

A SAS Macro Utility to Append SAS-Generated RTF Outputs and Create the Table of Contents

Sudhakar Anbazhagan, Ockham Development Group, Chennai, India
Shridhar Patel, Ockham Development Group, Cary, NC

ABSTRACT

In Clinical Trial reporting, the analyses and the results are conveyed through tables and data listings. Depending upon the complexity, the number of tables and listings may vary from study to study. However, it is extremely useful to organize all the individual tables and listings generated using SAS, into a single file with a table of contents (TOC). Traditionally, these outputs would be compiled either manually or by using Stored Word VBA process. The disadvantage of these methods is that they are either time consuming or prone to errors. Although output methods vary, reports generated in Rich Text Format (RTF) have gained popularity. SAS uses very basic RTF tags to produce elegant outputs. Since RTF files are in one way plain text files, we can utilize the powerful text handling features of SAS to gather the required information needed for creating the TOC page by identifying certain RTF tags which hold that information. Additionally, tags can be inserted to create hyperlinks and page numbers before compiling the individual outputs into a single comprehensive file by programmatically manipulating a few RTF tags.

INTRODUCTION

This paper demonstrates how to consolidate the SAS RTF outputs and to create a TOC page. It presents a brief overview of the information the RTF outputs should contain, how the TOC Page is created with page numbers of the outputs, and how the macro consolidates the outputs with TOC page. The focus is on key components of how RTF tags can be utilized to generate a TOC, rather than the full macro. Considering the constraints of individual standards, understanding of the approach will help a user to mold it into a customized macro.

PROCESS OVERVIEW

1. **Prerequisites** – SAS Generated RTF outputs should hold the title information in the document property section which can be added using TITLE option in ODS RTF Statement. Unique bookmarks should be created in the RTF outputs for hyperlinking from TOC page, using ANCHOR option in ODS RTF statements as explained later in process 1.
2. Title and page number information will be extracted from the individual RTF outputs by reading them using SAS INFILE statement. The macro will loop through all the RTF files in a given directory to accomplish this. The information collected will be used in creation of the TOC page along with the hyperlinks to respective outputs. Process 2 details this step.
3. Once the TOC page is created, the next step is to append the individual RTF files in order of the table or listing numbers, following the TOC page. Process 3 will show how the consolidated document is generated.

PROCESS 1: ADDING TITLE AND BOOKMARK IN SAS RTF OUTPUTS

Before proceeding with generating the TOC, ensure that the SAS RTF outputs have unique bookmarks and desired study related information in the title of every individual RTF output. This will be created using the code below, right before the PROC REPORT section in a table/listing program.

```
ODS RTF AUTHOR="&sysuserid" TITLE="Table 14.1.1 Subject Demographics Safety  
Population" ANCHOR="&Bookid" NOTOC DATA;  
ODS RTF FILE="D:\Projects\Project AA\outputs\tables\t_dm.rtf" STYLE=rtfstyle;
```

where

&sysuserid = SAS Automatic Macro variable which holds userid details
&bookid = numeric value of title/Listing number
Ex: Table 14.3.5.2 will have *&bookid* as 14030502 for sorting purpose.
Rtfstyle = style used to generate the reports

PROCESS 2: CREATION OF THE TOC PAGE

Two things are required for the TOC page – report title information and size of individual files (i.e., total pages). This will be extracted from the RTF code of individual files. There are various ways to view the code behind an RTF file; one way is to change the file extension from .rtf to .txt and open with Notepad.

Read all SAS RTF outputs in the given directory for title information. This is available in the {title xxxx xxx } tag of the RTF file. Usually it will be on line # 23 of the RTF file which follows RTF Specification 1.8 or less. Line where the page number information is found will vary depending on where and how the page numbers are shown on the table/listing outputs. Here, the page numbers were placed on the first header in 'Page x of y' format. Refer to the highlighted text below.

