not be used. Inputs to this program segment include a choice between the binomial and Poisson distributions for calculating probabilities of acceptance, the two specified points on the OC curve, a seed value for the sample size of the equivalent single sampling plan, and a value for the rejection number on the first sample of the double sampling plan.

The output consists of the minimum sampling plan, a series of double sampling plans, the double sampling plan found to have the minimum ASN evaluated at the input good quality level, and the maximum value for the ASN for the R1 value orginally input to the program.

The two points designated for the OC curve are related to the traditional Producer's and Consumer's risks. The program uses P0 to designate the producer's maximum acceptable quality level (an AQL as defined in MIL-STD-105D) or process average with the minimum probability of acceptance set at $(1- \alpha)$. In this case, α is the designated maximum producer's risk. The quality level P1 is the designated consumer's maximum acceptable quality level (RQL, or rejectable quality level) with a maximum probability of acceptance of β. In this case, β is the designed maximum Consumer's risk. The equations are of the form:

$$L(P0) \geq 1 - \alpha$$

$$L(P1) \leq \beta$$

where L(P) is the likelihood function (probability of acceptance formula) for the particular sampling plan being analyzed.

With these two equations alone, an infinite number of sampling plans, single and double, exist which satisfy the inequality constraints. A reasonable choice from among that group is that plan which provides for minimum inspection on the average. Thus an objective function is introduced that minimizes the ASN when the process is operating at or below the AQL. This value is designated ASN or ASN(P0) on the computer output.

Users familiar with MIL-STD-105D will remember that double and multiple sampling plans in that standard are designed such that their respective ASN's never exceed the sample size of the single sampling plan with the same OC curve. The capability of establishing this additional constraint has been provided for in this program segment. As part of the output, the user receives the maximum value of the ASN reached for each plan analyzed. This values is designed ASNMAX. (The program searches the ASN function as a function of p and outputs that value.) Thus the user may search through the

program output for those plans with a ASNMAX less than or equal to the minimum single sampling plan and select from them the plan with the minimum ASN(P0). It is worth noting at this point that, in most of the plans explored in the development of this segment, addition of this constraint did not result in changing the optimal choice.

Reference (2) presents detailed findings and a full description of the program's development.

Program Segment QAFI.FOR

This program segment develops single and double sampling plans which meet a specified Average Outgoing Quality Limit (AOQL). They are intended for use only when rectifying inspection (100% inspection of the balance of rejected lots) is employed. Calculations assumes that rectifying inspection is 100% effective and that the binomial distribution provides sufficient accuracy in calculating probabilities of acceptance.

Inputs to this segment include a Producer's Risk Point (P0, 1-α), the desired AOQL (designated AOQL*), and the lot or batch size. Outputs include the minimum single sampling plan satisfying the constraints, a series of double sampling plans all of which satisfy the AOQL constraint, and that plan which satisfies the constraints and minimizes the Average Fraction Inspected (AFI) when the process is operating at the quality level P0. The quality level P0 may be interpreted either as an AQL value as defined in MIL-STD-105D or as a process average as defined and employed in the Dodge-Romig tables. As in the Dodge-Romig tables, the rejection numbers on the first and second samples, R1 and R2, are set at the second acceptance number, C2, plus one.

The objective function and constraint equations are of the form:

minimize AFI(P0)

subject to:

$$L(P0) \geq 1 - \alpha$$
$$AOQL \leq AOQL^*$$
$$R1 = R2 = C2 + 1$$

First, the program finds the minimum single sampling plan satisfying the likelihood function and AOQL constraints. This information is used internally to assist in setting bounds for the algorithm that solves for the double sampling plans. Then the algorithm shifts to seeking the double sampling plan satisfying the constraints. In its search, a number of plans are found and it is from this group that the plan that minimizes AFI(P0) is selected. Output includes the sample sizes N1, and N2, acceptance numbers C1 and C2, and the AFI(P0), designated simply as AFI.

Reference (3) provides a complete description and analysis of the development and operation of the algorithm and program.

PROGRAM OPERATING INSTRUCTIONS AND OUTPUT

Initializing the Program

In the following instructions, user inputs are in capital letters. A backward arrow (←) indicates a carriage return.

Program initialization begins by entering:

@QUALITY←

This instruction executes the command file (QUALITY.COM) which compiles and links the program files into a single executable file (QMAIN.EXE). If QMAIN.EXE has been created and exists in the file, this step may be eliminated.

Once QMAIN.EXE has been created, the user enters:

RUN QMAIN←

This command starts program execution. Very shortly the following message will appear on the terminal screen:

```
                WHAT DO YOU WISH TO DO?
1-DERIVE SAMPLING PLANS TO MINIMIZE ASN
2-DERIVE SAMPLING PLANS TO MINIMIZE AFI
3-EVALUATE MIL-STD-105D SAMPLING SCHEME
4-EXIT THIS PROGRAM
```

Entering the number for your selection followed by a carriage return transfers program control to QASN.FOR, QAFI.FOR, QMIL.FOR, or the computer operating system. These instructions are repeated after each run of the program until the user exits with instruction (4).

Running QASN.FOR

Entering number 1 from the main transfers program control to QASN.FOR, the program for generating double sampling plans designed to minimize the ASN at quality level P0. What follows is the menu QASN.FOR.

The first question in this menu asks you to name an output file (8 alphanumeric characters or less).

```
          WHAT DO YOU WISH TO CALL YOUR OUTPUT FILE?
```

User enters a name and ←.

Subsequent questions are:

```
        CODES FOR SELECTING APPR. PROB. DIST.
          BINOMIAL                    =1
          POISSON                     =2
```

User then enters the appropriate code. The Poisson uses the intensity parameter $\lambda = np$ in terms of defects per 100 units.

```
              SELECT
                 SAMPLE PLANS ONLY = 1
                 ASN VALUES ONLY = 2
                 OR BOTH = 3
```

The most useful of these choices is to enter 3. Entering 1 produces an output of a large number of sampling plans all of which meet th criteria for the two points on the OC curve. Output includes the values of C1, C2, and N1, the range over which N2 may operate, and the probabilities of acceptance at P1 and P0, respectively. Entering 2 results in the production of a large number of plans satisfying the OC curve constraints and lists values of ASNMAX and ASN(P0). When 3 is entered, the optimization algorithm is called in thus the output is limited to those plans which were considered candidates for the optimum. Output includes C1, C2, and N1, the effective range for N2, and the ASNMAX and ASN(P0) when the smallest value of N2 is used. It then selects the global optimum plan for the input value of R1.

```
INPUT ALPHA          User enters the Producer's Risk, α←
INPUT BETA           User enters the Consumer's Risk, β←
INPUT P0             User enters P0←
INPUT P1             User enters P1←

INPUT A SEED FOR THE SINGLE SAMPLING NO.
IF NO SEED AVAILABLE ENTER ZERO AS THE SEED VALUE
```

If the user has some idea what the sample size will be for the single sampling plan satisfying the OC curve requirements, a conservative value somewhat lower than that number may be entered. This option is useful only when the sample size is known to be large and user wishes to save some time. Its use may lead to nonoptimal results if the seed value is larger than the optimal value.

```
INPUT A VALUE FOR (R1 - C2)
     IF R1 = C2 THEN THE VALUE WOULD BE 0
     IF R1 > C2 THEN THE VALUE WOULD BE A POSITIVE NO.
     IF R1 < C2 THEN THE VALUE WOULD BE A NEGATIVE NO.
```

This option allows the user to vary the value of R1 in the search for optimality. Each run of the program provides the optimal plan for a given selected value of R1.

From this point on the program takes over generating the desired output.

Running QAFI.FOR

Entering 2 from the main menu transfers control to QAFI.FOR, the program segment for finding rectifying inspection plans satisfying AOQL and AQL constraints while minimizing the AFI at the AQL level. The menu for QAFI.FOR leads the user as follows:

ENTER VALUE OF ALPHA	User enters Producer's Risk, α←
ENTER VALUE OF P0	User enters quality level P0←
ENTER AOQL VALUE	User enters AOQL← (in percent)
ENTER LOT SIZE	User enters lot size←

The program then proceeds to generate a series of sampling plans for which R1 = R2 = C2 + 1 and selects the optimal plan from among this group. Output includes the values of C1, C2, N1, N2, and AFI(P0), respectively, and the optimal plan.

Running QMIL.FOR

Entering 3 from the main menu transfers control to QMIL.FOR, the program segment for finding single and double sampling plans from MIL-STD-105D and, at the user's discretion, evaluating the resulting normal, tightened and reduced inspection plans as a system. Output of the evaluation may be either graphical or tabular. The menu for this segment is as follows:

WHAT DO YOU WISH TO CALL YOUR OUTPUT FILE?

User enters a name for the output file← (8 alphanumeric characters or less).

ENTER INSPECTION LEVEL IN QUOTATION MARKS
E.G.,; SPECIAL: 'S1', 'S2', 'S3', 'S4'
GENERAL: '1', '2', '3'

User enters the appropriate code followed by ←. A note of caution here. Any error on entry will cause program failure and automatic exit. Depending on the terminal being used, it may be necessary to use apostrophe marks rather than quotation marks surrounding the entry.

```
ENTER LOT SIZE:  User enters lot size←

ENTER AQL IN PERCENT.  REMEMBER, ONLY A STANDARD
AQL IS ALLOWABLE              User enters AQL ←

DO YOU WANT SINGLE ('S') OR DOUBLE ('D')
SAMPLING PLANS; (NOTE:  ENTER S OR D IN QUOTES).
```

The same caution for entry of the inspection level applies here as well.

The program then proceeds to select the desired sampling system from the Standard. Once the plans are displayed, user is asked:

```
DO YOU WANT SCHEME EVALUATION..?
IF YES ENTER.................1
IF NO ENTER..................2
```

If the answer to this question is no, program execution stops and the user is presented with the main menu. If the answer is yes, execution continues with:

```
DO YOU WANT A TABLE OR A GRAPH FORMAT?

FOR GRAPH.......ENTER: 1

FOR TABLE.......ENTER: 2
```

Entering 1← for graphical format results in the output of a plot of the OC curve, the ASN curve, the AOQ curve, and the AFI curve. (Naturally, the AOQ and AFI curves have no meaning unless rectifying inspection is intended.) In order for these curves to be readable, the printer must be capable of and set on compressed printing. The horizontal scale of each of the graphs (probability scale in the case of the OC curve) requires more than 80 columns. Thus, if an attempt is made to print graphs in standard 80 column format, the printing will occur on two consecutive lines making the whole thing look very weird.

When 2← is entered, i.e., a tabular format is requested, the computer returns with the following questions:

SPECIFY THE NUMBER OF FRACTION DEFECTIVE VALUES..

The user must enter the number of values of p for which the equation is to be made.

ENTER THE FRACTION DEFECTIVE VALUE(S),
(PUT A COMMA BETWEEN VALUES.).....

The user then enters the values as fractional quatntities, not percents. In this case the output is a table containing p, P(A), ASN, AOQ and AFI, respectively. It may be useful to obtain a graphical output on a first run to obtain the effective range of p required for a good tabular output. Naturally, the table is more accurate than is the graph.

REFERENCES

1. Siddiqi, Azmat H. and R. S. Leavenworth, An Interactive Computerized Approach for Tabulating and Evaluating MIL-STD-105D. ISE Research Report No. 84-30, August, 1984.

2. Rangarajan, R. W., K.W. Beitler, and R. S. Leavenworth. Developing Double Sampling Plans for Attributes to Meet Sample Size Criteria. ISE Research No. Report 84-32, August, 1984.

3. Walker, Jo Ellen and R. S. Leavenworth. Designing Optimal AOQL Sampling Plans - a Computerized Approach. ISE Research Report No. 84-1, May, 1984.

APPENDIXES

Appendix A contains several example runs for each of the program segments. The entire program is listed in Appendix B.

APPENDIX A

Program Example Runs

Example 1 QASN.FOR

```
                    WHAT DO YOU WISH TO DO?

                1-DERIVE PLANS TO MINIMIZE ASN

                2-DERIVE PLANS TO MINIMIZE AFI

                3-EVALUATE MIL-STD-105D SAMPLING SCHEME

                4-EXIT THIS PROGRAM


ENTER CHOICE
1
 WHAT DO YOU WISH TO CALL YOUR OUTPUT FILE?
PR1


CODES FOR SELECTING APPR. PROB. DIST.

                BINOMIAL              =1
                POISSON               =2
1
          SELECT
                SAMPLE PLANS ONLY =1
                ASN VALUES ONLY =2
                OR BOTH           =3
3
          INPUT ALPHA
.05
          INPUT BETA
.1
          INPUT P0
.015
          INPUT P1
.05
    INPUT A SEED FOR SINGLE SAMPLING N0.
          IF NO SEED AVAILABLE ENTER ZERO AS THE SEED VALUE
0
    INPUT A VALUE FOR (R1-C2)
          IF R1=C2 THEN THE VALUE WOULD BE 0
          IF R1>C2 THEN THE VALUE WOULD BE A POSITIVE NO.
          IF R1<C2 THEN THE VALUE WOULD BE A NEGATIVE NO.
```

1

ALPHA =0.0500 BETA =0.1000
P0 =0.0150 P1 =0.0500

REJECTION NO. OF FIRST SAMPLE (R1) = C2+(1)

SINGLE SAMPLING PLAN
ACCEPTANCE NO.(C) = 6
LOWER BOUND ON N (NS) = 209
UPPER BOUND ON N (NL) = 220

DOUBLE SAMPLING PLANS

FOR C1= 0 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
59	166	166	212.4477	156.9425
60	164	165	211.5781	157.7704

DOUBLE SAMPLING PLANS

FOR C1= 1 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
89	139	139	201.8087	142.6555
90	136	137	200.3593	143.2139

DOUBLE SAMPLING PLANS

FOR C1= 2 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
115	115	116	191.8224	143.4053
116	112	114	190.8090	144.1031

DOUBLE SAMPLING PLANS

FOR C1= 3 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
139	94	96	186.4893	153.2870
140	91	94	185.9685	154.0707

DOUBLE SAMPLING PLANS

FOR C1= 4 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
161	82	82	188.3876	167.9648
162	76	80	187.3810	168.5728

DOUBLE SAMPLING PLANS

FOR C1= 5 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
184	75	87	196.2480	186.8779
185	57	80	194.3076	187.2266

SINGLE SAMPLING PLAN
ACCEPTANCE NO. (C) = 7
LOWER BOUND ON N (NS) = 234
UPPER BOUND ON N (NL) = 266

DOUBLE SAMPLING PLANS

FOR C1= 0 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
50	226	228	265.0669	169.8499
51	220	226	260.3219	169.2180
52	215	225	256.5318	169.0233
53	211	223	253.6964	169.2884

DOUBLE SAMPLING PLANS

FOR C1= 1 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
81	198	202	252.9615	148.9811
82	192	200	248.7259	148.9649
83	187	198	245.3612	149.2348

DOUBLE SAMPLING PLANS

FOR C1= 2 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
108	178	181	242.3765	147.3077
109	170	179	237.3196	147.2064
110	164	177	233.7746	147.5018

DOUBLE SAMPLING PLANS

FOR C1= 3 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
134	157	164	231.0574	156.3438
135	147	162	225.8645	156.3163
136	139	160	221.9088	156.5329

DOUBLE SAMPLING PLANS

FOR C1= 4 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
159	141	156	224.8282	171.6242
160	125	152	218.3522	171.4111
161	115	149	214.6785	171.7019

DOUBLE SAMPLING PLANS

FOR C1= 5 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
184	117	181	220.1528	190.2280
185	96	172	214.6608	190.2104
186	85	165	212.2600	190.7030

DOUBLE SAMPLING PLANS

FOR C1= 6 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
209	75	266	220.3671	210.8894
210	57	266	218.6382	211.4632

GLOBAL MINIMUM ASN(P0)= 142.66

CORRESPONDING N1 = 89

CORRESPONDING N2S = 139

CORRESPONDING C1 = 1

CORRESPONDING C2 = 6

Example 2 QAFI.FOR

```
                    WHAT DO YOU WISH TO DO?

                    1-DERIVE PLANS TO MINIMIZE ASN

                    2-DERIVE PLANS TO MINIMIZE AFI

                    3-EVALUATE MIL-STD-105D SAMPLING SCHEME

                    4-EXIT THIS PROGRAM


ENTER CHOICE
2
          ENTER VALUE OF ALPHA
.05
          ENTER VALUE OF P0
.015
          ENTER AOQL VALUE
.02
          ENTER LOT SIZE
2000
          ALPHA=   0.050000
          P0=   0.015000
          AOQL=   0.020000
          N=     2000


          *** SINGLE SAMPLING PLAN ***


          NS=120
          C= 4
          AFI(P0)=0.093093


          ** DOUBLE SAMPLING PLANS **


          C1        C2        N1        N2          AFI

           0         4        29        91        0.056349
           1         4        55        66        0.060894


          C1        C2        N1        N2          AFI

           0         5        28       120        0.051799
           1         5        55        93        0.054159
```

C1	C2	N1	N2	AFI
0	6	28	147	0.050792
1	6	55	120	0.050957

C1	C2	N1	N2	AFI
0	7	28	174	0.051735
1	7	55	147	0.049855
2	7	82	121	0.056638

C1	C2	N1	N2	AFI
0	8	28	201	0.053922
1	8	55	174	0.050058
2	8	82	148	0.055690

SAMPLING PLAN MINIMUMS

C1= 1 C2= 7
N1= 55 N2=147
MINIMUM AFI=0.049855

Example 3 QMIL.FOR

```
                    WHAT DO YOU WISH TO DO?

          1-DERIVE PLANS TO MINIMIZE ASN

          2-DERIVE PLANS TO MINIMIZE AFI

          3-EVALUATE MIL-STD-105D SAMPLING SCHEME

          4-EXIT THIS PROGRAM



ENTER CHOICE
3
ENTER INSPECTION LEVEL IN QUOTATION MARKS
E.G.; SPECIAL :'S1','S2','S3','S4'
      GENERAL :'1','2','3'
'2'
ENTER LOT SIZE:
2000
ENTER AQL IN PERCENT.  REMEMBER, ONLY A
STANDARD AQL IS ALLOWABLE
1.5
DO YOU WANT SINGLE('S') OR DOUBLE('D')
SAMPLING PLANS ;(NOTE:ENTER S OR D IN QUOTES).
'S'

                THESE PLANS ARE:

        *:NORMAL::::::::::::TIGHTENED::::::::::::REDUCED::*
        ------------------------------------------------------
          AC 1=  5            AC 1=      3           AC 1=      2
          RE 1=  6            RE 1=      4           RE 1=      5
        ------------------------------------------------------
          N=   125            N=       125           N=        50
        ------------------------------------------------------
DO YOU WANT SCHEME EVALUATION..?
IF YES ENTER.................1
IF NO ENTER..................2
2
```

