Abstract

This paper describes how multidimensional data is presented in the form of dynamically generated graphics for output on the web. Target audiences should have a basic understanding of the web environment, HTML, SAS GRAPH and the SAS macro language. SAS products required for the implementation of this paper’s application: Base SAS, SAS SHARE, SAS/IntrNet, SAS CONNECT and SAS GRAPH. This paper is an extension of last year’s presentation at SUGI titled *Becoming “Web Enabled” with SAS/IntrNet Software*. Whereas last year’s presentation described how existing SAS programs became enabled for web application, this presentation describes the evolution of a conventional (i.e. text) report into the realm of reporting data with graphics. Our primary objective was to visually present several levels of data so trends in educational data would be easily revealed. SAS Internet and SAS GRAPH software running in a UNIX/AIX environment allowed us to achieve our objective in a convenient fashion. Through the use of SAS Internet and SAS GRAPH software, we were permitted the quick development of a web application that dynamically generates graphs portraying five dimensions of data.

The Web Enabled AEIS Print Report

The AEIS (Academic Excellence Indicator System) report has been produced annually since 1991 for each of the 1061 districts and 7053 public schools within the state of Texas (enrollment of 3.89 million students). Traditionally these reports have been produced in print form and because the AEIS data is disaggregated into several different student groups (e.g. ethnicity), the data is presented in tabular format for easy interpretation. Web enabling the AEIS report was a significant step in conveniently delivering a familiar product (i.e. AEIS report) to our clients.

(See Figure 1 - print AEIS web enabled report)
Student performance data was selected as the graphic to display as a means of highlighting relative performance between student groups. Furthermore, by graphing student performance data over a period of several years, “trends” could be readily noticed in the data. Due to the longitudinal quality of AEIS data, we chose to display the data using a histogram. Through the use of a multidimensional histogram, three dimensions of data including the longitudinal quality were permitted. And by adding color to the graph, two additional dimensions of data were also allowed. Thus in one graph, five dimensions of data are displayed and longitudinal trends made visible.

(See Figure 2 – AEIS graphic displaying five dimensions of data)

Within the dynamically generated graph the performance for different student groups is displayed over a period of five years. Additional information provided in the graph indicate which individual student groups were used for accountability analysis and whether or not a student group’s performance met the minimum requirements for acceptable schools as determined by the Texas Accountability System. The use of color allowed for these latter two dimensions of data to be added to the stacked or three-dimensional histogram.

SAS/IntrNet® and SAS/GRAPH® Software

The software used to create output for the web is SAS IntrNet software running on a Unix/AIX system. Creation of individual graphs displaying student performance was accomplished through the use of SAS GRAPH software. A separate SAS GRAPH program was required for every image (i.e. graph) contained within a dynamically generated report.

PROC GCHART DATA = GRAFDATA;
goptions ftext=svisssb
   htitle=2
   htext=1.3
   vpo=80
   hpo=105;
block Stdnt
   / sumvar=Perf
   type=percent
   mpoints='A11' 'Afr Amer' etc..
   group=year
   subgroup=Analys
   legend=legend
   noheading;
   pattern1 value=empty color=black;
   pattern2 value=solid color=v1ib;
   pattern3 value=solid color=l10;
   pattern4 value=x2 color=v1ib;
title1 H=3.0 F=centb COLOR=black 'Percent passing TAAS: Mathematics';
title2 H=1.5 F=swiss1 COLOR=black 'Note: Performance reported for student groups having at least 5 test takers';
legend frame label=(COLOR=BLACK "Groups used for Accountability Analysis");
footnote1 COLOR=v1ib 'YES-LP indicates a score falling below criteria for acceptable schools';
footnote2 COLOR=v1ib 'YES-RI indicates a score achieving required improvement (if applicable)';
footnote3 COLOR=BLACK H=1.5 F=swiss1 'For more information refer to the accountability manual for respective year of TAAS data.';
RUN;

Within the SAS GRAPH program used to create the image in Figure 2, a specific graph procedure is called, variables are specified as block members and customization of the graphic’s title and legend is made. SAS GRAPH also permits the control of font type, footnotes and colors to meet the specific needs of the data being used to construct the graph.

Use of SAS GRAPH requires certain data structure. The following discussion pertains to the above GCHART procedure. Depending on how the graph is to be formatted, data must be arranged and sorted in a particular manner. Furthermore, if additional dimensions of data are to be represented by color, special techniques must be used to designate colors for the individual subgroup categories.

