ABSTRACT: Many organizations collect data on specially designed forms for sales, orders, invoices, research, or other uses. One way to generate such forms is to work with a printing company, but this can be a time-consuming and costly process. A more efficient way is to produce the forms in-house using SAS/GRAPH GSLIDE procedure with the ANNOTATE feature. Rough drafts can be plotted quickly, adjustments can be made, and a final form can be ready to use in a short period. The advantage of this process is to have control of further changes and modifications.

GETTING STARTED

Have available a working copy of your desired form, either hand drawn or a copy of an existing form you wish to modify. This will expedite the form generation. Determine the size of the final form, then set SAS/GRAPH OPTIONS HSIZE and VSIZE accordingly. Once a final form size has been determined, a grid template plotted at the same size is essential. The grid template, plotted on transparency film, allows for easy overlay of the draft copy. Approximate X and Y coordinates can then be quickly determined when annotating lines and text. Refer to appendix 1 for the listing of the grid template sample program.

Using the SAS System to produce data collection forms solved the problem easily. Data forms can be quickly produced in-house, the final product has a camera-ready professional appearance, and modifications are quickly integrated into the form.
FUNCTION='MOVE' and FUNCTION='DRAW' (SAS 1985). Text is put in with FUNCTION='LABEL'.

MAKING FORMS

The most efficient way to generate a data form is to draw the skeletal lines of the form then add text later. Lines are produced using FUNCTION='MOVE' and FUNCTION='DRAW'. FUNCTION='MOVE' will move the plotter pen to the desired X and Y coordinate while FUNCTION='DRAW' will set the plotter pen onto the paper and draw a line to the X and Y coordinate used. The sequence of the observations within the data set is crucial to produce the desired output. When using MOVE and DRAW commands, the plotter will draw lines in the order the commands were given.

To draw a simple box, a five observation data set is needed. The first observation should contain FUNCTION='MOVE' and X and Y coordinates for the beginning point. The next four observations should contain FUNCTION='DRAW' with the last observation having the X and Y coordinates equal to the coordinates used in the MOVE observation. Example code to draw a box around the plotting area perimeter is:

FUNCTION='MOVE'; X=0; Y=0; OUTPUT;
FUNCTION='DRAW'; X=0; Y=100; OUTPUT;
FUNCTION='DRAW'; X=100; Y=100; OUTPUT;
FUNCTION='DRAW'; X=100; Y=0; OUTPUT;
FUNCTION='DRAW'; X=0; Y=0; OUTPUT;

Here are a few helpful hints for annotating lines:

1. Two methods generate thick lines onto your form. One method is to change the COLOR variable and use a thicker plotter pen (i.e., use 0.25 mm for most of the lines, then use a 0.7 mm pen for the thicker lines). The other method for drawing thick lines is to change the SIZE variable to 2 or 3; thus, two or three lines will be drawn extremely close to each other to simulate a thick line. Either method will produce identical results.

2. Use a line space (Y coordinate) of 1.515 to approximate 6 lines per inch printing at 8 1/2 by 11 inch size. This is extremely useful if the form will be used in a printer that requires 6 lines per inch printing.

3. Set incremental MOVE and DRAW commands into a base SAS software DO loop and increment the X coordinate for vertical lines or increment the Y coordinate for horizontal lines.

To facilitate error checking, try not to write more than 50 observations before plotting the results. Errors are then easily found before the next program segment is written. The process of annotating is more "trial and error" than science, so considerable time is needed to debug problems encountered. Once you have an acceptable skeletal form created (fig. 2), finish the form by adding text.

Figure 2--Skeletal data collection form.

ADDING TEXT

Once the lines have been placed on the form, text can be added. Two variables will need to be modified to achieve the desired output: SIZE and POSITION. The SIZE variable will determine the text height. The POSITION variable will place the text onto the form (e.g., POSITION='C' will place the text one half cell above left aligned while POSITION='6' will place the text centered left aligned [SAS 1985]). The POSITION value will greatly influence the values for the X variable and the Y variable. Refer to appendix 2 for sample program coding and figure 3 for the final data collection form.

In our example, we needed text left aligned and right aligned on the same line. Using a fixed length character string will not work unless a uniform font is used. The problem occurs with proportionately spaced fonts because each character will have a slightly different width when plotted. Instead use two observations: one observation containing POSITION='6' (left aligned) and another observation containing POSITION='4' (right aligned). Refer to appendix 2 for sample program coding and figure 3 for the XX's in the upper block for right aligned text output results.

