INTERNATIONAL FORUM

A VISUAL BASIC PROGRAM TO DETERMINE WALD'S SEQUENTIAL SAMPLING PLAN

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1. INTRODUCTION

In many engineering and quality control studies, such as in lot-to-lot acceptance inspection, in exploratory chemical and physical research, and in Monte Carlo computer simulation, the sample size is not fixed in advance, but is determined in part by the results of the sampling process. A study of this type is called sequential and was first proposed by Wald (1947). Sequential tests of hypotheses are now widely recognized as the most efficient means for comparing treatment effects. It has been estimated that in testing hypotheses sequential sampling commonly reduces the required sample size on the average to approximately 50 percent of that required by a single sampling plan of comparable discriminating power. For instance, suppose the effects of two treatments differ at least by a given amount; and the risks of type I and type II errors are fixed by α and β, respectively. In sequential trials, instead of repeating the experiment at a given number of times, we check after each trial whether we have by now sufficient information to reach a conclusion, i.e., we carry out exactly as many trials as necessary to determine with risks α and β which of the two treatments is superior to the other. The advantages of this procedure are obvious when the single experiments are costly and time consuming; but it is also valuable when the number of observations is limited. For example, in many quality engineering experiments, when a group of specimens are prepared and tested, the cost of preparation, testing and measurement may be so great that the use of a single sampling with a predetermined sample size may be almost prohibitive. On the basis of the results of each of the individual outcomes of one particular experiment, it is determined whether the trial or sequence of trials be continued or a decision can be reached. A general description of sequential sampling plans can be found in Wald (1947) and in many other texts such as Bowker and Lieberman (1972), Doty (1996), Duncan (1989), Ghosh (1970), Ghosh and Sen (1991), Grant and Leavenworth (1980), Guenther (1978), Hald (1981), McWilliams (1989), Mittag and Rinne (1993), Montgomery (2001), Sarkadi and Vincze (1974), and Wetherill and Glazebrook (1986). The Visual BASIC program given here generates truncated Wald's sampling plan for specified values of the parameters characterising the plan. The program also computes exact operating characteristic (OC) and the average sample size (ASN) for specified values of the lot fraction defective.

2. CHARACTERIZATION OF PLAN

Wald's sequential sampling plans are generally specified by four parameters:

p_0: an acceptable lot fraction defective known as the AQL,

p_1: an unacceptable lot fraction defective known as the LTPD,

α: the probability of rejecting the lot at the AQL,

and

β: the probability of accepting the lot at the LTPD.

Using the four parameters p_0, p_1, α, and β the plan is determined by the acceptance and rejection lines given as follows:

$$a_n = -h_0 + sn$$

and

$$r_n = h_1 + sn,$$

where

$$h_0 = \frac{1}{k}\log_e\left(\frac{1-\alpha}{\beta}\right), \qquad h_1 = \frac{1}{k}\log_e\left(\frac{1-\beta}{\alpha}\right)$$

$$s = \frac{1}{k}\log_e\left(\frac{1-p_o}{1-p_1}\right), \qquad k = \log_e\left(\frac{p_1(1-p_o)}{p_0(1-p_1)}\right)$$

and n is the sample size.

A graphical representation of the plan is shown in Figure 1.

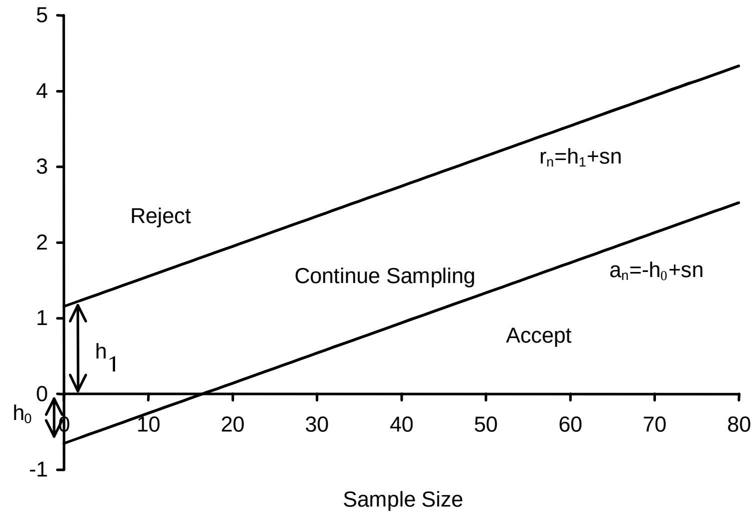

Figure 1. Sequential Sampling Chart.

