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Report Inspector

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ABSTRACT

In the statistical programming team, the statistician or the lead programmer plays a crucial role in the submission of statistical reports to regulatory authorities. One of their key tasks is reviewing these summary reports. Even though the reports are completely validated; the lead needs to review them meticulously. The volume, complexity, relationships, data-conventions and of course stringent timelines make these reviews a tedious task.

Report Inspector is a tool to help reviewers by performing value level checks as well as commonly required formats checks for summary reports.

INTRODUCTION

This paper discusses about the tool "Report Inspector". The paper is not intended to give the demo of the tool but to give a general idea of the tool. Report Inspector (RI) helps in making the review process easier by automating some of the review checks.

RI handles the format checks such as:

- Spell check
- Footnote truncation.
- No blank pages in the outputs

RI also handles some numbers and domain specific checks such as:

- The checks on number of subjects under each treatment column.
- For AE tables the preferred terms are sorted in the required order.

Even though these checks may sound trivial, nevertheless they are necessary. Furthermore as these checks are mostly done manually and may be frequently due to re-runs; it is time consuming and also prone to error.

OVERVIEW OF THE TOOL:

Report Inspector is a SAS®/VBA based tool and it handles formatting and value checks on the summary tables. This tool comes in a form of the word document. The basic requirements for a User are Office 2007 suite/applications and VBA enabled on the machine.

The basic assumption for using this tool is that the summary report should be in word Rich text format.
Report Inspector has a user Interface which collects the inputs through different parameters.

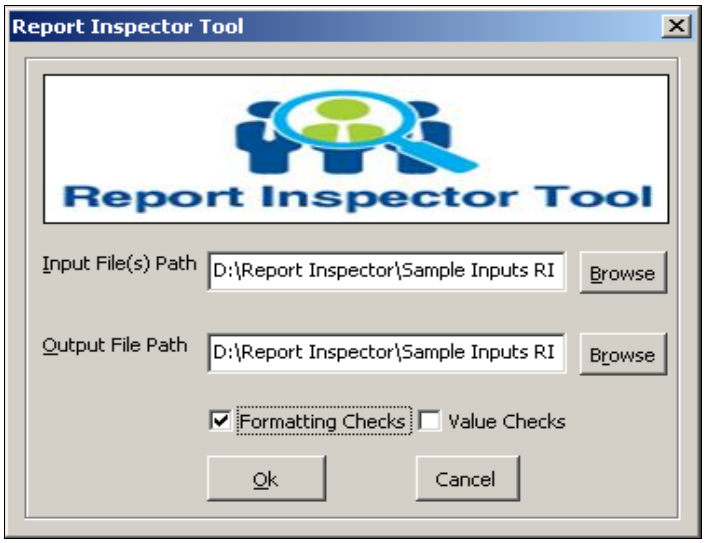
1. INPUT:

To start with the user is asked for the required critical inputs. The inputs are:

- Name of the summary report to be reviewed and it's folder path
- Path where the result of the report Inspector should be saved.
- Type of check. i.e.
    1. Formatting checks
    2. Value checks

- Format Checks: The input will be the metadata excel file. (We will discuss about the metadata in later section)
- Value Checks: The input will be analysis dataset and/or raw dataset.

Figure1: Screen shot of Report Inspector UI



2. BACKEND PROCESS:

Once the user has provided the inputs and selected the type of checks, the tool will deploy VBA if formatting checks are required or it will deploy SAS® if value level checks have been asked. However, an important point to note here is that both VBA and SAS® will run at the backend of the tool after the inputs are provided by the user.

3. OUTPUT:

Once the checks are done, findings will be listed in a word document. For formatting checks, RI provides word document using metadata as input. For value checks, SAS® code is generated and executed at the back end and provide the word document with findings. SAS® code executed at the back end will also be saved by default with the output of the value checks. The user can also customize the checks by modifying the generated code. The name of the output file given by the tool will be "name of the table_output_format" or "name of the table _output_value" for format checks and value checks respectively.

