Seeing the Forest for the Trees: Part Deux of Defensive Coding by Example

Nancy Brucken and Donna Levy, Syneos Health

June 20, 2018

Seeing the Forest for the Trees: Part Deux of Defensive Coding by Example

- Donna Levy has worked in oncology statistics in academic, consulting and pharmaceutical settings, and has been a SAS user for 20 years. She is a member of the Biostatistical Consulting Group at Syneos Health and an ASA Kentucky Chapter elected official. She has presented SAS and statistical topics at BASUG, NESUG & SCT. She has learned a lot of her SAS skills from colleagues as well as attending local and regional professional meetings. She is also an avid Habs fan (go Habs go!).
- Nancy Brucken has been a SAS programmer for over 25 years, more than 20 of which have been spent in the pharmaceutical industry. She has been a frequent presenter at Regional & Local SAS User Group meetings, and is a proud graduate of Marietta College and a devout Ohio State fan.

Introduction

Identifying Your Tools

Areas of Focus

- Efficient coding
  - Improving code quality and productivity
- Good programming
  - Increasing code readability
  - Improving SAS skills
- Programming no-no's
  - No need for a description….

Efficient Coding

Make a packing list. Talk to the paratroopers. Walk away.

Efficient Coding

- It is still important to write programs that make good use of both programmer and machine resources
- Minimize passes through datasets
- Modularize and document code

Use of Modular Code

- Make a “packing list”
  - Organize your thoughts and your program before you start coding
  - Break code into logical chunks / modules
  - Use pseudo code for planning
  - Modules can often be reused across multiple programs
  - Step back and see the big picture!

Example Module

```
%MACRO RandExp(sigma);
   ((&sigma) * RAND("Exponential"))
%MEND;
```

Can be reused for time to event simulations for the time and censoring variables

Wicklin, R. 2013a. *Simulating data with SAS*. SAS Institute, Cary, NC.

Minimize Passes Through Data

- Create multi-purpose DATA steps
- Only sort data when necessary
- Use WHERE and KEEP statements to remove extra baggage
- Pay attention to placement of WHERE and KEEP statements
- Summarize as early as possible

Make Use of SAS Features

- Take advantage of BY-group processing
  - Many tables/reports can be generated with a single PROC UNIVARIATE (or PROC MEANS) call that includes all variables, run BY treatment arm and any subgroup variables
  - Transpose results as needed
  - Much faster and easier to debug than programming 1 row/column at a time via macro variables

Minimize I/O

- Reading data from disk storage is often one of the slowest parts of a program
- Structure your programs to read the data in once (subsetting to desired records and variables)

Good Programming Concepts

Be prepared: Appropriately pack the needed gear

Keep Your Equipment Current

- Be Prepared
- Use it or lose it
  - Not applicable
- Build your library of tools
  - Keep exposing yourself to new methods
  - May not remember everything
  - Remember a snippet (that is hopefully searchable)
  - Keep those tools sharp

(New versus Old) and (New and Old)

- RAND & RANDGEN
  - Improved statistical properties
  - Including a longer period
  - Improved true randomness when compared to RANUNI (Wicklin, 2013b)

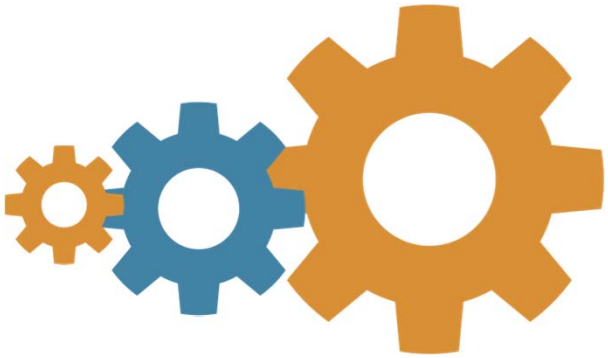
- PROC GENMOD versus GEE
- Missingness a concern
  - GEE

- GENMOD
  - Recently added goodness of fit test

Wicklin, Rick.2013b. “Six reasons you should stop using the RANUNI function to generate random numbers.” Accessed February 17, 2018. https://blogs.sas.com/content/iml/2013/07/10/stop-using-ranuni.html.

