

Reporting Multidimensional Data on the Web using SAS/GRAPH® and SAS/IntrNet™ Software

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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. The focus of this paper highlights the challenge of reporting multidimensional data on the web in the form of graphs. 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)

Given the richness of the educational data and subsequent detail of the report, we were determined to exploit the Internet as a medium to better deliver our product. Whereas the use of color and graphics were not possible before due to issues of cost, dynamically generating reports on the web now permitted the use of not only color and graphics, but also other web technologies facilitating the delivery of data. Our primary objective when enhancing the delivery of multilevel educational data was to produce images and graphs conveying multiple levels of data.

Throughout the development of the AEIS report, great concern has been always given to the presentation of the educational data in a manner that has allowed for easy interpretation. The advent of the Internet now permitted us to implement techniques of data presentation previously not available to our group of programmers. The major concern of ours when enhancing the presentation of AEIS was to display multiple levels of data in a concise and easy to interpret graph. Also, because the data presented is longitudinal, we wanted to make trends in the data clearly visible as well. Above all however, our intention was for the data to remain user-friendly. We wanted to graph data only where appropriate and only where graphs would improve the interpretation of data. We did not want to confuse and or distract our clients by inappropriately implementing the latest Internet technology.

AEIS data and Multidimensional Graphics

Several types of graphs are available when presenting data on the web. Not only is AEIS data voluminous for the individual reporting years, AEIS data spans multiple years. Our desire was not to graph everything in the report - clearly some data lend themselves to better presentation with graphics. We did not want to bombard our clients with graphs when text would better fit some of the data. Rather we chose to graph aspects of the print report that would benefit from the visual presentation of data.

Student performance data was selected as the graphic to display as a means of highlighting relative performance between student groups. Furthermore, by graphing student group 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=swissb
          htitle=2
          htext=1.3
          vpos=80
          hpos=105
  ;
  block Stdnt
    / sumvar=Perf
      type=percent
      midpoints='All' 'Afr Amer' ect...'
      group=year
      subgroup=Analys
      legend=legend
      noheading;

  pattern1 value=empty color=black;
```

```
  pattern2 value=solid color=vlib;
  pattern3 value=solid color=lio;
  pattern4 value=x2 color=vlib;

  title1 H=3.0 F=CENTB COLOR=BLACK 'Percent
  passing TAAS - Mathematics';

  title2 H=1.5 F=swissi 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=lio 'YES-LP indicates a score
  falling below criteria for acceptable schools';

  footnote2 COLOR=vlib ' YES-RI indicates a score
  achieving required improvement (if applicable)';

  footnote3 COLOR=BLACK H=1.5 F=swissi '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 on 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.

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District Name: HOUSTON ISD
 Campus Name: WALTRIP H S
 Campus #: 101912015

Academic Excellence Indicator System
 1997-98 Campus Performance
 Accountability Rating: Acceptable

Total Enrollment: 1397
 Grade Span: 09 - 12
 School Type: Secondary

TAAS Indicators:

