%ICS – A SAS® Macro to Automate Individual Case Summaries
Doug E. Lassman, PRA International, Lenexa, KS

ABSTRACT
This paper describes a SAS® macro that has been developed to automate the programming of individual case summaries. Also known as patient profiles or case report form tabulations, individual case summaries are listings of data from a single patient on just a few pages. They are used for regulatory submissions, writing patient narratives or case histories, and data clean up and audit activities. Modeled after PROC GREPLAY in SAS/GRAPH®, output from included code is placed in windows defined on the page. Typically, a complicated DATA _NULL_ is used which is difficult to write and even more difficult to modify. With this macro, output from common SAS procedures such as PRINT, REPORT, and MEANS, which may already have been written for study listings, can be used for the summary. This macro can have other applications including a laboratory summary by analyte.

INTRODUCTION
Individual Case Summaries are listings of the data of a patient in a clinical trial on usually one or a few pages. Data from clinical trials are usually stored in several different data sets of different structures. Combining these data sets is often difficult. This macro, modeled after PROC GREPLAY in SAS/GRAPH, defines windows on the page that are filled with output from common SAS procedures that are easy to write and also modify.

THE MACRO
The macro works in the following manner: PROC REPORT, PROC PRINT, DATA _NULL_ or other SAS Procedure code is written for each of the windows defined on the page. That code is then executed and the output is written to a text file. The file is read back into a SAS data set. A DATA _NULL_ then writes the output to the respective window on the page.

The macro relies on the pagesize and linesize definitions of the page. A typical use for a landscape page with 1 inch margin on top, 0.5 inch margins on the left, bottom, and right, and 8 point courier new font would be 143 spaces across and 56 lines down. Changing the orientation to portrait would have 105 spaces across and 76 lines down. Windows are defined by the upper left corner to the bottom right corner. First a macro variable is defined as the number of windows on the page. Then the x and y positions of those corners are defined for the two corners. The (1,1) position on the page is the upper left corner and in the landscape page defined above, the (143,56) position would be the bottom right corner.

When writing code for the windows it is important that the resulting output fits in the window. If for some reason it does not, the output would be truncated to fit in the window. The pagesize and linesize options can be used in some situations. There are minimum values for pagesize and linesize which are 15 and 64 respectively. The pagesize of 15 can be useful but often a linesize of less than 64 is desired. In those cases, other steps to limit the width of the output may be necessary. Using the nocenter option is the first step. Other procedure specific parameters like the spacing= option in PROC REPORT to control the number of spaces between the columns are also helpful.

EXAMPLES
Two examples are given. The first is a sample of an Integrated Case Summary. One note is that there are certain displays, for example adverse events and concomitant medications, which can be variable in length. In those cases, additional pages may be necessary. Code can be written that checks the number of observations of certain datasets and more pages can be conditionally called for those situations. The second example is a laboratory summary by analyte.

CONCLUSION
This macro is a powerful way to place data from different datasets easily on the same page. Common SAS procedures such as PROC PRINT and PROC REPORT can be used instead of a complicated DATA _NULL_. Moreover, code that may have already been written for study listings possibly can be used. The code is compartmentalized so that changes in one window do not affect other windows. In conclusion, code for individual case summaries can be developed with higher quality and in shorter time with the use of this macro.

CONTACT INFORMATION
Your comments and questions are valued and encouraged. Contact the author at:
Doug E. Lassman
PRA International
16400 College Blvd.
Lenexa, KS 66219
Work Phone: 913-438-7696
Fax: 913-599-0344
Email: lassmandoug@praintl.com

TRADEMARK INFORMATION
SAS and SAS/GRAPH are registered trademarks of SAS Institute Inc. in the USA and other countries.
## Patient Information

**Patient Number:** 1  
**Site Number:** 1  
**Randomization Number:** 1875  
**Patient Initials:** SAS  
**Gender:** Male  
**Race:** Caucasian  
**Age:** 34  
**Height (in):** 75  
**Weight (lbs):** 190  
**Treatment:** Placebo  
**First Dose Date:** 01APR2001  
**Last Dose Date:** 21APR2001  
**Exposure (days):** 21  
**Completed Study?** Yes  
**Withdrawal Reason:** N/A  