TRICKS AND PITFALLS

Plot draft copies of the form using felt tip plotter pens. Steel tip HP disposable draft plotter pens make an excellent final copy but tend to dry out when left in the pen carousel.
### FOREST SURVEY FIELD LOCATION DATA RECORD

**LOCATION IDENTIFICATION AND DESCRIPTION ITEMS**

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
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<td>43. NUMBER OF RECORDS</td>
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### POINT AND TREE DATA ITEMS

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<td>80. POINT NUMBER</td>
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Figure 3—Final data collection form.

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Thus, the first few pen strokes are either light and streaky or "invisible."

The HP 7550 pen plotter accepts two sizes of paper: 8 1/2 by 11 inch and 11 by 17 inch. All forms that require an area of 7 1/8 by 9 7/8 inch or less, can be developed using standard 8 1/2 by 11 inch paper and the default size for the SAS/GRAPH GOPTIONS DEVICE=HP7550A. However, if the final form is larger, 11 by 17 inch paper must be used with SAS/GRAPH GOPTIONS DEVICE=HP7550B and HSIZE and VSIZE set accordingly.

Documentation in any program is necessary, but when creating complex forms, it is essential. Annotated line segments especially need documentation. Once the form is complete, but modifications are required, annotated text can easily be found within the program. However, one line segment looks like another.

Setting GOPTIONS HSIZE and VSIZE equal to the same number produces a square plotting area instead of a rectangular area. Because both the X and Y axes are scaled from 0 to 100, plotting distance is the same for both directions. We found this works well for generating small forms due to the ease of repositioning lines and text.

**CONCLUSION**

Using SAS/GRAPH GSLIDE procedure with the ANNOTATE feature has greatly reduced the time necessary to produce camera-ready data collection forms. Updates and major modifications to the data collection forms are easily and quickly made.

The final product appearance is greatly enhanced using steel tip plotter pens instead of felt tip plotter pens.

**ACKNOWLEDGEMENTS**

We would like to thank Robert Fischer, for his pioneering work in creating data collection forms, and the Forest Survey staff for their help in making this paper possible.

**REFERENCES**


Questions and programming details for SAS/GRAPH GSLIDE procedure using the ANNOTATE feature and examples described are available from the authors:

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507 25th Street
Ogden, Utah 84401
(801) 625-5425

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**Appendix 1: LISTING OF GRID TEMPLATE PROGRAM**

```plaintext
Filename GRAPH 'APPENDIX 1.GSF';
* set up for 8 1/2" by 11" form size on 11" by 17" paper;
GOPTIONS DEVICE=HP7550B MODDISPLAY
CSMNAME=REPLACE CSGNAME=GRAPH ROTATTR
HSIZE=8.5 VSIZE=11;

Data LABELS;
Length FUNCTION $ 8
TEXT $ 5
COLOR $ 8;
LINE=1; XSYS='3'; YSYS='3'; SIZE=1.5;
POSITION='C'; STYLE='DUPLEX';
COLOR='BLACK?'; * draw the bottom line;
FUNCTION='MOVE'; X=0; Y=0; Output;
FUNCTION='DRAW'; X=100; Y=0; Output;
* draw the horizontal lines in increments of 1;
Do N=0 To 90 By 10;
* output the Y coordinate value so it may be annotated near the axis;
   X=1; Y=N+.2; COLOR='BLACK?';
   TEXT=N; TEXT=LeftITEXT);
   FUNCTION='LABEL'; Output;
   If N eq 90 Then Do;
      TEXT=' X'; Y=96.2; Output;
   End;
   Do I=1 To 10;
      If I eq 10 Then COLOR='BLACK7'; * bold;
      FUNCTION='MOVE'; X=0; Y=I+N; Output;
      If I le 5 Then Do;
         X=10; Output;
         Do J=1 To 5 By 10;
            FUNCTION='MOVE'; X=J; Y=I+N; Output;
         End;
      End;
      Else Output;
   End;
   COLOR='BLACK?';
   * draw the left line;
   FUNCTION='MOVE'; X=0; Y=0; Output;
   FUNCTION='DRAW'; X=100; Y=0; Output;
   * draw the vertical lines in increments of 1;
   Do J=0 To 90 By 10;
   * output the X coordinate value so it may be annotated near the axis;
   X=N+.1; Y=2; COLOR='BLACK?';
   TEXT=N; TEXT=LeftITEXT);
   FUNCTION='LABEL'; Output;
   If N ne 0 Then Do;
      TEXT=' X'; X=97; Output;
   End;
   End;
* skip over number areas;
If N eq 0 and I ge 1 and I le 3 Then Do;
   X=10; Output;
   Do J=10 to 90 by 10;
      FUNCTION='MOVE'; X=J+6; Output;
      FUNCTION='DRAW'; X=J+10;
      If J eq 90 Then X=97;
      Output;
   End;
   End;
   End;
   Else Output;
End;
End;
COLOR='BLACK?';
* draw the right line;
FUNCTION='MOVE'; X=0; Y=100; Output;
FUNCTION='DRAW'; X=0; Y=100; Output;
* draw the vertical lines in increments of 1;
Do J=0 to 90 by 10;
* output the Y coordinate value so it may be annotated near the axis;
   X=N+.1; Y=1; COLOR='BLACK?';
   TEXT=N; TEXT=LeftITEXT);
   FUNCTION='LABEL'; Output;
   If N eq 90 Then Do;
      TEXT=' X'; X=97; Output;
   End;
   End;
* skip over number areas;
If N eq 0 and (I ge 1 and I le 5) Then Do;
   X=I+N; Y=0;
   If(I ge 1 and I le 5) or (N eq 90 and I
   ge 8 and I le 9) Then X=4;
   Y=I+N; Output;
   FUNCTION='DRAW'; X=I+N; Y=100;
   * skip over number areas;
If N eq 0 and (I ge 1 and I le 5) Then Do;
```
Y=10; Output;
Do J=10 to 90 by 10;
  FUNCTION='MOVE'; Y=J+4; Output;
  FUNCTION='DRAW'; Y=J+10;
  If I eq 90 Then Y=65; Output;
End;
End;
Else Output;
End;
Run;

