Formatting outputs for clinical trial data to aid in readability

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ABSTRACT

When presenting descriptive and summary statistics in clinical trials and the healthcare industry, formatting of summary tables and supporting listings are critical for data review. Well-formatted outputs greatly enhance readability and reduce review time, which helps draw attention to any significant information embedded among thousands of pages. However, it's often a challenge for programmers to align different data types/formats when combining parameters. Here, we discuss several techniques to increase output readability by aligning both character and numeric data in summary tables and supporting listings. The first method is to use the option ASIS = ON, which reserves leading blank spaces of data. The second method is to use the escape character function, NBSPACE, which inserts, holds, and prints leading and trailing blank spaces for outputting. Last but not least, we introduce an in-house developed macro (%decimal) which evaluates the data and makes numeric data dynamically align by decimal point. The %decimal macro also includes options to set customized exclusions (e.g., option to selectively align decimal points for specific tests, and option to avoid alignment when the max number of decimal digits exceeds a certain number). Indicators, including high or low flags, can also be aligned separately for better visibility.

INTRODUCTION

In the pharmaceutical industry, reported results should be accurate, representative, concise, and readable. In this data-driven environment, clinical reports are strongly preferred to be well-formatted with proper indentation and alignment to enhance readability, thereby making the statistical or medical review, of what can sometimes be thousands of pages, much quicker and easier. When using SAS®, the most common and straightforward methods to align contents in PDF or RTF outputs are the standard justifications specified with the STYLE option in the REPORT Procedure : left, right, and center. However, to achieve proper indention and alignment, the programmer usually needs to insert blank spaces into the variables to force the values to align. In this paper, we will discuss how to achieve proper alignment using the ASIS = ON option and the NBSPACE function.

In addition, when reporting mixed form data with different precisions (e.g., lab data from multiple sites), data listings should be presented based on the precision with which the data was collected yet remain in a well-aligned manner for reviewing. To accommodate this need, we introduce an in-house developed macro, %decimal, which automatically aligns mixed-precision numeric values by decimal point and dynamically presents the formatted character variables for easier review.

ASIS = ON OPTION

ASIS is a style option which can be used in the REPORT procedure body style to define all columns in the entire output or specifically within the define statement to define the style for a specific column variable. By default, ASIS is set to OFF. When ASIS is turned on, it specifies that leading spaces will be honored, prints text with leading spaces, and allows for user-controlled indention. In the example below, space is commonly added to variables to make the final output display visually pleasing. In a typical adverse event table, we prefer to indent the preferred term to distinguish it from the system organ class. To achieve this, the code below can be run to create a new variable, "ROWVAR", which inserts three blank spaces if the record is for the preferred term (Display 1). When outputting using PROC REPORT with ASIS turned on, leading spaces are printed out, creating the desired indention for the PDF/RTF output (Display 2). When ASIS is turned off, leading spaces are neglected in the final output (Display 3).

```
data REPORT;
    set PREP;
    by AEBODSYS AEDECOD;
```

```
length ROWVAR $200;
if first.AEBODSYS then ROWVAR=(AEBODSYS);
    else ROWVAR="   "||(AEDECOD);
run;
```

Display 1: SAS data set - REPORT: Three blank spaces are inserted to ROWVAR if the record is for the preferred term.