Figure2: Screen shot of the output

Report for Document inspection

Document Inspected: D:\Report Inspector\Sample Inputs RI\t11_2.rtf

Checks	Output
# Table Body Part Font Type	Is Not Similar at Row 13
#Footnote Truncation	Footnote1 is Not Truncated
# Full stop after each footnote	Full Stop is Not present at Footnote1
# Blank Page	Blank page number is 2

4. FORMATTING CHECKS:

Under this section the basic checks like spelling check, font, font size, title, footnotes, page numbers, etc are performed. The findings of these checks are provided in the output file.

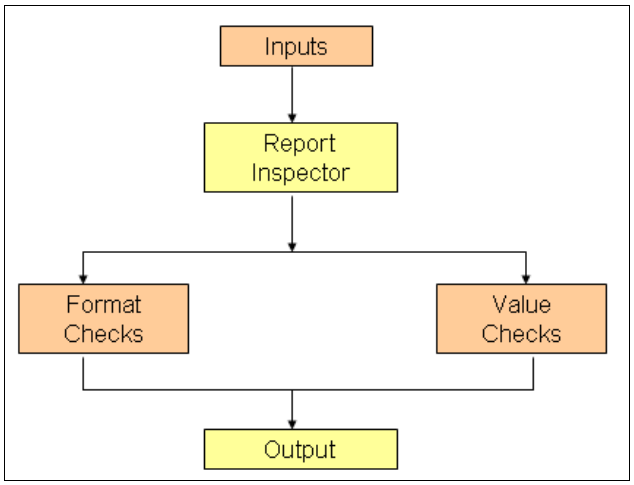
5. VALUE CHECKS:

Value checks are classified with respect to different domains like Demography, Adverse event, Subject status, ECG, Laboratory, vital signs. User has to select the domain and then choose the desired pre-defined checks by the tool. After the selection of the checks RI executes the SAS® code at back end and gets the result of the checks performed in the word document. The SAS® code executed at the back end is saved by default with the output of the value checks.

HOW DOES THE TOOL WORK:

As seen in the above section, inputs are provided by the user with the choice of type of check and RI list the findings in the word document.

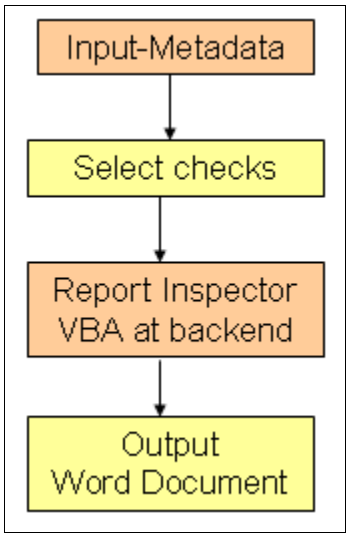
Figure3: Flow chart of RI



Now let us see format checks and value checks in detail.

1. FORMAT CHECKS:

Figure4: Flow chart of Format Checks



The mandatory inputs required for the format checks is metadata.