Display 1: Sample RTF output file with Highlighted information about Title and page number

```
18 \red128\green0\blue0;
19 \red128\green128\blue0;
20 \red128\green128\blue128;
21 \red192\green192\blue192;
22 }{\stylesheet{\widctlpar\adjustright\fs20\cgrid\snext0 Normal;}{\*\cs10\additive Default Paragraph Font;}
23 }{\info{\title Table 14.3.1.1 Treatment-Emergent Adverse Events by Body System and Preferred Term Safety Population}(
24 \widowctrl\ftnbj\aeendoc\formshade\viewkind1\viewscale100\pgbrdrhead\pgbrdrfoot\fet0\paperw16838\paperh11894\margl144
25 \sectd\linex0\endhere\pgwsxn16838\pghsxn11894\lndscpsxn\header1440\footery1440\marglsxn1440\margrsxn1440\margtsxn14
26 \pard\plain\qc{
27 \trowd\trkeep\trhdr\trqc\trgaph10
28 \cltxlrtb\clvertalt\cellx6978
29 \cltxlrtb\clvertalt\cellx13956
30 \pard\plain\intbl\sb10\sa10\ql\q1\fs16\cf1{xxx Pharmaceuticals, Inc.\cell}
31 \pard\plain\intbl\sb10\sa10\qr\q1\fs16\cf1{Page 1 of 4}\cell
```

The macro will read the title information and page number information from all RTF files located in given directory and it will create a dummy TOC page with Serial Number (Sno), Title of the Output, and Page number. (Serial number is only shown for demonstration purpose only)

READING TITLE INFORMATION

```
DATA _doc_p;
  INFILE "D:\Projects\Project AA\outputs\tables\t_dm.rtf" MISSOVER LENGTH=1
  LRECL=2000 FIRSTOBS=23 OBS=23;
  INPUT string $varying2000. 1;
  tit=strip(scan(scan(string,1,"}"),2,"{"));
RUN;
```

READING PAGE NUMBER INFORMATION

```
DATA _doc_pg;
  LENGTH table $200. ;
  INFILE "D:\Projects\Project AA\outputs\tables\t_dm.rtf" MISSOVER LENGTH=1
  LRECL = 2000 FIRSTOBS=28 OBS=37;
  INPUT string $varying2000. 1;
  IF INDEX(STRING,"Page 1 of ")>0 ;
  Pgno = SCAN(COMPRESS(SCAN(string,2,'{','}')\cell'),4,'');
  Table = "&&fname&i";
  KEEP table pgno ;
RUN;
```

CREATION OF THE TOC PAGE

Title and page numbers of all SAS generated outputs will be extracted using a loop. A unique bookmark number will be created from the titles collected as explained in the PROCESS 1. Hyperlink code to the respective bookmarks will be added. This will be done using:

```
fdisp='{ \field {*\fldinst HYPERLINK \l1 "" ||STRIP(newno)||'" \o "" ||STRIP(tit)||'" }
  {\fldrslt ' ||STRIP(final)||'|}';
```

Where
newno = bookmark number
tit = tool tip text
final1 = variable which needs hyperlink
fdisp = target variable

The TOC page will be generated using PROC REPORT. An alternative approach to create a customized TOC page can be employed.

```
TITLE; FOOTNOTE; ODS LISTING CLOSE;
ODS RTF FILE="TOC.rtf" NOCONTENTS NOTOC_DATA STYLE=rtfstyle;

PROC REPORT DATA=_nof_ NOWD MISSING;
  COLUMN pg lno fdisp nelg;

  DEFINE pg/ORDER NOPRINT;
  DEFINE lno/DISPLAY " " STYLE(header)=[JUST=left FONT_FACE= "Courier"]
    STYLE(column)=[just=left font_face= "Courier"];
  DEFINE fdisp/DISPLAY " " STYLE(header)=[JUST=left FONT_FACE= "Courier"]
    STYLE(column)=[JUST=left FONT_FACE= "Courier"];
  define nelg/DISPLAY " " STYLE(header)=[JUST=left FONT_FACE= "Courier"]
    STYLE(column)=[JUST=left FONT_FACE= "Courier"];

  BREAK AFTER pg/PAGE;
  COMPUTE BEFORE pg/STYLE=[FONT_FACE="Courier" FONT_SIZE=12pt
    FONT_WEIGHT=bold] ;
  LINE 'Table of Contents';
  LINE '';
  ENDCOMP;
RUN;

ODS RTF CLOSE;
ODS LISTING;
```

Note: rtfstyle can be replaced with a custom style.

