

## A Revolution? Development of Dynamic And Hypertext Linked Reports With Internet Technologies and SAS System

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### Abstract

The current SAS-based reporting system provides us with printed reports and tables with a spatial, physical, and static way and a fixed linear structure. Even though indexes, tables of contents, or cross-references exist superimposed on this linear framework and provide added value, often critically important, they do not change the underlying structure. As a result, there are some disadvantages for the linear structure multimedia in the current SAS-based reporting system. First of all, in order to put all these tables and reports together logically, one must organize them manually. In addition, a particular number which was processed and calculated in a table cell cannot be easily drilled down in a dynamic and interactive manner. The most common way we have for the current reporting system is to use footnotes to provide further or detailed explanation or information. Very often the track for further information might be much more time-consuming and labor intensive. The navigation in this kind of format reports and tables is quite difficult when the size gets bigger. This paper explores development of dynamic and hypertext linked report with internet technologies and SAS system.

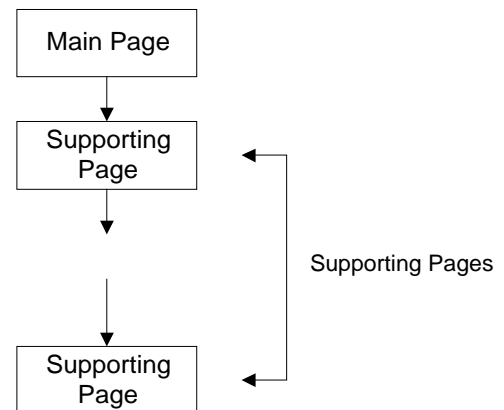
### I. Introduction

The advent in recent years of inexpensive, yet extremely powerful, computers and graphical displays has made it possible to step beyond this linear barrier. The internet related technologies enable us to report data with a much faster and non-linear way. With SAS System, we can create dynamic and hypertext linked tables/reports and update them quickly. This

paper demonstrates a dynamic, interactive, and hypertext linked report with internet technologies and introduces some SAS programming techniques which can produce dynamic and hypertext linked reports and tables with SAS system. The paper will provide some examples on the SAS-based hypertext linked reporting system with Internet technologies in the PC environment.

### II. Traditional Reports

A linear reporting system (see Figure 1) is described as a system where the printed reports with only SAS system have an obvious beginning and end, and a single fixed sequence



**Figure 1. A Linear Structure for Reporting**

of pages in between. Figure 2 shows a typical linear structure table produced by PROC TABULATE. In other words, the paper forms give us static, isolated, separate tables and reports. In order to get further information, one must put such information into footnotes or attached papers, with additional information

provided to guide the readers in finding specific information. This may become a much more time-consuming and labor-intensive process for both report authors and readers. If we can integrate SAS system with internet technologies, all this can be accomplished quickly and efficiently.

CATEGORY	SUBCAT	FPOBL	MED	SPOCP
Investment	Investment	29.49	32.32	24.93
	Budget Invest	28.18	28.61	24.89
Professional	Capital cost	.	2.32	12.38
	Primary care	7.82	11.87	4.58
	Specialist	27.11	26.48	48.22
Prescription Service	Prescription Service	18.44	18.79	89.84

This table was created by Jeff Sun on 10/20/97

Figure 2. A Report Using SAS PROC Tabulate

### III. Hypertext Linked Reports

Hypertext refers to a collection of tables, reports, and graphics that can be explored, by the reader, in a nonlinear way. The hypertext link is non-spatial and non-physical, possible dynamic, and often non-linear (see Figure 3). The techniques used for producing hypertext linked HTML files are based on DATA\_NULL\_ and Hypertext Markup Language (HTML 3.2).

Hypermedia systems are designed so that one can explore information in a variety of formats by activating hyperlinks. Since in hypertext the components can be related in decidedly non-linear ways, there are no simple organizational schemes, such as page numbering, that can serve as ubiquitous and commonly understood paradigms of navigation and location. The hypertext design with an integration of Internet technology and SAS system gives an easy navigability of reports and tables. In other words, the hypertext linked documents can be opened and updated quickly.

