Keep it Organized: A Grad Student "How-To" Paper

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ABSTRACT

Grad students learn the basics of SAS programming in class or on their own. The classroom lessons focus on statistical procedures and the datasets are usually ready for analysis. However, independent research projects may have data organized in many complex structures and may require many different SAS programs for data organization, exploration, and analysis. At the end of a project, you generally end up with multiple SAS programs and data sets. During the project, students may not realize the need to organize and document their project. However, it may become painfully clear if modifications need to be made to the completed analysis.

This paper will provide students with the tools that can help them survive the challenges of organizing and a documenting SAS code for a research project. We will present examples to help students keep their SAS code and data sets organized using base SAS as well as Enterprise Guide 5.1. The primary topics to be covered will include: documentation of SAS code, using comments, program headers, tables of contents, organization of SAS files, and organization of Enterprise Guide projects. This will allow the student researcher to remember what they did, how they did it, and where the results are. This diligence will be a critical timesaver in the final revisions of a research project or dissertation.

INTRODUCTION

My first research project using SAS was completed in the graduate school computer lab using Base SAS and example code written by my professor. After many days struggling to get my analyses correct, I printed off my results and put them in a folder on my desk. I wrote up the abstract and submitted it to a conference. After a couple of months, with the conference deadline quickly approaching, I began to write up my results. My professor reviewed my rough draft and suggested additional analyses to conduct. I returned to the computer lab to modify my SAS code only to be faced with the following questions: Where did I store the code? What does this code mean? What are all these data sets? And finally…Why are these results different from the ones I printed out before?

Students may use either Base SAS or Enterprise Guide for their research projects. This paper will first focus on organizing a project in Base SAS and then will focus on the benefits of using Enterprise Guide to organize a research project.

BASE SAS: WHERE DID I STORE THE CODE?

If you can't find your SAS code, then all the hours you worked were wasted. Instead, store all of your SAS files on your personal computer or a flash drive and always keep a backup copy of your files in a separate location. Do not store your data on public computers! Data sets may contain confidential information or may be deleted by technical support or other persons.

The key to finding your SAS files months after you've last used them is to store them in folders with descriptive and logical names that you will remember. Store all SAS files in a folder called "SAS" within the main project folder. For example, if I have a folder labeled "DISSERTATION", all my SAS files for the dissertation are located at "DISSERTATION\SAS". Another option is to have a folder called "SAS" with subfolders for each project. The first method facilitates backup and archiving of the project, though either method works as long as you are consistent with the organization. Similarly, keep SAS files (.SAS), SAS data sets (.SAS7BDAT), and SAS output (.LST) in separate directories. This avoids clutter and keeps

similar files together. Finally, store only the final drafts of the code or data sets in the main directories. All other drafts should be cleared out at the end of the project and placed in a folder called “TO DELETE”. These files are saved for reference or ‘just in case’.

BASE SAS: WHAT DOES THIS CODE MEAN?

A key to refreshing your memory about the purpose of your SAS code is to include documentation while you are writing it and still remember what it means! Use comments to create a main program header at the start of the SAS file to quickly give you an overview of the code. Several authors have provided examples of different header styles (Winn 2004, Levin 2004, Martin 2000). Standard information found in main program headers includes the program name, a description of the purpose of the program, the author of the program, the date written, input and output files, and a listing of modifications made to the code. It does not matter what header you use for your program, but pick one style and stick with it for all of your programs to make them consistent.

In addition, a table of contents at the end of the main program header can describe the major components of the program succinctly. Create section headers with comments that correspond to the table of contents. An example of a main program header with a table of contents and section header is presented below.

```
************************************************************************
************************************************************************
TITLE: DISSERATATION Blood Analysis
FOLDER: DISSERTATION\SAS\BloodAnalysis09152012.SAS
AUTHOR: Elisa L. Priest
CREATED:          November 9 2011
LAST MODIFIED:    July 06, 2012


INPUTS: ACCESS DATABASE "\DISSERTATION\DISSERTATIONDATABASE.mdb" TABLE:
BLOODTEST
OUTPUTS: DISSERTATION.BLOODANALYSIS09152012
      “DISSERTATION\SAS\OUTPUT\BLOODANALYSIS09152012.LST”
TEMPORARY: WORK.BLOODANALYSIS
MACROS USED: NONE
EXCEPTIONAL CONDITIONS TO PREVENT ERRORS: NONE

**********************************TABLE OF CONTENTS*****************

1. Import Blood Table
2. Recode Blood Table
3. Import Insulin Data
4. Recode Insulin Data
5. Merge and Label


************************************************************************;
*****1.   IMPORT BLOODTABLE*******************************************;
```

Comments should also be used liberally throughout the program to describe the actions of the program. One suggestion is to include a comment before every major DATA or PROC step (Levin 2004). However, if the code is repetitious, limit comments to the first instance of the code and to code that is tricky or non-standard. Comments can also be useful for documenting the rationale or reasoning behind code. It is very helpful to document that your professor suggested that you analyze the data in a specific manner!

