A FINANCIAL PLOTTING SYSTEM FOR ANALYSTS AND MANAGERS
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ABSTRACT

A major responsibility of financial analysts is to present the organization's financial picture to management in a concise and descriptive manner. This paper translates into a Financial Plotting System for the collection, calculation, and graphing of monthly and year-end financial data. Designed for the non-programmer, the system functions in an interactive environment and produces graphs according to user specifications. This paper outlines the development and structure of the system, its use by the financial analyst and business manager, and the advantages of its operation.

INTRODUCTION

Graphics has had an impact on almost every segment of the modern business community and practically has become necessary in most meeting rooms. In the Distributed Computer Services department of Texas Instruments' Equipment Group, the potential for applying graphics to financial analysis and forecasting had not been overlooked; rather, a new tool was called for to better illustrate the department's financial position. Seven types of graphs were needed, at both the cost center and top (department) levels, to replace the plots generated under a cruder graphics system. Because management concentrates on forecasting budgeting and expenditures from historical data against a benchmark plan (the year-end goal), the new graphs needed to clearly show actual, forecast, and benchmark plan dollars, by month, for the calendar year.

The old method involved a week-long effort to download the financial data from the corporate data base, make repetitive calculations for each cost center in the department, and manually enter the graphics data into an internally-developed graphics package. The graphs, once produced, were in black and white and were difficult to read when more than two lines were graphed, as is always the case since management prefers to see both actual and forecast data alongside the benchmark plan. Furthermore, the procedure was costly in people time and was extremely tedious to administration.

The solution was to automate as much of the procedure as possible, incorporate a new Hewlett-Packard color plotter, and resolve a problem of graphics technique: showing the actual and forecasted monthly data as one line across the calendar year. Ideally, the actuals (historical) data would be graphed as a solid section of the line, with the forecasts as a dashed section of the same line. The benchmark plan would then be graphed against the newly-created actuals/forecast line. The resultant Financial Plotting System was accomplished with a combination of SAS and CMS products.

STRUCTURE OF THE SYSTEM

The Financial Plotting System (FPS) operates under VM/SP CMS and works under a hierarchy of EXECs, panels, macros, and SAS and SAS/GRAPH programs. It is comprised of two parts: data retrieval, which accesses the corporate IMS data base and downloads the data to the VM system; and graphical analysis, which loads the data into the system's data base, queries the user for the type of plots to be generated and for which cost centers, performs the necessary calculations, and generates the graphs. Each part is fully automated. The only human intervention necessary is to transfer the data from the VM system to the user's ID after completing the data retrieval and to journey to the output room to pick up the completed graphs when the user quits FPS.

ACCESSING THE SYSTEM

The Financial Plotting System was developed especially for the monthly financial reviews, in which the department management explains historical trends and justifies the forecasts in meeting the year-end goals. The best time for running FPS, then, is after all inputs have been made to the corporate data base and the most recent data is available. This is generally after the second week of each month.

To run FPS, the user types: FINPLOT and is given the choice of receiving help information describing the system's structure and capabilities, retrieving the data from the corporate data base, or creating any number of graphs from the data downloaded in a previous run. If FPS has not been run since the latest update of the corporate data base, the user should opt for DATA RETRIEVAL. Otherwise, he will be working with outdated information. If, however, the most recent financial data had been retrieved prior to this run, the user can proceed with the graphical analysis section directly.

DATA RETRIEVAL

Data retrieval is a fairly quick procedure. Upon choosing this option, the user has a choice of either reviewing the help file or of updating the JCL that accesses the corporate IMS data base. The JCL must be updated on a monthly basis to account for changes in time periods and to update the password permitting access to the data base. While a procedure could have been written to automate these updates, the few manual updates will guard against unauthorized personnel accessing the data base.
After the JCL is updated, the user is asked for the current financial month, which is the month for which the latest actual data are recorded and is usually the one previous to the current calendar month. For example, if the current calendar month is June, the current financial month is May. The current financial month is written to a one-record file, which is later brought into the SAS/GRAPH programs by the %INCLUDE macro as the point that separates the historical data (solid line) from the forecasted data (dashed line) on the actual/forecast line.

After the current financial month is recorded, the JCL is sent along the communication lines to the corporate data base, completing part one of the system. The user is then instructed to inform the VM operators that the resultant files are to be transferred to his user ID on the VM system. Of the twenty or so files transferred to his reader, the user identifies by record length the one file containing the financial data, files it on disk, and deletes the other files (extraneous header and trailer files). Once this is done, he is ready to run part two of the system.