Thank you for the Default – No thank you

- Nice that SAS has defaults that do not need to be specified
  - But should specify
  - Defaults can change
  - Code can change



Example 3.A (no defaults specified):

```
PROC GLM;
classvar1;
  MODEL outvar = invar1 invar2 / CLM P;
RUN;
```

Example 3.B (with defaults specified):

```
PROC GLM DATA=InData ALPHA=0.05
 ORDER=FORMATTED;
  CLASS classvar1;
  MODEL outvar = invar1 invar2 / CLM P;
RUN; CLASS
```

Items that you Should Over Pack

- Comments are Free
- Have you ever heard someone say “This person has too many comments in their code?”

Items that you Should Over Pack con't

- Comments are Free
- Comment. Comment. Comment.
  - For your future self
    - Put it down and come back
    - Are you really going to remember that?
  - For whoever inherits your code
  - Big red bow

Items that you Should Over Pack con't

- Comments are Free
- Did we mention?
  - Comment. Comment. Comment.
- Indent and white space
  - Aid in readability
- Three big red bows

Programming No-Nos

Do not feed the bears

Overwriting Datasets

Wearing the same wet socks over and over

- We spoke about this in our last paper but important enough to say it again
- Rename datasets as you go
  - Your future self will thank you
    - Debugging
- Naming datasets in a meaningful way
  - WORK6 versus WORK06
  - WORK6 versus AVISTUM01

Overwriting Datasets

Wearing the same wet socks over and over

- We spoke about this in our last paper but important enough to say it again
- Rename datasets as you go
  - Your future self will thank you
    - Debugging
- Naming datasets in a meaningful way
  - WORK6 versus WORK06
  - WORK6 versus AVISTUM01

Plan this in your pseudo code

Appending Changes

No No No No

- The assigned statistician was taught
  - When you are working on a program that is fully functioning
  - An update is needed
  - You make the update at the end of the code
- Why?
  - Not messing with code that is working.
- While we understand the logic behind this suggestion, there are multiple issues with this programming technique.

- Remember your future self.
- Remember who will inherit your code.

Appending Changes con't

No No No No

- **Example 4.A (update at the end):**

```
DATA bad;
  SET x;
 IF age NE . AND age LE 18 THEN agecat="LE 18 years";
    ELSE IF age GT 18 THEN agecat="GT 18 years";
RUN;
*** other code ***;
 DATA final;
  SET almost;
 IF age NE . AND age LE 10 THEN agecat="LE 10 years";
RUN;
```

```
DATA MuchBetter;
  SET x;
  IF age NE . AND age LE 10 THEN agecat="LE 10 years";

*** additional category added;
    ELSE IF age NE . AND age LE 18 THEN agecat="LE 18 years";
    ELSE IF age GT 18 THEN agecat="GT 18 years";
RUN;
.
```

Appending Changes con't

No No No No

- Running the code over and over again
- Debugging over and over again
- Energy and frustration would probably be saved by putting the updated code in the correct and logical place
  - where the original age variable was developed.
- Keep related code together
- This is not a shortcut

- The safest route to quality programming code. While the code provided is a simple example, the more complex the code, the greater the importance of grouping related variables for the short and long term.

Syneos Health

Beta from a Statistician

Watch the weather. Follow the map. Call in the Park Rangers.