## Physical Exam

**Body System**  
**Screening**  
**End Study**  
**CARDIOVASCULAR**  
**NORMAL**  
**ENDOCRINE AND METABOLIC**  
**NORMAL**  
**GASTROINTESTINAL**  
**NORMAL**  
**GENITOURINARY**  
**NORMAL**  
**GYNECOLOGICAL**  
**N/A**  
**HEAD/EYES/BARS/NOSE/THROAT**  
**ABNORMAL**  
**HEMATOPOIETIC/LYMPHATIC**  
**NORMAL**  
**MUSCULOSKELETAL**  
**NORMAL**  
**NEUROLOGICAL**  
**ABNORMAL**  
**RESCUATORY**  
**NORMAL**  
**SKIN**  
**NORMAL**  

## Adverse Events

<table>
<thead>
<tr>
<th>Adverse Event</th>
<th>Start Date</th>
<th>Stop Date</th>
<th>Severity</th>
<th>Causality</th>
<th>Action Taken</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEADACHE</td>
<td>04APR2001</td>
<td>04APR2001</td>
<td>MILD</td>
<td>RELATED</td>
<td>CONCOMITANT MED</td>
<td>RECOVERED</td>
</tr>
<tr>
<td>FEVER</td>
<td>04APR2001</td>
<td>04APR2001</td>
<td>MILD</td>
<td>RELATED</td>
<td>CONCOMITANT MED</td>
<td>RECOVERED</td>
</tr>
<tr>
<td>FATIGUE</td>
<td>04APR2001</td>
<td>04APR2001</td>
<td>MILD</td>
<td>RELATED</td>
<td>NONE</td>
<td>RECOVERED</td>
</tr>
<tr>
<td>NAUSEA</td>
<td>04APR2001</td>
<td>04APR2001</td>
<td>MODERATE</td>
<td>RELATED</td>
<td>CONCOMITANT MED</td>
<td>RECOVERED</td>
</tr>
<tr>
<td>HANGNAIL</td>
<td>08APR2001</td>
<td>08APR2001</td>
<td>MILD</td>
<td>UNRELATED</td>
<td>NONE</td>
<td>RECOVERED</td>
</tr>
<tr>
<td>RASH</td>
<td>10APR2001</td>
<td>20APR2001</td>
<td>SEVERE</td>
<td>RELATED</td>
<td>CONCOMITANT MED</td>
<td>RECOVERED</td>
</tr>
<tr>
<td>TOOTHACHE</td>
<td>16APR2001</td>
<td>16APR2001</td>
<td>MODERATE</td>
<td>UNRELATED</td>
<td>NONE</td>
<td>UNKNOWN</td>
</tr>
</tbody>
</table>

## Concomitant Medications

<table>
<thead>
<tr>
<th>Concomitant Medication</th>
<th>Start Date</th>
<th>Stop Date</th>
<th>Continue</th>
<th>Dose/Units/Route</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYLENOL</td>
<td>04APR2001</td>
<td>04APR2001</td>
<td>NO</td>
<td>500 MG QID PO</td>
<td>HEADACHE/FEVER</td>
</tr>
<tr>
<td>ZANTAC</td>
<td>04APR2001</td>
<td>04APR2001</td>
<td>NO</td>
<td>75 MG PRN PO</td>
<td>NAUSEA</td>
</tr>
<tr>
<td>BENADRYL</td>
<td>10APR2001</td>
<td>20APR2001</td>
<td>NO</td>
<td>CREAM PRN TOPICALLY</td>
<td>RASH</td>
</tr>
<tr>
<td>MULTIVITAMIN</td>
<td>01JAN2001</td>
<td>01JAN2001</td>
<td>YES</td>
<td>1 TAB QD PO</td>
<td>SUPPLEMENT</td>
</tr>
<tr>
<td>ASPIRIN</td>
<td>01JAN2001</td>
<td>01JAN2001</td>
<td>YES</td>
<td>81 MG QD PO</td>
<td>CARDIAC PROPHYLAXIS</td>
</tr>
</tbody>
</table>