The procedure for a sequential sampling technique is then to test each item to determine the cumulative total defective units. The lot is rejected as soon as the cumulative number of defective units falls above the upper limit line for a given sample size. Likewise the lot is accepted when the cumulative number of defective units falls below the lower limit line. If the cumulative number of defective units falls between the limit lines, the sampling is continued. For example, sample size of twenty dictates three choices; (i) the cumulative number of defectives equal to two or greater the lot is rejected, (ii) the cumulative number of defectives equal to zero the lot is accepted, and (iii) the cumulative number of defectives equal to one the sampling is continued.

Usually, the sequential plan is applied in tabular rather than graphical form. The numbers a_n and r_n are computed for every n and listed in a tabular form. Note that a_n is rounded down to the nearest integer and r_n is rounded up to the nearest integer. The acceptance and rejection numbers, as well as the results of observations, i.e., the cumulative number of defective items in an experiment are tabulated. An alternative and succinct way to apply the plan in a tabular form is as follows: if d_n is the number of defective items in "n" inspections, then lot is accepted if $d_n \le -h_0 + sn$ and rejected if $d_n \ge h_1 + sn$. Thus, to accept the lot, $n \ge (d_n + h_0)/s$ and to reject the lot $n \le (d_n - h_1)/s$. The plan, therefore, consists in computing and tabulating the sample acceptance and rejection numbers n_a and n_r from previous relations, i.e., $n_a = (d_n + h_0)/s$ and $n_r = (d_n - h_1)/s$ for successive values of d_n. The program uses this alternative form.

A sequential sampling plan does not provide any definite upper bound for the number of units to be inspected. In practice the number of items inspected occasionally may be very large, but the probability is very small that it will exceed three times its average value. Usually, the test is truncated at three times max{ASN(p_o), ASN(p_1), ASN(s)} or at the sample size of a single sampling plan passing through the same two designated points of the OC curve. (The program truncates the sampling by the former rule). For the largest possible sample size of a truncated test, the lot is accepted if the cumulative number of defective units is equal to or less than the sample size times "s" and otherwise it is rejected. If the truncation is carried out as indicated above, the effect of truncation on the OC curve is negligibly small, since the probability is nearly one that the regular sequential procedure will terminate before.

The sequential sampling leads to considerable reduction in sample size required. Wald and Wolfowitz (1948) have shown that no other attributes sampling plan with the same two points on the OC curve can have a smaller average sample number at those two points. For intermediate points, however, it is possible (but not likely) that sequential plan will give larger samples on the average than a single or double sampling plan. In general, it has been estimated that sequential sampling may reduce the average sample number to approximately 50 percent that required by a comparative single sampling plan.

3. OPERATING CHARACTERISTIC (OC)

An approximation to OC curve for the Wald sampling plan can be obtained from five values of the fraction defective including the two points defining the plan. These values and the corresponding probability of acceptance are :

p	**P(p)**
0	1
p_0	$1 - \alpha$
s*	$h_1/(h_0 + h_1)$
p_1	β
1	0

*** It can be shown that s lies always between p_0 and p_1 (see, e.g.; Duncan, 1989, pp. 967-968)**

The additional points for the OC curve can be obtained from the parametric equations:

$$p = \frac{1 - \left(\frac{1-p_1}{1-p_o}\right)^h}{\left(\frac{p_1}{p_o}\right)^h - \left(\frac{1-p_1}{1-p_o}\right)^h}$$

and (1)

$$P(p) = \frac{\left(\frac{1-\beta}{\alpha}\right)^h - 1}{\left(\frac{1-\beta}{\alpha}\right)^h - \left(\frac{\beta}{1-\alpha}\right)^h}, \qquad -\infty < h < \infty.$$

The five values of p given above, that is, p = 0, p_0, s, p_1 and 1 correspond to the values of $h = \infty, 1, 0, -1, -\infty$ respectively. To compute the OC curve it is not necessary to solve the equation in h. The formulas (1) are used by the program for the computation of the OC.

For any arbitrarily chosen value of h, the values of p and P(p) may be computed directly. Once the intercepts h_0 and h_1 and the common slope s of the decision lines have been determined, a computationally simpler form of parametric equations are:

$$p = \frac{h^s - 1}{h - 1}, \qquad h > 1$$

and

$$P(p) = \frac{h^{h_0+h_1} - h^{h_0}}{h^{h_0+h_1} - 1} .$$

As before, the points on the OC curve can be determined by substituting the values of h between 1 and ∞.

