Paper 214-2011
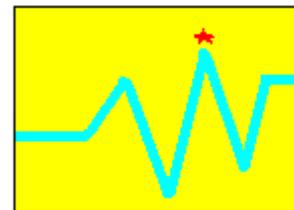
Annotated Plot of z/OS Auxiliary Storage Local Page Slot Allocation Using SAS/GRAPH® and MXG® software

Neal Musitano Jr.

U. S. Department of Veterans Affairs, Information Technology Center

Philadelphia, Pennsylvania

ABSTRACT

This paper is about creating an annotated SAS/GRAPH plot of z/OS® local page dataset slot utilization. The z/OS local page dataset slots are used by z/OS for management of system memory. The annotated plot shows the count of the local page slots defined and the number of slots that are used. A red star highlights the maximum local slot usage. Through the day, slots are used and released with copies of main memory information. For z/OS performance reasons the MXG slot utilization guideline is at or below 25%. At higher utilizations, z/OS response times can degrade. And an extreme local page slot shortage could even cause the z/OS server to crash. The data for the SAS/GRAPH plot is from the z/OS Resource Measurement Facility record type 71. The MXG performance database (PDB) stores this record information in SAS format in the PDB.TYPE71 dataset.

By plotting the daily local page slot usage our z/OS system support personnel are able easily verify that no shortage exists or to research potential problems that could contribute to a shortage. Such problems could be, insufficient central storage, or not allocating enough local page datasets with sufficient slots, or perhaps an unusual condition that never released unused slots. Each problem condition may require a different technical response to resolve the problem and to prevent a system outage. SAS and SAS/GRAPH help in daily z/OS monitoring to prevent any z/OS outage from a lack of local page slots.

This paper specifically details annotating z/OS RMF data in the MXG PDB.TYPE71 dataset and uses a user macro to plot the TYPE71 data variables. However, the annotated GPLOT example can be adapted to produce a variety of daily monitoring plots by using different input files and variables.

KEYWORDS – z/OS MXG SAS/GRAPH ANNOTATE GPLOT

INTRODUCTION

On the z/OS platform the RMF record type seventy-one records are produced as part of the daily System Management Facility (SMF) processing. MXG software processes this record type and many others into a Performance Database (PDB) consisting of a hundred or more MXG/SAS datasets. The MXG PDB TYEP71 dataset contains detailed z/OS paging activity, with each observation containing the record sorted by SYSPLEX, SYSTEM, SYSNAME and timestamp.

The z/OS SMF/RMF record types vary from record zero to record type two-hundred-fifty-five and provide additional detail for z/OS performance monitoring. The SMF/RMF record types are used to build numerous MXG SAS datasets on z/OS system activity. Each MXG PDB dataset contains performance variables in a SAS readable format that can be processed by SAS tasks. MXG also provides numerous examples for analysis and plots using BASE SAS and SAS/GRAPH.

Z/OS JOB CONTROL LANGUAGE (JCL) SETUP & PREPARATION

The daily z/OS MXG processing builds the MXG Performance Database including the PDB.TYEP71 dataset used in this example. The MXG PDB is the z/OS dataset HLQ.MXG.PDB.DAILY (0). HLQ is an abbreviation for high-level qualifier, the first qualifier of the z/OS dataset. Note, that many SAS datasets can exist within the one z/OS MXG Performance Database dataset.

The daily MXG PDB can be processed using the MXGSASV9 JCL procedure or with the standard SAS procedure that is shipped with SAS version 9 and used in this example.

The Figure #1 JCL example below uses LIBRARY and SOURCLIB DD cards to reference MXG FORMATS and SOURCLIB datasets, these datasets are used for most MXG processing and reports. The MXG FORMATS dataset is created with the installation of the MXG software and includes numerous formats for the MXG variables.

The PDB DD card is used to reference the MXG/SAS TYPE71 data member within the PDB.

Figure #1   **SAS BATCH JOB JCL TO READ THE DAILY MXG PDB**

```
//*********************************************************************
//* DOC: JCL FOR MXG PDB TYPE71 SAS GRAPHS                           *
//*********************************************************************
//SGF2011  EXEC SASV9,
//  OPTIONS='MACRO SYSPARM=SGFPATH'
//LIBRARY  DD DSN=HLQ.MXG.FORMATS,DISP=SHR
//SOURCLIB DD DSN=HLQ.MXG.USER.SOURCLIB,DISP=SHR
//         DD DSN=HLQ.MXG.SOURCLIB,DISP=SHR
//PDB      DD DSN=HLQ.MXG.PDB.DAILY(0),DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSOUT   DD SYSOUT=*
//SYSIN    DD *
 /**  SLOTUSED – PLOT DAILY LOCAL PAGE SLOT USAGE INFORMATION **/
```

Since the program will process my user macros the MACRO option is used to allow SAS to recognize the macro language statements, calls, and variable references.   The SYSPARM SAS option is used to specify a character string that is passed from z/OS to the SAS program. This example string of 'SGFPATH' is available to the program via the SAS &SYSPARM automatic macro variable and is used to select the application path for the graph.