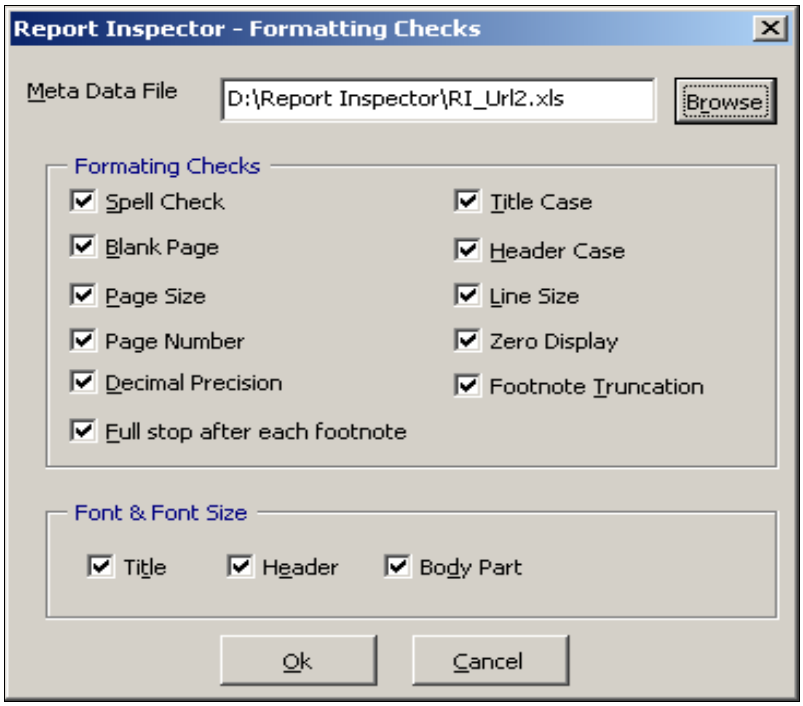
Metadata:
Metadata is the excel dataset that user will be providing for format checks. It will contain information like table number, table name, titles, footnotes, required page size, font and all other information that the tool requires to use for performing the checks. Tool will use this information against the summary report that needs to be reviewed. The pre-filled metadata will be provided to the user where the fields like font, font-size, Decimal Precision is pre-filled by the default value. If the user has different requirement then he can define the fields with his preference.

Figure5: Screen shot of metadata file:

Line Size	Title Font	Header Font	Body Part Font	Title Font size	Header Part size	Body Part Font size	Page no	Zero Display	Decimal Precision For percentages of Freq Counts	Decimal Precision: Mean	Decimal Precision: Median
122	Arial	Arial-Bold	Arial	9	9	9	a	0 (0.0)	0.0	0.0	0.0
122	Arial	Arial-Bold	Arial	9	9	9	a	0 (0.0)	0.0	0.0	0.0

After the metadata provided, user has to select the desired checks.

Figure6: Screen shot of the format checks UI



Let's see few of the format checks in detail:

1: SPELL CHECK:
The sentence in which the word is misspelled in the summary report will be displayed in the output with the misspelled word highlighted.

2: BLANK PAGE:
At times it happens that some of the middle page may remain blank within a report. This may get missed out at validation step as typically the validation is done using dataset which is passed through the proc report. RI catches the blank pages and indicates the page number of the same.

3: ZERO DISPLAY:

Every client has its own specific standard of displaying the zero frequency. I.e. zero can be displayed as 0 or 0(0.0) or (0.0%), etc. Example:

Race (N,%)	Asian	0(0.0)
	Black	0(0.0)
	White	217(100.0)
	Other	0(0.0)

Race (N,%)	Asian	0
	Black	0
	White	217(100.0)
	Other	0

Tool checks the display of zero in the report with given requirement in metadata and provides the result. The default value set by the tool is 0 (0.0).

4: DECIMAL PRECISION FOR STATISTICS:

In clinical reports descriptive statistics have to be calculated frequently. These statistics have different decimal precisions. Example:

- Minimum and maximum values should be displayed with the greatest number of decimals as present in the data.
- Mean, median, and any quartiles should be displayed with one decimal place additional than maximum.

User can specify these statistics decimal precisions in the metadata.