## Vital Signs

<table>
<thead>
<tr>
<th>Visit</th>
<th>Heart Rate</th>
<th>Systolic/Diastolic</th>
<th>Visit</th>
<th>Score1</th>
<th>Score2</th>
<th>Score3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCREENING</td>
<td>64</td>
<td>114/ 70</td>
<td>SCREENING</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>VISIT 1</td>
<td>78</td>
<td>118/ 70</td>
<td>VISIT 1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>VISIT 2</td>
<td>82</td>
<td>116/ 70</td>
<td>VISIT 2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>VISIT 3</td>
<td>76</td>
<td>122/ 80</td>
<td>VISIT 3</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>END STUDY</td>
<td>66</td>
<td>132/ 68</td>
<td>END STUDY</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>
TITLE 'Concomitant Medications';
PROC REPORT DATA=CONMED NOWINDOWS HEADSKIP
  SPLIT='|';
COLUMN CONMED START STOP CONT DOSE INDICAT;'|
DEFINE CONMED / DISPLAY WIDTH=15 'Concomitant|Medication';
DEFINE START / DISPLAY WIDTH=12 'Start Date';
DEFINE STOP / DISPLAY WIDTH=12 'Stop Date';
DEFINE CONT / DISPLAY WIDTH=10 'Continue';
DEFINE DOSE / DISPLAY WIDTH=21 'Dose/Units|Frequency|Route';
DEFINE INDICAT / DISPLAY WIDTH=20 'Indication';
RUN;

* This is the code in c:\ics\code6.sas *
* This creates a data set of concomitant medication *
* and outputs using proc report.*

TITLE 'Vital Signs';
PROC REPORT DATA=VITALS NOWINDOWS HEADSKIP
  SPLIT='|';
COLUMN ORDER VISIT HR BP;'|
DEFINE ORDER / ORDER NOPRINT;
DEFINE VISIT / DISPLAY WIDTH=9 'Visit';
DEFINE HR / DISPLAY WIDTH=10 Center 'Heart Rate';
DEFINE BP / DISPLAY WIDTH=18 Center 'Blood Pressure|Systolic|Diastolic';
run;

* This is the code in c:\ics\code6.sas *
* This creates a data set of vital sign *
* and outputs using proc report.*

TITLE 'Adverse Events';
PROC REPORT DATA=ADVERSE NOWINDOWS HEADSKIP
COLUMN AE START STOP SEVERIT CAUSE ACTION
DEFINE AE / DISPLAY WIDTH=17 'Action
DEFINE CAUSE / DISPLAY WIDTH=11 'Causality';
DEFINE SEVERIT / DISPLAY WIDTH=10 'Severity';
DEFINE START / DISPLAY WIDTH=12 'Start Date';
DEFINE STOP / DISPLAY WIDTH=12 'Stop Date';
DEFINE AE / DISPLAY WIDTH=15 'Adverse Event';
DEFINE ORDER / ORDER  NOPRINT;
COLUMN ORDER VISIT HR BP;
SPLIT='|';
PROC REPORT DATA=VITALS NOWINDOWS HEADSKIP
TITLE '                     Vital Signs';
run;

* This is the code in c:\ics\code5.sas *
* This creates a concomitant medication *
* data set and outputs using a proc report.*