Example 4 QMIL.FOR

```
                WHAT DO YOU WISH TO DO?

        1-DERIVE PLANS TO MINIMIZE ASN

        2-DERIVE PLANS TO MINIMIZE AFI

        3-EVALUATE MIL-STD-105D SAMPLING SCHEME

        4-EXIT THIS PROGRAM


ENTER CHOICE
3
ENTER INSPECTION LEVEL IN QUOTATION MARKS
E.G.; SPECIAL :'S1','S2','S3','S4'
      GENERAL :'1','2','3'
'2'
ENTER LOT SIZE:
2000
ENTER AQL IN PERCENT.  REMEMBER, ONLY A
STANDARD AQL IS ALLOWABLE
1.5
DO YOU WANT SINGLE('S') OR DOUBLE('D')
SAMPLING PLANS ;(NOTE:ENTER S OR D IN QUOTES).
'D'

            THESE PLANS ARE:

      *:NORMAL::::::::::::TIGHTENED::::::::::::REDUCED::*
      ------------------------------------------------------
        AC 1=  2          AC 1=      1          AC 1=      0
        RE 1=  5          RE 1=      4          RE 1=      4
        N1=   80          N1=       80          N1=       32
      ------------------------------------------------------
        AC 2=  6          AC 2=      4          AC 2=      3
        RE 2=  7          RE 2=      5          RE 2=      6
        N2=   80          N2=       80          N2=       32
      ------------------------------------------------------
DO YOU WANT SCHEME EVALUATION..?
IF YES ENTER.................1
IF NO ENTER..................2
1
DO YOU  WANT A  TABLE OR A  GRAPH FORMAT ?
 FOR GRAPH....ENTER: 1
 FOR TABLE....ENTER: 2
```

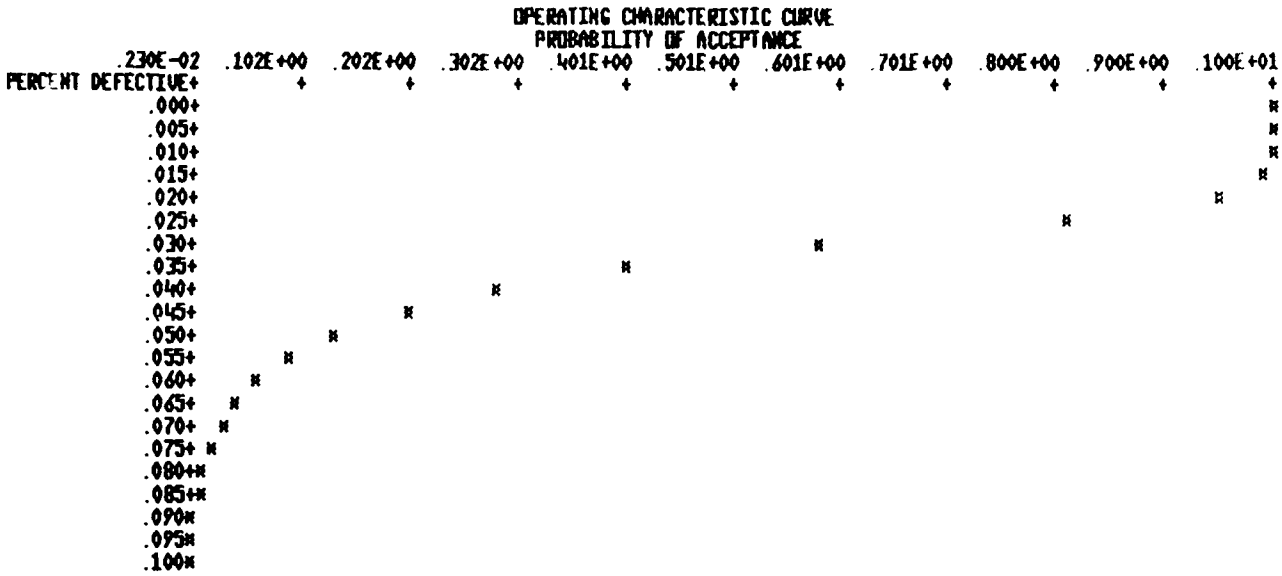
DEPT. OF ISE
UNIVERSITY OF FLORIDA

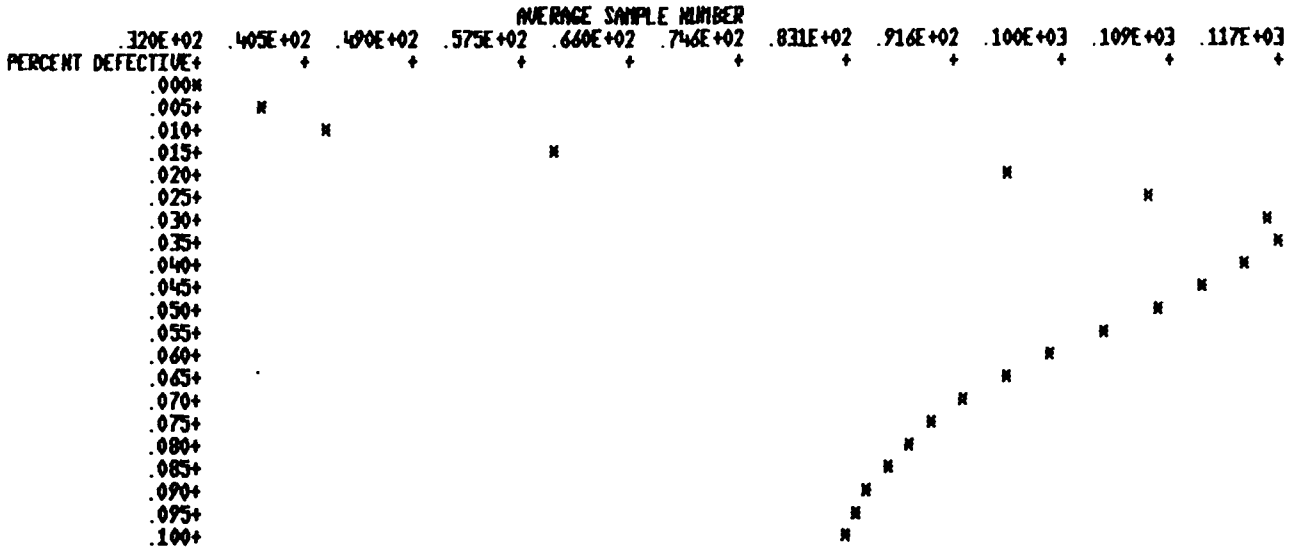
******SAMPLING SYSTEM TO EVALUATE MIL-STD-105D******

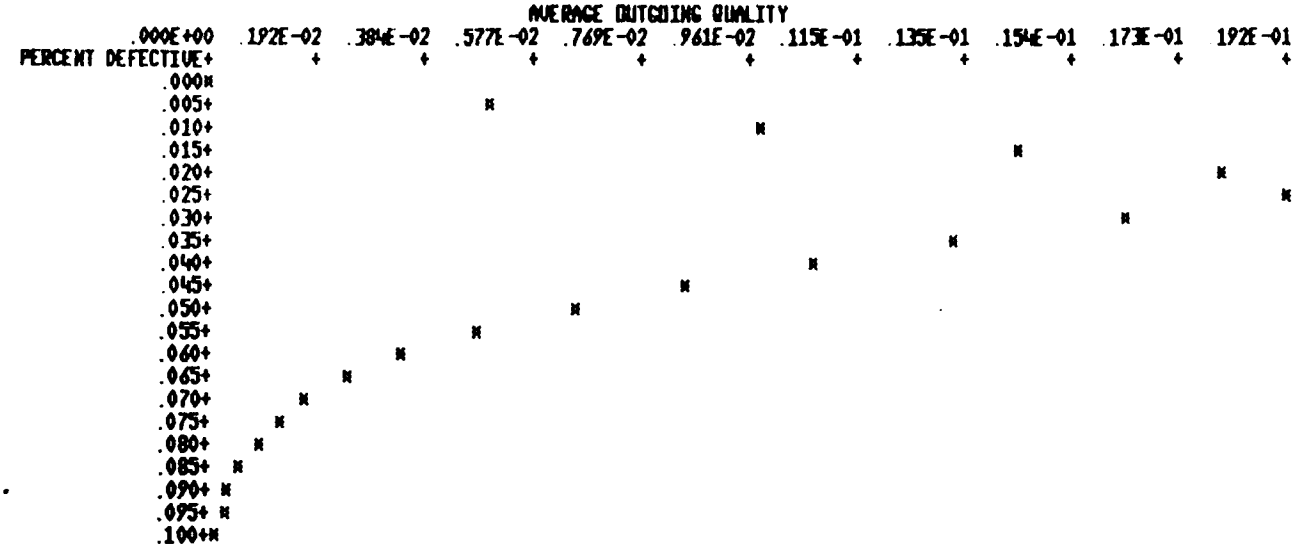
FOR: INSPECTION LEVEL 2
LOT SIZE= 2000
AQL= 1.50000
SAMPLING PLAN D

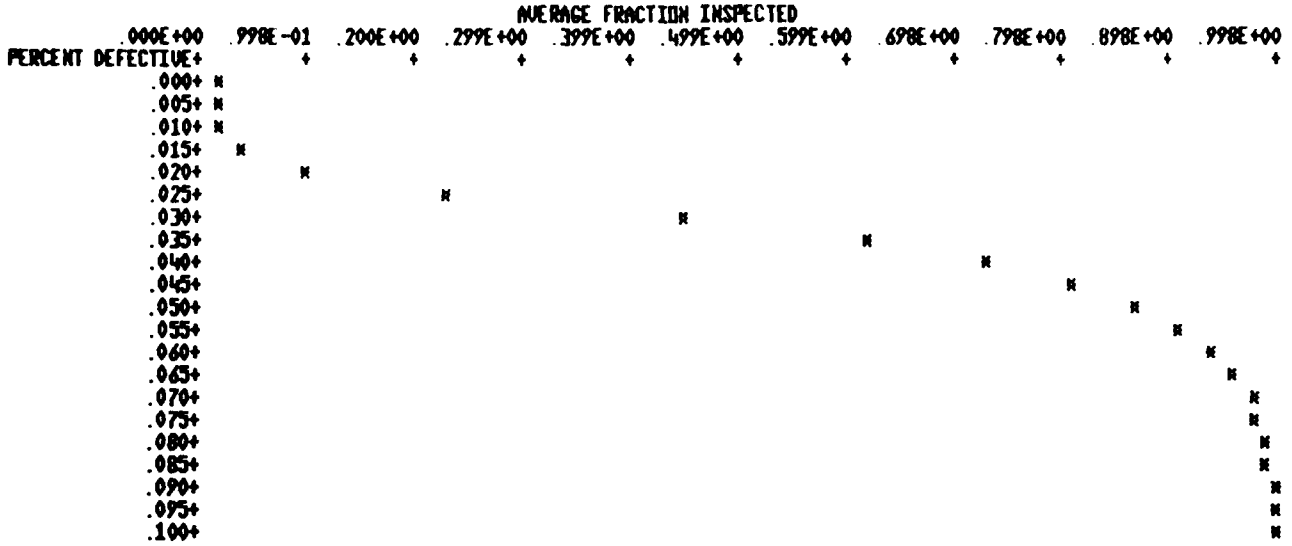
THESE PLANS ARE:

*:NORMAL:	:TIGHTENED:	:REDUCED: *
AC 1= 2	AC 1= 1	AC 1= 0
RE 1= 5	RE 1= 4	RE 1= 4
N1= 80	N1= 80	N1= 32
AC 2= 6	AC 2= 4	AC 2= 3
RE 2= 7	RE 2= 5	RE 2= 6
N2= 80	N2= 80	N2= 32


OPERATING CHARACTERISTIC CURVE
PROBABILITY OF ACCEPTANCE
.230E-02
.102E+00
.202E+00
.302E+00
.401E+00
.501E+00
.601E+00
.701E+00
.800E+00
.900E+00
.100E+01
PERCENT DEFECTIVE
.000
.005
.010
.015
.020
.025
.030
.035
.040
.045
.050
.055
.060
.065
.070
.075
.080
.085
.090
.095
.100


AVERAGE SAMPLE NUMBER
.320E+02 .405E+02 .490E+02 .575E+02 .660E+02 .746E+02 .831E+02 .916E+02 .100E+03 .109E+03 .117E+03
PERCENT DEFECTIVE+
.000+
.005+
.010+
.015+
.020+
.025+
.030+
.035+
.040+
.045+
.050+
.055+
.060+
.065+
.070+
.075+
.080+
.085+
.090+
.095+
.100+


AVERAGE OUTGOING QUALITY
.000E+00
.192E-02
.384E-02
.577E-02
.769E-02
.961E-02
.115E-01
.135E-01
.154E-01
.173E-01
.192E-01
PERCENT DEFECTIVE
.000
.005
.010
.015
.020
.025
.030
.035
.040
.045
.050
.055
.060
.065
.070
.075
.080
.085
.090
.095
.100


AVERAGE FRACTION INSPECTED
.000E+00
.998E-01
.200E+00
.299E+00
.399E+00
.499E+00
.599E+00
.698E+00
.798E+00
.898E+00
.998E+00
PERCENT DEFECTIVE+
.000+
.005+
.010+
.015+
.020+
.025+
.030+
.035+
.040+
.045+
.050+
.055+
.060+
.065+
.070+
.075+
.080+
.085+
.090+
.095+
.100+

Example 5 QAFI.FOR

```
                WHAT DO YOU WISH TO DO?

          1-DERIVE PLANS TO MINIMIZE ASN

          2-DERIVE PLANS TO MINIMIZE AFI

          3-EVALUATE MIL-STD-105D SAMPLING SCHEME

          4-EXIT THIS PROGRAM


ENTER CHOICE
3
ENTER INSPECTION LEVEL IN QUOTATION MARKS
E.G.; SPECIAL :'S1','S2','S3','S4'
      GENERAL :'1','2','3'
'2'
ENTER LOT SIZE:
2000
ENTER AQL IN PERCENT.  REMEMBER, ONLY A
STANDARD AQL IS ALLOWABLE
1.5
DO YOU WANT SINGLE('S') OR DOUBLE('D')
SAMPLING PLANS ;(NOTE:ENTER S OR D IN QUOTES).
'D'

                THESE PLANS ARE:

        *:NORMAL::::::::::::TIGHTENED::::::::::::REDUCED::*
        ------------------------------------------------------
          AC 1=  2            AC 1=      1          AC 1=      0
          RE 1=  5            RE 1=      4          RE 1=      4
          N1=   80            N1=       80          N1=       32
        ------------------------------------------------------
          AC 2=  6            AC 2=      4          AC 2=      3
          RE 2=  7            RE 2=      5          RE 2=      6
          N2=   80            N2=       80          N2=       32
        ------------------------------------------------------
DO YOU WANT SCHEME EVALUATION..?
IF YES ENTER.................1
IF NO ENTER..................2
1
DO YOU  WANT A  TABLE OR A  GRAPH FORMAT ?
 FOR GRAPH....ENTER: 1
 FOR TABLE....ENTER: 2
2
SPECIFY THE NUMBER OF FRACTION DEFECTIVE VALUES..
12
ENTER THE FRACTION DEFECTIVE VALUE(S),
(PUT A COMMA BETWEEN VALUES.).............
.015,.02,.025,.03,.04,.05,.06,.065,.07,.08,.09,.1
```

SCHEME OPERATING CHARACTERISTICS

P:	P(A):	ASN:	AOQ:	AFI
0.015	0.9943	59.80	0.0145	0.04
0.020	0.9467	95.47	0.0180	0.10
0.025	0.8106	107.15	0.0192	0.23
0.030	0.5785	115.85	0.0164	0.45
0.040	0.2833	114.88	0.0107	0.73
0.050	0.1364	107.39	0.0064	0.87
0.060	0.0621	99.40	0.0035	0.94
0.065	0.0413	95.86	0.0026	0.96
0.070	0.0274	92.75	0.0018	0.97
0.080	0.0120	87.90	0.0009	0.99
0.090	0.0053	84.67	0.0005	0.99
0.100	0.0023	82.65	0.0002	1.00

LIMIT NUMBER FOR REDUCED INSPECTION IS: 7

WHAT DO YOU WISH TO DO?

1-DERIVE PLANS TO MINIMIZE ASN

2-DERIVE PLANS TO MINIMIZE AFI

3-EVALUATE MIL-STD-105D SAMPLING SCHEME

4-EXIT THIS PROGRAM

ENTER CHOICE
4
FORTRAN STOP

APPENDIX B

Program Listing

Program QMAIN.FOR

```
0002      C*************************************************************
0003      C       CONTROLLING PROGRAM FOR THE QUALITY CONTROL
0004      C       INSPECTION SAMPLING SOFTWARE PACKAGE
0005      C
0006      C       DR. RICHARD S. LEAVENWORTH
0007      C       DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING
0008      C       UNIVERSITY OF FLORIDA
0009      C       GAINESVILLE, FLORIDA  32611
0010      C*************************************************************
0011      C
0012            BYTE OUTFIL(8)
0013            COMMON/BLK1/N2S,N2I
0014            COMMON/BLK2/PS,PL
0015            COMMON/BLK3/N1
0016            COMMON/BLK4/ALPHA,BETA
0017            COMMON/BLK5/P0,P1
0018            COMMON/BLK6/C1,C2
0019            COMMON/BLK7/SUMLOG(4000)
0020            COMMON/BLK8/N
0021            COMMON/BLK9/C2MAX,C1MAX(15)
0022            COMMON/BLK10/NS,NL
0023            COMMON/BLK11/ASN,ASNMAX
0024            COMMON/BLK12/OUTFIL
0025      C
0026            NUM=0
0027         10 NUM=NUM+1
0028            WRITE(5,15)
0029         15 FORMAT(///////,23(' '),'WHAT DO YOU WISH TO DO?')
0030            WRITE(5,20)
0031         20 FORMAT(//,15(' '),'1-DERIVE PLANS TO MINIMIZE ASN')
0032            WRITE(5,25)
0033         25 FORMAT(/,15(' '),'2-DERIVE PLANS TO MINIMIZE AFI')
0034            WRITE(5,30)
0035         30 FORMAT(/,15(' '),'3-EVALUATE MIL-STD-105D SAMPLING SCHEME')
0036            WRITE(5,35)
0037         35 FORMAT(/,15(' '),'4-EXIT THIS PROGRAM')
0038            WRITE(5,40)
0039         40 FORMAT(/////,' ENTER CHOICE')
0040            READ(5,45) ICH
0041         45 FORMAT(I1)
0042      C
0043            IF ((ICH .NE. 1).AND.(ICH .NE. 2).AND.(ICH .NE. 3).AND.
0044           $(ICH .NE. 4)) THEN
0045               WRITE(5,50)
0046         50    FORMAT(/,15(/),' YOU MUST ENTER 1,2,3, OR 4')
0047               GO TO 10
0048            ENDIF
0049      C
0050            IF((ICH .NE. 4) .AND. (NUM .EQ. 1)) THEN
0051               WRITE(5,*)' WHAT DO YOU WISH TO CALL YOUR OUTPUT FILE?'
0052               READ(5,55) OUTFIL
0053         55    FORMAT(10A1)
0054               CALL ASSIGN(1,OUTFIL)
0055            ENDIF
0056      C
0057            GO TO (60,65,70,75), ICH

QMAIN$MAIN

0058      C
0059         60 CALL QASN
0060            GO TO 10
0061         65 CALL QAFI
0062            GO TO 10
0063         70 CALL QMIL
0064            GO TO 10
0065         75 STOP
0066            END
```