AEBODSYS	AEDECOD	ROWVAR
Musculoskeletal and connective tissue disorders		Musculoskeletal and connective tissue disorders
Musculoskeletal and connective tissue disorders	Arthritis	Arthritis
Musculoskeletal and connective tissue disorders	Back pain	Back pain
Musculoskeletal and connective tissue disorders	Bursitis	Bursitis
Musculoskeletal and connective tissue disorders	Intervertebral disc degeneration	Intervertebral disc degeneration
Musculoskeletal and connective tissue disorders	Intervertebral disc protrusion	Intervertebral disc protrusion
Musculoskeletal and connective tissue disorders	Joint swelling	Joint swelling
Musculoskeletal and connective tissue disorders	Pain in extremity	Pain in extremity
Nervous system disorders		Nervous system disorders
Nervous system disorders	Dizziness	Dizziness
Nervous system disorders	Essential tremor	Essential tremor
Nervous system disorders	Headache	Headache
Nervous system disorders	Hypoaesthesia	Hypoaesthesia
Respiratory, thoracic and mediastinal disorders		Respiratory, thoracic and mediastinal disorders
Respiratory, thoracic and mediastinal disorders	Asthma	Asthma
Respiratory, thoracic and mediastinal disorders	Epistaxis	Epistaxis
Respiratory, thoracic and mediastinal disorders	Nasal congestion	Nasal congestion
Respiratory, thoracic and mediastinal disorders	Sinus congestion	Sinus congestion
Respiratory, thoracic and mediastinal disorders	Wheezing	Wheezing
Injury, poisoning and procedural complications		Injury, poisoning and procedural complications
Injury, poisoning and procedural complications	Contusion	Contusion
Injury, poisoning and procedural complications	Foot fracture	Foot fracture
Injury, poisoning and procedural complications	Ligament sprain	Ligament sprain
Injury, poisoning and procedural complications	Thermal burn	Thermal burn

Display 2: ASIS = ON: Leading blank spaces are printed out.

```
Statistics & Data Corporation
Version: Final


System Organ Class (SOC)
   Preferred Term (PT)

Musculoskeletal and connective tissue disorders
    Arthritis
    Back pain
    Bursitis
    Intervertebral disc degeneration
    Intervertebral disc protrusion
    Joint swelling
    Pain in extremity

Nervous system disorders
    Dizziness
    Essential tremor
    Headache
    Hypoaesthesia

Respiratory, thoracic and mediastinal disorders
    Asthma
    Epistaxis
    Nasal congestion
    Sinus congestion
    Wheezing

Injury, poisoning and procedural complications
    Contusion
    Foot fracture
    Ligament sprain
    Thermal burn
```

Display 3: ASIS = OFF: Leading blank spaces are not printed out.

```
Statistics & Data Corporation
Version: Final


System Organ Class (SOC)
   Preferred Term (PT)

Musculoskeletal and connective tissue disorders
Arthritis
Back pain
Bursitis
Intervertebral disc degeneration
Intervertebral disc protrusion
Joint swelling
Pain in extremity

Nervous system disorders
Dizziness
Essential tremor
Headache
Hypoaesthesia

Respiratory, thoracic and mediastinal disorders
Asthma
Epistaxis
Nasal congestion
Sinus congestion
Wheezing

Injury, poisoning and procedural complications
Contusion
Foot fracture
Ligament sprain
Thermal burn
```

NBSPACE FUNCTION

Summary statistics are often presented using center alignment and displayed in different forms. However, when there is no calculable percentage, reviewers prefer the value of counts to be aligned by the last digit before the parenthesis (Display 7, last 3 columns). In this case, ASIS = ON is not enough. If justification is set to center with ASIS = ON, TEMP1 with no extra space is inserted by the programmer, the output value of 0 is centered but not aligned (2nd column in Display 4 and 2nd column in Display 5). Common attempts to obtain the desired alignment include using the STRIP function and manually padding the values with spaces, either before or after, as depicted in the SAS code below for variables TEMP2 and TEMP3. The TEMP2 variable is manually padded with spaces before the value, and the TEMP3 variable is inserted with extra spaces after the value. When extra space is inserted in front of 0, since leading blanks will be printed out with ASIS = ON, the entire length of '   0' will be centered. Thus, 0 is printed out after the parenthesis instead of aligned with the last digit before the parenthesis (3rd column in Display 4 and 3rd column in Display 5). Inserting trailing blanks does not work since ASIS = ON does not honor trailing blank space as shown in this case (last column in Display 4 and last column in Display 5).

```
data REPORT;
   set PREP;
   length TEMP1 TEMP2 TEMP3 $50;
   TEMP1=TRT_A;
   TEMP2=TRT_A;
   TEMP3=TRT_A;
   if strip(TRT_A) ='0' then do;
      TEMP1='0';
      TEMP2='        0';
      TEMP3='0        ';
   end;
run;
```

Display 4: SAS data set – REPORT: When there is no percentage calculated, TEMP1 has no space inserted, while TEMP2 is padded with leading spaces and TEMP3 is padded with trailing spaces.