**GRAPHICAL ANALYSIS**

Graphical analysis, as part of the Financial Plotting System, consists of three main activities: plot and data selection by the user, the building of the system's data file, and construction of the graphs. These activities are apparent to the user only because various messages are issued from time to time as to the on-going procedure.

**Virtual Storage, Graphics Selection**

Virtual storage is the first thing checked when the user calls for the graphical analysis section of the program. If space is insufficient, the user is asked to boost storage to 960K, enough for the largest of the SAS programs, and then to re-call the procedure. Otherwise, if storage is adequate, the graphics panel (Figure 1) is brought up to receive plotting specifications. Any number of programs may be selected from this panel, as well as any number of cost centers. Lastly, either paper or foil must be selected for the medium. All entries are checked for validity; an error is flagged with a descriptive message and returns the user to the panel for re-entry. When the plot request is satisfied, the program turns to the next main activity, construction of the data file.

**Construction of the System's Data File**

The corporate data base listing is returned as a sequential file with approximately 700 records, giving for each cost center and the department top-level (treated also as a cost center) the historical and forecasted data, as well as the benchmark plan, for the calendar year. Historical periods are in months; forecasted periods are in either months or in quarters, depending upon how far in the future is the given period. If the forecasted period is in the same calendar quarter as the current financial month, the forecasts will be broken down by month; otherwise, they will be in quarters. Benchmark plans (BMP) are given in quarters. Actuals, forecasts, and BMP are also given in year-end figures. And all this is given for each major account, such as depreciation or labor expense, for each cost center. When this file is translated into the FPS data file, the data is reorganized to write a sequential record for all accounts associated with a particular cost center at a particular time. For example:

<table>
<thead>
<tr>
<th>Cost Center</th>
<th>Time Period</th>
<th>Salary</th>
<th>Equip.</th>
<th>Deprec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>9999</td>
<td>AUG 1982</td>
<td>12.3</td>
<td>6.5</td>
<td>21.5</td>
</tr>
</tbody>
</table>

Only those cost centers that the user had requested through the panel are written to the system's data file. An XEDIT macro scans the original listing for a chosen cost center and then writes to a HISTORY FILE all the account information, by period, relating to it. Since this process takes a few minutes, the user is notified of the on-going activity. Once the new data file is completed, it is then translated into a SAS permanent data set, OVERHEAD.DATA, for future efficiency. The selected SAS/GRAPH programs are now ready to be run.

**SAS/GRAPH Programs**

As shown in the graphics panel (Figure 1), seven different programs are available. These seven, however, are broken down into two types of graphs. The first six are very much alike, in that they utilize PROC GPLOT to graph actual and forecast data against a benchmark plan over the calendar year, while the last one employs PROC GCHART to produce an horizontal bar chart of cost center accounts from the year-end view. They differ also in the data that they use: the first type uses almost all time periods but only a few accounts; the second type uses all the accounts but only one time period. Both types of graphs, though, produce one plot per cost center.

An example of the first type of program is reproduced in Figure 2. As seen in its output, given in Figure 3, this program plots billings against the benchmark plan as cumulative over time. The program features the %INCLUDE option to bring in the current financial month, the OVERLAY option to superimpose several lines on one graph, and PROC FORMAT to spell out the name of the cost center being graphed and to properly organize and label the months of the year.

The first steps calculate the billings by month (different combinations of the various billings accounts are needed for several types of cost centers), read in the current financial month, and assign numerical values to the months of the year. Later, with PROC FORMAT to spell out the values will be translated back into their proper names.

After the preliminary work is completed, actual, forecast, and BMP values are assigned to their proper data sets for each month of the year, with each month cumulative over the previous month and with missing values assigned to those months of each data set which do not have calculated values. First, quarterly benchmark plan values are broken down by month and given to the BMP data set. Then, since billings have already been calculated for
Select the appropriate programs, cost centers, and type of output. Enter any character beside your selections.

CUMULATIVE:
Costs vs. Billings:
Billings vs. BMP:
Costs vs. BMP:

MONTHLY:
Costs vs. Billings:
Billings vs. BMP:
Costs vs. BMP:

Account Costs as % of Total Costs:

COST CENTERS:
026:
9776:
9777:
9778:
9779:

OUTPUT:
Foils:
Paper:
(paper are 8.5 x 11)

PF3 => HELP
PF3 => ABDRT

Figure 1: GRAPHICS PANEL

the historical months (those up to and including the current financial month), these "actuals" are relegated to the ACTUALS data set. Note that missing values in the ACTUALS data set are assigned to those months falling in the forecast period (after the current financial month). Lastly, the FORECAST data set is constructed. The current financial month is included in this data set to provide the link between the actual and forecast portions of the actual/forecast line. Otherwise, it would be disjointed between the two sections. The FORECAST data set is also comprised of any monthly forecasts (future months of the present quarter), as well as the year-end forecast. Missing values are given for those future months without monthly values, except for December, which is assigned the year-end forecast (same thing, since the data is graphed cumulative over the year). When plotted, SAS connects the last forecasted month with the year-end value, so that the missing values appear to be interpolated.