The exact OC curve of a truncated sequential plan can be obtained from the fact that such a plan is identical to the item-by-item multiple sampling and thus the probability of acceptance can be computed analogous to the case of a multiple sampling plan (see, e.g., Statistical Research Group, 1945, pp. 189-281; Hald, 1981, pp. 258-259; and Duncan, 1989, pp. 201-203). The process is simple enough and can be readily programmed if an orderly procedure is followed. The steps consist in calculating the probability of accepting, rejecting, and continuing after each observation. More explicitly, the OC may be computed by the formula:

$$P(p) = \sum_{i=1}^{n_o} P_a^{(i)}(p), \tag{2}$$

where

$$P_a^{(i+1)}(p) = \sum_{x=a_i+1}^{r_i-1} f_x^{(i)} \qquad i = 0,1,.......,n_o - 1,$$

$$f_x^{(i+1)} = \begin{cases} p\, f_{x-1}^{(i)} + (1-p)\, f_x^{(i)}, & a_i + 2 \le x \le r_i - 1 \\ 0, & \text{otherwise} \end{cases}$$

with

$$f_{a_i+1}^{(i+1)} = (1-p) f_{a_i+1}^{(i)},$$

$$f_{r_i}^{(i+1)} = p f_{r_i-1}^{(i)}$$

$$f_x^{(i+1)} = 0, \quad \text{otherwise}$$

and n_0 being the point of truncation.

4. AVERAGE SAMPLE NUMBER

An approximation to the average sample number (ASN) can also be obtained from the five values of the fraction defective including the two points defining the plan. As in the case of operating characteristics they are:

p	**ASN**
0	h_0/s
p_0	$[(1 - \alpha)h_0 - \alpha h_1]/(s - p_0)$
s	$h_0h_1/s(1-s)$
p_1	$[(1 - \beta)h_1 - \beta h_0]/(p_1 - s)$
1	$\mathbf{h_1/(1 - s)}$

The additional points for the ASN curve, if desired, can be obtained from the formula given below (see, e.g. Duncan, 1989, p. 199; Mittag and Rinne, 1993, p. 242; Wald, 1947, p. 53):

$$ASN = \frac{P(p)\log_e\left(\frac{\beta}{1-\alpha}\right) + [1-P(p)]\log_e\left(\frac{1-\beta}{\alpha}\right)}{p\log_e\left(\frac{p_1}{p_o}\right) + (1-p)\log_e\left(\frac{1-p_1}{1-p_o}\right)} . \qquad (3)$$

PROGRAM DESCRIPTION

A program has been written in VISUAL BASIC to perform the sequential sampling procedure. For consecutive values of the cumulative number of defectives, starting with zero, the program determines the sample size required to reach an accept or reject decision. If d_n is the cumulative number of defectives in n inspections, then the program computes $n_a = (d_n + h_0)/s$ and $n_r = (d_n + h_1)/s$. The lot is accepted if $n \geq n_a$ and rejected if $n \leq n_r$; otherwise the sampling is continued. If the regular sequential rule does not lead to a final decision for $n \leq 3\max\{(ASN(p_o), ASN(p_1), ASN(s)\}$ the procedure is truncated at this number. The program also computes the exact operating characteristics (OC) and the average sample number (ASN) of the plan corresponding to a prescribed value of the lot fraction defective, using the exact formulas (1) and (3). The program also prints the sequential sampling chart for a given data set similar to Figure 1.

The program requires the following four input parameters:

p_0: acceptable quality (quality for which acceptance is required) known as AQL,

p_1: unacceptable quality (quality for which rejection is desired) known as LTPD,

AL: the probability of rejecting the lot at AQL,

BT: the probability of accepting the lot at LTPD,

and

PD: lot fraction defective

The input parameters must satisfy the following conditions:

$$0 < p_0 < p_1 < 1$$

$$0 < BT < 1 - AL < 1.$$

The program checks these conditions and it will not run if the parameters are outside the given range.