SAS – [VIEWTABLE: WORK.Report]

dow   Help

ROWVAR	TEMP1	TEMP2	TEMP3
Musculoskeletal and connective tissue disorders	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)
Arthritis	0	0	0
Back pain	0	0	0
Bursitis	0	0	0
Intervertebral disc degeneration	0	0	0
Intervertebral disc protrusion	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)
Joint swelling	0	0	0
Pain in extremity	0	0	0
Nervous system disorders	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)
Dizziness	0	0	0
Essential tremor	0	0	0
Headache	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)
Hypoaesthesia	0	0	0
Respiratory, thoracic and mediastinal disorders	2 (1.2 %)	2 (1.2 %)	2 (1.2 %)
Asthma	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)
Epistaxis	0	0	0
Nasal congestion	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)
Sinus congestion	0	0	0
Wheezing	0	0	0
Injury, poisoning and procedural complications	2 (1.2 %)	2 (1.2 %)	2 (1.2 %)
Contusion	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)
Foot fracture	0	0	0
Ligament sprain	0	0	0
Thermal burn	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)

Display 5: PDF output for TEMP1, TEMP2, TEMP3 with ASIS = ON: The value of 0 is not aligned with the last digit of count.

```
Statistics & Data Corporation                                                      Sponsor Name
Version: Final                                                              Study: Protocol Number
                                                    Table 14.3.1.3
                                               All Non-Ocular Adverse Events

                                                   Treatment A        Treatment A         Treatment A
System Organ Class (SOC)                             'TEMP1'            'TEMP2'             'TEMP3'
    Preferred Term (PT)                               N=162              N=162               N=162

Musculoskeletal and connective tissue disorders    1 (  0.6 %)        1 (  0.6 %)         1 (  0.6 %)
    Arthritis                                           0                  0                   0
    Back pain                                           0                  0                   0
    Bursitis                                            0                  0                   0
    Intervertebral disc degeneration                    0                  0                   0
    Intervertebral disc protrusion                  1 (  0.6 %)        1 (  0.6 %)         1 (  0.6 %)
    Joint swelling                                      0                  0                   0
    Pain in extremity                                   0                  0                   0

Nervous system disorders                            1 (  0.6 %)        1 (  0.6 %)         1 (  0.6 %)
    Dizziness                                           0                  0                   0
    Essential tremor                                    0                  0                   0
    Headache                                        1 (  0.6 %)        1 (  0.6 %)         1 (  0.6 %)
    Hypoaesthesia                                       0                  0                   0

Respiratory, thoracic and mediastinal disorders    2 (  1.2 %)        2 (  1.2 %)         2 (  1.2 %)
    Asthma                                          1 (  0.6 %)        1 (  0.6 %)         1 (  0.6 %)
    Epistaxis                                           0                  0                   0
    Nasal congestion                                1 (  0.6 %)        1 (  0.6 %)         1 (  0.6 %)
    Sinus congestion                                    0                  0                   0
    Wheezing                                            0                  0                   0

Injury, poisoning and procedural complications     2 (  1.2 %)        2 (  1.2 %)         2 (  1.2 %)
    Contusion                                       1 (  0.6 %)        1 (  0.6 %)         1 (  0.6 %)
    Foot fracture                                       0                  0                   0
    Ligament sprain                                     0                  0                   0
    Thermal burn                                    1 (  0.6 %)        1 (  0.6 %)         1 (  0.6 %)
```