data conmed;
  FORMAT START STOP DATE9.;
  ae='HEADACHE '; START='04APR2001';D;
  STOP='04APR2001';D; CAUSE='RELATED '; SEVERIT='MILD '; SERIOUS='NO '; ACTION='CONCOMITANT MED'; OUTCOME='RECOVERED';
  OUTPUT;
  ae='FEVER '; START='04APR2001';D;
  STOP='04APR2001';D; CAUSE='RELATED '; SEVERIT='MILD '; SERIOUS='NO '; ACTION='CONCOMITANT MED'; OUTCOME='RECOVERED';
  OUTPUT;
  ae='NAUSEA '; START='04APR2001';D;
  STOP='04APR2001';D; CAUSE='RELATED '; SEVERIT='MILD '; SERIOUS='NO '; ACTION='CONCOMITANT MED'; OUTCOME='RECOVERED';
  OUTPUT;
  ae='HANGNAIL '; START='08APR2001';D;
  STOP='08APR2001';D; CAUSE='RELATED '; SEVERIT='MILD '; SERIOUS='NO '; ACTION='CONCOMITANT MED'; OUTCOME='RECOVERED';
  OUTPUT;
  ae='RASH '; START='10APR2001';D;
  STOP='10APR2001';D; CAUSE='RELATED '; SEVERIT='MILD '; SERIOUS='NO '; ACTION='CONCOMITANT MED'; OUTCOME='RECOVERED';
  OUTPUT;
  ae='TOOTHACHE '; START='16APR2001';D;
  STOP='16APR2001';D; CAUSE='RELATED '; SEVERIT='MILD '; SERIOUS='NO '; ACTION='CONCOMITANT MED'; OUTCOME='RECOVERED';
  OUTPUT;
  ae='CARDIAC PROPHYLAXIS'; START='01JAN2001';D;
  DOSE='81 MG QD PO '; STOP=.; CONT='YES';
  conmed='ASPIRIN '; START='01JAN2001';D;
  ind='CARDIAC PROPHYLAXIS';
  OUTPUT;
  ae='SUPPLEMENT '; START='01JAN2001';D;
  DOSE='1 TAB QD PO '; STOP=.; CONT='YES';
  conmed='MULTIVITAMIN'; START='01JAN2001';D;
  ind='SUPPLEMENT';
  OUTPUT;
  ae='FATIGUE '; START='04APR2001';D;
  STOP='04APR2001';D; CAUSE='RELATED '; SEVERIT='MILD '; SERIOUS='NO '; ACTION='CONCOMITANT MED'; OUTCOME='RECOVERED';
  OUTPUT;
  ae='NAUSEA '; START='04APR2001';D;
  STOP='04APR2001';D; CAUSE='RELATED '; SEVERIT='MILD '; SERIOUS='NO '; ACTION='CONCOMITANT MED'; OUTCOME='RECOVERED';
  OUTPUT;
  ae='HEADACHE/FEVER '; START='04APR2001';D;
  STOP='04APR2001';D; CAUSE='RELATED '; SEVERIT='MILD '; SERIOUS='NO '; ACTION='CONCOMITANT MED'; OUTCOME='RECOVERED';
  OUTPUT;
  ae='HANGNAIL '; START='08APR2001';D;
  STOP='08APR2001';D; CAUSE='RELATED '; SEVERIT='MILD '; SERIOUS='NO '; ACTION='CONCOMITANT MED'; OUTCOME='RECOVERED';
  OUTPUT;
  ae='TOOTHACHE '; START='16APR2001';D;
  STOP='16APR2001';D; CAUSE='RELATED '; SEVERIT='MILD '; SERIOUS='NO '; ACTION='CONCOMITANT MED'; OUTCOME='RECOVERED';
  OUTPUT;
  ae='CARDIAC PROPHYLAXIS'; START='01JAN2001';D;
  DOSE='81 MG QD PO '; STOP=.; CONT='YES';
  conmed='ASPIRIN '; START='01JAN2001';D;
  ind='CARDIAC PROPHYLAXIS';
  OUTPUT;
  ae='SUPPLEMENT '; START='01JAN2001';D;
  DOSE='1 TAB QD PO '; STOP=.; CONT='YES';
  conmed='MULTIVITAMIN'; START='01JAN2001';D;
  ind='SUPPLEMENT';
  OUTPUT;
  ae='FATIGUE '; START='04APR2001';D;
  STOP='04APR2001';D; CAUSE='RELATED '; SEVERIT='MILD '; SERIOUS='NO '; ACTION='CONCOMITANT MED'; OUTCOME='RECOVERED';
  OUTPUT;
  ae='NAUSEA '; START='04APR2001';D;
  STOP='04APR2001';D; CAUSE='RELATED '; SEVERIT='MILD '; SERIOUS='NO '; ACTION='CONCOMITANT MED'; OUTCOME='RECOVERED';
  OUTPUT;
  ae='HEADACHE/FEVER '; START='04APR2001';D;
  STOP='04APR2001';D; CAUSE='RELATED '; SEVERIT='MILD '; SERIOUS='NO '; ACTION='CONCOMITANT MED'; OUTCOME='RECOVERED';
  OUTPUT;
run;
ORDER=_N_;  
FORMAT DATE DATE9.;  
VISIT='SCREENING'; DATE='15MAR2001'D;  
SCORE1=INT(RANUNI(DATE)*4)+1;  
SCORE2=INT(RANUNI(DATE)*4)+1;  
SCORE3=INT(RANUNI(DATE)*4)+1;  
TOTAL=SCORE1+SCORE2+SCORE3; OUTPUT;  
VISIT='VISIT 1  '; DATE='01APR2001'D;  
SCORE1=INT(RANUNI(DATE)*4)+1;  
SCORE2=INT(RANUNI(DATE)*4)+1;  
SCORE3=INT(RANUNI(DATE)*4)+1;  
TOTAL=SCORE1+SCORE2+SCORE3; OUTPUT;  
VISIT='VISIT 2  '; DATE='08APR2001'D;  
SCORE1=INT(RANUNI(DATE)*4)+1;  
SCORE2=INT(RANUNI(DATE)*4)+1;  
SCORE3=INT(RANUNI(DATE)*4)+1;  
TOTAL=SCORE1+SCORE2+SCORE3; OUTPUT;  
VISIT='VISIT 3  '; DATE='15APR2001'D;  
SCORE1=INT(RANUNI(DATE)*4)+1;  
SCORE2=INT(RANUNI(DATE)*4)+1;  
SCORE3=INT(RANUNI(DATE)*4)+1;  
TOTAL=SCORE1+SCORE2+SCORE3; OUTPUT;  
VISIT='END STUDY'; DATE='22APR2001'D;  
SCORE1=INT(RANUNI(DATE)*4)+1;  
SCORE2=INT(RANUNI(DATE)*4)+1;  
SCORE3=INT(RANUNI(DATE)*4)+1;  
TOTAL=SCORE1+SCORE2+SCORE3; OUTPUT;  
RUN; 