With the difference in the decimal precisions, arrangement of these statistics in the table also varies at times.
Example:

Layout1:

Statistics
N
Mean (SD)
Median
Q1 - Q3
Min - Max

Layout2:

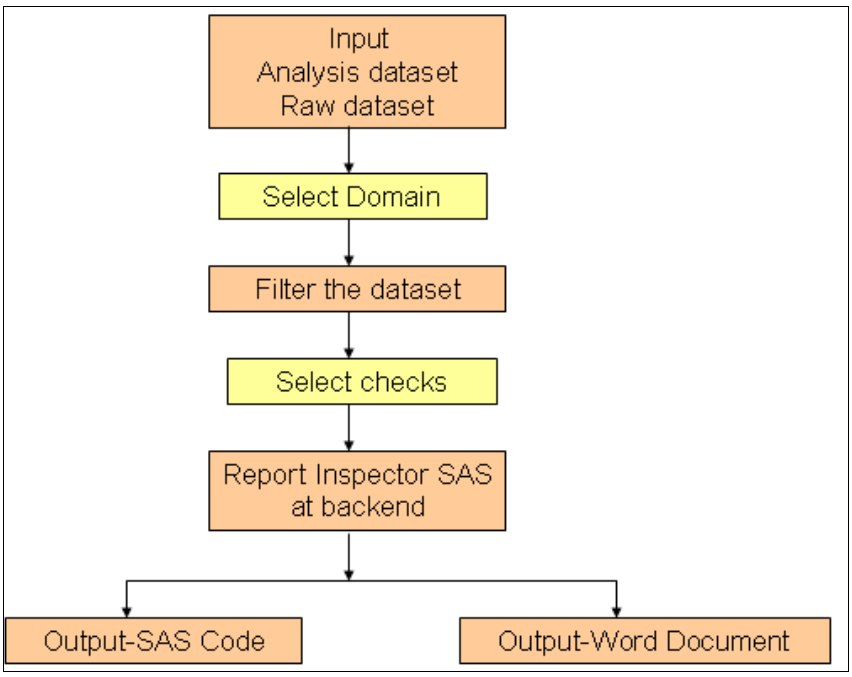
Statistics
N
Mean
Std Dev.
Median
Minimum
Maximum

The tool will assume the format of displaying statistics as in Layout 1 given above. If the user requires statistics to be displayed in any other format then he needs to provide the prototype of the same. The metadata has the provision for user to pass the changed prototype of statistics required.

2: VALUE CHECKS:

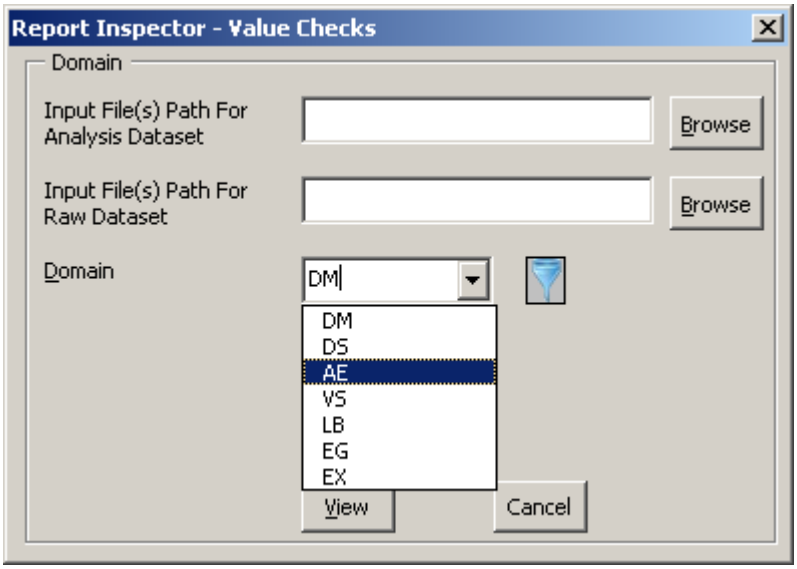
Under value checks the specific data values will be cross checked with analysis and/or raw dataset.

Figure7: Flow chart of Value Checks



To perform value checks, user has to provide one or more analysis dataset and/or raw data set required to perform the checks. After the dataset is provided, user can select the required data domain. After the selection of the domain, user can provide the filter condition on the dataset. Example: Safety flag="Yes".