BASE SAS: WHAT ARE ALL THESE DATASETS?

The amount of data sets produced for a project may require additional organization beyond the basic 'DATA' folder. If needed, additional folders can be created to categorize specific types of datasets, such as input or analysis datasets. While many permanent datasets may be necessary, using the temporary SAS work library can reduce the number of datasets that require organization. Keep input datasets as permanent datasets as well as the final analysis dataset. Never save over your input datasets. Instead, use the temporary datasets for creating and modifying variables during the SAS session. The final analysis dataset should contain all recoded variables for all analyses, if possible. This will reduce the number of datasets needed to recreate an analysis.

To easily find and understand the contents of datasets, document the meaning of dataset and variable names. Dataset labels and variable labels describe the data and the dataset and both can be assigned during a DATA step. All labels should be concise and descriptive. Labels should provide additional information beyond the variable names, such as the unit of measure. Both dataset and variable labels can be viewed using PROC CONTENTS which can then be used as a codebook.

```
Data Dissertation.BloodAnalysis09152012 (Label="Final Analysis Dataset
09/15/2012");
set work.BloodAnalysis;

Label
BloodMonth0="baseline BLOOD MONTH"
BloodDay0="baseline BLOOD DAY"
BloodYear0="baseline BLOOD YEAR"
Cholesterol0="baseline CHOLESTEROL (mg/dL)"
HDL0="baseline HDL (mg/dL)"
LDL0="baseline LDL (mg/dL)"
VLDL0="baseline VLDL (mg/dL)"
;
Run;

Proc contents data=Dissertation.Analysis09152012;
Run;
```

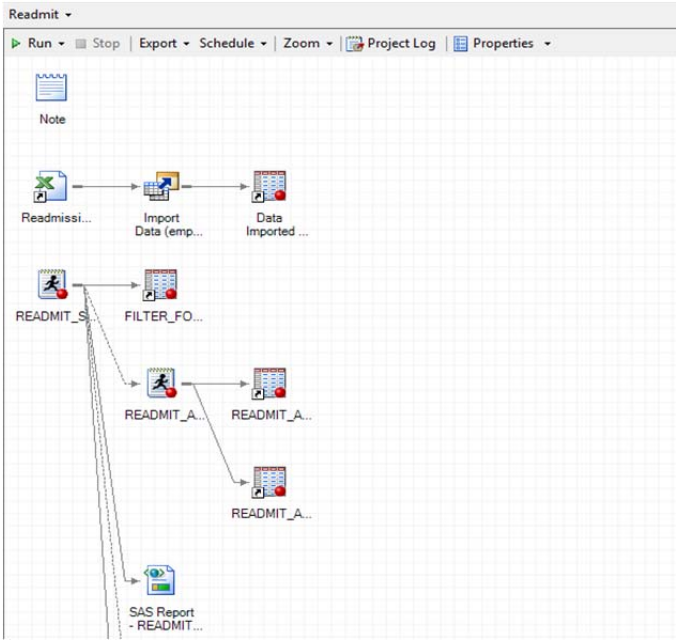
BASE SAS: WHY ARE THESE RESULTS DIFFERENT FROM THE ONES I PRINTED BEFORE?

One way to avoid changing results is to save all the files required to recreate the data analysis. The important files to save include the input datasets, SAS code used to create the analysis dataset, the analysis dataset, and the output window (.LST) file with the relevant results. With all of this information, there is no need to re-run an analysis unless you discover a mistake in the coding that created the analysis dataset. In addition, if there are multiple versions of analysis datasets and outputs, save each .SAS file associated with the different versions. If you have documented the inputs and outputs to the code in the header, you should have no problem recreating your analysis with the correct code and datasets or modifying your analysis if your professor requests it!

NOW… ON TO ENTERPRISE GUIDE

SAS Enterprise Guide (EG) “is a point-and-click, menu- and wizard-driven tool that empowers users to analyze data and publish results,” (SAS, 2004) which can make a SAS programmer cringe. However, Enterprise Guide is a great tool to use for organizing a research project. There are several new terms a programmer needs to learn to use EG: project and process flow.

A project in Enterprise Guide is the base to keeping a research project organized. Not only is SAS programs kept in a project, but also data, tasks, results and notes. Projects can be made up of several nodes or process flows. The process flow contains the data, SAS programs, tasks, notes and reports.