Program QASN.FOR

```
0001
0002
0003          QUALITY CONTROL DOUBLE SAMPLING PROGRAM TO ANALYSE
0004          DOUBLE SAMPLING PLANS, ASN(PO) AND ASNMAX.
0005      C       BINOMIAL AND POISON PROBALITY DISTRIBUTIONS USED).
0006      C
0007      C       PROGRAMED BY R. WAREN RANGARAJAN
0008      C       DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING
0009      C       UNIVERSITY OF FLORIDA
0010      C       GAINESVILLE, FLORIDA 32611
0011      C*************************************************************
0012      C
0013            SUBROUTINE QASN
0014            DOUBLE PRECISION SUMLOG
0015            INTEGER C,C1,C2,C1MIN,C2MIN,R1,R11
0016            BYTE OUTFIL(8)
0017      C
0018            COMMON/BLK1/N2S,N2L
0019            COMMON/BLK2/PS,PL
0020            COMMON/BLK3/N1
0021            COMMON/BLK4/ALPHA,BETA
0022            COMMON/BLK5/P0,P1
0023            COMMON/BLK6/C1,C2
0024            COMMON/BLK7/SUMLOG(4000)
0025            COMMON/BLK8/N
0026            COMMON/BLK9/C2MAX,C1MAX(15)
0027            COMMON/BLK10/NS,NL
0028            COMMON/BLK11/ASN,ASNMAX
0029            COMMON/BLK12/OUTFIL
0030      C*************************************************************
0031      C       BEGINNING INITIALIZATION
0032      C*************************************************************
0033            N=0
0034            C2=1000
0035            ASNMIN=15000.
0036            C=-1
0037      C*************************************************************
0038      C       INPUT FORMAT
0039      C*************************************************************
0040         10 WRITE (5,15)
0041         15 FORMAT (///' CODES FOR SELECTING APPR. PROB. DIST.'//
0042           115X,'BINOMIAL',12X,'=1',
0043           2/15X,'POISSON',13X,'=2')
0044            READ (5,*) K
0045            IF(K.GT.2.OR.K.LT.1) GOTO 10
0046         20 WRITE(5,25)
0047         25 FORMAT(10X,'SELECT'/16X,'SAMPLE PLANS ONLY =1'
0048           1/16X,'ASN VALUES ONLY =2'
0049           2/16X,'OR BOTH         =3')
0050            READ(5,*) KOPT
0051            IF(KOPT.GT.3.OR.KOPT.LT.1) GOTO 20
0052            WRITE (5,30)
0053         30 FORMAT(10X,'INPUT ALPHA ')
0054            READ (5,*) ALPHA
0055            WRITE (5,35)
0056         35 FORMAT(10X,'INPUT BETA ')
0057            READ (5,*) BETA
```

```
MAIN
0058
0059          WRITE (5,40)
0060       40 FORMAT(10X,'INPUT PO ')
0061          READ (5,*) PO
0062          WRITE(5,45)
0063       45 FORMAT(10X,'INPUT P1 ')
0064          READ (5,*) P1
0065          WRITE(5,50)
0066       50 FORMAT( 5X,'INPUT A SEED FOR SINGLE SAMPLING NO.'//
0067         1'              IF NO SEED AVAILABLE ENTER ZERO AS THE SEED VALUE')
0068          READ(5,*) NS
0069          WRITE(5,55)
0070       55 FORMAT( 5X,'INPUT A VALUE FOR (R1-C2) '//
0071         1'              IF R1=C2 THEN THE VALUE WOULD BE 0'//
0072         2'              IF R1>C2 THEN THE VALUE WOULD BE A POSITIVE NO.'//
0073         3'              IF R1<C2 THEN THE VALUE WOULD BE A NEGATIVE NO.')
0074          READ(5,*) R11
0075    C
0076          WRITE (1,60)
0077       60 FORMAT('1',///10X,'DEPT. OF ISE '
0078         1/,10X,'UNIVERSITY OF FLORIDA '/
0079         2/5X,5('*'),'DOUBLE SAMPLING SYSTEM TO MINIMIZE ASN',
0080         35('*'),2X,/)
0081          WRITE (5,65) ALPHA,BETA,PO,P1
0082          WRITE (1,65) ALPHA,BETA,PO,P1
0083       65 FORMAT(//10X,'ALPHA =',F6.4,5X,'BETA =',F6.4,
0084         1/10X,'PO =',F6.4,8X,'P1 =',F6.4)
0085          WRITE(5,70) R11
0086          WRITE(1,70) R11
0087       70 FORMAT(/5X,'REJECTION NO. OF FIRST SAMPLE (R1) = C2+(',I3,')')
0088          MC1=10.0/(P1/PO)
0089       75 C=C+1
0090    C*************************************************************
0091    C       SINGLE SAMPLING PROCEDURE BEGINS
0092    C*************************************************************
0093       80 NS=NS+1
0094    C*************************************************************
0095    C       COMPUTATION OF LOWER BOUND OF SINGLE SAMPLING PLAN
0096    C*************************************************************
0097          IF(K.EQ.1) CALL PROBS1(NS,P1,C,BXLEC,N)
0098          IF(K.EQ.2) CALL PROBS2(NS,P1,C,BXLEC,N)
0099          IF(BXLEC.GT.BETA) GOTO 80
0100          NLT=NS-1
0101          NL=MAXO(1,NLT)
0102    C*************************************************************
0103    C       COMPUTATION OF UPPER BOUND OF SINGLE SAMPLING PLAN
0104    C*************************************************************
0105       85 NL=NL+1
0106          IF(K.EQ.1) CALL PROBS1(NL,PO,C,BXLEC)
0107          IF(K.EQ.2) CALL PROBS2(NL,PO,C,BXLEC)
0108          IF(BXLEC.GE.(1-ALPHA)) GOTO 85
0109          NL=NL-1
0110    C*************************************************************
0111    C       TEST FOR FEASIBILITY
0112    C*************************************************************
0113          IF(NS.GT.NL) GOTO 75
0114          WRITE (5,90)
```

```
0115            WRITE(1,70)
0116         70 FORMAT(/9X,'*SINGLE SAMPLING PLAN*')
0117            WRITE(5,95) C,NS,NL
0118            WRITE(1,95) C,NS,NL
0119         95 FORMAT(10X,'ACCEPTANCE NO.(C) =',I2
0120           1,/10X,'LOWER BOUND ON N (NS) =',I4
0121           2,/10X,'UPPER BOUND ON N (NL) =',I4)
0122      C*************************************************************
0123      C       COMPUTATION OF DOUBLE SAMPLING PLAN BEGINS  FOR EACH VALUE OF C2
0124      C*************************************************************
0125            IF(C.LT.C2) MC=C+MC1-1
0126            C2=C
0127      C
0128            R1=C2+R11
0129      C
0130            DO 140 K1=1,C2
0131               C1=K1-1
0132      C*************************************************************
0133      C       CALL SUBROUTINE TO COMPUTE THE FIRST SAMPLE NUMBER
0134      C*************************************************************
0135               CALL TRY1(NTRY,C1,P1,NS,BETA,K)
0136               N1=NTRY
0137               IF(NTRY.GT.NS) GOTO 145
0138      C
0139      C
0140               WRITE(5,100)
0141               WRITE(1,100)
0142         100   FORMAT(/10X,'DOUBLE SAMPLING PLANS',/)
0143               WRITE(5,105) C1,C2
0144               WRITE(1,105) C1,C2
0145         105   FORMAT(/10X,'FOR  C1=',I2,2X,'C2=',I2,//)
0146      C
0147               NTEMP=N1
0148               IF(KOPT.EQ.1) WRITE(1,110)
0149               IF(KOPT.EQ.1) WRITE(5,110)
0150               IF(KOPT.EQ.2) WRITE(1,112)
0151               IF(KOPT.EQ.2) WRITE(5,112)
0152               IF(KOPT.EQ.3) WRITE(5,115)
0153               IF(KOPT.EQ.3) WRITE(1,115)
0154         110   FORMAT(11X,'(N1)',3X,' (N2S)   (  N2  (     (N2L)',
0155           1   6X,'PS',10X,'PL'//)
0156         112   FORMAT(10X,'N11',3X,'N2S',4X,'ASNMAX',6X,'ASN',//)
0157         115   FORMAT(10X,'(N1)',3X,'(N2S)',3X,'(N2L)',4X,
0158           1   'ASNMAX',6X,'ASN'/)
0159               NTEMP1=NS
0160      C*************************************************************
0161      C       COMPUTATION OF SECOND SAMPLE FOR EACH VALUE OF FIRST SAMPLE
0162      C*************************************************************
0163               ASN=FLOAT(NS)*10
0164               DO 135 IZ=NTEMP,NTEMP1
0165                  I=IZ
0166                  IF ((NTEMP1-I) .LE. (C2*1.5)) GOTO 135
0167      C*************************************************************
0168      C       CALL SUBROUTINE TO COMPUTE SECOND SAMPLE
0169      C*************************************************************
0170                  CALL TRY2(NS,NL,K,I,R1)
0171                  IF(KOPT.NE.1) GOTO 125
```

```
GASN

0172                  WRITE(1,120) I,N2S,N2L,PS,PL
0173                  WRITE(5,120) I,N2S,N2L,PS,PL
0174        120       FORMAT(10X,I4,5X,I4,'      (  N2  (      ',I4,4X,F8.6,4X,F8.6)
0175                  GOTO 135
0176        C*************************************************************
0177        C       TEST FOR FEASIBILITY
0178        C*************************************************************
0179          125     IF(N2S.GT.N2L) GOTO 135
0180                  IF(N2S.LT.(C2-C1).OR.I.LE.C2) GOTO 135
0181                  ASNTEM=ASN
0182        C*************************************************************
0183        C       CALL SUBROUTINE TO COMPUTE ASN(P0) AND ASNMAX VALUES
0184        C*************************************************************
0185                  CALL ASNN(MC,NS,K,I,KOPT,C1MIN,C2MIN,N1MIN,N2MIN,ASNMIN)
0186                  IF(KOPT.NE.3) GOTO 135
0187                  WRITE(1,130)I,N2S,N2L,ASNMAX,ASN
0188                  WRITE(5,130)I,N2S,N2L,ASNMAX,ASN
0189          130     FORMAT(10X,I3,5X,I3,5X,I3,4X,2(F8.4,3X))
0190                  IF(ASN.GT.ASNTEM) GOTO 140
0191          135   CONTINUE
0192        C
0193          140 CONTINUE
0194        C
0195          145 IF(C.LT.MC) GOTO 75
0196              IF(KOPT .EQ. 1) GO TO 155
0197              WRITE(1,150) ASNMIN,N1MIN,N2MIN,C1MIN,C2MIN
0198              WRITE(5,150) ASNMIN,N1MIN,N2MIN,C1MIN,C2MIN
0199          150 FORMAT(////,10X,'GLOBAL MINIMUM ASN(P0)=',F8.2,//
0200             110X,'CORRESPONDING N1        =',I5//
0201             210X,'CORRESPONDING N2S       =',I5//
0202             310X,'CORRESPONDING C1        =',I2//
0203             410X,'CORRESPONDING C2        =',I2)
0204        C
0205          155 RETURN
0206              END
```

```
0001              SUBROUTINE TRY1(NTRY,C1,P,NL,BETA,K)
0002        C*************************************************************
0003        C       THIS SUBROUTINE COMPUTES FIRST SAMPLE NUMBER OF DOUBLE
0004        C       SAMPLING PLAN BY AN INTEGER FORM OF BISECTION METHOD
0005        C*************************************************************
0006              INTEGER C1
0007        C
0008              NLARGE=NL
0009              NSMALL=0
0010        C
0011            10 NTRY=(NSMALL+NLARGE)/2.0
0012        C*************************************************************
0013        C       CALL APPROPRIATE PROBAILITY SUBROUTINE FOR PROB. CALCULATIONS
0014        C*************************************************************
0015            15 IF(K.EQ.1) CALL PROBS1(NTRY,P,C1,BXLEC)
0016               IF(K.EQ.2) CALL PROBS2(NTRY,P,C1,BXLEC)
0017               IF(BXLEC.LE.BETA) GOTO 20
0018               NSMALL=NTRY
0019               GOTO 25
0020            20 NLARGE=NTRY
0021            25 IF(NSMALL.NE.(NLARGE-1)) GOTO 10
0022               NTRY=NLARGE
0023               RETURN
0024               END
```

```
      SUBROUTINE TRY2(NS,NL,K,J,R1)
C*************************************************************
C     THIS SUBROUTINE COMPUTES THE SECOND SAMPLE NUMBER OF
C     THE DOUBLE SAMPLING NUMBER BY AN INTEGER BISECTION
C     METHOD. SEVERAL TESTS ARE DONE TO LOCATE THE PARAMETER
C     AT ITS TRUE POSITION.
C*************************************************************
      INTEGER C1,C2,R1
C
      COMMON/BLK1/N2S,N2L
      COMMON/BLK2/PS,PL
      COMMON/BLK3/N1
      COMMON/BLK4/ALPHA,BETA
      COMMON/BLK5/P0,P1
      COMMON/BLK6/C1,C2
C
      K1=C1+1
C*************************************************************
C     SET LIMITS FOR COMPUTING N2S
C*************************************************************
      NSMALL=NS-J
      NLARGE=NSMALL
C*************************************************************
C     INDEXING TO SPECIFY WHAT BOUND (N2S OR N2L)
C     IS BEING COMPUTED
C*************************************************************
      I=1
C*************************************************************
C     INITIAL TEST AT EACH LIMIT
C*************************************************************
      CALL PROBD1(J,NSMALL,P1,DPROB,K,R1)
      IF(DPROB.LE.BETA) GOTO 40
C*************************************************************
C     BISECTION METHOD
C*************************************************************
      NLARGE=NL
   10 NTRY=(NSMALL+NLARGE)/2.0
      GOTO (15,20),I
C
   15 CALL PROBD1(J,NTRY,P1,DPROB,K,R1)
      IF(DPROB.LE.BETA) GOTO 30
      GOTO 25
   20 CALL PROBD1(J,NTRY,P0,DPROB,K,R1)
      IF(DPROB.LT.(1-ALPHA)) GOTO 30
   25 NSMALL=NTRY
      GOTO 35
   30 NLARGE=NTRY
   35 IF((NLARGE-NSMALL).GT.1) GOTO 10
C*************************************************************
C     CHECK THE INDEX TO FIND WHERE THE PROCESS IS
C*************************************************************
      GOTO (40,45),I
C*************************************************************
C     CHANGE THE INDEX AFTER N2S COMPUTATION
C*************************************************************
   40 I=I+1
C*************************************************************
```

```
0058      C       TESTING EACH POSSIBLE CASES TO LOCATE
0059      C       THE LOWER BOUND AT ITS TRUE POSITION
0060      C*************************************************************
0061            N2S=MAXO(0,NLARGE)
0062            CALL PROBD1(J,NLARGE,P1,DPROB,K,R1)
0063            PS=DPROB
0064            MTEMP=NLARGE-1
0065            NSMALL=MAXO(0,MTEMP)
0066            NLARGE=NL
0067            GOTO 10
0068         45 N2L=NSMALL
0069            CALL PROBD1(J,NSMALL,P0,DPROB,K,R1)
0070            PL=DPROB
0071            CALL PROBD1(J,NLARGE,P0,DPROB,K,R1)
0072            IF(DPROB.GE.(1-ALPHA)) N2L=NLARGE
0073            IF(DPROB.GE.(1-ALPHA)) PL=DPROB
0074      C
0075         50 RETURN
0076            END
```

```
0001            SUBROUTINE PROBS2(NN,P,C,BXLEC)
0002      C*************************************************************
0003      C       THIS SUBROUTINE COMPUTES CUMULATIVE POISON
0004      C       PROBABILITIES
0005      C*************************************************************
0006            INTEGER C
0007      C
0008            PP=P*NN
0009            TERM=1.0
0010            SUM=TERM
0011      C
0012            IF(C.EQ.0) GOTO 15
0013            DO 10 I=1,C
0014               TERM=TERM*PP/I
0015               SUM=SUM+TERM
0016         10 CONTINUE
0017      C
0018         15 BXLEC=SUM/EXP(PP)
0019      C
0020            RETURN
0021            END
```

```
0001            SUBROUTINE ASNN(MC,NS,K,N11,KOPT,C1MIN,C2MIN,N1MIN,N2MIN,ASNMIN)
0002      C*****************************************************************
0003      C       THIS SUBROUTINE COMPUTES ASN(P0) VALUES AND
0004      C       ASNMAX VALUES.
0005      C*****************************************************************
0006            DOUBLE PRECISION SUMLOG
0007            INTEGER C1MIN,C2MIN
0008      C
0009            COMMON/BLK1/N2S,N2L
0010            COMMON/BLK3/N1
0011            COMMON/BLK4/ALPHA,BETA
0012            COMMON/BLK5/P0,P1
0013            COMMON/BLK6/I1,I2
0014            COMMON/BLK7/SUMLOG(4000)
0015            COMMON/BLK8/N
0016            COMMON/BLK11/ASN,ASNMAX
0017            COMMON/BLK12/OUTFIL
0018      C*****************************************************************
0019      C       INITIALIZATION
0020      C       COMPUTE P* (MAXIMUM PROB. FOR ASNMAX)
0021      C*****************************************************************
0022            J=I1+1
0023            XXX=0.0
0024            IF(I1.GT.0) XXX=SUMLOG(I1)
0025            AKONST=10.**(SUMLOG(I2)+SUMLOG(N11-I2-1)-XXX-SUMLOG(N11-I1-1))
0026            TEMP=1.0/FLOAT(I2-I1)
0027            AKONST=AKONST**TEMP
0028            PSTAR=AKONST/(1.0+AKONST)
0029            IF(K.EQ.1) CALL PROBS1(N11,PSTAR,I2,BXLEC)
0030            IF(K.EQ.2) CALL PROBS2(N11,PSTAR,I2,BXLEC)
0031            TEMP=BXLEC
0032            IF(K.EQ.1) CALL PROBS1(N11,PSTAR,I1,BXLEC)
0033            IF(K.EQ.2) CALL PROBS2(N11,PSTAR,I1,BXLEC)
0034            TEMP1=TEMP-BXLEC
0035            ASNMAX=FLOAT(N11)+N2S*TEMP1
0036      C
0037            IF(K.EQ.1) CALL PROBS1(N11,P0,I2,BXLEC)
0038            IF(K.EQ.2) CALL PROBS2(N11,P0,I2,BXLEC)
0039            TEMP=BXLEC
0040            IF(K.EQ.1) CALL PROBS1(N11,P0,I1,BXLEC)
0041            IF(K.EQ.2) CALL PROBS2(N11,P0,I1,BXLEC)
0042            TEMP2=TEMP-BXLEC
0043            ASN=FLOAT(N11)+N2S*TEMP2
0044            IF(ASNMAX.GT.NS.OR.ASN.GT.ASNMIN) GOTO 10
0045            ASNMIN=ASN
0046            N1MIN=N11
0047            N2MIN=N2S
0048            C1MIN=I1
0049            C2MIN=I2
0050      C
0051         10 IF(KOPT.NE.2) GOTO 20
0052            WRITE(1,15) N11,N2S,ASNMAX,ASN
0053            WRITE(5,15) N11,N2S,ASNMAX,ASN
0054         15 FORMAT(10X,2(I3,3X),2(F8.4,3X))
0055      C
0056         20 RETURN
0057            END
```