The output parameters returned by the program are:

N: the vector containing number sampled,

ND: the vector containing consecutive values of cumulative number of defectives,

NA: the vector containing sample acceptance numbers; the lot will be accepted if the number of samples inspected to obtain the corresponding cumulative number of defectives is equal or greater than this number,

NR: the vector containing sample rejection numbers; the lot will be rejected if the number of samples inspected to obtain the corresponding cumulative number of defectives is equal to or less than this number,

PA: the probability of acceptance corresponding to the lot fraction defective equal to PD,

NCD: the sample size at which the procedure is truncated,

and

ASN: the average sample number corresponding to the lot fraction defective equal to PD.

5. NUMERICAL EXAMPLE

As an example, suppose p_0 = 0.01, p_1 = 0.10, AL = 0.05, and BT = 0.20. Table 1 contains the output of the sampling plan generated by the program. The column 1 of Table 1 gives the sample size, column 2 gives the minimum number of inspections required to accept the lot and column 3 gives the maximum number of inspections permitted to reject the lot. Table 2 contains output of the probability of acceptance (PA) and the average sample number (ASN) corresponding to the lot fraction defective PD. Figure 2 shows the window for output listing consisting of input parameters and output of the sequential sampling plan along with graph discussed in the example.

Table 1. Acceptance and Rejection Numbers for the Sequential Sampling Plan for $p_0 = 0.01$, $p_1 = 0.10$, $\alpha = 0.05$,and $\beta = 0.20$.

N	NA	NR	N	NA	NR	N	NA	NR
2	*	2	22	0	3	42	1	3
3	*	2	23	0	3	43	1	3
4	*	2	24	0	3	44	1	3
5	*	2	25	0	3	45	1	3
6	*	2	26	0	3	46	1	3
7	*	2	27	0	3	47	1	4
8	*	2	28	0	3	48	1	4
9	*	2	29	0	3	49	1	4
10	*	2	30	0	3	50	1	4
11	*	2	31	0	3	51	1	4
12	*	2	32	0	3	52	1	4
13	*	2	33	0	3	53	1	4
14	*	2	34	0	3	54	1	4
15	*	2	35	0	3	55	1	4
16	*	2	36	0	3	56	1	4
17	0	2	37	0	3	57	1	4
18	0	2	38	0	3	58	1	4
19	0	2	39	0	3	59	1	4
20	0	2	40	0	3			
21	0	2	41	0	3			

*No acceptance until 17 items have been inspected.

Table 2. Probability of Acceptance (PA) and the Average Sample Number (ASN) at Different Values of Lot Fraction Defective (PD).

h	PD	PA	ASN
1.0	0.010	0.95	18.81
0.8	0.014	0.92	19.35
0.6	0.018	0.88	19.83
0.4	0.024	0.81	20.13
0.2	0.031	0.73	20.11
0.0	0.040	0.64	19.69
-0.2	0.050	0.54	18.82
-0.4	0.061	0.44	17.60
-0.6	0.073	0.34	16.16
-0.8	0.086	0.26	14.66
-1.0	0.100	0.20	13.20