(See Figure 3 – data structure for SAS/GRAPH)

The distinguishing characteristics of the dataset found in Figure 3 are that the data are sorted by the group variable (Year) and the primary block variable (Stdnt). This arrangement of data controls the layout of the stacked histogram’s cells. Value displayed in the individual cells is determined by specifying the sumvar variable (Perf). Note: the dataset contains missing observations within the first several rows of data. This is done intentionally to assign colors to the specific subgroup categorical data (Analys). The sorted order of missing values within the subgroup variable determines the colors specified by the numbered pattern statements. The
use of this “preloading” technique is permitted on account that SAS GRAPH does not graph missing data when the block variable has missing values. In other words, if a value for the variable chosen to determine a row of the histogram is missing, SAS GRAPH will not display the data.

The individual report in which graphics are generated is created by a separate program implementing SAS IntrNet software.

(See Figure 4 – SAS/IntrNet program code with imbedded links to SAS/GRAPH programs)

Web output for this example is generated by using the OUT2HTM macro. HTML code is produced and the separate SAS GRAPH programs are called through the use of put statements. When run, the SAS Internet program dynamically generates a campus report which includes links or references to the individual SAS GRAPH programs responsible for creating graphics. Each report also contains dynamically generated hyperlinks to supplemental documentation.

Advantages of implementing SAS/IntrNet® and SAS/GRAPH® Software

Whereas before in the print AEIS report, data existed for interpretation and evaluation in a format familiar to our clients, the traditional AEIS report used the format of rows and columns to present data. This technique permitted a vast amount of data to be presented in a concise and orderly fashion. Although the presentation of data found within the AEIS report is quite efficient, the presentation of some data can be augmented through the use of graphics. The option to display the same data in the form of a graph provides the client a powerful tool for interpreting data. In one image or graph, longitudinal trends can be made more apparent and additional dimensions of data can add richness to otherwise stale data. Although programmers can “distort” or manipulate the display of data through the use of graphics, the advantages of graphically displaying data are many. When used responsibly and with discretion, the graphic presentation of data is a tremendous tool in data delivery. Through the use of SAS IntrNet and SAS GRAPH software we now have means of delivering multilevel educational data in the form of graphs easy to interpret. Moreover, we have provided our clients with an additional tool to examine and interpret data.
## Section I

### District Name: HOUSTON ISD

**Academic Excellence Indicator System**

**1997-98 Campus Performance**

**Accountability Rating: Acceptable**

**Total Enrollment: 1397**

**Grade Span: 09 - 12**

**School Type: Secondary**

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### TAAS % Passing

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Figure 2

Percent passing TAAS — Mathematics

NOTE: Performance reported for student groups having at least 5 test takers.

![Bar chart showing percent passing TAAS Mathematics by year and group.]

Groups used for Accountability Analysis:
- NO
- YES
- YES-LP
- YES-R

YES-LP indicates a score falling below criteria for acceptable schools.
YES-R indicates a score achieving required improvement (if applicable).

For more information, refer to the accountability manual for respective year of TAAS data.

Figure 3

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Figure 4

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libname act98 '/home/SAS/data/98' access=readonly;

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by campus;
if CAMPUS = 'namenum';

label CAMPUS = 'Campus Number'
   CAMPNAME = 'Campus Name';

options formchar='|...|+=-|=|\';
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      by CAMPUS;

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   <tr align=left><th>Address:</th></tr>
   <td>address / '</td>
   <tr align=left><th>Phone:</th></tr>
   <td>phone / '</td>
   <tr align=left><th>Fax:</th></tr>
   <td>fax / '</td>
   <tr align=left><th>Email:</th></tr>
   <td>email / '</td>
   <tr align=left><th>Website:</th></tr>
   <td>website / '</td>
   <tr align=left><th>Year Established:</th></tr>
   <td>year / '</td>
   <tr align=left><th>Website:</th></tr>
   <td>website / '</td>

put '</table>';
put '<h1>Academic Excellence Indicator System Data (1994-1998)</h1>';
put 'For more information please refer to the <a href=http://index.html>
   accountability manual</a> for respective year of'
put 'TAAS data. Click <a href=http://index.html>here</a> for information
   on the Academic Excellence Indicator System.';
put '<br>';

put '<img src=/cgi/broker?'
   'service=hogg&'
   'program=ed.tmgrph.sas&camp='CAMPUS''>'';

put '<br>';
.
.
.
.
.
run;
%out2htm(capture=off,
   htmlref=WEBOUT,
   openmode=replace,
   runmode=s,
   septype=none,
   encode=n,
   bgtype=color,
   bg=white);