To set up a hypertext linked report, one needs to link up text-based information using source and target nodes. A source node is simply a word or phrase or number in the hypertext report that one wants to link up to some supporting document. When a reader selects the source node by clicking the mouse, the target node gets triggered and takes him directly to the specific supporting document.

A hypertext linked report works a lot like the SAS hypertext help system. By clicking hypertext links (sometimes called hot spots) or by directing users to another page, you can maneuver throughout the whole reporting system just as you do with SAS online help. To get more information on a topic, just click on that topic. That topic will be a link that takes you to a new page, i.e. a supporting page.

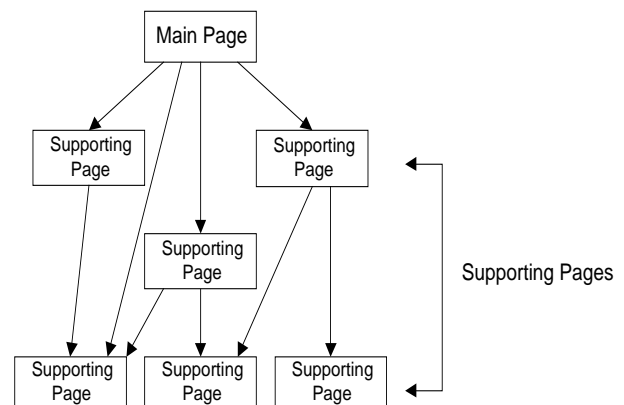


Figure 3. A Non-linear Structure of Reporting

A main page in a hypertext linked report might contain words or phrases or numbers you can click to view multimedia events for related information. The idea behind hypertext linked reporting system is that instead of reading reports or tables in a rigid, linear structure, you can skip easily from one point to another. You can get more information, go back, jump to another topic, and navigate through the report based on what interests you have at the time. A hyperlink might take the reader directly to the top of a document or to any point within another document.



text (for example, Figure 8) or graphics (for instance, Figure 9), or a combination of both.

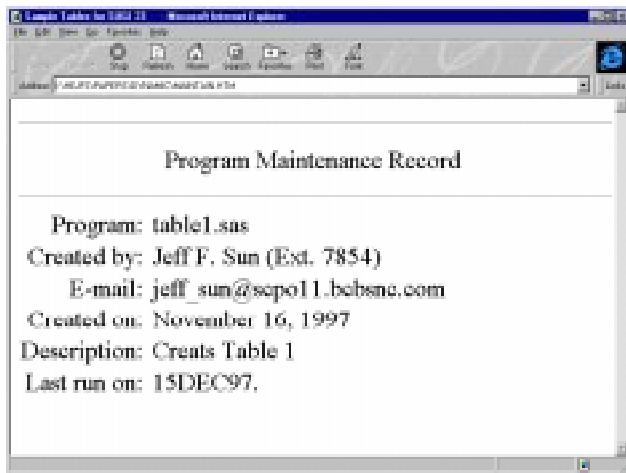


Figure 8. Program Maintenance Record Page

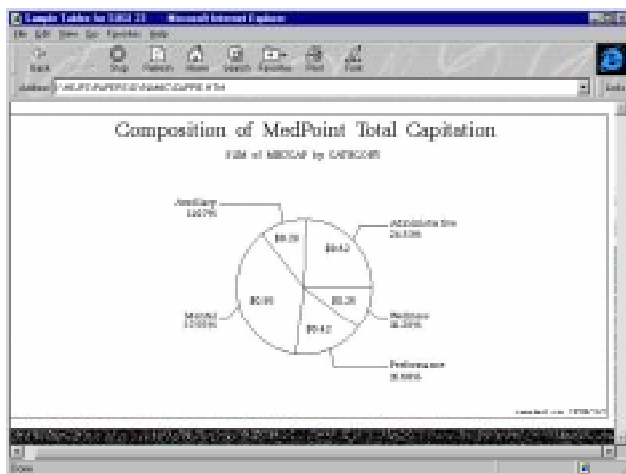


Figure 9. Composition of MedPoint Total Capitation

In a hypermedia reporting system, you can navigate by jumping from category/sub-category to definition/explanation, or column names to definitions, or numbers/topics to media element - picture, sound, video, and so on.