OPTIONS NOCENTER;  
TITLE '                          Efficacy';  
PROC REPORT DATA=EFFICACY NOWINDOWS HEADSKIP  
SPLIT='|';  
COLUMN ORDER VISIT SCORE1 SCORE2 SCORE3 TOTAL;  
DEFINE ORDER / ORDER NOPRINT;  
DEFINE VISIT / DISPLAY WIDTH=9  '|Visit';  
DEFINE SCORE1 / DISPLAY WIDTH=6 Center  
'|Score1';  
DEFINE SCORE2 / DISPLAY WIDTH=6 Center  
'|Score2';  
DEFINE SCORE3 / DISPLAY WIDTH=6 Center  
'|Score3';  
DEFINE TOTAL / DISPLAY WIDTH=5 Center  
'|Total';  
RUN;  
***********************************************************************************;  
* End of code in c:\ics\code7.sas  
***********************************************************************************;
Leukocytes Lab Summary -- Units: 10^9/L -- Normal Range 3.2 to 9.8

Descriptive Statistics

<table>
<thead>
<tr>
<th>Analysis Variable: RESULT</th>
<th>FINAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>TREATMENT VISIT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N Obs</td>
</tr>
<tr>
<td>ACTIVE Baseline</td>
<td>222</td>
</tr>
<tr>
<td>Final</td>
<td>222</td>
</tr>
<tr>
<td>PLACEBO Baseline</td>
<td>278</td>
</tr>
<tr>
<td>Final</td>
<td>278</td>
</tr>
</tbody>
</table>