To obtain the desired alignment we use the NBSPACE function, which is an inline-style function available starting with SAS 9.2. NBSPACE holds and prints blanks when used with ODS ESCAPECHAR. The number after NBSPACE indicates how many spaces NBSPACE will insert. When used with ASIS = ON, trailing spaces defined by NBSPACE will take effect and be presented, aligning the last digit. In the example below, TEMPNB2, TEMPNB3, and TEMPNB4 all hold and print trailing spaces when used with ASIS = ON (Display 6). When printing to the PDF/RTF destination, the effects of TEMPNB2, TEMPNB3, and TEMPNB4 are almost identical (Display 7). For TEMPNB2, the total number of trailing spaces are 9, which is equal to the white space between 0 and the defined escape character "$" plus one more space defined by NBSPACE. TEMPNB3 demonstrates an alternative method to accomplish the result when coding as NBSPACE 9. TEMPNB4 has no leading space before the digit "0" and coded as NBSPACE 7. When no leading space is added and the column is center justified, the effect of TEMPNB4 is the same as TEMPNB2 and TEMPN3.

```
ods escapcher $;
data RPT;
    set RPT;
    length TEMP1 TEMPNB2 TEMPNB3 TEMPNB4 $50;
    TEMP1=TRT_A;
    TEMPNB2=TRT_A;
    TEMPNB3=TRT_A;
    TEMPNB4=TRT_A;
    if strip(TRT_A) ="0" then do;
        TEMP1="0";
        TEMPNB2="  0          ${nbspace 1}";;
        TEMPNB3="  0${nbspace 9}";
        TEMPNB4="0${nbspace 7}";
    end;
run;
```

Display 6: SAS data set – REPORT: TEMPNB2, TEMPNB3 and TEMPNB4 use NBSPACE to insert blank spaces.

ROWVAR	TEMP1	TEMPNB2	TEMPNB3	TEMPNB4
Musculoskeletal and connective tissue disorders	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)
Arthritis	0	0 ${nbspace 1}	0${nbspace 9}	0${nbspace 7}
Back pain	0	0 ${nbspace 1}	0${nbspace 9}	0${nbspace 7}
Bursitis	0	0 ${nbspace 1}	0${nbspace 9}	0${nbspace 7}
Intervertebral disc degeneration	0	0 ${nbspace 1}	0${nbspace 9}	0${nbspace 7}
Intervertebral disc protrusion	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)
Joint swelling	0	0 ${nbspace 1}	0${nbspace 9}	0${nbspace 7}
Pain in extremity	0	0 ${nbspace 1}	0${nbspace 9}	0${nbspace 7}
Nervous system disorders	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)
Dizziness	0	0 ${nbspace 1}	0${nbspace 9}	0${nbspace 7}
Essential tremor	0	0 ${nbspace 1}	0${nbspace 9}	0${nbspace 7}
Headache	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)
Hypoaesthesia	0	0 ${nbspace 1}	0${nbspace 9}	0${nbspace 7}
Respiratory, thoracic and mediastinal disorders	2 (1.2 %)	2 (1.2 %)	2 (1.2 %)	2 (1.2 %)
Asthma	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)
Epistaxis	0	0 ${nbspace 1}	0${nbspace 9}	0${nbspace 7}
Nasal congestion	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)
Sinus congestion	0	0 ${nbspace 1}	0${nbspace 9}	0${nbspace 7}
Wheezing	0	0 ${nbspace 1}	0${nbspace 9}	0${nbspace 7}
Injury, poisoning and procedural complications	2 (1.2 %)	2 (1.2 %)	2 (1.2 %)	2 (1.2 %)
Contusion	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)
Foot fracture	0	0 ${nbspace 1}	0${nbspace 9}	0${nbspace 7}
Ligament sprain	0	0 ${nbspace 1}	0${nbspace 9}	0${nbspace 7}
Thermal burn	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)	1 (0.6 %)