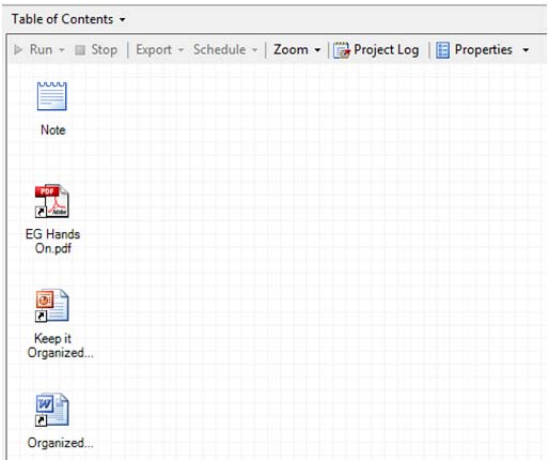
EG: WHERE DID I STORE THE CODE?

As with SAS 9.3, it is important to store your Enterprise Guide project on your PC, server, or flash drive and always have a backup copy. As equally important, the project should be saved in in a folder that has a descriptive and logical name, such as “DISSERTATION\SAS” to locate easier in the future. One advantage that EG has over Base SAS is that the project includes all of the programs, datasets, tasks and notes in one file. You do not have to have cluttered folders with many different programs anymore. However, if you prefer the clutter, exporting the programs in a project is an easy task in EG.

EG: WHAT DOES THIS CODE MEAN?

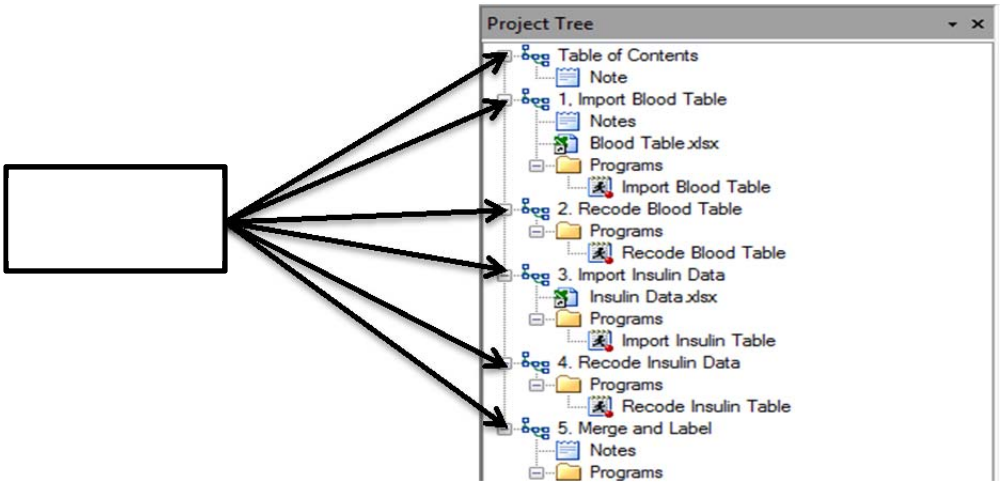
Comments in your SAS code are not the only way to make notes. Enterprise Guide has the ability to add notes in a project. Notes can be added in each process flow, which can be used to explain what the program does, where the datasets are from or any other necessary information.

Also, you can add PDF, PowerPoint, Excel, Word and other files to the project.



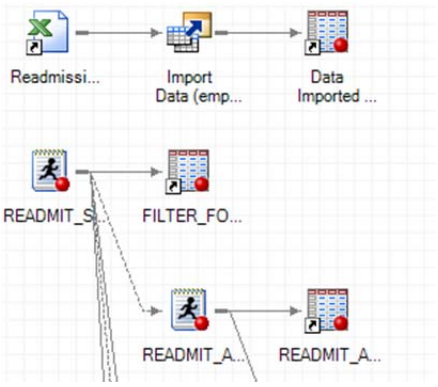
EG: WHAT ARE ALL THESE DATASETS?

EG makes it easy to organize programs and datasets and the project tree creates a “visual” table of contents.



The process flows allow you to see the relationships between the datasets, code and output. You can be see what dataset was imported, the program used to create a new dataset, and filters that were added.

This visual aid lets the user quickly decipher a dataset’s origin without looking through pages of code.



EG: WHY ARE THESE RESULTS DIFFERENT FROM THE ONES I PRINTED BEFORE?

If these organization guidelines are followed, then the results shouldn't be different! However, if they are, then check your input datasets to see if they are the same, check changes you made in the program and most importantly, check your notes for forgotten details.

CONCLUSION

Student researchers are often on their own for their first project. The previous guidelines have successfully kept these researchers organized and able to reproduce results for a project quickly and without frustration.

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