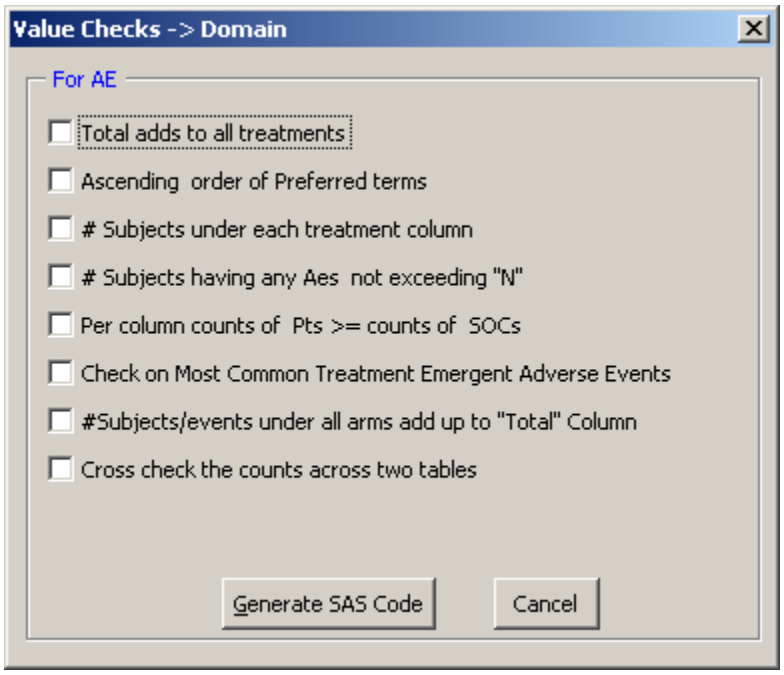
Figure8: Screen shot of value check UI



Let's see few domain-wise checks:

AE domain:

Figure9: Screen shot of AE domain value checks:



The input required will be analysis dataset for demography and adverse event.

Let's see few of the AE value checks in detail:

1: # SUBJECTS UNDER EACH TREATMENT COLUMN:

Here the task is to verify the subject count under each treatment i.e. value of "N".
The Report Inspector will first calculate the number of distinct treatment and then calculate the subject count under each treatment. Demo analysis dataset will be used for these calculations.
If the N is incorrect for any treatment then the tool highlights the wrong N and gives the correct N values.
Example:

Figure10: Snap shot of the output

Report for Document inspection

Document Inspected: D:\Report Inspector\Sample Inputs RI\t11_2.rtf

Checks	Output
# Subjects under each treatment column	N for Treatment 0.5 mg is wrong. Correct N =5

2: PER COLUMN COUNT OF PTS >= COUNTS OF SOCS:

Counts of the total number of events/ subjects by preferred term under any particular body system should be greater than equal to the total number of events/ subjects by SOC term. This is one of the tests available with the tool.

Table1: Table for Adverse events by primary system organ class and preferred term

Primary system organ class Preferred term	0.01 mg N=2 n (%)	0.3mg N=3 n (%)	0.5mg N=3 n (%)	0.6mg N=7 n (%)	1.5mg N=8 n (%)	Total N=23 n (%)
-Any Primary system organ class						
-Total	2 (100.0)	3 (100.0)	3 (100.0)	7 (100.0)	8 (100.0)	23 (100.0)
Blood and lymphatic system disorders						
-Total	0 (0.0)	1 (33.3)	2 (66.7)	4 (57.1)	7 (87.5)	14 (60.9)
Anaemia	0 (0.0)	0 (0.0)	0 (0.0)	2 (28.6)	5 (62.5)	7 (30.4)
Leukopenia	0 (0.0)	1 (33.3)	0 (0.0)	0 (0.0)	3 (37.5)	4 (17.4)
Lymphopenia	0 (0.0)	0 (0.0)	0 (0.0)	1 (14.3)	0 (0.0)	1 (4.3)
Neutropenia	0 (0.0)	0 (0.0)	1 (33.3)	0 (0.0)	1 (12.5)	2 (8.7)
Thrombocytopenia	0 (0.0)	1 (33.3)	2 (66.7)	4 (57.1)	7 (87.5)	14 (60.9)
Cardiac disorders						
-Total	0 (0.0)	0 (0.0)	1 (33.3)	1 (14.3)	1 (12.5)	3 (13.0)
Palpitations	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (12.5)	1 (4.3)
Sinus tachycardia	0 (0.0)	0 (0.0)	0 (0.0)	1 (14.3)	0 (0.0)	1 (4.3)