Display 7: PDF output for TEMP1, TEMPNB2, TEMPNB3 with ASIS = ON: When there is no percentage calculated, the value of 0 is aligned with the last digit of count.

```
Statistics & Data Corporation                                                              Sponsor Name
Version: Final                                                                   Study: Protocol Number
                                            Table 14.3.1.3
                                     All Non-Ocular Adverse Events

                                          Treatment A       Treatment A       Treatment A       Treatment A
System Organ Class (SOC)                    'TEMP1'          'TEMPNB2'         'TEMPNB3'         'TEMPNB4'
   Preferred Term (PT)                       N=162            N=162             N=162             N=162

Musculoskeletal and connective tissue disorders   1 (  0.6 %)      1 (  0.6 %)      1 (  0.6 %)      1 (  0.6 %)
   Arthritis                                 0                0                0                0
   Back pain                                 0                0                0                0
   Bursitis                                  0                0                0                0
   Intervertebral disc degeneration          0                0                0                0
   Intervertebral disc protrusion           1 (  0.6 %)      1 (  0.6 %)      1 (  0.6 %)      1 (  0.6 %)
   Joint swelling                            0                0                0                0
   Pain in extremity                         0                0                0                0

Nervous system disorders                    1 (  0.6 %)      1 (  0.6 %)      1 (  0.6 %)      1 (  0.6 %)
   Dizziness                                 0                0                0                0
   Essential tremor                          0                0                0                0
   Headache                                 1 (  0.6 %)      1 (  0.6 %)      1 (  0.6 %)      1 (  0.6 %)
   Hypoaesthesia                             0                0                0                0

Respiratory, thoracic and mediastinal disorders   2 (  1.2 %)      2 (  1.2 %)      2 (  1.2 %)      2 (  1.2 %)
   Asthma                                   1 (  0.6 %)      1 (  0.6 %)      1 (  0.6 %)      1 (  0.6 %)
   Epistaxis                                 0                0                0                0
   Nasal congestion                         1 (  0.6 %)      1 (  0.6 %)      1 (  0.6 %)      1 (  0.6 %)
   Sinus congestion                          0                0                0                0
   Wheezing                                  0                0                0                0

Injury, poisoning and procedural complications    2 (  1.2 %)      2 (  1.2 %)      2 (  1.2 %)      2 (  1.2 %)
   Contusion                                1 (  0.6 %)      1 (  0.6 %)      1 (  0.6 %)      1 (  0.6 %)
   Foot fracture                             0                0                0                0
   Ligament sprain                           0                0                0                0
   Thermal burn                             1 (  0.6 %)      1 (  0.6 %)      1 (  0.6 %)      1 (  0.6 %)
```

%DECIMAL MACRO

Data with mixed types and precisions are very common in clinical trials (e.g., laboratory results, electrocardiogram, and vital sign data). Different sites might have different systems to report the results of the same parameter or the results may be collected in varying precisions. When it comes to patient profile listings, clinical studies strive to report the original data, which includes displaying the significant decimal places as originally recorded in the database. By default, SAS applies a single format to all values within a column without regard to different types of values, which is not always desirable.

Ideally, we would like to control the format of the output within a column so it is as neat as possible, while also making it easy to notice any significant information. By utilizing ASIS = ON and the NBSPACE function, we developed an in-house macro which evaluates the data type and aligns numeric data dynamically by decimal point. Calling %decimal will add the new format variables to the original data set which makes the output more visually appealing. This macro also has the capability to add any flags to the formatted value and set customized exclusions for decimal alignment, such as options to selectively align decimal points for specific records or to avoid alignment when the maximum number of decimal points exceeds a set number.

In the example below (Display 8), the 'Formatted Value' column is formatted using %decimal, which aligns all numeric values according to their decimal points and adds pre-defined flags which are also aligned. In the macro call, the WHERE macro variable excludes observations where PARAM='K' from being aligned and the MAXCHAR macro variable restricts the number of decimal places presented to 10. Character values that have any alphabetic characters or any special characters such as '+-=<>' are ignored by the macro.

Display 8: Formatted output with %decimal. %decimal (dataset= REPORT, where= where PARAM ne 'K', maxchar =10, param = PARAM, avalc= AVALC, hlflg=FLAG);

```
Statistics & Data Corporation                                              Sponsor Name
Version: Final                                                   Study: Protocol Number
                                       Listing 16.2.4.7
                                         Lab Listing

     Record ID    Tests     Un-Formatted value            Formatted value
       100-1       CA              836                         836
       100-2       CA             9.09                        9.09
       100-3       CA            836.25                      836.25
       100-4       CA          0.12836L                    0.12836 L
       100-5       CA           9.09005                     9.09005
       100-6       CA         9999909H                    9999909   H
       100-7       CA          10.12836                    10.12836
       100-8       CA        999990999H                  999990999   H
       100-9       CA           +4.321                      +4.321
       100-10      CA             -31                         -31
       100-11      CA        13.562852453                13.562852453
       100-12      CA            <931                        <931
       100-13      CA           >4.321                      >4.321
       100-14      CA        NOT AVAILABLE               NOT AVAILABLE
       100-15      CA          Not Done                    Not Done
       100-16      K               836                         836
       100-17      K              9.09                        9.09
       100-18      K              9854                        9854
```