Procs Gelode Annotate=LABELS;
Title;
Run;

Appendix 2: PROGRAM SEGMENT OF SAMPLE TEXT

FILENAME GRAPH 'TEXT.GSF';
GOPTIONS DEVICE=HP550B ROTATE NODISPLAY
  GSFSIZE=8.5 VSIZE=11;
Data LABELS;
  Length FUNCTION $ 8 TEXT $ 46 COLOR $ 8;
  SIZE=0.5; XSYS='3'; YSYS='3';
  COLOR='BLACK25'; STYLE='SIMPLEX';
  LSPACE=1.51;
* annotate the text into the upper portion of
  Fox 1 to 2;
    FUNCTION='LABEL'; X=1;
    POSITION='4'; * right align
    If I eq 3 Then Do;
      X=17.2; POSITION='1'; * center left
      End;
Y=64.22; ANGLE=65;
  X=2; TEXT='POINT NUMBER';
  X=5.5; TEXT='POINT HISTORY';
  X=8.7; TEXT='TREE NUMBER';
  X=12.5; TEXT='SPLOT';
  X=15.5; TEXT='DISTANCE';
Run;

Procs Gelode Annotate=LABELS;
Title;
Run;

Y=1-LSPACE; TEXT='10 LOCATION NUMBER';
  If I eq 2 Then TEXT='XXXX'; Output;
Y=1-LSPACE; TEXT='11 PAST DATES';
  If I eq 3 Then TEXT='XXXX'; Output;
End;
  ** create the numbers and field size (XX's) for
  the lower portion of the form;
Y=62.22; POSITION='6'; * centered left
  aligned;
  * in 3 places 1st under the heading, end at the
  bottom;
  Do I=1 to 3;
    SPACE=0;
    If I eq 2 Then Do;
      SPACE=0.3; x=62.22; * for XX's under the numbers;
      End;
    Else If I eq 3 Then Do;
      SPACE=0.7; y=0.5; * bottom of the
      End;
    X=1-Space; TEXT='57';
    If I eq 2 Then TEXT='XX'; Output;
    X=4.2-Space; TEXT='58';
    If I eq 2 Then TEXT='XX'; Output;
    X=7.4-Space; TEXT='59';
    If I eq 2 Then TEXT='XX'; Output;
    X=10.6-Space; TEXT='60';
    If I eq 3 Then TEXT='XXX'; Output;
    If I eq 2 Then TEXT='XX'; Output;
End;
...