ABSTRACT

Statistical Programmers often have to work as both programmers and in validation or verification of programs during the course of a project. Sometimes after we deliver the program for validation, many requests are received in order to change the results or update the code. Why does that happen? Maybe because we have not checked the results as carefully as we should.

In this paper, if you work in UNIX environment, I want to show you some tips for reviewing your results before delivering to QC, so you can prevent many of those requests, avoid re-work and save time.

INTRODUCTION

When we start to work as Statistical Programmers and we finish our assignments, our Lead Project inform us that we have to send our programs to other programmers who were assigned to validate our results and documentation and oh surprise! We start to receive some emails or reports with all mistakes that we have done during our programming.

When you are working in UNIX environment and you don’t have an easy access to SAS interactive, the editors are helpful for creating or editing the programs. In this paper I want to present some useful tips and SAS procedures for all programmers, from beginners to advanced, in order to avoid a headache when a program is submitted to QC/validation.

HEADER

A header helps to describe the purpose of the program, input, output short description, macros called and change history.

When a program is copied from another project, the person copying the program becomes the author,

So the first step: to review the header before sending our program to QC/validation, this can sound tedious but believe me, it is very helpful to be sure that it is complete and totally populated, i.e.:

```
* Program: asl.sas
* Programmer: Beatriz Garcia
* Date: 10DEC2013
* Purpose: To create the ASL data set
* INPUT:
  * From: rawdata: dm.sas7bdat
  *     vs.sas7bdat
* OUTPUT:
  * To: outdata:..asl.sas7bdat
* Macros: %FixVar, %FixDate
* Changes: Bgarcia
  * 30DEC2013 - Update the header for input data sets.
```

The Changes section is very important to document the revisions made to the program. It should be updated each time the code is revised after finalization of the first version of a program.
Tips for finding your bugs before QC does, continued

PROC CONTENTS
Prints descriptions of the contents of one or more files from a SAS data library, i.e.

CONTENTS PROCEDURE
Data Set Name: WORK.ORANGES Observations: 4
Member Type: DATA Variables: 5
Engine: V9 Indexes: 0
Created: 15:56 Monday, April 27, 1999 Observation Length: 40
Last Modified: 15:56 Monday, April 27, 1999 Deleted Observations: 0
Protection: Compressed: NO
Data Set Type: Sorted: YES
Label:

-----Engine/Host Dependent Information-----

Data Set Page Size: 6144
Number of Data Set Pages: 1
First Data Page: 1
Max Obs per Page: 152
Obs in First Data Page: 4
Number of Data Set Repairs: 0
Physical Name: SYS96050.T153830.RA000.USERID.R0000004
Release Created: 8.0000B1
Release Last Modified: 8.0000B1
Created by: USERID
Last Modified by: USERID
Subextents: 1
Total Blocks Used: 1

Taste Test Results For Oranges

CONTENTS PROCEDURE

-----Alphabetic List of Variables and Attributes-----

<table>
<thead>
<tr>
<th>#</th>
<th>Variable</th>
<th>Type</th>
<th>Len</th>
<th>Pos</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>FLAVOR</td>
<td>Num</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>LOOKS</td>
<td>Num</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>3</td>
<td>TEXTURE</td>
<td>Num</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>TOTAL</td>
<td>Num</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>1</td>
<td>VARIETY</td>
<td>Char</td>
<td>8</td>
<td>0</td>
</tr>
</tbody>
</table>

The procedure output provides values for the physical characteristics of the SAS data set WORK.ORANGES. Here we have the important values:

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Observations</strong></td>
<td>Is the number of nondeleted records in the data set.</td>
</tr>
<tr>
<td><strong>Observation Length</strong></td>
<td>Is the maximum record size in bytes.</td>
</tr>
<tr>
<td><strong>Compressed</strong></td>
<td>Has the value NO if records are not compressed; it has the value CHAR or BINARY if records are compressed.</td>
</tr>
<tr>
<td><strong>Data Set Page Size</strong></td>
<td>Is the size of pages in the data set.</td>
</tr>
<tr>
<td><strong>Number of Data Set Pages</strong></td>
<td>Is the total number of pages in the data set.</td>
</tr>
<tr>
<td><strong>First Data Page</strong></td>
<td>Is the number of the page that contains the first data record; header records are stored in front of data records.</td>
</tr>
<tr>
<td><strong>Max Obs per Page</strong></td>
<td>Is the maximum number of records a page can hold.</td>
</tr>
<tr>
<td><strong>Obs in First Data Page</strong></td>
<td>Is the number of data records in the first data page.</td>
</tr>
</tbody>
</table>
Tips for finding your bugs before QC does, continued