Program QAFI.FOR

```
0001      C
0002      C*************************************************************
0003      C       QUALITY CONTROL PROGRAM TO DERIVE DOUBLE SAMPLING
0004      C       PLANS TO MINIMIZE AVERAGE FRACTION INSPECTED.
0005      C
0006      C       PROGRAMMED BY JO ELLEN WALKER
0007      C       DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING
0008      C       UNIVERSITY OF FLORIDA
0009      C       GAINESVILLE, FLORIDA  32611
0010      C*************************************************************
0011      C
0012            SUBROUTINE QAFI
0013            INTEGER C1,C2,C,CSTAR,C2M1
0014            INTEGER R1,R1M1
0015            DOUBLE PRECISION SUMLOG
0016            BYTE OUTFIL(8)
0017            COMMON/BLK4/ALPHA,BETA
0018            COMMON/BLK6/C1,C2
0019            COMMON/BLK7/SUMLOG(4000)
0020            COMMON/BLK8/N
0021            COMMON/BLK12/OUTFIL
0022      C*************************************************************
0023      C       INPUT PARAMETERS
0024      C*************************************************************
0025            KINDEX=1
0026            WRITE(5,10)
0027         10 FORMAT(10X,'ENTER VALUE OF ALPHA')
0028            READ(5,*)ALPHA
0029            WRITE(5,15)
0030         15 FORMAT(10X,'ENTER VALUE OF P0')
0031            READ(5,*)P0
0032            WRITE(5,20)
0033         20 FORMAT(10X,'ENTER AOQL VALUE')
0034            READ(5,*)AOQL
0035            WRITE(5,25)
0036         25 FORMAT(10X,'ENTER LOT SIZE')
0037            READ(5,*)NNN
0038      C
0039      C
0040      C
0041            WRITE(1,28)
0042         28 FORMAT('1',///10X,'DEPT. OF ISE '
0043           $/,10X,'UNIVERSITY OF FLORIDA '/
0044           $/5X,5('*'),'DOUBLE SAMPLING SYSTEM TO MINIMIZE AFI',
0045           $5('*'),2X,/)
0046            WRITE(5,30)ALPHA
0047            WRITE(1,30)ALPHA
0048         30 FORMAT(10X,'ALPHA=',2X,F8.6)
0049            WRITE(5,35)P0
0050            WRITE(1,35)P0
0051         35 FORMAT(10X,'P0=',2X,F8.6)
0052            WRITE(5,40)AOQL
0053            WRITE(1,40)AOQL
0054         40 FORMAT(10X,'AOQL=',2X,F8.6)
0055            WRITE(5,45)NNN
0056            WRITE(1,45)NNN
0057         45 FORMAT(10X,'N=',2X,I6)
```

```
0058     C*************************************************************
0059     C      COMPUTE SINGLE SAMPLING PLAN
0060     C*************************************************************
0061     C
0062     C      INITIALIZATION
0063     C
0064     C*************************************************************
0065           NS=1
0066           C=0
0067           N=0
0068           AFI=1.DO
0069     C
0070           WRITE(5,50)
0071           WRITE(1,50)
0072        50 FORMAT(///10X,'*** SINGLE SAMPLING PLAN ***')
0073     C*************************************************************
0074     C      FIND NS,C COMBO THAT SATISFIES L(PO) G.T. 1-ALPHA
0075     C*************************************************************
0076        55 CALL PROBS1(NS,PO,C,BXLEC)
0077           IF(BXLEC.LT.(1.DO-ALPHA))C=C+1
0078           IF(BXLEC.LT.(1.DO-ALPHA))NS=C+1
0079     C*************************************************************
0080     C      SEARCH TO FIND MIN NS VALUE SUCH THAT AOQL L.T. AOQL*
0081     C*************************************************************
0082        60 CALL SEARCH(NNN,C,NS,SAOQ)
0083           IF(SAOQ.LE.AOQL)GOTO 75
0084           NSTEMP=NNN
0085           CALL SEARCH(NNN,C,NSTEMP,SAOQ)
0086           IF(SAOQ.GT.AOQL)C=C+1
0087     C
0088     C
0089           IF(SAOQ.GT.AOQL)NS=C+1
0090     C
0091     C
0092           BL=NS
0093           BH=NNN
0094        65 NSTEMP=IIDINT((BL+BH)/2.DO)
0095           CALL SEARCH(NNN,C,NSTEMP,SAOQ)
0096           IF(SAOQ.LE.AOQL)BH=NSTEMP
0097     C
0098           IF(SAOQ.LE.AOQL)AOQ=SAOQ
0099     C
0100           IF(SAOQ.GT.AOQL)BL=NSTEMP
0101           IF((BH-BL).EQ.1.DO)GOTO 70
0102           GOTO 65
0103        70 NS=NSTEMP
0104           IF(SAOQ.GT.AOQL)NS=BH
0105     C*************************************************************
0106     C      CHECK THAT NS,C COMBO STILL SATISFIES L(PO) CONSTRAINT
0107     C*************************************************************
0108        75 CALL PROBS1(NS,PO,C,BXLEC)
0109           IF(BXLEC.GE.(1.DO-ALPHA))GOTO 80
0110           C=C+1
0111     C
0112           NS=C+1
0113     C
0114           GOTO 60
```

```
0115     C*************************************************************
0116     C       COMPUTE AFI
0117     C*************************************************************
0118        80 ATIPO=NS*BXLEC+NNN*(1.DO-BXLEC)
0119           AFIPO=ATIPO/NNN
0120     C
0121           NSTAR=NS
0122     C
0123           WRITE(5,85)NS
0124           WRITE(1,85)NS
0125        85 FORMAT(//10X,'NS=',I3)
0126           WRITE(5,90)C
0127           WRITE(1,90)C
0128        90 FORMAT(10X,'C=',I2)
0129           WRITE(5,95)AFIPO
0130           WRITE(1,95)AFIPO
0131        95 FORMAT(10X,'AFI(PO)=',F8.6)
0132     C
0133       100 CSTAR=C
0134     C*************************************************************
0135     C       DOUBLE SAMPLING
0136     C*************************************************************
0137     C
0138           WRITE(5,105)
0139           WRITE(1,105)
0140       105 FORMAT(///10X,'** DOUBLE SAMPLING PLANS **'\
0141           PLAN=1.DO
0142           C2=CSTAR
0143       110 R1=C2+1
0144           C2M1=C2-1
0145           C1PO=C1+1
0146           R1M1=R1-1
0147           DDATI=NNN
0148           TTCMIN=1.
0149     C
0150           C1=0
0151           JJ=0
0152     C
0153           WRITE(5,115)
0154           WRITE(1,115)
0155       115 FORMAT(///10X,'C1',6X,'C2',7X,'N1',8X,'N2',9X,'AFI',//)
0156     C*************************************************************
0157     C       CALCULATE FIRST SAMPLE NUMBER
0158     C
0159     C       FROM RESULTS OF PREVIOUS RUNS, IT WAS FOUND THAT N1 IS NOT LESS
0160     C       THAN NSTAR/8.  THUS, THE INITIAL VALUE OF N1 IS SET ACCORDINGLY.
0161     C*************************************************************
0162     C
0163       120 DO 165 LL=INT(NSTAR/8),NSTAR
0164           N1=LL
0165           IF(N1.LT.C2)N1=R1M1
0166     C*************************************************************
0167     C       CHECK B(N1,PO,C2) G.T. 1-ALPHA CONSTRAINT
0168     C*************************************************************
0169       125 CALL PROBS1(N1,PO,C2,BXLEC)
0170           IF(BXLEC.LT.(1.-ALPHA))GOTO 175
0171     C*************************************************************
```

```
0172      C       CALCULATE SECOND SAMPLE
0173      C*************************************************************
0174            N2=NSTAR-N1
0175      C*************************************************************
0176      C       CHECK THAT DOUBLE PROBABILITY G.T. 1-ALPHA
0177      C*************************************************************
0178        130 CALL PROBD1(N1,N2,PO,DPROB,KINDEX,R1)
0179            IF(DPROB.GE.(1.-ALPHA))GOTO 135
0180            IF(C1.EQ.C2M1)GOTO 175
0181            C1=C1+1
0182            GOTO 130
0183      C*************************************************************
0184      C       FIND N2 VALUE SATISFYING AOQL L.T. AOQL*
0185      C*************************************************************
0186        135 CALL SRCH2(NNN,N1,N2,AOQ1)
0187            IF(AOQ1.LE.AOQL)GOTO 150
0188      C*************************************************************
0189      C       N2 WILL NOT BE LESS THAN N1*9, THE INITIAL LOWER BOUND ON N2.
0190      C*************************************************************
0191            N2TEMP=N1*9
0192      C
0193            CALL SRCH2(NNN,N1,N2TEMP,AOQ1)
0194            IF(AOQ1.GT.AOQL)GOTO 165
0195      C
0196            BL=N2
0197            BH=N1*9
0198        140 N2TEMP=INT((BL+BH)/2)
0199            CALL SRCH2(NNN,N1,N2TEMP,AOQ1)
0200            IF(AOQ1.LE.AOQL)BH=N2TEMP
0201            IF(AOQ1.LE.AOQL)FAOQ=AOQ1
0202      C
0203            IF(AOQ1.GT.AOQL)BL=N2TEMP
0204            IF((BH-BL).EQ.1.)GOTO 145
0205            GOTO 140
0206        145 N2=N2TEMP
0207            IF(AOQ1.GT.AOQL)N2=BH
0208      C*************************************************************
0209      C       CHECK THAT BINOMIAL PROBABILITIES ARE G.T. 1-ALPHA
0210      C*************************************************************
0211            CALL PROBD1(N1,N2,PO,DPROB,KINDEX,R1)
0212            IF(DPROB.LT.(1.-ALPHA))GOTO 165
0213        150 CALL PROBS1(N1,PO,C1,BXLEC)
0214            PA2=DPROB-BXLEC
0215      C*************************************************************
0216      C       COMPUTE ATI
0217      C*************************************************************
0218            DATI=N1*DPROB+N2*PA2+NNN*(1.-DPROB)
0219      C*************************************************************
0220      C       IF THE ATI INCREASES, CONTINUE FOR 5 ADDITIONAL INCREASING
0221      C       ITERATIONS.  THEN INCREMENT C1 AND CONTINUE.
0222      C*************************************************************
0223            IF(JJ.EQ.4)GOTO 155
0224            IF(DATI.GE.DDATI)JJ=JJ+1
0225            IF(DATI.GE.DDATI)GOTO 165
0226            DDATI=DATI
0227            DDAOQ=FAOQ
0228      C
```

```
0229            K1=C1
0230            K2=C2
0231            K3=N1
0232            K4=N2
0233      C
0234            GOTO 165
0235      C*************************************************************
0236      C       MINIMUM OF CELL (TCMIN) FOUND
0237      C*************************************************************
0238        155 TCMIN=DDATI/NNN
0239            DDATI=NNN
0240      C
0241            WRITE(5,160)K1,K2,K3,K4,TCMIN
0242            WRITE(1,160)K1,K2,K3,K4,TCMIN
0243        160 FORMAT(10X,I2,6X,I2,5X,I4,6X,I4,7X,F8.6)
0244      C*************************************************************
0245      C       IF MINIMUM OF COLUMN IS FOUND, INCREASE C2
0246      C*************************************************************
0247            IF(TCMIN.GE.TTCMIN)GOTO 170
0248            KK1=K1
0249            KK2=K2
0250            KK3=K3
0251            KK4=K4
0252            TTCMIN=TCMIN
0253            TTAOQ=DDAOQ
0254      C
0255            IF (C1.EQ.C2M1) GOTO 175
0256            C1=C1+1
0257      C
0258            JJ=0
0259            N1=KK3
0260      C
0261            GOTO 125
0262      C
0263        165 CONTINUE
0264      C*************************************************************
0265      C       MINIMUM OF COLUMN (TMIN) FOUND
0266      C*************************************************************
0267        170 TMIN=TTCMIN
0268            TAOQ=TTAOQ
0269      C*************************************************************
0270      C       IF MINIMUM SAMPLING PLAN FOUND, STOP
0271      C*************************************************************
0272            IF(TMIN.GE.PLAN)GOTO 190
0273      C
0274            PLAN=TMIN
0275            KKK1=KK1
0276            KKK2=KK2
0277            KKK3=KK3
0278            KKK4=KK4
0279        175 C2=C2+1
0280      C*************************************************************
0281      C        NEW BOUNDS ON SAMPLING PLAN CALCULATED FOR NEW VALUE OF C2
0282      C*************************************************************
0283        180 CALL SEARCH(NNN,C2,NSTAR,AOQ)
0284            IF(AOQ.LE.AOQL)GOTO 185
0285            IF(NSTAR.GT.NNN)GOTO 175
0286            NSTAR=NSTAR+1
0287            GOTO 180
0288      C
0289      C
0290        185 CALL PROBS1(NSTAR,PO,C2,BXLEC)
0291            GOTO 110
0292      C
0293      C
0294        190 WRITE(5,195)
0295            WRITE(1,195)
0296        195 FORMAT(//10X,'SAMPLING PLAN MINIMUMS')
0297            WRITE(5,200)KKK1,KKK2
0298            WRITE(1,200)KKK1,KKK2
0299        200 FORMAT(/10X,'C1=',I2,2X,'C2=',I2)
0300            WRITE(5,205)KKK3,KKK4
0301            WRITE(1,205)KKK3,KKK4
0302        205 FORMAT(10X,'N1=',I3,2X,'N2=',I3)
0303            WRITE(5,210)PLAN
0304            WRITE(1,210)PLAN
0305        210 FORMAT(10X,'MINIMUM AFI=',F8.6)
0306        215 RETURN
0307            END
```

```
0001            SUBROUTINE SEARCH(NNN, C, NS, AOQ)
0002      C*****************************************************
0003      C       SEARCH TO FIND VALUE OF PSTAR USING GOLDEN
0004      C       SECTION METHOD.  INITIAL LIMITS OF 0 AND 1
0005      C*****************************************************
0006            INTEGER C
0007            DOUBLE PRECISION SUMLOG
0008            COMMON/BLK7/SUMLOG(4000)
0009            COMMON/BLK8/N
0010      C
0011            A1=0.D0
0012            A2=1.D0
0013            T=1.D-3
0014            R=5.D-1*(DSQRT(5.D0)-1.D0)
0015            H=A2-A1
0016            PLFT=A1+(R*R)*H
0017            PRT=A1+(R*H)
0018      C
0019      C
0020            CALL PROBS1(NS, PLFT, C, BXLEC)
0021            ATI=(NS*BXLEC)+NNN*(1.D0-BXLEC)
0022            AFI1=ATI/NNN
0023            AOQ1=PLFT*(1.D0-AFI1)
0024            CALL PROBS1(NS, PRT, C, BXLEC)
0025            ATI=(NS*BXLEC)+NNN*(1.D0-BXLEC)
0026            AFI2=ATI/NNN
0027            AOQ2=PRT*(1.D0-AFI2)
0028            GOTO 110
0029      C
0030      C
0031          100 CALL PROBS1(NS, PLFT, C, BXLEC)
0032            ATI=(NS*BXLEC)+NNN*(1.D0-BXLEC)
0033            AFI1=ATI/NNN
0034            AOQ1=PLFT*(1.D0-AFI1)
0035            GO TO 110
0036      C
0037          105 CALL PROBS1(NS, PRT, C, BXLEC)
0038            ATI=(NS*BXLEC)+NNN*(1.D0-BXLEC)
0039            AFI2=ATI/NNN
0040            AOQ2=PRT*(1.D0-AFI2)
0041      C
0042          110 IF(AOQ1.LT.AOQ2) GOTO 115
0043            A2=PRT
0044            H=PRT-A1
0045            IF(ABS(PRT-PLFT).LE.T)GOTO 120
0046      C
0047            PRT=PLFT
0048            PLFT=A1+(R*R)*H
0049            AOQ2=AOQ1
0050            GO TO 100
0051          115 A1=PLFT
0052            H=A2-PLFT
0053      C
0054            IF(ABS(PRT-PLFT).LE.T)GOTO 120
0055            PLFT=PRT
0056            PRT=A1+R*H
0057            AOQ1=AOQ2
```

```
0001            SUBROUTINE SRCH2(NNN,N1,N2,AOQ)
0002      C
0003            INTEGER C1,C2,R1
0004            COMMON/BLK6/C1,C2
0005      C
0006            KINDEX=1
0007            A1=0.
0008            A2=1.
0009            T=.0001
0010            R=.5*(DSQRT(5.D0)-1.)
0011            H=A2-A1
0012            PLFT=A1+(R*R)*H
0013            PRT=A1+(R*H)
0014      C
0015      C
0016            CALL PROBS1(N1,PLFT,C1,PA1)
0017            CALL PROBD1(N1,N2,PLFT,DPROB,KINDEX,R1)
0018            PA2=DPROB-PA1
0019            ATI=DPROB*N1+PA2*N2+NNN*(1.-DPROB)
0020            AFI1=ATI/NNN
0021            AOQ1=PLFT*(1.-AFI1)
0022            CALL PROBS1(N1,PRT,C1,PA1)
0023            CALL PROBD1(N1,N2,PRT,DPROB,KINDEX,R1)
0024            PA2=DPROB-PA1
0025            ATI=DPROB*N1+PA2*N2+NNN*(1.-DPROB)
0026            AFI2=ATI/NNN
0027            AOQ2=PRT*(1.-AFI2)
0028            GOTO 110
0029      C
0030      C
0031        100 CALL PROBS1(N1,PLFT,C1,PA1)
0032            CALL PROBD1(N1,N2,PLFT,DPROB,KINDEX,R1)
0033            PA2=DPROB-PA1
0034            ATI=DPROB*N1+PA2*N2+NNN*(1.-DPROB)
0035            AFI1=ATI/NNN
0036            AOQ1=PLFT*(1.-AFI1)
0037            GOTO 110
0038        105 CALL PROBS1(N1,PRT,C1,PA1)
0039            CALL PROBD1(N1,N2,PRT,DPROB,KINDEX,R1)
0040            PA2=DPROB-PA1
0041            ATI=DPROB*N1+PA2*N2+NNN*(1.-DPROB)
0042            AFI2=ATI/NNN
0043            AOQ2=PRT*(1.-AFI2)
0044      C
0045      C
0046        110 IF(AOQ1.LT.AOQ2)GOTO 115
0047      C
0048      C
0049            A2=PRT
0050            H=PRT-A1
0051            IF(ABS(PRT-PLFT).LE.T)GOTO 120
0052            PRT=PLFT
0053            PLFT=A1+(R*R)*H
0054            AOQ2=AOQ1
0055            GOTO 100
0056        115 A1=PLFT
0057      C
0058      C
0059            H=A2-PLFT
0060            IF(ABS(PRT-PLFT).LE.T)GOTO 120
0061            PLFT=PRT
0062            PRT=A1+R*H
0063            AOQ1=AOQ2
0064            GOTO 105
0065      C
0066      C
0067        120 PS=(PLFT+PRT)/2.
0068            CALL PROBS1(N1,PS,C1,PA1)
0069            CALL PROBD1(N1,N2,PS,DPROB,KINDEX,R1)
0070            PA2=DPROB-PA1
0071            AFI=(DPROB*N1+PA2*N2+NNN*(1.-DPROB))/NNN
0072            AOQ=PS*(1.-AFI)
0073            RETURN
0074            END
```