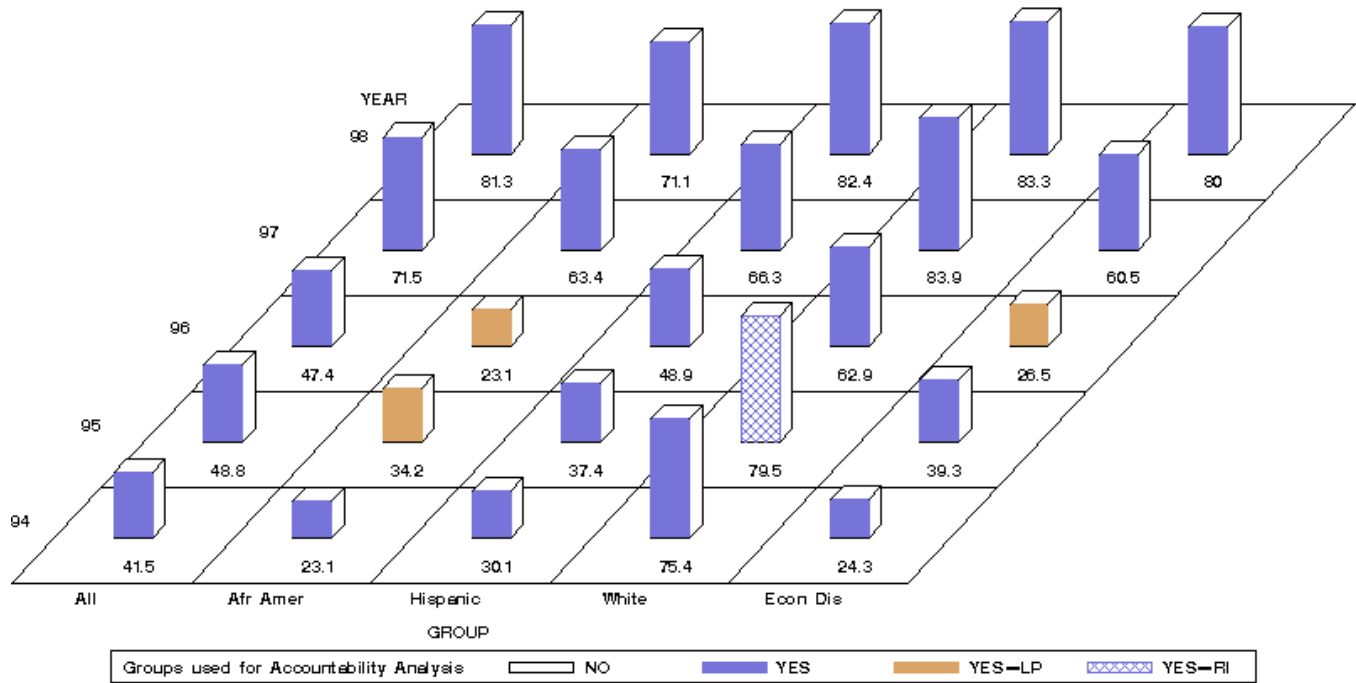
		State	District	Campus Group	Campus	African American	Hispanic	White	Native American	Asian/Pac.Is.	Male	Female	Econ. Disadv.	Special Educ.
TAAS % Passing Grade 10														
Reading	1998	88.3%	81.5%	87.8%	89.3%	92.3%	83.3%	93.8%	-	100.0%	89.2%	89.4%	81.7%	66.7%
	1997	86.1%	79.7%	84.5%	88.2%	85.4%	86.4%	94.6%	-	80.0%	87.6%	88.8%	71.8%	33.3%
Writing	1998	89.9%	83.1%	90.2%	95.9%	97.4%	92.8%	98.5%	-	100.0%	94.5%	96.7%	90.0%	52.9%
	1997	88.5%	79.9%	87.6%	87.6%	90.2%	83.9%	96.4%	-	60.0%	83.3%	91.8%	71.1%	*
Math	1998	78.4%	69.6%	74.3%	81.3%	71.1%	82.4%	83.3%	-	100.0%	85.1%	79.0%	80.0%	43.5%
	1997	72.6%	60.7%	70.5%	71.5%	63.4%	66.3%	83.9%	-	80.0%	77.1%	66.0%	60.5%	12.5%
All Tests	1998	73.1%	62.5%	66.7%	74.4%	71.8%	69.4%	78.8%	-	100.0%	77.3%	72.6%	66.7%	38.5%
	1997	67.8%	55.1%	66.9%	65.7%	61.9%	59.6%	80.7%	-	50.0%	68.0%	63.3%	46.2%	12.5%