Talking about deriveds, you should review the following aspects:

- Attributes: Label, length, type, format
- Check proc contents variables vs. specifications in order to include only those variables needed.
- If there are variables without label before sending our output to QC.

**PROC PRINT**

For reviewing your data partially, is recommended to use PROC PRINT to see how data is stored in the data set.

**SYNTAX**

```
PROC PRINT <option(s)>;
    BY <DESCENDING> variable-1 <...<DESCENDING> variable-n>
    <NOTSORTED>;
    PAGEBY BY-variable;
    SUMBY BY-variable;
    ID variable(s) <option>;
    SUM variable(s) <option>;
    VAR variable(s) <option>;
```

Although it is a tool very complete, we can simplify it i.e.

```
PROC PRINT data=ASL (obs=10)
    Var Usbjid Studyid trt;
Run;
```

In this example, one of the patients has an empty TRT, in this case, you can back to the code and check what is happening and fix it.
PROC FREQ
Use a PROC FREQ to check counts, completeness and consistency of data, since it provides descriptive statistics about a particular data set and it is very helpful for analyzing healthcare data sets, especially on TLG’s.

Although it has a very huge capacity, it can be used in its simple form, only for reviewing the numbers on how many patients should be for each treatment, how many patients are male or female, etc.

The basic syntax for one-way table is:

PROC FREQ <options>;
TABLES variable 1 * variable 2;
Run;

i.e.
PROC FREQ Data=ASL;
   TABLES trt;
Run;

In the example we can see the frequency of TRT variable and how many patients we have in the whole Data set.

PROC MEANS
Use PROC MEANS for analyzing the values of numeric variables

PROC MEANS Data=ASL n mean median min max;
   Title "Demographics";
       var age weight;
   by trt;
   run;

PROC SQL
Use PROC SQL in its simple form for simplifying the code and get the total of patients.

PROC SQL:
   select count( distinct usubjid) as Count_pat from ASL;
quit;
Tips for finding your bugs before QC does, continued

**SPECS**

Specs is commonly known as Specifications for programming Deriveds, Tables, Listings or Graphs and it is the document that shows the rules on how to do the output.

So the best is to be sure that this document is including all the variables and their derivations for creating the outputs properly.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>PARAMETER</th>
<th>VARIABLE LABEL</th>
<th>VARIABLE TYPE</th>
<th>DISPLAY FORMAT</th>
<th>SOURCE / DERIVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>STUDID</td>
<td>&lt;36 CHAR&gt;</td>
<td>Patient Number</td>
<td>Num</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UBD1</td>
<td>&lt;6 CHAR&gt;</td>
<td>Age Group</td>
<td>Char</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UBD2</td>
<td>&lt;6 CHAR&gt;</td>
<td>Imputed Birth Date</td>
<td>Date</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PATIDN</td>
<td>&lt;36 CHAR&gt;</td>
<td>Baseline Age</td>
<td>Num</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Once the outputs are ready, pay special attention to titles and footnotes and do the comparison between the output and the specifications, ensure that all the variables are included.

**CONCLUSION**

We need to be sure that the header is populated correctly and we need to provide the complete information since the programs are property of the companies and someone else can be in charge of the same code and the correct header can avoid rework or spent extra time, the documentation is very important.

It's a very good suggestion to add these Procedures to our code in order to prove that we have checked our results.

Using simple techniques we can review our results before sending to QC or validation and avoid a couple of bad stripes to our performance.

**RECOMMENDED READING**

- Base SAS® Procedures Guide
- http://support.sas.com/onlinedoc/912/docMainpage.jsp
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