Program QMIL.FOR

```
0001      C**********************************************************
0002      C**                    MILSTD.FOR                          **
0003      C**                    ----------                          **
0004      C**       THIS IS AN INTERACTIVE PROGRAM TO EVALUATE       **
0005      C**       THE MIL-STD 105D SAMPLING SCHEME.                **
0006      C**                                                        **
0007      C**    PROGRAMMED BY: AZMAT H.SIDDIQI                      **
0008      C**    INDUSTRIAL AND SYSTEMS ENGINEERING DEPT             **
0009      C**    UNIVERSITY OF FLORIDA,GAINESVILLE,                  **
0010      C**    FLORIDA 32611                                       **
0011      C**********************************************************
0012      C
0013            SUBROUTINE QMIL
0014            BYTE OUTFIL(8)
0015            CHARACTER*2,CDL,SP
0016            INTEGER FS,FA,SA,AR,SR,AC,AT,AE,SC,ST,Z,A,B
0017           INTEGER NN,NFS,NFA,NAE,NSA,NAR,NAC,NAT,TN,TFS,TFA,TAE,TSA
0018           INTEGER TAR,TAC,TAT,RN,RFA,RAE,RAR,RAC,RAT,FRR,FTR,FNR,SNR
0019          $ ,STR,SRR,RFS,S1,S2,S3,S4,S
0020            COMMON/SCL/L,SP,S,I,NQ,T,R,CDL,FS,D,J,K,AQL,M,FA,SA,
0021          $ AR,SR,AC,AT,AE,SC,ST,Z,NTN,NFS,NFA,NAE,NSA,NAR,NAC,NAT,
0022          $ TN,TFS,TFA,TAE,TSA,TAR,TAC,TAT,RN,RFS,RFA,RAE,RAR,RAC,RAT
0023          $ ,FRR,FTR,FNR,SNR,STR,SRR,NNNN
0024            COMMON/BLK12/OUTFIL
0025      C
0026      C     ..... ..... ..... ..... ..... ..... ..... .....
0027      C
0028      C       THIS SECTION ASKS THE USER TO ENTER VALUES FOR
0029      C       THE NECESSARY PARAMETERS.
0030      C
0031      C     ..... ..... ..... ..... ..... ..... ..... .....
0032      C
0033            PRINT *,'ENTER INSPECTION LEVEL IN QUOTATION MARKS '
0034            PRINT *,'E.G.; SPECIAL : ''S1'',''S2'',''S3'',''S4'' '
0035            PRINT *,'        GENERAL : ''1'',''2'',''3'' '
0036            READ *,I
0037            PRINT *,'ENTER LOT SIZE: '
0038            READ *,L
0039            PRINT *,'ENTER AQL IN PERCENT.  REMEMBER, ONLY A'
0040            PRINT *,'STANDARD AQL IS ALLOWABLE'
0041            READ *,AQL
0042            PRINT *,'DO YOU WANT SINGLE(''S'') OR DOUBLE(''D'') '
0043            PRINT *,'SAMPLING PLANS ; (NOTE: ENTER S OR D IN QUOTES). '
0044            READ *,SP
0045            WRITE(1,2)
0046          2 FORMAT('1',///10X,'DEPT. OF ISE ',
0047           1 /,10X,'UNIVERSITY OF FLORIDA '//,5X,5('*'),
0048           2 'SAMPLING SYSTEM TO EVALUATE MIL-STD-105D',
0049           3 5('*'),2X,/)
0050            WRITE(1,3) I
0051          3 FORMAT(//,10X,'FOR   INSPECTION LEVEL ',A3)
0052            WRITE(1,4) L
0053          4 FORMAT(16X,'LOT SIZE= ',I8)
0054            WRITE(1,6) AQL
0055          6 FORMAT(16X,'AQL= ',F10.5)
0056            WRITE(1,8) SP
0057          8 FORMAT(16X,'SAMPLING PLAN',A3)
```

```
0058              WRITE(5,*)
0059              WRITE(5,*)
0060          *   FORMAT(//,'X   THESE PLANES ARE
0061                ALL CODE
0062                ALL SS
0063                ALL INDEX
0064                ALL VALUES
0065                S=0
0066                IF(RFA.LT.100)THEN
0067                FRR=RFA+1
0068                ENDIF
0069               IF(RAC.LT.100)THEN
0070               RFA=RAC
0071               FRR=RFA+3
0072                ENDIF
0073                IF(RAT.LT.100)THEN
0074                RFA=RAT
0075                FRR=RFA+2
0076                ENDIF
0077                IF(RAE.LT.100)THEN
0078                RFA=RAE
0079                FRR=RFA+5
0080                ENDIF
0081                IF(RAR.LT.100)THEN
0082                RFA=RAR
0083                FRR=RFA+4
0084                ENDIF
0085                IF(TFA.LT.100)THEN
0086                FTR=TFA+1
0087                ENDIF
0088                IF(TAT.LT.100)THEN
0089                TFA=TAT
0090                FTR=TFA+2
0091                ENDIF
0092                IF(TAC.LT.100)THEN
0093                TFA=TAC
0094                FTR=TFA+3
0095                ENDIF
0096                IF(TAR.LT.100)THEN
0097                TFA=TAR
0098                FTR=TFA+4
0099                ENDIF
0100                IF(TAE.LT.100)THEN
0101                TFA=TAE
0102                FTR=TFA+5
0103                ENDIF
0104                IF(NFA.LT.100)THEN
0105                FNR=NFA+1
0106                ENDIF
0107                IF(NAT.LT.100)THEN
0108                NFA=NAT
0109                FNR=NFA+2
0110                ENDIF
0111                IF(NAC.LT.100)THEN
0112                NFA=NAC
0113                FNR=NFA+3
0114                ENDIF
```

```
0115              IF(NAR.LT.100)THEN
0116              NFA=NAR
0117              FNR=NAR+4
0118              ENDIF
0119              IF(NAL.LT.100)THEN
0120              NFA=NAL
0121              FNR=NFA+5
0122              ENDIF
0123              IF(NSA.LT.100)THEN
0124              NTN=NSA
0125              SNR=NTN+1
0126              ENDIF
0127              IF(TSA.LT.100)THEN
0128              TN=TSA
0129              STR=TN+1
0130              ENDIF
0131              IF(SC.LT.100)THEN
0132              Z=SC
0133              SRR=Z+3
0134              ENDIF
0135              IF(ST.LT.100)THEN
0136              Z=ST
0137              SRR=Z+2
0138              ENDIF
0139              IF(SR.LT.100)THEN
0140              Z=SR
0141              SRR=Z+4
0142             ENDIF
0143             IF(RFS.GE.L.OR.FS.GE.L.OR.NQ.GE.L.OR.RN.GE.L)THEN
0144     C
0145     C.....................................................................
0146     C       THIS SECTION CONTAINS THE FORMAT STATEMENTS
0147     C       NEEDED TO SET UP TABLES FOR THE PLAN STATISTICS
0148     C       AT THE DIFFERENT INSPECTION LEVELS.
0149     C       THE USER IS ASKED IF SCHEME EVALUATION IS
0150     C       DESIRED, IF SO THEN SUBROUTINE OC IS INVOKED.
0151     C.....................................................................
0152     C
0153             WRITE(1,12)
0154             WRITE(5,12)
0155          12 FORMAT(10X,'USE 100 PERCENT INSPECTION',/,'AS SAMPLE',
0156            $ ' SIZE EQUALS OR EXCEEDS LOT SIZE')
0157             S=1
0158             ENDIF
0159             IF(S.EQ.1)GO TO 60
0160             IF((SP.EQ.'S').OR.(SP.EQ.'D'.AND.CDL.NE.'A'))THEN
0161             WRITE(1,14)
0162             WRITE(5,14)
0163          14 FORMAT(10X,'* NORMAL                    TIGHTENED                ',
0164            $    'REDUCED   *')
0165             WRITE(1,16)
0166             WRITE(5,16)
0167          16 FORMAT(10X,54('-'))
0168             WRITE(1,10)NFA,TFA,RFA
0169             WRITE(5,10)NFA,TFA,RFA
0170          10 FORMAT(12X,'AC 1=',I3,10X,'AC 1=',I7,10X,'AC 1=',I7)
0171             WRITE(1,20)FNR,FTR,FRR
```

```
0172            WRITE(5,20)FNR,FTR,FRR
0173         20 FORMAT(12X,'RF 1 ',I3,10X,'RE 1 ',I7,10X,'RF 1 ',I7)
0174            ENDIF
0175            IF(SP.EQ.'D'.AND.CDL.NE.'A')THEN
0176            WRITE(1,25)FS,FS,RFS
0177            WRITE(5,25)FS,FS,RFS
0178         25 FORMAT(12X,'N1=',I5,10X,'N1 ',I9,10X,'N1=',I9)
0179            WRITE(1,28)
0180            WRITE(5,28)
0181         28 FORMAT(10X,54('-'))
0182            ENDIF
0183            IF(SP.EQ.'D'.AND.CDL.NE.'A')THEN
0184            WRITE(1,30)NTN,TN,Z
0185            WRITE(5,30)NTN,TN,Z
0186         30 FORMAT(12X,'AC 2=',I3,10X,'AC 2=',I7,10X,'AC 2=',I7)
0187            WRITE(1,40)SNR,STR,SRR
0188            WRITE(5,40)SNR,STR,SRR
0189         40 FORMAT(12X,'RE 2=',I3,10X,'RE 2=',I7,10X,'RE 2=',I7)
0190            WRITE(1,45)FS,FS,RFS
0191            WRITE(5,45)FS,FS,RFS
0192         45 FORMAT(12X,'N2=',I5,10X,'N2=',I9,10X,'N2=',I9)
0193            ENDIF
0194            WRITE(1,48)
0195            WRITE(5,48)
0196         48 FORMAT(10X,54('-'))
0197            IF(SP.EQ.'S')THEN
0198            WRITE(1,50)NQ,NQ,RN
0199            WRITE(5,50)NQ,NQ,RN
0200         50 FORMAT(12X,'N=',I6,10X,'N=',I10,10X,'N=',I10)
0201            WRITE(1,51)
0202            WRITE(5,51)
0203         51 FORMAT(10X,54('-'))
0204            ENDIF
0205            IF((SP.EQ.'D'.AND.CDL.EQ.'A'.AND.J.GE.19).OR.(SP.EQ.'D'.AND.CDL.
0206           $ EQ.'A'.AND.M.LE.16))THEN
0207            WRITE(1,54)
0208            WRITE(5,54)
0209         54 FORMAT(10X,'SAMPLE SIZE NOT AVAILABLE AT ANY INSPECTION',
0210           $   ' LEVEL',/,'CORRESPONDING SINGLE SAMPLING PLAN WILL',
0211           $   'BE USED:')
0212            SP='S'
0213            GO TO 1
0214            ENDIF
0215            PRINT*,'DO YOU WANT SCHEME EVALUATION..?'
0216            PRINT *,'IF YES ENTER.....1'
0217            PRINT *,'IF NO ENTER.....2'
0218            READ *,AZ
0219            IF(AZ.EQ.2) GO TO 60
0220            IF(AZ.EQ.1) GO TO 58
0221         58 NNNN=L
0222            IF(SP.EQ.'S') JT=1
0223            IF(SP.EQ.'D') JT=2
0224            CALL OC(NNNN,FS,RFS,RFA,SRR,FRR,NQ,RN,TFA,TN,FTR,STR,NFA,NTN
0225           $ ,FNR,SNR,Z,JT,AQL)
0226         60 RETURN
0227            END
```

```
0001            SUBROUTINE SS
0002      C
0003      C**********************************************************
0004      C**    THIS SUBROUTINE FINDS THE SAMPLE SIZE, 'NQ'      **
0005      C**    BOTH THE DOUBLE AND THE SINGLE SAMPLING PLANS    **
0006      C**    AT NORMAL, TIGHTENED AND REDUCED INSPECTION      **
0007      C**    LEVELS.                                          **
0008      C**********************************************************
0009      C
0010            CHARACTER *2,CDL,SP
0011            INTEGER FS,FA,SA,AR,SR,AC,AT,AE,SC,ST,Z,NN,NFS,NFA,NAE,NSA
0012            INTEGER NAC,NAT,TN,TFS,TFA,TAE,TSA,TAR,TAC,TAT,RN,RFA,RAE
0013            INTEGER RAR,RAC,RAT,NAR,FRR,FTR,FNR,SNR,STR,SRR
0014            COMMON/SCL/L,SP,S,I,NQ,T,R,CDL,FS,D,J,K,AQL,M,FA,SA,AR
0015           $ ,SR,AC,AT,AE,SC,ST,Z,NTN,NFS,NFA,NAE,NSA,NAR,
0016           $ NAC,NAT,TN,TFS,TFA,TAE,TSA,TAR,TAC,TAT,RN,RFS,RFA
0017           $ ,RAE,RAR,RAC,RAT,FRR,FTR,FNR,SNR,STR,SRR
0018            IF(SP.EQ.'S')THEN
0019                  IF(CDL.EQ.'A')THEN
0020                  NQ=2
0021                  ENDIF
0022                  IF(CDL.EQ.'B')THEN
0023                  NQ=3
0024                  ENDIF
0025                  IF(CDL.EQ.'C') THEN
0026                  NQ=5
0027                  ENDIF
0028                  IF(CDL.EQ.'D') THEN
0029                  NQ=8
0030                  ENDIF
0031                  IF(CDL.EQ.'E')THEN
0032                  NQ=13
0033                  ENDIF
0034                  IF(CDL.EQ.'F')THEN
0035                  NQ=20
0036                  ENDIF
0037                  IF(CDL.EQ.'G')THEN
0038                  NQ=32
0039                  ENDIF
0040                  IF(CDL.EQ.'H') THEN
0041                  NQ=50
0042                  ENDIF
0043                  IF(CDL.EQ.'J')THEN
0044                  NQ=80
0045                  ENDIF
0046                  IF(CDL.EQ.'K')THEN
0047                  NQ=125
0048                  ENDIF
0049                  IF(CDL.EQ.'L')THEN
0050                  NQ=200
0051                  ENDIF
0052                  IF(CDL.EQ.'M')THEN
0053                  NQ=315
0054                  ENDIF
0055                  IF(CDL.EQ.'N')THEN
0056                  NQ=500
0057                  ENDIF
```

```
0058                    IF(CDL.EQ.'P')THEN
0059                    NQ=800
0060                    ENDIF
0061                    IF(CDL.EQ.'Q')THEN
0062                    NQ=1250
0063                    ENDIF
0064                    IF(CDL.EQ.'R')THEN
0065                    NQ=2000
0066                    ENDIF
0067                    IF(CDL.EQ.'S')THEN
0068                    NQ=3150
0069                    ENDIF
0070                     IF(CDL.EQ.'A'.OR.CDL.EQ.'B'.OR.CDL.EQ.'C')THEN
0071                     RN=2
0072                     ENDIF
0073                     IF(CDL.EQ.'D') THEN
0074                     RN=3
0075                     ENDIF
0076                     IF(CDL.EQ.'E') THEN
0077                     RN=5
0078                     ENDIF
0079                     IF(CDL.EQ.'F')THEN
0080                     RN=8
0081                     ENDIF
0082                     IF(CDL.EQ.'G')THEN
0083                     RN=13
0084                     ENDIF
0085                     IF(CDL.EQ.'H')THEN
0086                     RN=20
0087                     ENDIF
0088                     IF(CDL.EQ.'J')THEN
0089                     RN=32
0090                     ENDIF
0091                     IF(CDL.EQ.'K')THEN
0092                     RN=50
0093                     ENDIF
0094                     IF(CDL.EQ.'L')THEN
0095                     RN=80
0096                     ENDIF
0097                     IF(CDL.EQ.'M')THEN
0098                     RN=125
0099                     ENDIF
0100                     IF(CDL.EQ.'N')THEN
0101                     RN=200
0102                     ENDIF
0103                     IF(CDL.EQ.'P')THEN
0104                     RN=315
0105                     ENDIF
0106                     IF(CDL.EQ.'Q')THEN
0107                     RN=500
0108                     ENDIF
0109                     IF(CDL.EQ.'R')THEN
0110                     RN=800
0111                     ENDIF
0112            ENDIF
0113                        IF(SP.EQ.'D'.AND.CDL.EQ.'A')THEN
0114                        FS=0
```

```
0115                    ENDIF
0116                    IF(SP.EQ. 'D'.AND.CDL.NE. 'A')THEN
0117                    IF(CDL.EQ. 'B')THEN
0118                    FS=2
0119                    ENDIF
0120                    IF(CDL.EQ. 'C')THEN
0121                    FS=3
0122                    ENDIF
0123                    IF(CDL.EQ. 'D')THEN
0124                    FS=5
0125                    ENDIF
0126                    IF(CDL.EQ. 'E')THEN
0127                    FS=8
0128                    ENDIF
0129                    IF(CDL.EQ. 'F')THEN
0130                    FS=13
0131                    ENDIF
0132                    IF(CDL.EQ. 'G')THEN
0133                    FS=20
0134                    ENDIF
0135                    IF(CDL.EQ. 'H')THEN
0136                    FS=32
0137                    ENDIF
0138                    IF(CDL.EQ. 'J')THEN
0139                    FS=50
0140                    ENDIF
0141                    IF(CDL.EQ. 'K')THEN
0142                    FS=80
0143                    ENDIF
0144                    IF(CDL.EQ. 'L')THEN
0145                    FS=125
0146                    ENDIF
0147                    IF(CDL.EQ. 'M')THEN
0148                    FS=200
0149                    ENDIF
0150                    IF(CDL.EQ. 'N')THEN
0151                    FS=315
0152                    ENDIF
0153                    IF(CDL.EQ. 'P')THEN
0154                    FS=500
0155                    ENDIF
0156                    IF(CDL.EQ. 'Q')THEN
0157                    FS=800
0158                    ENDIF
0159                    IF(CDL.EQ. 'R')THEN
0160                    FS=1250
0161                    ENDIF
0162                    IF(CDL.EQ. 'S')THEN
0163                    FS=2000
0164                    ENDIF
0165            ENDIF
0166             IF((SP.EQ. 'D').AND.(CDL.EQ. 'B'.OR.CDL.EQ. 'C'))THEN
0167                    RFS=0
0168                    ENDIF
0169             IF(SP.EQ. 'D'.AND.CDL.NE. 'B'.AND.CDL.NE. 'C')THEN
0170                    IF(CDL.EQ. 'D')THEN
0171                    RFS=2
```

```
0172                        ENDIF
0173                        IF(CDL.EQ.'E')THEN
0174                        RFS=3
0175                        ENDIF
0176                        IF(CDL.EQ.'F')THEN
0177                        RFS=5
0178                        ENDIF
0179                        IF(CDL.EQ.'G')THEN
0180                        RFS=8
0181                        ENDIF
0182                        IF(CDL.EQ.'H')THEN
0183                        RFS=13
0184                        ENDIF
0185                        IF(CDL.EQ.'J')THEN
0186                        RFS=20
0187                        ENDIF
0188                        IF(CDL.EQ.'K')THEN
0189                        RFS=32
0190                        ENDIF
0191                        IF(CDL.EQ.'L')THEN
0192                        RFS=50
0193                        ENDIF
0194                        IF(CDL.EQ.'M')THEN
0195                        RFS=80
0196                        ENDIF
0197                        IF(CDL.EQ.'N')THEN
0198                        RFS=125
0199                        ENDIF
0200                        IF(CDL.EQ.'P')THEN
0201                        RFS=200
0202                        ENDIF
0203                        IF(CDL.EQ.'Q')THEN
0204                        RFS=315
0205                        ENDIF
0206                        IF(CDL.EQ.'R')THEN
0207                        RFS=500
0208                        ENDIF
0209              ENDIF
0210              RETURN
0211              END
```

```
0001            SUBROUTINE  INDEX
0002      C
0003      C*****************************************************
0004      C**  THIS SUBROUTINE LOCATES THE CELL IN THE        **
0005      C**  TABLES PRESENTED IN MIL-STD-105D CONTAINC      **
0006      C**  ACCEPTANCE AND REJECTION NUMBERS FOR ANY       **
0007      C**  PATICULAR COMBINATION OF AQL AND CODE LETTER.  **
0008      C*****************************************************
0009      C
0010            CHARACTER I*2, CDL, SP
0011            INTEGER FS, FA, SA, AR, SR, AC, AT, AE, SC, ST, Z
0012            COMMON/SCL/L, SP, S, I, NQ, T, R, CDL, FS, D, J, K, AQL, M, FA, SA, AR,
0013           $ SR, AC, AT, AE, SC, ST, Z
0014              IF(CDL.EQ.'A')THEN
0015              K=1
0016                ELSE IF(CDL.EQ.'B')THEN
0017                K=2
0018               ELSE IF(CDL.EQ.'C')THEN
0019               K=3
0020               ELSE IF(CDL.EQ.'D')THEN
0021               K=4
0022               ELSE IF(CDL.EQ.'E')THEN
0023               K=5
0024               ELSE IF(CDL.EQ.'F')THEN
0025               K=6
0026               ELSE IF(CDL.EQ.'G')THEN
0027               K=7
0028               ELSE IF(CDL.EQ.'H')THEN
0029               K=8
0030               ELSE IF(CDL.EQ.'J')THEN
0031               K=9
0032               ELSE IF(CDL.EQ.'K')THEN
0033               K=10
0034               ELSE IF(CDL.EQ.'L')THEN
0035               K=11
0036               ELSE IF(CDL.EQ.'M')THEN
0037               K=12
0038               ELSE IF(CDL.EQ.'N')THEN
0039               K=13
0040               ELSE IF(CDL.EQ.'P')THEN
0041               K=14
0042               ELSE IF(CDL.EQ.'Q')THEN
0043               K=15
0044               ELSE IF(CDL.EQ.'R')THEN
0045               K=16
0046               ELSE IF(CDL.EQ.'S')THEN
0047               K=17
0048               ENDIF
0049            IF(AQL.EQ.0.010)THEN
0050            J=1
0051                  ELSE IF(AQL.EQ.0.015)THEN
0052                  J=2
0053                  ELSE IF(AQL.EQ..025)THEN
0054                  J=3
0055                  ELSE IF(AQL.EQ.0.040)THEN
0056                  J=4
0057                  ELSE IF(AQL.EQ.0.065)THEN
```

```
0058                    J=5
0059                    ELSE IF(AQL.EQ.0.10)THEN
0060                    J=6
0061                    ELSE IF(AQL.EQ.0.15)THEN
0062                    J=7
0063                    ELSE IF(AQL.EQ.0.25)THEN
0064                    J=8
0065                    ELSE IF(AQL.EQ.0.4)THEN
0066                    J=9
0067                    ELSE IF(AQL.EQ.0.65)THEN
0068                    J=10
0069                    ELSE IF(AQL.EQ.1)THEN
0070                    J=11
0071                    ELSE IF(AQL.EQ.1.5)THEN
0072                    J=12
0073                    ELSE IF(AQL.EQ.2.5)THEN
0074                    J=13
0075                    ELSE IF(AQL.EQ.4)THEN
0076                    J=14
0077                    ELSE IF(AQL.EQ.6.5)THEN
0078                    J=15
0079                    ELSE IF(AQL.EQ.10)THEN
0080                    J=16
0081                    ELSE IF(AQL.EQ.15)THEN
0082                    J=17
0083                    ELSE IF(AQL.EQ.25)THEN
0084                    J=18
0085                    ELSE IF(AQL.EQ.40)THEN
0086                    J=19
0087                    ELSE IF(AQL.EQ.65)THEN
0088                    J=20
0089                    ELSE IF(AQL.EQ.100)THEN
0090                    J=21
0091                  ELSE
0092                    J=22
0093          ENDIF
0094            M=J+K
0095          RETURN
0096          END
```

```
0001            SUBROUTINE VALUES
0002      C
0003      C*****************************************************************
0004      C**   THIS SUBROUTINE FINDS ACCEPTANCE AND REJECTION            **
0005      C**   NUMBERS FOR THE CELL IDENTIFIED BY SUBROUTINE INDEX.      **
0006      C*****************************************************************
0007      C
0008            CHARACTER *2,CDL,SP
0009            INTEGER FS,FA,SA,AR,SR,AC,AT,AE,SC,ST,Z,NN,NFS,NFA,NAE,NSA
0010            INTEGER NAR,NAC,NAT,TN,TFS,TFA,TAE,TAR,TAC,TAT,RN,RFA,RAE
0011            INTEGER FRR,FTR,FNR,SNR,STR,SRR,RAR,RAC,RAT,RFS,TSA
0012            COMMON/SCL/L,SP,S,I,NQ,T,R,CDL,FS,D,J,K,AQL,M,FA,SA,
0013           $ AR,SR,AC,AT,AE,SC,ST,Z,NTN,NFS,NFA,NAE,NSA,NAR,NAC,NAT,TN
0014           $ ,TFS,TFA,TAE,TSA,TAR,TAC,TAT,RN,RFS,RFA,RAE,RAR,RAC,RAT
0015           $ ,FRR,FTR,FNR,SNR,STR,SRR
0016            NFA=100
0017            TFA=100
0018            RFA=100
0019            NAT=100
0020            TAT=100
0021            RAT=100
0022            TAC=100
0023            RAC=100
0024            TAR=100
0025            RAR=100
0026            TAE=100
0027            RAE=100
0028            TSA=100
0029            NAC=100
0030            NAR=100
0031            NAE=100
0032            NSA=100
0033            ST=100
0034            SC=100
0035            SR=100
0036            IF(SP.EQ.'S')THEN
0037                    IF(M.GE.2.AND.M.LE.16)NFA=0
0038                    IF(M.GE.26)NFA=21
0039                    IF(M.EQ.25)NFA=14
0040                    IF(M.EQ.24)NFA=10
0041                    IF(M.EQ.23)NFA=7
0042                    IF(M.EQ.22)NFA=5
0043                    IF(M.EQ.21)NFA=3
0044                    IF(M.EQ.20)NFA=2
0045                    IF(M.EQ.19)NFA=1
0046                    IF(M.EQ.17.AND.J.NE.16)NFA=0
0047                    IF(M.EQ.18.AND.J.NE.18)NFA=1
0048                    IF(K.EQ.16.AND.J.LE.2)NFA=0
0049                    IF(J.EQ.16.AND.K.LE.2)NFA=1
0050                  IF(M.GE.26)TFA=18
0051                  IF(M.EQ.25)TFA=12
0052                  IF(M.EQ.24)TFA=8
0053                  IF(M.EQ.23)TFA=5
0054                  IF(M.EQ.22)TFA=3
0055                  IF(M.EQ.21)TFA=2
0056                  IF(M.GE.18.AND.M.LE.20.AND.J.NE.16)TFA=1
0057                  IF(K.EQ.16.AND.J.EQ.2)TFA=2
```

```
0058                    IF(M.LE.17.AND.J.LE.15)RFA=0
0059                    IF(J.EQ.16.AND.K.LE.2)RFA=1
0060                  IF(M.GE.26)RAC=10
0061                  IF(M.EQ.25)RAC=7
0062                  IF(M.EQ.24)RAC=5
0063                  IF(M.EQ.23)RAC=3
0064                  IF(M.EQ.22.AND.J.LE.19)RAC=2
0065                  IF(M.EQ.21)RAC=1
0066                  IF(M.EQ.20.AND.J.LE.18)RAT=1
0067                  IF(M.EQ.19.AND.J.LE.17)RAT=0
0068                  IF(M.GE.2.AND.M.LE.16)RFA=0
0069                  IF(M.EQ.17.AND.J.LE.15)RFA=0
0070                  IF(J.LE.2)RFA=0
0071                  IF(J.EQ.16.AND.K.LE.3)RAT=0
0072                  IF(J.EQ.17.AND.K.EQ.1)RAT=0
0073                  IF(J.EQ.21.AND.K.LE.2)RFA=5
0074                  IF(J.EQ.20.AND.K.EQ.1)RFA=3
0075                  IF(J.EQ.20.AND.K.EQ.2)RAT=3
0076                  IF(J.EQ.19.AND.K.EQ.1)RFA=2
0077                  IF(J.EQ.19.AND.K.EQ.2)RAT=2
0078                  IF(J.EQ.18.AND.K.EQ.1)RFA=1
0079                  IF(J.EQ.18.AND.K.EQ.2)RAT=1
0080          ENDIF
0081           IF(SP.EQ.'D')THEN
0082                    IF(M.LE.16.AND.J.LE.15)THEN
0083                    NAT=0
0084                    NSA=1
0085                    TAT=0
0086                    TSA=1
0087                    RAT=0
0088                    ST=0
0089                    END IF
0090                    IF(K.EQ.16.AND.J.LE.2)THEN
0091                     NAT=0
0092                     NSA=1
0093                     TAT=0
0094                     TSA=1
0095                     RAT=0
0096                     ST=0
0097                     ENDIF
0098                    IF(K.EQ.1.AND.J.EQ.18)THEN
0099                     NSA=3
0100                   NAC=0
0101                   TAT=0
0102                   TSA=1
0103                   ENDIF
0104                   IF(M.GE.26)THEN
0105                   NAE=11
0106                   NSA=26
0107                   ENDIF
0108                     IF(M.EQ.25)THEN
0109                   NAR=7
0110                   NSA=18
0111                   ENDIF
0112                     IF(M.EQ.24)THEN
0113                   NAR=5
0114                   NSA=12
```