Code and walk-through:

```
%macro decimal (DATASET= , WHERE= ,  MAXCHAR= 10,
                PARAM  = , AVALC= ,  HLFLG  = );
Parameters:
DATASET = input data set name
WHERE   = subset records that do not need alignment and flags printed
MAXCHAR = if a numeric string has a total number of all digits (plus
          decimal point) larger than maxchar, then this record will
          not be aligned with decimal point. By default, maxchar = 10;
PARAM   = variable for test names
AVALC   = values in character format
```

```
     HLFLG    = flag for avalc, (ie, L, H, Normal)
```

1) The first step (marked in the code section below) is to subset the input data set by the WHERE condition, if any.

2) Then subset the input data set into two data sets: CHAR and DIGIT. The CHAR data set includes character values and any numeric values with more decimal places than &MAXCHAR. The DIGIT data set includes numeric values that have less decimal places than &MAXCHAR. Steps 3 to 6 will process the DIGIT data set only.

3) This step creates a new flag variable (FLG_NEW) for flag alignment, if called in %decimal. If &HLFLG is specified, the macro variable &NUM is the max length of the actual flag variable. If &HLFLG is not specified in %decimal, &NUM is assigned as 0. If &HLFLG is not null, FLG_NEW is assigned as the value of &HLFLG. Otherwise, FLG_NEW is assigned to "$nbspace &NUM," which holds blank spaces to be printed as the flag.

4) This step creates 4 new variables:

    a. INT for the length of the integer part for &AVALC

    b. MAXINT for the maximum number of length for the integer part of &AVALC

    c. DEC for the length of the decimal part for &AVALC

    d. MAXDEC for the max number of length for the decimal part of &AVALC

    These variables are used in step 5 to decide how many blank spaces should be inserted to align the values by decimal point.

5) This step first compares INT to MAXINT and inserts needed blank spaces in front of INT to create the variable INT_TEMP. This forces the length of all records to have the same number of characters resulting in all values being aligned to the last digit of INT. The same logic is applied to DEC_TEMP, which adds the appropriate number of blank trailing spaces. &AVALC._F is created as the final formatted variable, which concatenates the processed integer portion (INT_TEMP), the processed decimal portion (DEC_TEMP), and the new flag variable (FLG_NEW).