After the three data sets have been constructed, they are merged into one data set for plotting. Sometimes, though, the user wants to see the actual data points prior to plotting. A simple PROC PRINT, the listing of which is given in Figure 4, is included in the code and may be commented out when it is not needed.

PROC GLOT uses the OVERLAY option to superimpose the actual, forecast, and BMP data sets to create the two lines of Figure 3. In two other programs, sum billings vs. sum costs and monthly billings vs. monthly costs, four data sets are used, merged, and overlaid to create two lines, each part actuals and part forecast. The graphics information for each program is stored in a permanent SAS data set, in this example PLOT.CUMBILL, which is sent to the color plotter via PROC GREPLAY by another SAS program called by the graphics analysis procedure.

The second type of graph, which charts account costs as percentages of total cost for each cost center, is not so complicated, but it does require extra information from the user. The accounts brought in from the corporate data base do not represent 100% of the total cost to the cost centers, since many other miscellaneous accounts may accrue costs to a cost center. Since the graph should account for 100% of the total cost, a miscellaneous account needs to be created.

Department administration knows from the cost data used in the other programs what the total cost should be. This information is the only additional data needed to calculate the miscellaneous account. Prior to execution of this program, a panel is brought up to ask the user to input the total cost value for each cost center to be graphed. The graphics analysis procedure then makes a copy of the SAS program and uses an XEDIT macro to imbed the total cost values within the program. The SAS program subtracts from the total cost all of the other accounts and takes the difference as the miscellaneous account. All accounts are charted as horizontal bar graphs, complete with frequencies and percentages. The SAS code and the graph are given in Figure 5.

After all requested graphs have been shipped off to the color plotter, the user is directed to the output room and given a time estimate. The original data listing and the newly-created data file and SAS data set are kept on disk for later use or reference.

CONCLUSION

The Financial Plotting System provides a simple, efficient means for generating a variety of plots for monthly financial review. As a tool for presenting large amounts of financial information, the graphs have benefitted non-periodic operations reviews as well. The system has freed the department's Administrative Services branch from a week-long effort every month and enabled management to create any number of color graphs without an appreciable time lag. As an aid to financial decision-making, graphics is an invaluable tool.

ACKNOWLEDGEMENTS

The author wishes to thank J.D. Hill and Karl Harnon of Texas Instruments for their technical contributions.
* CUMBILL plots each cust center's actual and forecast cumulative billings against the benchmark plan established the year before.

As part of the financial forecasting system, it is called through the Graphical Analysis section of the system. All data is received directly from the corporate data base and written to the permanent SAS data set called OVERHEAD.DATA.

%INCLUDE CURRENT / SOURCE2 52=60;

**GOPTIONS**

DEVICE = HP7220T  BAUD == 1200  VSIZE = 7.5  HSIZE == 10  NOTERMINAL

**CMS FILEDEF**

OVERHEAD DISK DUMMY DUMMY *;

* Reference each month by number. They will be re-translated and ordered prior to plotting;

**IF PERIOD 'MAR 1982' THEN MONTH1 2**;

**ELSE IF PERIOD 'APR 1982' THEN MONTH1 3**;

**ELSE IF PERIOD 'MAY 1982' THEN YEAR2**;

**ELSE IF PERIOD 'JUN 1982' THEN MONTH1 4**;

**ELSE IF PERIOD 'JUL 1982' THEN MONTH1 5**;

**ELSE IF PERIOD 'AUG 1982' THEN MONTH1 6**;

**ELSE IF PERIOD 'SEP 1982' THEN MONTH1 7**;

**ELSE IF PERIOD 'OCT 1982' THEN MONTH1 8**;

**ELSE IF PERIOD 'NOV 1982' THEN MONTH1 9**;

**ELSE IF PERIOD 'DEC 1982' THEN MONTH1 10**;

**END**;

**FULLYEAR = 0;**

**CMS FILEDEF**

CURRENT DISK INSERT SASCODE D *

**END**;

* Calculate billings. The billings accounts have negative values in the corporate data base. Translate these to positives for division;