VALUES

```
0115                    ENDIF
0116                     IF(M.EQ.23)THEN
0117                    NAR=3
0118                    NSA=8
0119                    ENDIF
0120                     IF(M.EQ.22)THEN
0121                    NAC=2
0122                    NSA=6
0123                    ENDIF
0124                     IF(M.EQ.21)THEN
0125                    NAC=1
0126                    NSA=4
0127                    ENDIF
0128                     IF(M.EQ.20)THEN
0129                    NAC=0
0130                    NSA=3
0131                    ENDIF
0132                IF((M.EQ.19.AND.J.GT.2).OR.(M.EQ.18.AND.J.GT.2))THEN
0133                    NAT=0
0134                    NSA=1
0135                    ENDIF
0136                     IF(J.EQ.16.AND.K.LE.3)THEN
0137                    NAT=0
0138                    NSA=1
0139                     ENDIF
0140                      IF(M.GE.26)THEN
0141                     TAE=9
0142                     TSA=23
0143                     ENDIF
0144                      IF(M.EQ.25)THEN
0145                     TAR=6
0146                     TSA=15
0147                     ENDIF
0148                     IF(M.EQ.24)THEN
0149                     TAR=3
0150                     TSA=11
0151                     ENDIF
0152                     IF(M.EQ.23)THEN
0153                     TAC=2
0154                     TSA=6
0155                     ENDIF
0156                      IF(M.EQ.22)THEN
0157                     TAC=1
0158                     TSA=4
0159                     ENDIF
0160                      IF(M.EQ.21)THEN
0161                     TAC=0
0162                     TSA=3
0163                     ENDIF
0164            IF(M.GE.18.AND.M.LE.20.AND.J.GE.3)THEN
0165                     TAT=0
0166                     TSA=1
0167                      ENDIF
0168                  IF(M.EQ.26)THEN
0169                RAE=5
0170                SR=12
0171                ENDIF
```

```
0172                    IF(M.EQ.25)THEN
0173                  RAR=3
0174                  SR=8
0175                   ENDIF
0176                   IF(M.EQ.24)THEN
0177                  RAR=2
0178                  SC=6
0179                  ENDIF
0180                   IF(M.EQ.23)THEN
0181                  RAR=1
0182                  SC=4
0183                  ENDIF
0184                   IF(M.EQ.22)THEN
0185                  RAR=0
0186                  SC=3
0187                  ENDIF
0188                  IF(M.EQ.21)THEN
0189                  RAR=0
0190                  SR=1
0191                  ENDIF
0192                  IF(M.EQ.20)THEN
0193                  RAC=0
0194                  SR=0
0195                  ENDIF
0196                   IF(M.EQ.19)THEN
0197                  RAT=0
0198                  ST=0
0199                  ENDIF
0200                   IF(M.EQ.18.AND.J.GE.3.AND.J.LE.15)THEN
0201                  RAT=0
0202                  ST=0
0203                   ENDIF
0204            ENDIF
0205            RETURN
0206            END
```

```
0001            SUBROUTINE CODE
0002      C
0003      C*****************************************************************
0004      C**   THIS SUBROUTINE IDENTIFIES THE CODE LETTER ASSOCIATED     **
0005      C**   WITH EITHER THE SPECIAL OR GENERAL INSPECTION LEVELS      **
0006      C**   FOR ANY GIVEN LOT OR BATCH SIZE.                          **
0007      C*****************************************************************
0008      C
0009            CHARACTER I*2,CDL,SP
0010            INTEGER S1,S2,S3,S4
0011            COMMON/SCL/L,SP,S,I,NQ,T,R,CDL
0012             IF(I.EQ.'S1')THEN
0013                       IF(L.GE.2.AND.L.LE.50)CDL='A'
0014                       IF(L.GE.51.AND.L.LE.500)CDL='B'
0015                       IF(L.GE.501.AND.L.LE.35000)CDL='C'
0016                       IF(L.GE.35001)CDL='D'
0017             ENDIF
0018             IF(I.EQ.'S2')THEN
0019                       IF(L.GE.2.AND.L.LE.25)CDL='A'
0020                       IF(L.GE.26.AND.L.LE.150)CDL='B'
0021                       IF(L.GE.151.AND.L.LE.1200)CDL='C'
0022                       IF(L.GE.1201.AND.L.LE.35000)CDL='D'
0023                       IF(L.GE.35001)CDL='E'
0024             ENDIF
0025             IF(I.EQ.'S3')THEN
0026                       IF(L.GE.2.AND.L.LE.15)CDL='A'
0027                       IF(L.GE.26.AND.L.LE.50)CDL='B'
0028                       IF(L.GE.51.AND.L.LE.150)CDL='C'
0029                       IF(L.GE.151.AND.L.LE.500)CDL='D'
0030                       IF(L.GE.501.AND.L.LE.3200)CDL='E'
0031                       IF(L.GE.3201.AND.L.LE.35000)CDL='F'
0032                       IF(L.GE.35001.AND.L.LE.500000)CDL='G'
0033                       IF(L.GE.500001)CDL='H'
0034             ENDIF
0035             IF(I.EQ.'S4')THEN
0036                       IF(L.GE.2.AND.L.LE.15)CDL='A'
0037                       IF(L.GE.16.AND.L.LE.25)CDL='B'
0038                       IF(L.GE.26.AND.L.LE.90)CDL='C'
0039                       IF(L.GE.91.AND.L.LE.150)CDL='D'
0040                       IF(L.GE.151.AND.L.LE.500)CDL='E'
0041                       IF(L.GE.501.AND.L.LE.1200)CDL='F'
0042                       IF(L.GE.1201.AND.L.LE.10000)CDL='G'
0043                       IF(L.GE.10001.AND.L.LE.35000)CDL='H'
0044                       IF(L.GE.35001.AND.L.LE.500000)CDL='J'
0045                       IF(L.GT.500000)CDL='K'
0046             ENDIF
0047             IF(I.EQ.'1')THEN
0048                       IF(L.GE.2.AND.L.LE.15)CDL='A'
0049                       IF(L.GE.16.AND.L.LE.25)CDL='B'
0050                       IF(L.GE.26.AND.L.LE.90)CDL='C'
0051                       IF(L.GE.91.AND.L.LE.150)CDL='D'
0052                       IF(L.GE.151.AND.L.LE.280)CDL='E'
0053                       IF(L.GE.281.AND.L.LE.500)CDL='F'
0054                       IF(L.GE.501.AND.L.LE.1200)CDL='G'
0055                       IF(L.GE.1201.AND.L.LE.3200)CDL='H'
0056                       IF(L.GE.3201.AND.L.LE.10000)CDL='J'
0057                       IF(L.GE.10001.AND.L.LE.35000)CDL='K'
```

```
0058            IF(L.GE.35001.AND.L.LE.150000)CDL='L'
0059            IF(L.GE.150001.AND.L.LE.500000)CDL='M'
0060            IF(L.GE.500001)CDL='N'
0061          ENDIF
0062           IF(I.EQ.'2')THEN
0063                    IF(L.GE.2.AND.L.LE.8)CDL='A'
0064                    IF(L.GE.9.AND.L.LE.15)CDL='B'
0065                    IF(L.GE.16.AND.L.LE.25)CDL='C'
0066                    IF(L.GE.26.AND.L.LE.50)CDL='D'
0067                    IF(L.GE.51.AND.L.LE.90)CDL='E'
0068                    IF(L.GE.91.AND.L.LE.150)CDL='F'
0069                    IF(L.GE.151.AND.L.LE.280)CDL='G'
0070                    IF(L.GE.281.AND.L.LE.500)CDL='H'
0071                    IF(L.GE.501.AND.L.LE.1200)CDL='J'
0072                    IF(L.GE.1201.AND.L.LE.3200)CDL='K'
0073                    IF(L.GE.3201.AND.L.LE.10000)CDL='L'
0074                  IF(L.GE.10001.AND.L.LE.35000)CDL='M'
0075                 IF(L.GE.35001.AND.L.LE.150000)CDL='N'
0076                 IF(L.GE.150001.AND.L.LE.500000)CDL='P'
0077                 IF(L.GE.500001)CDL='Q'
0078          ENDIF
0079          IF(I.EQ.'3')THEN
0080                IF(L.GE.2.AND.L.LE.8)CDL='B'
0081                IF(L.GE.9.AND.L.LE.15)CDL='C'
0082                IF(L.GE.16.AND.L.LE.25)CDL='D'
0083                IF(L.GE.26.AND.L.LE.50)CDL='E'
0084                IF(L.GE.51.AND.L.LE.90)CDL='F'
0085                IF(L.GE.91.AND.L.LE.150)CDL='G'
0086                IF(L.GE.151.AND.L.LE.280)CDL='H'
0087                IF(L.GE.281.AND.L.LE.500)CDL='J'
0088                IF(L.GE.501.AND.L.LE.1200)CDL='K'
0089                IF(L.GE.1201.AND.L.LE.3200)CDL='L'
0090                IF(L.GE.3201.AND.L.LE.10000)CDL='M'
0091                IF(L.GE.10001.AND.L.LE.35000)CDL='N'
0092                IF(L.GE.35001.AND.L.LE.150000)CDL='P'
0093              IF(L.GE.150001.AND.L.LE.500000)CDL='Q'
0094              IF(L.GE.500001)CDL='R'
0095           ENDIF
0096           RETURN
0097           END
```

```
0001            SUBROUTINE OC(NNNN,IFS,IRFS,IRFA,ISRR,IFRR,NQ,IRN,ITFA
0002           1  ITN,IFTR,ISTR,NFA,NTN,IFNR,ISNR,IZ,J,AQL)
0003      C
0004      C*****************************************************************
0005      C**    THIS SUBROUTINE EVALUATES THE SCHEME OPERATING          **
0006      C**    CHARACTERISTICS,FOR THE REQUIRED SAMPLING PLANS.        **
0007      C*****************************************************************
0008      C
0009            REAL*8 AQ(20,20),BQ(20,20)
0010            DIMENSION N(30),PR(30),V(100,50),P(30),TPA(30,4),ASN(30,4)
0011            DIMENSION AOQ(30,4),ATI(30,4),NN(4),TM(20,20),ZP(20,20)
0012            DIMENSION ASNC(30),AOQC(30),ATIC(30),AFI(30),PA(30)
0013            INTEGER A(50),R(50),HI,AA(2,4),RR(2,4)
0014            IF(J.EQ.2) GO TO 197
0015            IF(J.EQ.1) GO TO 172
0016       172  NN(1)=NQ
0017            NN(2)=NQ
0018            NN(3)=IRN
0019            NN(4)=IRN
0020            AA(1,4)=IFRR-1
0021            RR(1,3)=IRFA+1
0022            GO TO 272
0023       197  NN(1)=IFS
0024            NN(2)=IFS
0025            NN(3)=IRFS
0026            NN(4)=IRFS
0027            AA(1,4)=IRFA
0028            AA(2,4)=ISRR-1
0029            RR(1,3)=IFRR
0030       272  AA(1,1)=ITFA
0031            AA(2,1)=ITN
0032            RR(1,1)=IFTR
0033            RR(2,1)=ISTR
0034            AA(1,2)=NFA
0035            AA(2,2)=NTN
0036            RR(1,2)=IFNR
0037            RR(2,2)=ISNR
0038            AA(1,3)=IRFA
0039            AA(2,3)=IZ
0040            RR(2,3)=IZ+1
0041            RR(1,4)=IFRR
0042            RR(2,4)=ISRR
0043            PRINT *,'DO YOU  WANT A  TABLE OR A  GRAPH FORMAT ?'
0044            PRINT *,' FOR GRAPH....ENTER:  1 '
0045            PRINT *,' FOR TABLE....ENTER:  2 '
0046            READ *,XTC
0047            IF(XTC.EQ.1) GO TO 733
0048            PRINT *,'SPECIFY THE NUMBER OF FRACTION DEFECTIVE VALUES..'
0049            READ *,J1
0050            PRINT *,'ENTER THE FRACTION DEFECTIVE VALUE(S),'
0051            PRINT *,'(PUT A COMMA BETWEEN VALUES.).....'
0052            READ *,(P(I),I=1,J1)
0053            WRITE(1,27)
0054            WRITE(5,27)
0055            GO TO 447
0056       733  J1=21
0057            DO 55 I=1,J1
```

```
0058                P(I)=(I-1)/20.0
0059          30    P(I)=P(I)/10.0
0060          44    DO 105 L=1,31
0061                DO 10 LM=1,4
0062                DO 17 I=1,J
0063                A(I)=AA(I,LM)
0064                R(I)=RR(I,LM)
0065                N(I)=NN(I,LM)
0066          17    CONTINUE
0067                NNN=NNNN
0068                M=INT(NNN*P(L))
0069                ZNK=NNN*P(L)
0070                ZN=M
0071                IF(ZNK-ZN.LE.0.5) GO TO 148
0072                M=M+1
0073          148   CONTINUE
0074                SUM=0
0075                I1=R(1)
0076          C
0077          C.....
0078          C   THE NEXT STATEMENTS CALCULATE THE PROBABILITY THAT
0079          C   THERE ARE (I-1) DEFECTIVES IN THE FIRST SAMPLE.
0080          C.....
0081          C
0082                DO 20 I=1,I1
0083                V(I,1)=PP(N(1),P(L),I-1)
0084          20    SUM=SUM+V(I,1)
0085                V(R(1)+1,1)=1.-SUM
0086                IF(A(1).LE.0) GO TO 21
0087                I1=A(1)
0088          C
0089          C.....
0090          C  THE FOLLOWING STATMENTS CALCULATE THE PROB. THAT THERE
0091          C  ARE LESS THAN OR EQUAL TO A(1) DEFECTIVE ITEMS.
0092          C.....
0093          C
0094                DO 30 I=1,I1
0095          C
0096          C.....
0097          C  THE NEXT SECTION CALCULATES THE INTERMEDIATE PROBABILITIES
0098          C  OF CONTINUED SAMPLING FOR THE DOUBLE SAMPLING PLANS.
0099          C.....
0100          C
0101
0102          30    V(A(1)+1,1)=V(A(1)+1,1)+V(I,1)
0103          21    IF(J.EQ.1) GO TO 41
0104                LOW  =1
0105                I=2
0106                NNN=NNN-N(I-1)
0107                NR=R(I)
0108                LOW=MAXO(LOW,A(I-1)+2)
0109                HI=R(I-1)
0110                DO 60 I1=1,NR
0111                V(I1,I)=0
0112                IF(I1.LT.LOW) GO TO 60
0113                IF(A(I).EQ.(-1)) GO TO 61
0114                IF(A(I)+1.NE.I1) GO TO 61
```

```
0115                MMM=MINO(I1,HI)
0116                DO 70 I2=LOW   ,MMM
0117                I4=I1-I2+1
0118                DO 50 II=1,NR
0119                PR(II)=PP(N(I),P(L),II-1,NNN,M-I2+1)
0120          50    CONTINUE
0121                DO 80 I3=1,I4
0122          80    V(I1,I)=V(I1,I)+V(I2,I-1)*PR(I3)
0123          70    CONTINUE
0124                GO TO 60
0125          61    MMM=MINO(HI,I1)
0126                DO 90 I2=LOW      ,MMM
0127                I3=I1-I2+1
0128                DO 743 IJ=1,NR
0129         743    PR(IJ)=PP(N(I),P(L),IJ-1)
0130          90    V(I1,I)=V(I1,I)+V(I2,I-1)*PR(I3)
0131          60    CONTINUE
0132                V(R(I)+1,I)=0
0133                DO 110 I1=LOW   ,HI
0134                SUM=0
0135                I3=R(I)-I1+1
0136                DO 120 I2=1,I3
0137         120    SUM=SUM+PR(I2)
0138         110    V(R(I)+1,I)=V(R(I)+1,I)+(1.-SUM)*V(I1,I-1)
0139          41    CONTINUE
0140     C
0141     C.....
0142     C   THE  NEXT SECTION EVALUATES THE SCHEME FOR THE SINGLE
0143     C   SAMPLING PLAN (OR THE FIRST STAGE IN DOUBLE SAMPLING).
0144     C.....
0145     C
0146          121    ASN(L,LM)=0
0147                 TPA(L,LM)=0
0148                 SS=0
0149                 DO 130 I=1,J
0150                 SS=SS+N(I)
0151                 IF(A(I).EQ.(-1)) GO TO 131
0152                 ASN(L,LM)=ASN(L,LM)+(V(A(I)+1,I)+V(R(I)+1,I))*SS
0153                 TPA(L,LM)=TPA(L,LM)+V(A(I)+1,I)
0154                 GO TO 130
0155          131    ASN(L,LM)=ASN(L,LM)+V(R(I)+1,I)*SS
0156          130    CONTINUE
0157                 XXX=0
0158                 SSS=0
0159                 VVV=0
0160                 DO 133 I=1,J
0161                 SSS=SSS+N(I)
0162                 XXX=XXX+SSS*V(A(I)+1,I)
0163                 VVV=VVV+(NNNN-SSS)*V(A(I)+1,I)
0164         133      CONTINUE
0165                 ATI(L,LM)=XXX+(NNNN*(1.0-TPA(L,LM)))
0166                 AOQ(L,LM)=(VVV*P(L))/NNNN
0167          140    CONTINUE
0168           10    CONTINUE
0169           19    FORMAT(10X,F5.3,2X,F9.4,F10.2,4X,F6.4,1X,F10.2)
0170           27    FORMAT(///,16X,'SCHEME OPERATING CHARACTERISTICS ',/,10X
0171              $  ,'P          P(A)          ASN          AOQ          ATI')
```

```
0172              DO 1 I = 1,20
0173              DO 1 JJ=1,20
0174        1     TM(I,JJ)=0
0175        C
0176        C
0177        C   THIS SECTION FIRST CALCULATES THE PROB. OF BEING
0178        C   IN NORMAL,TIGHTENED OR REDUCED INSPECTION LEVELS AND
0179        C   THEN COMPUTES THE PROB. OF PASSING THE LIMIT NUMBER
0180        C   CRITERIA.
0181        C
0182        C
0183              T=TPA(L,1)
0184              S=TPA(L,2)
0185              RR1=TPA(L,3)
0186              R1=TPA(L,4)
0187              NZ=10*ASN(L,2)
0188              CALL LNM(AQL,NZ,LNC)
0189              Q=B(NZ,P(L),LNC)
0190        C
0191        C
0192        C   THIS SECTION READS IN THE PROBABILITY TRANSITION MATRIX.
0193        C
0194        C
0195              TM(1,1)=1.-T
0196              TM(1,2)=T
0197              TM(2,1)=1.-T
0198              TM(2,3)=T
0199              TM(3,1)=1.-T
0200              TM(3,4)=T
0201              TM(4,1)=1.-T
0202              TM(4,5)=T
0203              TM(5,1)=1.-T
0204              TM(5,6)=T
0205              TM(6,7)=1.-S
0206              TM(6,11)=S
0207              TM(7,1)=1.-S
0208              TM(7,8)=S
0209              TM(8,1)=1.-S
0210              TM(8,9)=S
0211              TM(9,1)=1.-S
0212              TM(9,10)=S
0213              TM(10,1)=1.-S
0214              TM(10,14)=S
0215              TM(11,7)=1.-S
0216              TM(11,12)=S
0217              TM(12,7)=1.-S
0218              TM(12,13)=S
0219              TM(13,7)=1.-S
0220              TM(13,14)=S
0221              TM(14,7)=1.-S
0222              TM(14,15)=S
0223              TM(15,7)=1.-S
0224              TM(15,16)=S
0225              TM(16,7)=1.-S
0226              TM(16,17)=S
0227              TM(17,7)=1.-S
0228              TM(17,18)=S
```

```
0229                TM(18,17)=1.-S
0230                TM(18,19)=S
0231                TM(19,7)=1.-S
0232                TM(19,19)=(1.-Q)*S
0233                TM(19,20)=Q*S
0234                TM(20,6)=1.-RR1
0235                TM(20,20)=RR1
0236                NR=20
0237                NC=20
0238                DO 100 I=1,NR
0239                DO 100 JJ=1,NC
0240                IF(JJ-I)111,15,111
0241             15 ZP(JJ,I)=TM(I,JJ)-1.0
0242                GO TO 100
0243            111 ZP(JJ,I)=TM(I,JJ)
0244            100 CONTINUE
0245                DO 115 I=2,NR
0246                DO 115 JJ=1,NC
0247                KL=I-1
0248                AQ(I,JJ)=ZP(KL,JJ)
0249            115 CONTINUE
0250                DO 18 JJ=1,NC
0251                AQ(1,JJ)=1.0
0252             18 CONTINUE
0253                CALL INVERT(NR,AQ,BQ)
0254                PA(L)=0
0255                ASNC(L)=0
0256                AOQC(L)=0
0257                ATIC(L)=0
0258                DO 161 I=1,NR
0259                IF(I.GT.5)GO TO 200
0260                ZZ=T
0261                Z1=ASN(L,1)
0262                Z2=AOQ(L,1)
0263                Z3=ATI(L,1)
0264                GO TO 201
0265            200 IF(I.GT.19) GO TO 210
0266                ZZ=S
0267                Z1=ASN(L,2)
0268                Z2=AOQ(L,2)
0269                Z3=ATI(L,2)
0270                GO TO 201
0271            210 ZZ=R1
0272                Z1=ASN(L,4)
0273                Z2=AOQ(L,4)
0274                Z3=ATI(L,4)
0275          C
0276          C.....
0277          C   THE FOLLOWING STATEMENTS MULTIPLY THE PROBABILITIES
0278          C   OF BEING IN THE VARIOUS STATES BY THE CHARACTERISTICS
0279          C   OF EACH STATE.
0280          C.....
0281          C
0282            201   PA(L)=PA(L)+BQ(I,1)*ZZ
0283                ASNC(L)=ASNC(L)+BQ(I,1)*Z1
0284                AOQC(L)=AOQC(L)+BQ(I,1)*Z2
0285                ATIC(L)=ATIC(L)+BQ(I,1)*Z3
```

```
0286                AFI(L)=ATIC(L)/NNNN
0287          161   CONTINUE
0288                IF(XTC.NE.2) GO TO 105
0289                 WRITE(1,19) P(L),PA(L),ASNC(L),AOQC(L),AFI(L)
0290                 WRITE(5,19) P(L),PA(L),ASNC(L),AOQC(L),AFI(L)
0291          105   CONTINUE
0292                IF(XTC.EQ.2) GO TO 556
0293                WRITE(1,45)
0294                WRITE(5,45)
0295                WRITE(1,46)
0296                WRITE(5,46)
0297                CALL PLOTOC(P,PA)
0298                 WRITE(1,47)
0299                 WRITE(5,47)
0300                CALL PLOTOC(P,ASNC)
0301                  WRITE(1,48)
0302                  WRITE(5,48)
0303                CALL PLOTOC(P,AOQC)
0304                 WRITE(1,49)
0305                 WRITE(5,49)
0306                CALL PLOTOC(P,AFI)
0307           45   FORMAT(1H1,50X,'OPERATING CHARACTERISTIC CURVE')
0308           46   FORMAT(53X,'PROBABILITY OF ACCEPTANCE')
0309           47   FORMAT(1H1,50X,'AVERAGE SAMPLE NUMBER')
0310           48   FORMAT(1H1,50X,'AVERAGE OUTGOING QUALITY')
0311           49   FORMAT(1H1,50X,'AVERAGE FRACTION INSPECTED')
0312                 GO TO 898
0313          556   CONTINUE
0314                WRITE(1,555),LNC
0315                WRITE(5,555),LNC
0316          555   FORMAT(10X,'LIMIT NUMBER FOR REDUCED INSPECTION IS:',I9)
0317          898   RETURN
0318                END
```

```
0001                FUNCTION PP(N,P,K)
0002                Q=1. -P
0003                PP=Q**N
0004               IF(K.EQ.0)RETURN
0005               DO 20 I=1,K
0006          20   PP=PP*P*(N-I+1)/(Q*I)
0007               RETURN
0008               END
```

```
0001                FUNCTION B(N,P,K)
0002                PN=P*N
0003                Q=1.-P
0004                IF(PN.GT.0.) GO TO 1
0005                B=EXP(-PN)
0006                Z=EXP(-PN)
0007                IF(K.EQ.0) RETURN
0008                DO 10 I=1,K
0009                Z=Z*PN/I
0010          10    B=B+Z
0011                RETURN
0012           1    B=Q**N
0013                Z=Q**N
0014                IF(K.EQ.0)RETURN
0015                DO 20 I=1,K
0016                Z=Z*(N-I+1)*P/(Q*I)
0017          20    B=B+Z
0018                RETURN
0019                END
```

```
0001            SUBROUTINE  INVERT(NR,AQ,BQ)
0002      C
0003      C*************************************************************
0004      C**   THIS SUBROUTINE INVERTS THE MATRIX BY GAUSSIAN       **
0005      C**   ELIMINATION.                                         **
0006      C*************************************************************
0007      C
0008            REAL*8 AQ(20,20),BQ(20,20),ZTAMP,ATEMP
0009            DO 15 I=1,NR
0010            DO 10 J=1,NR
0011       10   BQ(I,J)=0.0
0012       15   BQ(I,I)=1.0
0013            DO 35 I=1,NR
0014            ZTAMP=AQ(I,I)
0015            DO 20 J=1,NR
0016            AQ(I,J)=AQ(I,J)/ZTAMP
0017       20   BQ(I,J)=BQ(I,J)/ZTAMP
0018            DO 30 II=1,NR
0019            IF(I.EQ.II) GO TO 30
0020            ATEMP=AQ(II,I)
0021            DO 25 J=1,NR
0022            AQ(II,J)=AQ(II,J)-AQ(I,J)*ATEMP
0023       25   BQ(II,J)=BQ(II,J)-BQ(I,J)*ATEMP
0024       30   CONTINUE
0025       35   CONTINUE
0026            RETURN
0027            END
```

```
0001            SUBROUTINE PLOTOC(P,T)
0002      C
0003      C*****************************************************************
0004      C**   THIS SUBROUTINE PLOTS OC, ASN, AOQ AND AFI CURVES FOR     **
0005      C**   THE FULL RANGE OF INCOMING FRACTION DEFECTIVE.            **
0006      C*****************************************************************
0007      C
0008            DIMENSION U(11),T(30),P(30),LINE(101)
0009            INTEGER ASTERK,BLANK,PLUS
0010            DATA ASTERK,BLANK,PLUS/'*',' ','+'/
0011            DO 1 K=1,101
0012          1 LINE(K)=BLANK
0013            XMAX=T(1)
0014            XMIN=T(1)
0015            DO 2 I=1,21
0016            IF(T(I).LT.XMIN) XMIN=T(I)
0017            IF(T(I).GT.XMAX) XMAX=T(I)
0018          2 CONTINUE
0019            IF(XMAX.LT.1) XMIN=0
0020            RANGE=XMAX-XMIN
0021            RG=RANGE/10
0022            U(1)=XMIN
0023            DO 3 I=2,11
0024          3 U(I)=U(I-1)+RG
0025              WRITE(1,130)(U(I),I=1,11)
0026              WRITE(5,130)(U(I),I=1,11)
0027            DO 4 K=1,101,10
0028          4 LINE(K)=PLUS
0029              WRITE(1,100)(LINE(K),K=1,101)
0030              WRITE(5,100)(LINE(K),K=1,101)
0031            DO 6 K=1,21
0032            DO 5 I=1,101
0033          5 LINE(I)=BLANK
0034            KPRINT=100*(T(K)-XMIN)/RANGE+1.5
0035            LINE(1)=PLUS
0036            LINE(KPRINT)=ASTERK
0037              WRITE(1,140)P(K),(LINE(I),I=1,101)
0038              WRITE(5,140)P(K),(LINE(I),I=1,101)
0039          6 CONTINUE
0040        100   FORMAT(4X,'PERCENT DEFECTIVE',101A1)
0041        130   FORMAT(12X,11(2X,E8.3))
0042        140   FORMAT(17X,F4.3,101A1)
0043              RETURN
0044              END
```

```
0001            SUBROUTINE LNM(AQL,NZ,LNC)
0002      C
0003      C*************************************************
0004      C**     THIS SUBROUTINE FINDS THE LIMIT NUMBER   **
0005      C**     FOR REDUCED INSPECTION.                  **
0006      C*************************************************
0007      C
0008            LNC=222
0009            IF(NZ.LE.29.AND.AQL.LE.15) LNC=0
0010            IF(NZ.GE.30.AND.NZ.LE.49.AND.AQL.LE.10) LNC=0
0011            IF(NZ.GE.50.AND.NZ.LE.79.AND.AQL.LE.6.5) LNC=0
0012            IF(NZ.GE.80.AND.NZ.LE.129.AND.AQL.LE.4.0) LNC=0
0013            IF(NZ.GE.130.AND.NZ.LE.199.AND.AQL.LE.2.5) LNC=0
0014            IF(NZ.GE.200.AND.NZ.LE.319.AND.AQL.LE.1.5) LNC=0
0015            IF(NZ.GE.320.AND.NZ.LE.499.AND.AQL.LE.1.0) LNC=0
0016            IF(NZ.GE.500.AND.NZ.LE.799.AND.AQL.LE.0.65) LNC=0
0017            IF(NZ.GE.800.AND.NZ.LE.1249.AND.AQL.LE.0.40) LNC=0
0018            IF(NZ.GE.1250.AND.NZ.LE.1999.AND.AQL.LE.0.25)LNC=0
0019            IF(NZ.GE.2000.AND.NZ.LE.3149.AND.AQL.LE.0.15)LNC=0
0020            IF(NZ.GE.3150.AND.NZ.LE.4999.AND.AQL.LE.0.10)LNC=0
0021            IF(NZ.GE.5000.AND.NZ.LE.7999.AND.AQL.LE.0.065)LNC=0
0022            IF(NZ.GE.8000.AND.NZ.LE.12499.AND.AQL.LE.0.040)LNC=0
0023            IF(NZ.GE.12500.AND.NZ.LE.19999.AND.AQL.LE.0.025)LNC=0
0024            IF(NZ.GE.20000.AND.NZ.LE.31499.AND.AQL.LE.0.015)LNC=0
0025            IF(NZ.GE.31500.AND.NZ.LE.49999.AND.AQL.EQ.0.010)LNC=0
0026            IF(LNC.EQ.0) GO TO 10
0027            IF(NZ.LE.29)THEN
0028                  IF(AQL.EQ.25)LNC=2
0029                  IF(AQL.EQ.40)LNC=4
0030                  IF(AQL.EQ.65)LNC=8
0031                  IF(AQL.EQ.100)LNC=14
0032            ENDIF
0033            IF(NZ.GE.30.AND.NZ.LE.49)THEN
0034                  IF(AQL.EQ.15)LNC=1
0035                  IF(AQL.EQ.25)LNC=3
0036                  IF(AQL.EQ.40)LNC=7
0037                  IF(AQL.EQ.65)LNC=13
0038                  IF(AQL.EQ.100)LNC=22
0039            ENDIF
0040            IF(NZ.GE.50.AND.NZ.LE.79)THEN
0041                  IF(AQL.EQ.10)LNC=2
0042                  IF(AQL.EQ.15)LNC=3
0043                  IF(AQL.EQ.25)LNC=7
0044                  IF(AQL.EQ.40)LNC=14
0045                  IF(AQL.EQ.65)LNC=25
0046                  IF(AQL.EQ.100)LNC=40
0047            ENDIF
0048            IF(NZ.GE.80.AND.NZ.LE.129)THEN
0049                  IF(AQL.EQ.6.5)LNC=2
0050                  IF(AQL.EQ.10)LNC=4
0051                  IF(AQL.EQ.15)LNC=7
0052                  IF(AQL.EQ.25)LNC=14
0053                  IF(AQL.EQ.40)LNC=24
0054                  IF(AQL.EQ.65)LNC=42
0055                  IF(AQL.EQ.100)LNC=68
0056            ENDIF
0057            IF(NZ.GE.130.AND.NZ.LE.199)THEN
```

```
0058                IF(AQL.EQ.4.0)LNC=5
0059                IF(AQL.EQ.6.5)LNC=9
0060                IF(AQL.EQ.10)LNC=7
0061                IF(AQL.EQ.15)LNC=13
0062                IF(AQL.EQ.25)LNC=25
0063                IF(AQL.EQ.40)LNC=42
0064                IF(AQL.EQ.65)LNC=72
0065                IF(AQL.EQ.100)LNC=115
0066              ENDIF
0067              IF(NZ.GE.200.AND.NZ.LE.319)THEN
0068                IF(AQL.EQ.2.5)LNC=2
0069                IF(AQL.EQ.4.0)LNC=4
0070                IF(AQL.EQ.6.5)LNC=8
0071                IF(AQL.EQ.10)LNC=14
0072                IF(AQL.EQ.15)LNC=22
0073                IF(AQL.EQ.25)LNC=40
0074                IF(AQL.EQ.40)LNC=68
0075                IF(AQL.EQ.65)LNC=115
0076                IF(AQL.EQ.100)LNC=181
0077              ENDIF
0078              IF(NZ.GE.320.AND.NZ.LE.499)THEN
0079                IF(AQL.EQ.1.5)LNC=1
0080                IF(AQL.EQ.2.5)LNC=4
0081                IF(AQL.EQ.4)LNC=8
0082                IF(AQL.EQ.6.5)LNC=14
0083                IF(AQL.EQ.10)LNC=24
0084                IF(AQL.EQ.15)LNC=39
0085                IF(AQL.EQ.25)LNC=68
0086                IF(AQL.EQ.65)LNC=113
0087                IF(AQL.EQ.100)LNC=189
0088              ENDIF
0089              IF(NZ.GE.500.AND.NZ.LE.799)THEN
0090                IF(AQL.EQ.1.0)LNC=2
0091                IF(AQL.EQ.1.5)LNC=3
0092                IF(AQL.EQ.2.5)LNC=7
0093                IF(AQL.EQ.4.0)LNC=14
0094                IF(AQL.EQ.6.5)LNC=25
0095                IF(AQL.EQ.10)LNC=40
0096                IF(AQL.EQ.15)LNC=63
0097                IF(AQL.EQ.25)LNC=110
0098                IF(AQL.EQ.40)LNC=181
0099              ENDIF
0100              IF(NZ.GE.800.AND.NZ.LE.1249)THEN
0101                IF(AQL.EQ.0.65)LNC=2
0102                IF(AQL.EQ.1.0)LNC=4
0103                IF(AQL.EQ.1.5)LNC=7
0104                IF(AQL.EQ.2.5)LNC=14
0105                IF(AQL.EQ.4.0)LNC=24
0106                IF(AQL.EQ.6.5)LNC=42
0107                IF(AQL.EQ.10)LNC=68
0108                IF(AQL.EQ.15)LNC=105
0109                IF(AQL.EQ.25)LNC=181
0110              ENDIF
0111              IF(NZ.GE.1250.AND.NZ.LE.1999)THEN
0112                IF(AQL.EQ.0.40)LNC=2
0113                IF(AQL.EQ.0.65)LNC=4
0114                IF(AQL.EQ.1.0)LNC=7
```

```
0115              IF(AQL.EQ.1.5)LNC=110
0116              IF(AQL.EQ.2.5)LNC=24
0117              IF(AQL.EQ.4.0)LNC=40
0118              IF(AQL.EQ.6.5)LNC=69
0119              IF(AQL.EQ.10)LNC=110
0120              IF(AQL.EQ.15)LNC=169
0121            ENDIF
0122            IF(NZ.GE.2000.AND.NZ.LE.3149)THEN
0123                  IF(AQL.EQ.0.25)LNC=2
0124                  IF(AQL.EQ.0.40)LNC=4
0125                  IF(AQL.EQ.0.65)LNC=8
0126                  IF(AQL.EQ.1.0)LNC=14
0127                  IF(AQL.EQ.1.5)LNC=22
0128                  IF(AQL.EQ.2.5)LNC=40
0129                  IF(AQL.EQ.4.0)LNC=68
0130                  IF(AQL.EQ.6.5)LNC=105
0131                  IF(AQL.EQ.10)LNC=181
0132            ENDIF
0133            IF(NZ.GE.3150.AND.NZ.LE.4999)THEN
0134                  IF(AQL.EQ.0.15)LNC=1
0135                  IF(AQL.EQ.0.25)LNC=4
0136                  IF(AQL.EQ.0.40)LNC=8
0137                  IF(AQL.EQ.0.65)LNC=14
0138                  IF(AQL.EQ.1.0)LNC=24
0139                  IF(AQL.EQ.1.5)LNC=38
0140                  IF(AQL.EQ.2.5)LNC=67
0141                  IF(AQL.EQ.4.0)LNC=111
0142                  IF(AQL.EQ.6.5)LNC=186
0143            ENDIF
0144            IF(NZ.GE.5000.AND.NZ.LE.7999)THEN
0145                  IF(AQL.EQ.0.10)LNC=2
0146                  IF(AQL.EQ.0.15)LNC=3
0147                  IF(AQL.EQ.0.25)LNC=7
0148                  IF(AQL.EQ.0.40)LNC=14
0149                  IF(AQL.EQ.0.65)LNC=25
0150                  IF(AQL.EQ.1.0)LNC=40
0151                  IF(AQL.EQ.1.5)LNC=63
0152                  IF(AQL.EQ.2.5)LNC=110
0153                  IF(AQL.EQ.4.0)LNC=181
0154            ENDIF
0155            IF(NZ.GE.8000.AND.NZ.LE.12499)THEN
0156                  IF(AQL.EQ.0.065)LNC=2
0157                  IF(AQL.EQ.0.10)LNC=4
0158                  IF(AQL.EQ.0.15)LNC=7
0159                  IF(AQL.EQ.0.25)LNC=14
0160                  IF(AQL.EQ.0.40)LNC=24
0161                  IF(AQL.EQ.0.65)LNC=42
0162                  IF(AQL.EQ.1.0)LNC=68
0163                  IF(AQL.EQ.1.5)LNC=105
0164                  IF(AQL.EQ.2.5)LNC=181
0165            ENDIF
0166            IF(NZ.GE.12500.AND.NZ.LE.19999)THEN
0167                  IF(AQL.EQ.0.040)LNC=2
0168                  IF(AQL.EQ.0.065)LNC=4
0169                  IF(AQL.EQ.0.10)LNC=7
0170                  IF(AQL.EQ.0.15)LNC=13
0171                  IF(AQL.EQ.0.25)LNC=24
```

```
                    IF(AQL.EQ.0.40)LNC=40
                    IF(AQL.EQ.0.65)LNC=69
                    IF(AQL.EQ.1.0)LNC=110
                    IF(AQL.EQ.1.5)LNC=169
                ENDIF
                IF(NZ.GE.20000.AND.NZ.LE.31499)THEN
                    IF(AQL.EQ.0.025)LNC=2
                    IF(AQL.EQ.0.040)LNC=4
                    IF(AQL.EQ.0.065)LNC=8
                    IF(AQL.EQ.0.10)LNC=14
                    IF(AQL.EQ.0.15)LNC=22
                    IF(AQL.EQ.0.25)LNC=40
                    IF(AQL.EQ.0.40)LNC=68
                    IF(AQL.EQ.0.65)LNC=115
                    IF(AQL.EQ.1.0)LNC=181
                ENDIF
                IF(NZ.GE.31500.AND.NZ.LE.49999)THEN
                    IF(AQL.EQ.0.015)LNC=1
                    IF(AQL.EQ.0.025)LNC=4
                    IF(AQL.EQ.0.040)LNC=8
                    IF(AQL.EQ.0.065)LNC=14
                    IF(AQL.EQ.0.10)LNC=24
                    IF(AQL.EQ.0.15)LNC=38
                    IF(AQL.EQ.0.25)LNC=67
                    IF(AQL.EQ.0.40)LNC=111
                    IF(AQL.EQ.0.65)LNC=186
                ENDIF
                IF(NZ.GE.50000)THEN
                    IF(AQL.EQ.0.010)LNC=2
                    IF(AQL.EQ.0.015)LNC=3
                    IF(AQL.EQ.0.025)LNC=7
                    IF(AQL.EQ.0.040)LNC=14
                    IF(AQL.EQ.0.065)LNC=25
                    IF(AQL.EQ.0.10)LNC=40
                    IF(AQL.EQ.0.15)LNC=63
                    IF(AQL.EQ.0.25)LNC=110
                    IF(AQL.EQ.0.40)LNC=181
                    IF(AQL.EQ.0.65)LNC=301
                 ENDIF
    10          CONTINUE
                RETURN
                END
```