In the above table, the highlighted SOC has total 2 subjects. The total of the preferred terms under Blood and Lymphatic system disorders is 3.This is the desire count. If the count under the SOC terms is greater than total of the counts under PTs then the tool shows up the error.

3: CHECK ON MOST COMMON TREATMENT EMERGENT ADVERSE EVENTS:

Footnotes or title for some tables mention that only counts which have percentages above any cut-off value for each arm or the total column are to be displayed. RI checks if the report values conform to these footnotes or title.
For example:

Table2: Table for Most Common Treatment Emergent Adverse Events Reported

Most Common Treatment Emergent Adverse Events Reported in 10% or more subjects in any treatment group during the 6-month extension study
Safety Set Population

Preferred term	Placebo Subjects (N=30)	Trt A Subjects (N=28)	Trt B Subjects (N=20)	Trt C Subjects (N=70)
Subjects with any events	20 (66.7)	15 (53.6)	15 (75.0)	50 (71.4)
Alanine aminotransferase increased	1 (3.4)	1 (3.7)	4 (14.3)	4 (4.9)
Arthralgia	4 (13.8)	0	1 (3.6)	1 (1.2)
Fatigue	3 (10.3)	1 (3.7)	0	2 (2.5)
Gamma-glutamyltransferase increased	1 (3.4)	2 (7.4)	3 (10.7)	4 (4.9)
Headache	1 (3.4)	2 (7.4)	4 (14.3)	5 (6.2)
Multiple sclerosis relapse	3 (10.3)	3 (11.1)	1 (3.6)	2 (2.5)
Upper respiratory tract infection	4 (13.8)	1 (3.7)	2 (7.1)	6 (7.4)
Urinary tract infection	3 (10.3)	3 (11.1)	2 (7.1)	3 (3.7)

Here, tool checks if every preferred term has Percentages >=10%.If the any preferred term do not have percentage >=10% in any treatment group then it throws the error.
Now let's look into laboratory Domain:

1: CHECKS ON BASELINE VISIT:

Consider the below standard laboratory table where the statistics has to be calculated per visit: for observed value, change from baseline and percentage change from baseline.

Table3: Table for Liver function Tests Results

Table x.x.x
Liver function Tests Results: Observed Values and Changes from Baseline by Visit
Safety Set Population
Lab Parameter: Alanine Aminotransferase - ALT (U/L)

Visit		Descriptive Statistics	TRT A (N=26)	TRT B (N=24)	TRT C (N=24)
Visit xx	Observed Value	N	xx	xx	xx
		Mean ±SD	xx.xx ±xx.xx	xx.xx ±xx.xx	xx.xx ±xx.xx
		Median	xx	xx	xx
		Q1; Q3	xx.xx; xx.xx	xx.xx; xx.xx	xx.xx; xx.xx
		Min; Max	xx.x; xx.x	xx.x; xx.x	xx.x; xx.x
	Change from Baseline	N	xx	xx	xx
		Mean ±SD	xx.xx ±xx.xx	xx.xx ±xx.xx	xx.xx ±xx.xx
		Median	xx	xx	xx
		Q1; Q3	xx.xx; xx.xx	xx.xx; xx.xx	xx.xx; xx.xx
		Min; Max	xx.x; xx.x	xx.x; xx.x	xx.x; xx.x
	% Change from Baseline	N	xx	xx	xx
		Mean ±SD	xx.xx ±xx.xx	xx.xx ±xx.xx	xx.xx ±xx.xx
		Median	xx	xx	xx
		Q1; Q3	xx.xx; xx.xx	xx.xx; xx.xx	xx.xx; xx.xx
		Min; Max	xx.x; xx.x	xx.x; xx.x	xx.x; xx.x
....					