6) The last step brings back any excluded records (excluded by WHERE statement, and/or &MAXCHAR, and records with character values) to the processed data set and sorts the final data set to its original order.

```
%macro decimal (DATASET= , WHERE= ,  MAXCHAR= 10, PARAM  = ,
                AVALC  = , HLFLG= );


*********************************************************;
*Separate data sets - digit only, and character only;
*********************************************************;

Data &DATASET;
   set &DATASET;
   N=_N_;
run;

data SUBSET;
   set &DATASET;
   &WHERE;
run;
```
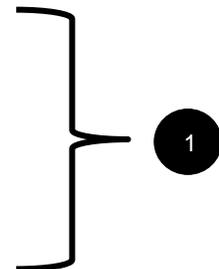
```
data CHAR DIGIT;
   set SUBSET;
      if anyalpha(&AVALC)=0 and indexc(&AVALC,'+-=<>') =0
      and length(strip(&AVALC))<&MAXCHAR then output DIGIT;
         else output CHAR;
run;

%if &HLFLG ^= %then %do;
data _NULL_;
  set DIGIT;
    if &HLFLG ne ' ';
    call symput("NUM",lengthn(strip(&HLFLG)));
run;
%end;

%if &HLFLG = %then  %do;
   %let NUM = 0;
   %let HLFLG = ' ';
%end;

data DIGIT2;
   length FLG_NEW $200;
   set DIGIT;
   if &HLFLG = ' ' then FLG_NEW="${nbspace &NUM}";
      else FLG_NEW=strip(&HLFLG);
run;

***********************************************************;
*Process digit data set;
*Get maximum length before decimal point, and after decimal
*point;
***********************************************************;
proc sql;
   create table PARAM as
   select a.*, ifn(index(&AVALC,'.')>0,
          length(strip(scan(&AVALC,1,'.'))),length(strip
          (&AVALC))) as INT,  max(ifn(index(&AVALC,'.')>0,
          length(strip(scan(&AVALC, 1,'.'))), length(strip
          (&AVALC)))) as MAXINT, ifn(index(&AVALC, '.')>0,
          length(strip(scan(&AVALC,2,'.'))), 0) as DEC,
          max(ifn(index(&AVALC,'.')>0, length(strip(scan(
          &AVALC,2,'.'))),0)) as MAXDEC
   from DIGIT2 as a;
quit;

data PARAM2 ;
   length INT_TEMP &AVALC._F DEC_TEMP $200;
   set PARAM;
   if INT<MAXINT then INT_TEMP=repeat(' ', MAXINT-INT-1)||
   strip(scan(&AVALC,1,'.'));
      else INT_TEMP=strip(scan(&AVALC,1,'.'));
   if DEC<(MAXDEC-1) then DEC_TEMP=strip(scan(&AVALC,2,'.'))
   ||repeat(" ", MAXDEC-DEC-2)||"${nbspace 1}";
      else if DEC=(MAXDEC-1) then DEC_TEMP=strip(scan(&AVALC,
      2,'.')) ||"${nbspace 1}";
      else if DEC=MAXDEC then DEC_TEMP=strip(scan(&AVALC,
      2,'.'));
```
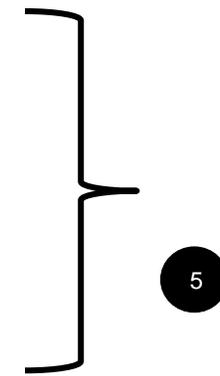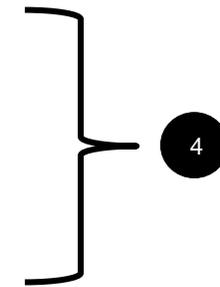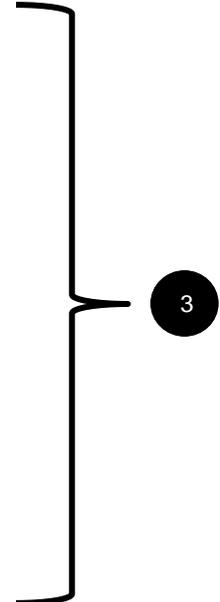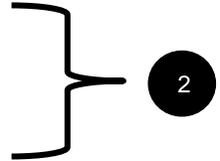
9

```
    if index(&AVALC,'.')>0 then DEC_TEMP='.'||DEC_TEMP;
       else DEC_TEMP=' '||DEC_TEMP;
    &AVALC._F=trim(INT_TEMP)||trim(DEC_TEMP)||' '||strip(FLG_NEW);
run;

**********************************************************;
*get excluded records (excluded because of WHERE condition,
*character values, and numeric values with decimal digits which
*exceed &MAXCHAR);
**********************************************************;

proc sql;
   create table LEFTOUT as
   select a.*, strip(a.&AVALC) as &AVALC._F length=200
   from &DATASET as a left join PARAM2 as b
      on a.N = b.N
      where b.N is null;
quit;

data FINAL;
   set PARAM2  LEFTOUT;
run;

proc sort data = FINAL out=&DATASET(drop=INT_TEMP DEC_TEMP N
FLG_NEW INT MAXINT DEC MAXDEC);
   by N;
run;

%mend;
```

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CONCLUSION

Summary tables and supporting listings for clinical trials should be displayed as neatly as possible to help the review process. In this paper, we discussed several straightforward and useful techniques to enhance the output formatting. With a combination of the ASIS = ON option and the NBSPACE function, programmers can customize the layout of specific values. In addition, our in-house developed macro, %decimal, evaluates data types and presents mixed results while preserving consistent decimal alignment. With %decimal, indicators, including high or low flags, can also be aligned separately for better visibility. When implemented properly, outputs using these formatting techniques can enhance readability and expedite statistical and medical review of clinical trial data.

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