Program PROBS1.FOR

```
0001            SUBROUTINE PROBS1(NN,P,Q,BXLEC
0002      C*****************************************************
0003      C       THIS SUBROUTINE COMPUTES CUMULATIVE BINOMIAL
0004      C       PROBABILITIES
0005      C*****************************************************
0006            INTEGER C
0007            DOUBLE PRECISION SUMLOG
0008      C
0009            COMMON/BLK7/SUMLOG(4000)
0010            COMMON/BLK8/N
0011      C
0012            Q=1.-P
0013      C*****************************************************
0014      C           BINOMIAL PROB. WHEN C=0
0015      C*****************************************************
0016            CSUMS=Q**NN
0017            IF (C.EQ.0) GOTO 45
0018      C*****************************************************
0019      C       AVOID RECOMPUTING SUMLOG(I)'S ALREADY IN MEMORY
0020      C*****************************************************
0021            IF (N-NN) 10,25,25
0022         10 M=NN+1
0023      C*****************************************************
0024      C           COMPUTE N SUMLOGS-EQUIVALENT TO N-FACTORIAL
0025      C*****************************************************
0026            IF (M.GT.1) GOTO 15
0027            SUMLOG(1)=0.
0028            IF(NN.LE.1) GOTO 25
0029            M=2
0030         15 DO 20 I=M,NN
0031               SUMLOG(I)=DLOG10(DFLOAT(I))+SUMLOG(I-1)
0032         20 CONTINUE
0033      C*****************************************************
0034      C           COMPUTE C SUMS-EQUIVALENT TO SSUM OF PROB.COMPIN.
0035      C           I.E. CUMULATIVE BINOMIAL DISTRIBUTION COMPUTATION
0036      C*****************************************************
0037         25 IF(NN.GT.N) N=NN
0038      C*****************************************************
0039      C           DETERMINE BEST NUMBER HANDLING LOOP
0040      C*****************************************************
0041            IF (NN.GT.300) GOTO 35
0042            DO 30 K=1,C
0043               CSUMS=10.**(SUMLOG(NN)-SUMLOG(NN-K)-SUMLOG(K))
0044           1                  *P**K*Q**(NN-K)+CSUMS
0045         30 CONTINUE
0046            GOTO 45
0047      C*****************************************************
0048      C           LOOP FOR LARGE EXPONENTS
0049      C*****************************************************
0050         35 DO 40 K=1,C
0051               CSUMS=10.**(SUMLOG(NN)-SUMLOG(NN-K)-SUMLOG(K)
0052           1     +K*DLOG10(DBLE(P))+(NN-K)*DLOG10(DBLE(Q)))+CSUMS
0053         40 CONTINUE
0054      C
0055         45 BXLEC = CSUMS
0056            RETURN
0057            END
```