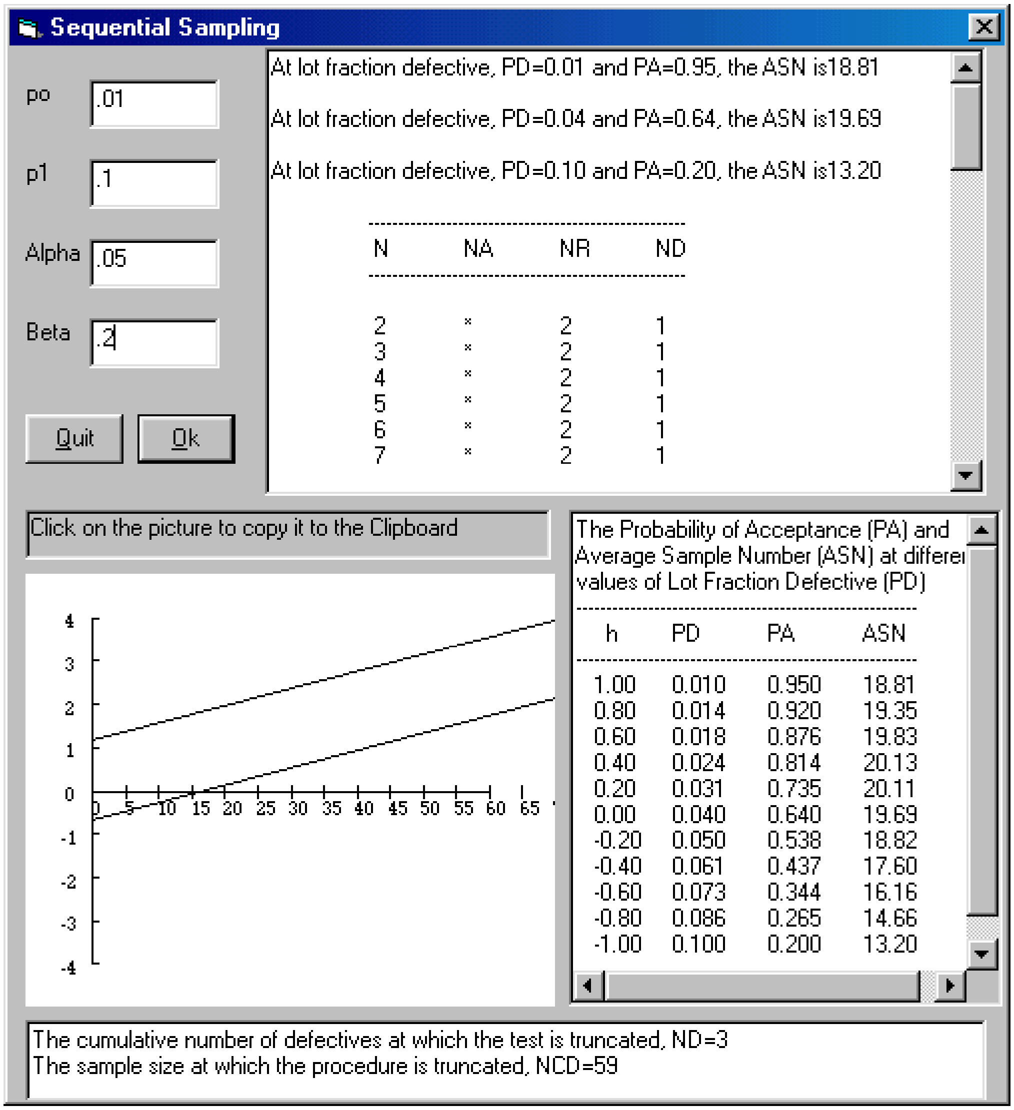

Figure 2. Window for Output Listing of Example.

6. APPENDIX

VISUAL BASIC PROGRAM LISTING

Program to calculate acceptance and rejection numbers of sequential sampling plan, along with the Probability of Acceptance (PA) and Average Sample Number (ASN) at different values of Lot Fraction Defective (PD)

```
Option Explicit
Dim a(), r() As Integer
Dim n As Integer
Dim h0, h1, s As Single
```

Input the values of Parameters po, p1, α and β. Program also checks the range of parameters

```
Private Sub cmdok_Click()
Dim po, p1, aL, b, pd, h, nup, dep, nupp, depp, nasn, dasn As Single
Dim a0, a1, b0, b1, k, P, PA, ASN As Single
Dim asnpo, asnp1, asns, PApo, PAp1, PAs, max As Single
Dim i As Integer
```

```
Dim str, astr, str1, str2 As String
If txtpo.Text = "" Or Val(txtpo.Text) < 0 Or Val(txtpo.Text) > 1 Then
txtpo.SetFocus
txtpo.SelStart = 0
txtpo.SelLength = Len(txtpo.Text)
lblmsg.Caption = "Value should be between 0 and 1"
Exit Sub
End If
If txtp1.Text = "" Or Val(txtp1.Text) < 0 Or Val(txtp1.Text) > 1 Then
txtp1.SetFocus
txtp1.SelStart = 0
txtp1.SelLength = Len(txtp1.Text)
lblmsg.Caption = "Value should be between" & Val(txtpo.Text) & "  and 1"
Exit Sub
End If
If txta.Text = "" Or Val(txta.Text) < 0 Or Val(txta.Text) > 1 Then
txta.SetFocus
txta.SelStart = 0
txta.SelLength = Len(txta.Text)
lblmsg.Caption = "Value should be between 0 and 1"
Exit Sub
End If
If txtb.Text = "" Or Val(txtb.Text) < 0 Or Val(txtb.Text) > 1 Then
txtb.SetFocus
txtb.SelStart = 0
txtb.SelLength = Len(txtb.Text)
lblmsg.Caption = "Value should be between 0 and " & (1 - Val(txta.Text))
Exit Sub
End If
po = Val(txtpo.Text)
p1 = Val(txtp1.Text)
aL = Val(txta.Text)
b = Val(txtb.Text)
```