**IF CC == 025 THEN BILLING == -(LAB_978 + LAB_943 + BNS_COMP);**

**ELSE IF CC == 026 THEN BILLING == BNS_COMP;**

**ELSE IF CC == 027 THEN BILLING == -LAB_978;**

**ELSE BILLING == -LAB_978;**

* Read in the current financial month;

**FULLYEAR = 0;**

**CMS FILEDEF**

CURRENT DISK INSERT SASCODE D *

**END**;

**END**;

* Compute forecast year's months if a full year's data is unavailable, rename the year-end value as OVERFLOW (year-end value = cum. yearly actuals as of Dec.) and fill in unforecasted future months with missing values;

**IF FULLYEAR = 0 THEN DO;**

* Compute forecast year's months if a full year's data is unavailable, rename the year-end value as OVERFLOW (year-end value = cum. yearly actuals as of Dec.) and fill in unforecasted future months with missing values;

**END**;

* Sort each data set by cust center and time periods and merge them into one data set for plotting;

**DATA ACT2;**

**MERGE**

BMP ACT2; **BY CC MONTH**;

**DROP**

ACT_BILL BMP_BILL;

**PROC**

SORT **DATA** == BMP; **BY CC MONTH**;

**PROC**

SORT **DATA** == ACT2; **BY CC MONTH**;

**PROC PRINT;**

*BY CC; *BY MONTH; *VAR ACT_BILL FCSTBILL BMP_BILL;*

*FOOTNOTE3 .F=SIMPLEX .C=BLUE BMP: SQUARES, SODA BLUE;*

*FOOTNOTE2 .F=SIMPLEX .C=GREEN FORECAST: TRIANGLES, DASHED GREEN;*

*FOOTNOTE .F=SIMPLEX .C=GREEN ACTUALS: TRIANGLES, SOLID GREEN;*

*PROC PRINT;**

*BY CC; *BY MONTH; *VAR ACT_BILL FCSTBILL BMP_BILL;*

*FOOTNOTE3 .F=SIMPLEX .C=BLUE BMP: SQUARES, SODA BLUE;*

*FOOTNOTE2 .F=SIMPLEX .C=GREEN FORECAST: TRIANGLES, DASHED GREEN;*

*FOOTNOTE .F=SIMPLEX .C=GREEN ACTUALS: TRIANGLES, SOLID GREEN;*

**TITLE**

*ACTUALS VS. BENCHMARK PLAN;*
BILLINGS VS. BENCHMARK PLAN
(ACTUAL & FORECAST DATA)

Figure 3: SAMPLE GRAPH

BILLINGS ACTUALS, FORECAST, & BENCHMARK PLAN

<table>
<thead>
<tr>
<th>MONTH</th>
<th>ACT_BILL</th>
<th>FCSTBILL</th>
<th>BMP_BILL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>965.1</td>
<td>1150.0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2275.6</td>
<td>2300.1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3823.7</td>
<td>3450.1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5166.7</td>
<td>4774.4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>6550.5</td>
<td>6098.7</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>8149.4</td>
<td>8149.4</td>
<td>7423.0</td>
</tr>
<tr>
<td>7</td>
<td>9634.1</td>
<td>8837.1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>11343.8</td>
<td>10251.2</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>12829.6</td>
<td>11665.3</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>13226.8</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>14788.2</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>16349.7</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4: DATA POINTS TO BE PLOTTED

These data points match the graph shown in Figure 3. The current financial month is June and the forecast periods available in the corporate data base include the third quarter and the year-end goal (regarded as December here). October and November are assigned missing values because they don’t have forecasts of their own.
Each cost center's various account costs are plotted as percentages of its total cost.

The year-end cost is the only time period required. Total the various depreciation and rental accounts;

* Gross cost values are input below, before Misc is calculated;


Order the accounts and output their values;

1: DEPR; 2: K.DOLLARS = DEPR; OUTPUT;
5: ACCOUNT; 6: K.DOLLARS = MISC; OUTPUT;
7: ACCOUNT; 8: K.DOLLARS = MAINT; OUTPUT;
8: ACCOUNT; 9: K.DOLLARS = LAB - 1: IC; OUTPUT;
9: ACCOUNT; 10: K.DOLLARS = SW LIG; OUTPUT;
10: ACCOUNT; 11: K.DOLLARS = OPEX; OUTPUT;
11: ACCOUNT; 12: K.DOLLARS = DIRECT; OUTPUT;

* PROC PRINT; * BY CC; * ID ACCOUNT; * VAR K.DOLLARS;
* FORMAT ACCOUNT ACFMT.

Figure 5: ACCOUNT COSTS AS PERCENTAGES OF TOTAL COST -- CODE AND GRAPH