Shift Table

<table>
<thead>
<tr>
<th>Baseline Treatment Visit</th>
<th>Result</th>
<th>Baseline Treatment Visit</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Baseline</td>
<td></td>
<td>Placebo Baseline</td>
<td></td>
</tr>
<tr>
<td>Low - Normal - High</td>
<td>0</td>
<td>0 - 6 - 0</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>0%</td>
<td>2% - 0% - 0%</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>2%</td>
<td>92% - 2% - 0%</td>
<td></td>
</tr>
<tr>
<td>Endpoint 0</td>
<td>4</td>
<td>0 - 6 - 0</td>
<td></td>
</tr>
<tr>
<td>Low - Normal - High</td>
<td>0</td>
<td>0 - 2 - 0</td>
<td></td>
</tr>
<tr>
<td>Abnormal Values</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Treatment Visit</td>
<td></td>
<td>Patient Treatment Visit</td>
<td></td>
</tr>
<tr>
<td>0020 ACTIVE Final</td>
<td>3.1 L</td>
<td>0287 ACTIVE Baseline</td>
<td>10.0 H</td>
</tr>
<tr>
<td>0035 ACTIVE Final</td>
<td>2.5 L</td>
<td>0291 ACTIVE Final</td>
<td>10.0 H</td>
</tr>
<tr>
<td>0039 PLACEBO Final</td>
<td>9.9 H</td>
<td>0292 ACTIVE Baseline</td>
<td>2.4 L</td>
</tr>
<tr>
<td>0073 PLACEBO Final</td>
<td>10.7 H</td>
<td>0328 PLACEBO Baseline</td>
<td>2.8 L</td>
</tr>
<tr>
<td>0087 PLACEBO Final</td>
<td>10.0 H</td>
<td>0349 ACTIVE Final</td>
<td>3.1 L</td>
</tr>
<tr>
<td>0143 ACTIVE Baseline</td>
<td>3.1 L</td>
<td>0447 ACTIVE Final</td>
<td>2.8 L</td>
</tr>
<tr>
<td>0155 ACTIVE Final</td>
<td>2.9 L</td>
<td>0451 PLACEBO Baseline</td>
<td>10.6 H</td>
</tr>
<tr>
<td>0156 ACTIVE Baseline</td>
<td>10.3 H</td>
<td>0466 ACTIVE Baseline</td>
<td>2.8 L</td>
</tr>
<tr>
<td>0160 PLACEBO Baseline</td>
<td>2.7 L</td>
<td>0488 PLACEBO Final</td>
<td>10.2 H</td>
</tr>
<tr>
<td>0170 ACTIVE Baseline</td>
<td>10.0 H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0193 ACTIVE Final</td>
<td>10.3 H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0197 ACTIVE Final</td>
<td>10.0 H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0231 ACTIVE Baseline</td>
<td>2.5 L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0234 ACTIVE Baseline</td>
<td>10.5 H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0238 PLACEBO Baseline</td>
<td>3.1 L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0272 PLACEBO Baseline</td>
<td>3.0 L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0282 PLACEBO Final</td>
<td>2.6 L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0285 PLACEBO Final</td>
<td>10.2 H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0286 ACTIVE Final</td>
<td>10.6 H</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: 132 obs hidden.
```sas
options missing=' ' ls=159 ps=61;
%let numwind=5;
%let wind1x1= 2; %let wind1y1= 3;
%let wind1x2= 77; %let wind1y2= 4;
%let wind2x1=78; %let wind2y1= 4;
%let wind2x2=158; %let wind2y2=60;
%let wind3x1= 2; %let wind3y1= 20;
%let wind3x2= 77; %let wind3y2= 34;
%let wind4x1= 2; %let wind4y1= 35;
%let wind4x2= 77; %let wind4y2= 58;
%let wind5x1= 2; %let wind5y1= 1;
%let wind5x2= 158; %let wind5y2= 2;

%let code1='c:\lab\code1.sas';
%let code2='c:\lab\code2.sas';
%let code3='c:\lab\code3.sas';
%let code4='c:\lab\code4.sas';
%let code5='c:\lab\code5.sas';

filename out 'c:\lab\out.txt';
%ics;
%ics;
%ics;
%ics;
%ics;

data lab;
  seed=408322093;
  test='Leukocyte Count (WBC)';
  units='10^9/L';
  do i=1 to 1000;
    result=normal(seed)*1.5+6.5;
    if result<.0005 then result=0.0005;
    if result>12 then result=12;
    output;
  end;
run;
```

```sas
data lab;
  set lab;
  if mod(_n_,2)=1 then visit='Baseline';
  else visit='Final';
  patient=put(int(_n_/2)+1,z4.);
  *** normal range 3.2 to 9.8 ***;
  if result<3.2 then flag='L';
  if result>9.8 then flag='H';