#### IV. SAS Programming and Implementation

The basic approach used to develop this kind of dynamic and hypertext linked reporting system is to use DATA \_NULL\_ to create HTML files and link these files conditionally to other supporting documents. Figure 10 illustrates a general structure of DATA \_NULL\_ for creation of HTML files. It can be seen that this

DATA \_NULL\_ step can be divided into three parts: page top, page bottom, and main page.

```

More SAS statements;
DATA _NULL_;
SET FILENAME END=EOF;
FILE HTMLFILE NOTITLE;
BY CATEGORY SUBCAT;
IF _N_=1 THEN LINK PAGETOP;
  more SAS statements;
IF EOF THEN LINK PAGEBTM;
RETURN;
PAGETOP:
  PUT ...
RETURN;
PAGEBTM:
  PUT ...
RETURN;
RUN;

```

Figure 10. A General Structure of DATA \_NULL\_

*Part 1 - Page Top:* this part creates a set of HTML tags for HTML title, table title, and other beginning setups.

The basic linkage in this part is to link a keyword to a text documentation. The space for a title or subtitle is usually limited. So more information about some background information and formal definitions is needed to help the readers to understand what this report is all about. Figure 11 gives a sample of coding page top with DATA \_NULL\_. This part creates two links from the main page to the Region.htm and Pmpmdef.htm files.

```

PAGETOP:
PUT @2 '<HTML>/'
  @4 '<TITLE>/'
  @6 'SAMPLE TABLES FOR SUGI 23/'
  @4 '</TITLE>/'
  @6 '<CENTER>/'
  @6 '<CAPTION><A HREF="REGION.HTM">
    DURHAM REGION</A>
    <A HREF="PMPMDEF.HTM"> PMPM </A>
    MEDICAL EXPENSE SUMMARY/'
  @6 '<BR>(8/1997 THROUGH 8/1997)
    </CAPTION>/'
  @6 '<BR><P>/'
  @6 '<BODY BGCOLOR="WHITE">/'
  @8 '<CENTER>/'
  @8 '<TABLE BORDER=1 COLOR=BLACK>/'
  @10 '<FONT SIZE=-1 COLOR=BLACK>'
  ;
RETURN;

```

Figure 11. Link A Title to Another Page

**Part 2 - Page Bottom:** this part creates a set of HTML tags for table footnotes, and other ending setups.

One can link a footnote to a text documentation in this part. Footnote in this kind of report only needs to contain the hypertext link to file maintenance information. Figure 12 shows a PUT statement used to create a footnote in the hypertext tables. A hypertext link is set up to direct the place where you want to jump to.

```
PAGEBTM:
  PUT @10 '</FONT>'/
  @8 '</TABLE>'/
  @8 '<BR><P>'/
  @8 'THIS TABLE WAS CREATED BY
  <A HREF="MAINTAIN.HTM">JEFF SUN</A>'/
  @8 " ON &SYSDATE%STR(,)'/"
  @6 '</BODY>'/
  @2 '</HTML>'/
RETURN;
```

**Figure 12. Link A Footnote to Another Page**

**Part 3 - Main Page:** this part creates a set of HTML table and link tags that indicate table structure, elements, formatting, and hypertext links to other supporting pages. There are five kinds of linkage in this part.

a. Link a column name to a text file;

Usually the column is an abbreviation of the full name for that column. For those who have little knowledge about this subject can benefit from this kind of support. Figure 13 shows a usage of PUT statement to create a linkage of column name PCP to an HTML file DEFINITI.HTM.

```
IF _N_=1 THEN DO;
  PUT @10 '<TR>'/
  @12 '<TH>CATEGORY'/
  @12 '<TH>SUB-CATEGORY'/
  @12 '<TH>PPO/'
  @12 '<TH>MEDPOINT/'
  @12 '<TH><A HREF="DEFINITI.HTM">
  PCP </A>'/
  @10 '</TR>'/
  ;
END;
```