Check the condition on parameters, i.e., $0<po<p1<1$ and $0<\beta<1<1-\alpha<1$

```
If po < 0 Or p1 < po Or p1 > 1 Then
MsgBox "Parameters po and p1 donot satisfy the condition ( 0 < po < p1 < 1 ), Change the values"
lblmsg.Caption = "Value should be between" & Val(txtpo.Text) & "  and 1"
txtp1.SetFocus
Exit Sub
End If
If b < 0 Or (1 - aL) < b Or (1 - aL) > 1 Then
MsgBox "Parameters Alpha and Beta donot satisfy the condition ( 0 < Beta < (1-Alpha) < 1 ), Change the values"
lblmsg.Caption = "Value should be between 0 and " & (1 - Val(txta.Text))
txtb.SetFocus
```

```
Exit Sub
End If
Picture1.Enabled = True
Picture1.BackColor = vbWhite
```

Calculation of Average Sample Number (ASN)

```
a0 = 1 - po: a1 = 1 - p1: b0 = 1 - aL: b1 = 1 - b
k = Log((p1 * a0) / (po * a1))
h0 = Log(b0 / b) / k
h1 = Log(b1 / aL) / k
s = Log(a0 / a1) / k
PApo = 1 - aL
PAp1 = b
PAs = h1 / (h0 + h1)
asnpo = (b0 * h0 - aL * h1) / (s - po)
asnp1 = (b1 * h1 - b * h0) / (p1 - s)
asns = (h1 * h0) / (s * (1 - s))
If asnpo > asnp1 Then GoTo L410
If asnp1 > asns Then GoTo L430
L400:
   max = asns: GoTo L450
L410:
   If asnpo > asns Then GoTo L440
   GoTo L400
L430:
   max = asnp1: GoTo L450
L440:
   max = asnpo
L450:
   n = Int(3 * max)
```

Printing of the output of Average Sample Number (ASN) at different values of Lot Fraction Defective

```
   ReDim a(n), r(n), ND(n) As Integer
   lblmsg.Caption = ""
   lblmsg.Caption = "Wait for a moment......"
MousePointer = 11
str = str & "At lot fraction defective, PD=" & Format(po, "0.##") & " and PA=" & Format(PApo, "0.##") & ", the ASN is" & Format$(asnpo, "###.##") & vbCrLf & vbCrLf
str = str & "At lot fraction defective, PD=" & Format(s, "0.##") & " and PA=" & Format(PAs, "0.##") & ", the ASN is" & Format$(asns, "###.##") & vbCrLf & vbCrLf
str = str & "At lot fraction defective, PD=" & Format(p1, "0.#0") & " and PA=" & Format(PAp1, "0.#0#") & ", the ASN is" & Format$(asnp1, "###.#0") & vbCrLf & vbCrLf
```

Calculations and printing of Acceptance & Rejection numbers along with cumulative number of defective

```
str = str & vbTab & "---------------------------------------------------" & vbCrLf
str = str & vbTab & " N" & vbTab & "NA" & vbTab & "NR" & vbTab & "ND" & vbCrLf
str = str & vbTab & "---------------------------------------------------" & vbCrLf
str = str & vbCrLf
```

```
Text1.Text = str
DoEvents
For i = 2 To n
 a(i) = Int(s * i - h0)
    r(i) = Int((h1 + s * i) + 1): ND(i) = r(i) - 1
If a(i) < 0 Then astr = "*" Else astr = a(i)
  str = str & vbTab & " " & i & vbTab & astr & vbTab & r(i) & vbTab & ND(i) & vbCrLf
Next i
Text1.Text = str
MousePointer = 0
 lblmsg.Caption = ""
 drw
```