TAAS % Passing Sum of 3-8 & 10 Accountability Subset

Reading	1998	87.0%	81.4%	86.9%	89.3%	92.3%	83.3%	93.8%	-	100.0%	89.2%	89.4%	81.7%	66.7%
	1997	84.0%	78.3%	84.5%	88.2%	85.4%	86.4%	94.6%	-	80.0%	87.6%	88.8%	71.8%	33.3%
Writing	1998	87.4%	82.7%	90.2%	95.9%	97.4%	92.8%	98.5%	-	100.0%	94.5%	96.7%	90.0%	52.9%
	1997	85.3%	79.0%	87.6%	87.6%	90.2%	83.9%	96.4%	-	60.0%	83.3%	91.8%	71.1%	*
Math	1998	84.2%	77.2%	74.3%	81.3%	71.1%	82.4%	83.3%	-	100.0%	85.1%	79.0%	80.0%	43.5%
	1997	80.1%	71.3%	70.5%	71.5%	63.4%	66.3%	83.9%	-	80.0%	77.1%	66.0%	60.5%	12.5%
All Tests	1998	77.7%	69.5%	66.7%	74.4%	71.8%	69.4%	78.8%	-	100.0%	77.3%	72.6%	66.7%	38.5%
	1997	73.2%	63.8%	66.9%	65.7%	61.9%	59.6%	80.7%	-	50.0%	68.0%	63.3%	46.2%	12.5%

Figure 2
Percent passing TAAS – Mathematics

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



YES-LP indicates a score falling below criteria for acceptable schools

YES-RI indicates a score achieving required improvement (if applicable)

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

Figure 3

OBS	Analys	Year	Stdnt	Perf
01	NO	94		.
02	YES	94		.
03	YES-LP	94		.
04	YES-RI	94		.
05	YES	94	All	41.5
06	YES	94	Afr Amer	23.1
07	YES	94	Econ Dis	24.3
08	YES	94	Hispanic	30.1
09	YES	94	White	75.4
10	YES	95	All	48.8
11	YES-LP	95	Afr Amer	34.2
12	YES	95	Econ Dis	39.3
13	YES	95	Hispanic	37.4
14	YES-RI	95	White	79.5
15	YES	96	All	47.4
16	YES-LP	96	Afr Amer	23.1
17	YES-LP	96	Econ Dis	26.5
18	YES	96	Hispanic	48.9
19	YES	96	White	62.9
20	YES	97	All	71.5
21	YES	97	Afr Amer	63.4
22	YES	97	Econ Dis	60.5
23	YES	97	Hispanic	66.3
24	YES	97	White	83.9
25	YES	98	All	81.3
26	YES	98	Afr Amer	71.1
27	YES	98	Econ Dis	80.0
28	YES	98	Hispanic	82.4
29	YES	98	White	83.3

Figure 4

```

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

DATA data1;
merge taas.TAASGRPH
      act98.cacctidx;
by campus;
if CAMPUS = "&namenum";

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

options formchar='|---|+|---+|-/\'*';

%out2htm(capture=on);
  DATA _NULL_;
  FILE print;
  SET data1;
  by CAMPUS;

  put '<table border=1>';
  put '<tr align=left><th>District Name:</tr>
      <td>' distname / '</td>
      <td rowspan=3><basefont size=6><em>Campus Report </em></basefont></h1></td></tr>
      <tr align=left><th rowspan=1>Campus Name:</th>
      <td>' campname / '</td></tr>
      <tr align=left><th rowspan=1>Campus Number:</th>
      <td>' campus / '</td></tr>';
  put '</table>';
  put '<h1>Academic Excellence Indicator System Data (1994-1998)</h1>';
  put 'Groups eligible for accountability analysis: All, Afr Amer, Hispanic, White, & Econ Dis.';
  put 'For more information please refer to the <a href="http://index.html">
<b> accountability manual</b></a> for respective year of';
  put 'TAAS data. Click <a href="http://index.html"> <b>here</b></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,
        htmlfref=_WEBOUT,
        openmode=replace,
        runmode=s,
        septype=none,
        encode=n,
        bgtype=color,
        bg=white);

```