**Figure 13. Link A Column Name to Another Page**

b. Link a row name to a text documentation;  
To understand definitions of categories or sub-categories, one can link a row name or row

names to certain files which can provide detailed information for the readers. Figure 14 illustrates a linkage of all category definitions to an HTML file CATEDEF.HTM. If one wants to link a particular value of that category to a text file, a conditional flow control needs to be used to make a selection.

```
IF FIRST.CATEGORY THEN DO;
  PUT @10 '<TR>'/
  @12 '<TD><A HREF="CATDEF.HTM">'
  CATEGORY '</A>'/;
  @12 '<TD>' SUBCAT '/;
  @12 '<TD>' PPO/
  @12 '<TD>' MED /
  @12 '<TD>' PCP/
  @10 '</TR>'/
  ;
END;
```

**Figure 14. Link A Row Name to Another Page**

c. Link a table cell to a text documentation;

One can create a documentation to show how the number in this table cell was calculated. Some raw numbers and intermediate results appeared in this supporting documentation are much helpful for the readers to understand the final results. In Figure 15 the drug PMPM for MedPoint is special due to different calculation for membership. So additional information for the number in this cell is definitely needed.

```
IF DRUG THEN DO;
  PUT @12 '<TD>' /
  @12 '<TD>' SUBCAT /
  @12 '<TD>' PPO/
  @12 '<TD><A HREF="MEDDRUG.HTM"> MED '</A>'/
  @12 '<TD>' PCP /
  @10 '</TR>'
  ;
END;
```

**Figure 15. Link A Cell to Another File**

d. Link a number to a text documentation;

One can link any numbers which meet a certain criterion to a supporting documentation. Figure 16 shows a number, which is less than 10, link to a text documentation, in which a detailed calculation is given.

```
PUT @12 '<TR>'/
  @12 '<TD><FONT COLOR=WHITE>' DUMMY
  '</FONT>'/
  @12 '<TD>' SUBCAT /;
IF PPOSEL<=10 THEN DO;
  PUT @12 '<TD><A HREF="N.HTM">' PPOS
```



```

        </A>/;
END;
ELSE DO;
  PUT @12 '<TD>' PPOS /;
END;
  PUT @12 '<TD>' MED /
      @12 '<TD>' PCP /
      @10 '</TR>';

```

**Figure 16. Link A Number to Another File**

- e. Link a reader to any point within another document;

In the previous four types of hypertext links, a hyperlink will take the reader directly to the top of a supporting document. But what if, instead of linking to the top of a supporting page in general, one wanted to link to a specific place within that page? One can do this by creating an anchor within the supporting page. The anchor creates a special thing inside the supporting page which you can link to. The link you create in the main page will contain both the name of the file you're linking to and the name of that anchor (see Figure 17).

```

IF _N_=1 THEN DO;
  PUT @10 '<TR>/'
      @12 '<TH>CATEGORY/'
      @12 '<TH>SUB-CATEGORY/'
      @12 '<TH>PPO/'
      @12 '<TH>MEDPOINT/'
      @12 '<TH><A HREF="DEFINITL.HTM#PCP">
          PCP </A>/'
      @10 '</TR>/'
      ;
END;

```

**Figure 17. Link A Column Name to An Anchor within A Page**

In this example, a simple linkage was demonstrated to show the idea behind hypertext linked report design and development. Obvious advantages can be seen from this example. In a real hypertext linked report system, the "hot" words embedded in each supporting page might be linked further to another table or report to provide complete information.

## V. Concluding Remarks

This paper provides a general approach on how to create a dynamic and hypertext linked report with SAS System and Internet technologies.

SAS system can be used to process, and analyze data efficiently, and update files quickly. PROC's and DATA steps provide powerful tools to process and analyze data. DATA \_NULL\_ can be used to update HTML files quickly. The internet technology can be employed to delivery information quickly and efficiently.

With internet technologies and SAS system, we can develop more informative reporting system for different purposes. Literally, surfing this kind of hypertext linked reporting system is as easy as flipping through pages in a book. Because the hypertext linked reporting system can be updated any time, new releases can be distributed quickly and easily. Changes and bug fixes to the documentation, which is all online, can be made directly to the files. And new reports and tables can be published almost immediately. In a hypertext-only system, you only need to display new text when a source node is selected. In a more sophisticated hypermedia system, you could display a graph image, run a video clip, or even play a sound.

## Trademarks

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Any questions or comments regarding the paper may be directed to the author:

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