Calculations and output of Probability of Acceptance (PA) and Average Sample Number (ASN) at different Lot Fraction Defective (PD)

```
 h = 1
str1 = str1 & "The Probability of Acceptance (PA) and" & vbCrLf
str1 = str1 & "Average Sample Number (ASN) at different" & vbCrLf
str1 = str1 & "values of Lot Fraction Defective (PD)" & vbCrLf
str1 = str1 & "-------------------------------------------------------" & vbCrLf
str1 = str1 & "     h" & vbTab & "PD" & vbTab & "PA" & vbTab & "ASN" & vbCrLf
str1 = str1 & "-------------------------------------------------------" & vbCrLf
L500:
nup = 1 - (a1 / a0) ^ h
dep = ((p1 / po) ^ h) - ((a1 / a0) ^ h)
P = nup / dep
nupp = (b1 / aL) ^ h - 1
depp = ((b1 / aL) ^ h) - ((b / b0) ^ h)
PA = nupp / depp
nasn = PA * Log(b / b0) + (1 - PA) * Log(b1 / aL)
dasn = P * Log(p1 / po) + (1 - P) * Log(a1 / a0)
ASN = nasn / dasn
str1 = str1 & "    " & Format(h, "0.#0") & vbTab & Format(P, "0.##0") & vbTab & Format(PA, "0.##0") & vbTab
& Format(ASN, "##.#0") & vbCrLf
h = h - 0.19999
If h > -1 Then GoTo L500
Text2.Text = str1
MousePointer = 0
 lblmsg.Caption = ""
 drw
```

Output of ND and NCD at which test is truncated

```
str2 = str2 & "The cumulative number of defectives at which the test is truncated, ND=" & ND(n) & vbCrLf
str2 = str2 & "The sample size at which the procedure is truncated, NCD=" & n & vbCrLf & vbCrLf
Text3.Text = str2
MousePointer = 0
lblmsg.Caption = ""
```

```
 drw
End Sub
```

Quit Program

```
Private Sub cmdquit_Click()
End
End Sub
```

Drawing the Sequential Sampling Plane

```
Private Sub Form_Load()
Picture1.BackColor = frmsampling.BackColor
Picture1.Enabled = False
End Sub
Private Sub Picture1_Click()
Clipboard.Clear
Clipboard.SetData Picture1.Image, vbCFBitmap
End Sub
Private Sub Picture1_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)
lblmsg.Caption = "Click on the picture to copy it to the Clipboard"
End Sub
Private Sub Text1_Click()
Clipboard.SetText Text1.Text
End Sub
Private Sub Text1_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)
lblmsg.Caption = "Click on the text box to copy text to the Clipboard"
End Sub
Private Sub txta_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)
lblmsg.Caption = "Probability of rejecting the lot at (po) , ( 0 < Alpha < 1 )"
End Sub
Private Sub txtb_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)
lblmsg.Caption = "Probability of accepting the lot at (p1), ( 0 < Beta < " & 1 - Val(txta.Text) & " )"
End Sub
Private Sub txtp1_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)
lblmsg.Caption = "Unacceptable lot fraction defective ( " & Val(txtpo.Text) & " < p1 < 1 )"
End Sub
Private Sub txtpd_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)
lblmsg.Caption = "The lot fraction defective for which the OC and ASN are required. , (0 < PD < 1 )"
End Sub
Private Sub txtpo_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)
lblmsg.Caption = "Acceptable lot fraction defective ( 0 < po < 1)"
End Sub
Private Sub drw()
Picture1.Cls
Dim m As Integer
Dim min, max, range, i, ini, scly, sclx, zero As Single
If n > 100 Then
m = 100
```

```
Else: m = Int(n / 10 + 1) * 10
End If
min = -h0 - 1
max = (h1 + s * m) + 1
range = 2 * max
scly = (Picture1.ScaleHeight - 300) / range
sclx = (Picture1.ScaleWidth - 1000) / m
ini = (Picture1.ScaleHeight - 300) / 2
Picture1.Line (500, ini + 150)-(Picture1.ScaleWidth - 500, ini + 150)
For i = 0 To 100 Step 5
Picture1.Line (500 + sclx * i, ini + 200)-(500 + sclx * i, ini + 100)
Picture1.PSet (450 + sclx * i, ini + 200), vbWhite
Picture1.Print i
Next
Picture1.Line (500, 150 + ini - scly * Int(-max + 1))-(500, 150 + ini - scly * Int(max))
For i = Int(-max + 1) To Int(max)
Picture1.Line (500, 150 + ini - scly * i)-(550, 150 + ini - scly * i)
Picture1.PSet (250, 100 + ini - scly * i), vbWhite
Picture1.Print i
Next
Picture1.Line (500, 150 + ini - scly * (-h0 + s * 0))-((100 * sclx) + 500, 150 + ini - scly * (-h0 + s * 100))
Picture1.Line (500, 150 + ini - scly * (h1 + s * 0))-((100 * sclx) + 500, 150 + ini - scly * (h1 + s * 100))
End Sub
```

REFERENCES

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