Call in the Park Rangers

- Checked your toolbox?
- Googled it?
- Stop circling the trail
- Ask for beta to get over the crux
  - Talk through the problem
  - Sometimes that is enough

Call in the Park Rangers

- Checked your toolbox?
- Googled it?
- Stop circling the trail
- Ask for beta to get over the crux
  - Talk through the problem
  - Sometimes that is enough

Do not forget that sometimes you should walk away (but of course eventually come back)

Beware of Merging Blindly

- The Only SQL I know…merging many to many

```
data work.patient_treatment;
  input patientid treatment $ date_treatment :mmddyy10.;
  format date_treatment mmddyy10.;
  datalines;
    1 A 1/5/2018
    1 A 2/5/2018
  ;
run;
data work.treatment_drug;
  input treatment $ drug $;
  datalines;
  A DRUG1
  A DRUG2
  ;
run;
```

```
**** Example code 5.A;
data work.merged;
  merge work.patient_treatment
work.treatment_drug;
  by treatment;
run;
title "With merge";
proc print data=work.merged;
run;
```

Output 1 shows the output from example code 5.A

With merge

Obs	patientid	treatment	date_ treatment	drug
1	1	A	01/05/2018	DRUG1
2	1	A	02/05/2018	DRUG2

Syneos Health

Beware of Merging Blindly con't

- The Only SQL I know…merging many to many

```
**** Example code 5.B;
title "With Proc SQL";
proc sql;
  select a.patientid, a.treatment,
       a.date_treatment, b.drug
  from work.patient_treatment a,
       work.treatment_drug b
  where a.treatment=b.treatment;
quit;
```

With Proc SQL

patientid	treatment	date_treatment	drug
1	A	01/05/2018	DRUG1
1	A	01/05/2018	DRUG2
1	A	02/05/2018	DRUG1
1	A	02/05/2018	DRUG2

Output 2. Output from a PROC SQL

Output 2 shows the output from example code 5.B

And from part 1

Conclusions

Never get lost in the woods. Keep your pack manageable. Feet on the trail.

Conclusions

- We hope you never get lost in the woods
  - Plan your route (pseudo code)
  - Keep your feet on the trail
- Keep your tools sharp
  - Keep expanding your SAS skills and knowledge
- Avoid the No nos

Contact Information

Nancy Brucken

Syneos Health

Nancy.Brucken@syneoshealth.com

Donna Levy

Syneos Health

Donna.Levy@syneoshealth.com

Extra Slides

References

- Brucken, Nancy. Levy, Donna E. 2015. “Defensive Coding by Example: Kick the Tires, Pump the Breaks, Check Your Blind Spots, and Merge Ahead!.” *Proceedings of the SAS Global Forum 2015 Conference*. Available at http://support.sas.com/resources/papers/proceedings15/3305-2015.pdf.
- Hughes, Ed. 2015. “SAS/OR 14.1: Improvements and New Features.” Accessed February 17, 2018. https://blogs.sas.com/content/operations/2015/09/04/sasor-14-1-improvements-and-new-features/.
- Rodriguez, Robert N. Gibbs, Phil. Tobias, Randy. 2017. “Step Up Your Statistical Practice with Today’s SAS/STAT® Software.” *Proceedings of the SAS Global Forum 2017 Conference*. Available at http://support.sas.com/resources/papers/proceedings17/SAS0521-2017.pdf.
- SAS (n.d.) SAS/STAT(R) 9.22 User’s Guide – Stepwise Selection (STEPWISE). Available at https://support.sas.com/documentation/cdl/en/statug/63347/HTML/default/viewer.htm#statug_glmselect_a0000000241.htm
-
- Wicklin, R. 2013a. *Simulating data with SAS*. SAS Institute, Cary, NC.
-
- Wicklin, Rick.2013b. “Six reasons you should stop using the RANUNI function to generate random numbers.” Accessed February 17, 2018. https://blogs.sas.com/content/iml/2013/07/10/stop-using-ranuni.html.

Plan your Hike

- Be Prepared
  - Like camping and hiking, we should plan our code before we start writing our code
  - Planning helps you
    - Process where you are
    - Process where you are going
    - Get the correct sequence of coding and variables

Plan your Hike con't

- Be Prepared
  - Pseudo code
  - Includes some details
    - What plan to pack?
    - Plan to pack based on identified needs?
    - Plan to pack based on planned hike path
      - Need to take the right path to see the sites
  - Know where you are going and what you want to see

– Programming plan of attack
– Programming methods