PROCESS 3: CONSOLIDATE ALL RTF OUTPUTS AND APPEND TO THE TOC PAGE

The macro will append the SAS generated RTF outputs in the order of their title numbers using the bookmark number variables as derived from PROCESS 1.

RTF tag “}” at the end of a RTF file is one which closes the output. The tag will be removed from the files before appending them. The tag “\sect” creates a new section in the document. This will be inserted in between the files to represent the outputs in the following section of the consolidated document. This whole process will be done in a loop. Here is the code that achieves this:

Removing the RTF Tag “}” from output and add section break:

```
DATA readrtf_a;
  INFILE "D:\Projects\Project AA\outputs\tables\t_dm.rtf" MISSOVER LENGTH = 1
    END = LASTOBS LRECL = 2000 FIRSTOBS = 25;
  INPUT string $varying2000. 1;

  IF rownum=1 THEN string="\sect" ||STRIP(string);
  ELSE string=string;

  IF lastobs THEN DO;
    string=COMPRESS(string, ' ');
  END;
RUN;
```

Create the consolidated document with DATA _NULL_ FILE - PUT method:

```
DATA _null_;  
  FILE tcf LRECL = 2000 MOD;  
  SET readrtf_a;  
  PUT string;  
RUN;
```

Close the consolidated document with “}” tag:

```
DATA _NULL_;  
  FILE tcf LRECL = 2000 MOD;  
  PUT " }";  
RUN;
```

Display 2. Sample TOC Page explained in Process 2

Table of Contents	
1. Table 14.1.1 - Subject Disposition - All Enrolled Subjects	2
2. Table 14.1.2 - Subject Demographics and Baseline - All Randomized Subjects	4
3. Table 14.3.1.1 - Treatment-Emergent Adverse Events by Body System and Preferred Term - Safety Population	10
4. Table 14.3.5.1 - Change from Baseline in Clinical Chemistry Lab Measurements - Safety Population	14
5. Table 14.3.5.2 - Change from Baseline in Hematology Lab Measurements - Safety Population	175
6. Table 14.3.6.1 - Change from Baseline in Vital Signs Measurements - Safety Population	280
7. Table 14.3.6.2 - Change from Baseline in ECG Measurements - Safety Population	407
8. Table 14.3.6.3 - Change from Baseline in Pulmonary Function Test Results - Safety Population	443

CONCLUSION

The above segments of code explain the core logic to create the consolidated SAS generated RTF outputs with TOC page. This macro will not work for manually saved RTF files.

In summary, the SAS macro can be used to automate the process of generating a Table of Contents from SAS generated RTF outputs, hence eliminating the very time consuming and manual process.

REFERENCES

RTF Specification 1.8 for word 2003

ACKNOWLEDGMENTS

Thanks to Dr. Ramesh Amatya, Kristina Ruppenkamp, Paul Ragland, and Harivardhan for providing their valuable input and support.

CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the author at:

Sudhakar Anbazhagan
Ockham Development Group
110, Mahatma Gandhi road, Prakash Presidium,
Nungambakkam, Chennai, India
Phone: +91 442 825 3938
Email: sudhakar@ockham-india.com

Shridhar Patel
Ockham Development Group
8000 Regency Parkway, Suite # 360
Cary, NC 27518
Phone: (919) 380 5664
Email: spatel@ockham.com

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. © indicates USA registration.

Other brand and product names are trademarks of their respective companies.