Here the test would be to verify that for the baseline visit; the change from baseline and %change from baseline is not calculated. If this test gives the negative result then same is highlighted in the output.

2: CHECKS ON SHIFT TABLE:

Let us now consider another analysis from a Laboratory Shift Table. Here RI will verify the vertical as well as horizontal counts in the table match with the total. This total is cross checked with the subject count.

Consider a mock shell for the shift table to be produced for CTC grades at baseline to post dose value for Fasting Glucose.

Table4: Lab Shift Table

Table 14.3-2.4.1
Fasting glucose shift table - Safety analysis set

Treatment	Baseline n (%)	Post Baseline Grade 1 n (%)	Grade 2 n (%)	Grade 3 n (%)	Grade 4 n (%)
TRTA (N=xxx)	Grade 1	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)
	Grade 2	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)
	Grade 3	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)
	Grade 4	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)
	Total	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)
TRTB (N=xxx)	Grade 1	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)
	Grade 2	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)
	Grade 3	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)
	Grade 4	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)
	Total	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)
Overall (N=xxx)	Grade 1	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)
	Grade 2	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)
	Grade 3	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)
	Grade 4	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)
	Total	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)	xx (xx.x)

Glucose unit is mg/dL.
Baseline is defined as the last non-missing value prior to the first study drug.

This check is about the total should match the total number of subjects under the respective treatment (N). The vertical total as well as horizontal total also should get add up to this number.

3: CROSS CHECK "N" ACROSS TWO TABLES:

It is crucial to check that the counts are consistent across all tables .Hence Cross checking tables is important .Here is one of the examples: consider the subgroup analysis for average of Lymphocyte counts by Race and age category. Let's consider the table for Race "Asian" with different age category.

Table 5.1. Average of Lymphocyte Counts by Race and Age Category

	Asian			
	Age category			
Lymphocyte count Category Subcategory	< 25 (N = 2) Mean (95% CI)	25 - < 35 (N = 50) Mean (95% CI)	35 - < 45 (N = 30) Mean (95% CI)	≥ 45 (N = 15) Mean (95% CI)

Below is the table of average lymphocyte counts by Race:

Table 5.1.1. Average of Lymphocyte Counts by Race

Lymphocyte count Categories	Asian (N = 98)	Black (N = 40)	Other (N = 114)
	Mean	Mean	Mean
	(95% CI)	(95% CI)	(95% CI)

The sum of the N's across the two tables should be the same.
The Total Ns in table 2.2.1 should add up to "N" of Race "Asian" from table 2.2.1.1 which is: 98.
However the N's under Table 2.2.1(refer the highlighted numbers) are: 2+50+30+15=97 and *not* 98.
So, as illustrated above, the tool highlights the fact that the data is missing and the Ns are not matching.

ASSUMPTION

1. The summary report to be reviewed has to be in RTF format.
2. The tool is compatible with MS office 2007.
3. Metadata and Ads /Raw datasets has to be provided by user with appropriate inputs.

ENHANCEMENTS

1. In the current version, RI handles limited layouts to perform format checks. In next version tool will be able to handle variety of table layouts.
2. Version 2 can avail the user to pass multiple tables for review at once.
3. In the current version, the value checks can be edited or add new ones after the SAS® is generated. Next version will handle the editing of the value checks during runtime.

CONCLUSION

During every submission, formatting and value checks are done manually which is quite time consuming. In addition to these checks, the reviewer needs to do a detail review of the table as well, but the basic checks gets covered by this tool thus providing additional time for the reviewer to focus on complex checks.

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CONTACT INFORMATION

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