  resultc=put(result,4.1)||' '||flag;
run;
```

```sas
proc sort; by patient;
run;
```

```sas
proc sort; by patient;
run;
```

```sas
data lab;
  merge lab patient;
  by patient;
run;
```

```sas
title 'Descriptive Statistics';
proc means data=lab maxdec=2 fw=7;
  var result;
run;
```

```sas
proc freq data=forgraph noprint;
  tables bflag*fflag*treatmnt / out=freqout;
run;
```

```sas
proc sort data=freqout; by treatmnt bflag fflag;
run;
```

```sas
data all;
  length treatmnt $7;
  input treatmnt $ bflag $ fflag $;
cards;
ACTIVE N N
ACTIVE N H
```
proc sort data=all; by treatmnt bflag fflag;
run;
data freqout;
merge freqout all;
by treatmnt bflag fflag;
if count=. then count=0;
if treatmnt='ACTIVE' then
  percent=100*count/&Active;
if treatmnt='PLACEBO' then
  percent=100*count/&Placebo;
run;
data freqout;
set freqout;
by treatmnt;
if bflag='L' and fflag='H' then do;
c1=count; p1=put(percent,3.) || '%'; end;
if bflag='N' and fflag='H' then do;
c2=count; p2=put(percent,3.) || '%'; end;
if bflag='H' and fflag='H' then do;
c3=count; p3=put(percent,3.) || '%'; end;
if bflag='L' and fflag='N' then do;
c4=count; p4=put(percent,3.) || '%'; end;
if bflag='N' and fflag='N' then do;
c5=count; p5=put(percent,3.) || '%'; end;
if bflag='H' and fflag='N' then do;
c6=count; p6=put(percent,3.) || '%'; end;
if bflag='L' and fflag='L' then do;
c7=count; p7=put(percent,3.) || '%'; end;
if bflag='N' and fflag='L' then do;
c8=count; p8=put(percent,3.) || '%'; end;
if bflag='H' and fflag='L' then do;
c9=count; p9=put(percent,3.) || '%'; end;
retain c1-c9 p1-p9;
if last.treatmnt;
run;
data _null_; file print;
put #10 @1 'Normal' @10 P4 @20 P5 @30 P6;
put #11 ;
put #12 @1 'Endpoint' @10 C7 @20 C8 @30 C9;
put #13 @1 'Low' @10 P7 @20 P8 @30 P9 @0;
run;
else if treatmnt='PLACEBO' then do;
p2 48 'Placebo Treatment';
p3 43 'Baseline' @53 'Baseline';
p4 46 'Low' @54 'Normal' @65 'High';
put #5 ;
p6 37 'Endpoint' @47 C1 @57 C2 @67 C3;
p7 37 'High' @47 P1 @57 P2 @67 P3;
p8 @0 ;
p9 37 'Endpoint' @47 C4 @57 C5 @67 C6;
p10 37 'Normal' @47 P4 @57 P5 @67 P6;
p11 ;
p12 37 'Endpoint' @47 C7 @57 C8 @67 C9;
p13 37 'Low' @47 P7 @57 P8 @67 P9 @0;
run;
***********************************************************;
* End of code in c:\lab\code3.sas                        *;
***********************************************************;
***********************************************************;
* This is the code in c:\lab\code4.sas                 *;
* This creates a table of abnormal values.              *;
***********************************************************;
proc report nowindows data=lab panels=2 ps=22
spacing=1;
title '                      Abnormal Values';
where flag in ('L' 'H');
column patient treatmnt visit resultc;
define patient / display left width=7
'Patient';
define treatmnt / display left width=9
'Treatment';
define visit / display left width=9
'Visit';
define resultc / display left width=6
'Result';
run;
***********************************************************;
* End of code in c:\lab\code4.sas                        *;
***********************************************************;
***********************************************************;
* This is the code in c:\lab\code5.sas                 *;
* This creates the title block.                         *;
***********************************************************;
title;
data _null_; file print;
put #45 'Leukocytes Lab Summary -- Units:
10^9/L  --  Normal Range 3.2 to 9.8';
run;
***********************************************************;
* End of code in c:\lab\code5.sas                        *;
***********************************************************;