Program PROBD1.FOR

```
0001            SUBROUTINE PROBD1(N1,N2,P,DPROB,C1,C2)
0002      C*****************************************************************
0003      C       THIS SUBROUTINE COMPUTES DOUBLE PROBABILITIES FOR
0004      C       COMPUTING SECOND SAMPLE NUMBER OF DOUBLE SAMPLING NUMBER
0005      C*****************************************************************
0006            COMMON/BLK6/C1,C2
0007            INTEGER C1,C2,R1
0008      C
0009            IF(K.EQ.1) CALL PROBS1(N1,P,C1,BXLEC)
0010            IF(K.EQ.2) CALL PROBS2(N1,P,C1,BXLEC)
0011            DPROB=BXLEC
0012            TEMP=BXLEC
0013            NTEMP=C1+1
0014            KTEMP=R1-1
0015            DO 10 IX=NTEMP,KTEMP
0016                J=IX
0017                I=C2-I
0018                IF(K.EQ.1) CALL PROBS1(N1,P,I,BXLEC)
0019                IF(K.EQ.2) CALL PROBS2(N1,P,I,BXLEC)
0020                PROB1=BXLEC-TEMP
0021                TEMP=BXLEC
0022                IF(K.EQ.1) CALL PROBS1(N2,P,J,BXLEC)
0023                IF(K.EQ.2) CALL PROBS2(N2,P,J,BXLEC)
0024                DPROB=DPROB+(PROB1*BXLEC)
0025           10 CONTINUE
0026      C
0027            RETURN
0028            END
```

END

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