The JCL was edited using the z/OS Time Sharing Option, Interactive System Productivity Facility TSO/ISPF or simply TSO, and the "HILITE ON" setting was used to make the JCL easier to read. From the edit session the PF1 key can be used for HELP or the PROFILE command can be used to check the edit session setting.

WHAT'S IN THE DAILY MXG PERFORMANCE DATABASE

SAS PROC CONTENTS is used to review the details of what is in the daily PDB. The SAS code in Figure #2 provides an example to list the contents of all the datasets in the daily PDB and the directory. Sometimes it's a good idea to print or direct the output to a file for reference, since the contents report of the daily MXG PDB can exceed 15,000 lines out output.

The output in Figure #3 and Figure #4 are partial listing of the z/OS PDB dataset directory with its SAS datasets and more details on the hundreds of variables in the PDB.TYPE71 file of the PDB. The directory option lists over 100 files (i.e. JOBS, STEPS, TAPES, TYPE70, TYPE71, etc.) in the PDB. And given the number of variables in each file, the output listing becomes too large to include within this paper.

Figure #2   **PROC CONTENTS TO DISPLAY PDB INFORMATION**

```
   PROC CONTENTS DATA=PDB._ALL_ DIRECTORY  ;
```

Figure #3   **PROC CONTENTS DIRECTORY OUTPUT AND LIST OF MEMBERS**

```
                              THE SAS SYSTEM

                           THE CONTENTS PROCEDURE

                                 DIRECTORY

                  LIBREF                  PDB
                  ENGINE                  BASE
                  ACCESS                  READONLY
                  PHYSICAL NAME           HLQ.MXG.PDB.DAILY.G1234V00
                  UNIT                    DISK
                  VOLUME                  CAP001
                  DISPOSITION             SHR
…more info on  DEVICE , BLOCKSIZE, BLOCKS PER TRACK , TOTAL BLOCKS, etc
                  MEMBERS                 104

                                  NUMBER
                  MEMBER              OF
 #  NAME         TYPE     PAGESIZE   PAGES  CREATED                    LAST MODIFI

 1  ASUMCEC   DATA        46080        10  10MAR10:00:26:00           10MAR10:
 2  ASUMCELP  DATA        23040         3  10MAR10:00:25:59           10MAR10:
..    more members.

58  TYPE70    DATA        46080        14  10MAR10:00:11:06           10MAR10:
…more members

63  TYPE71    DATA        46080         5  10MAR10:00:11:15           10MAR10:

   list continues for 100+ member datasets
```

Figure #4   **SNIP OF OUTPUT FROM THE CONTENTS PROCEDURE**

```
DATA SET NAME          PDB.TYPE71                  OBSERVATIONS           96
MEMBER TYPE            DATA                        VARIABLES              400
ENGINE                BASE                        INDEXES                0
CREATED               MONDAY, MAY 10,             OBSERVATION LENGTH     2003
                      2010 12:05:34 AM
LAST MODIFIED         MONDAY, MAY 10,             DELETED OBSERVATIONS   0
                      2010 12:05:34 AM
PROTECTION                                        COMPRESSED             CHAR
DATA SET TYPE                                     REUSE SPACE            NO
LABEL                 TY71: RMF PAGING ACTIVITY   POINT TO OBSERVATIONS  YES
DATA REPRESENTATION   MVS_32                      SORTED                 YES
ENCODING              EBCDIC1047  WESTERN (EBCDIC)


                    ENGINE/HOST DEPENDENT INFORMATION


            DATA SET PAGE SIZE         46080
            NUMBER OF DATA SET PAGES   5
            NUMBER OF DATA SET REPAIRS 0
            PHYSICAL NAME              HLQ.MXG.PDB.DAILY.G5678V00
            RELEASE CREATED            9.0101M3
            RELEASE LAST MODIFIED      9.0101M3
            CREATED BY                 NSGFMXGB
            LAST MODIFIED BY           NSGFMXGB
            SUBEXTENTS                 1
            TOTAL BLOCKS USED          10


                ALPHABETIC LIST OF VARIABLES AND ATTRIBUTES
   ..
  #  VARIABLE  TYPE  LEN  FORMAT        LABEL

 26  ASMNVSC   NUM   5                  LOCAL SLOTS*ALLOCATED*NON-VIO
 27  ASMSLOTS  NUM   5                  LOCAL*SLOTS*DEFINED
 28  ASMSLOTX  NUM   5                  LOCAL*SLOTS*UNALLOCATED
 29  ASMVSC    NUM   5                  LOCAL SLOTS*ALLOCATED*VIO
 30  AVLEXTAV  NUM   5                  AVAILABLE*EXT STORAGE*AVG PAGES
 31  AVLEXTMN  NUM   5                  AVAILABLE*EXT STORAGE*MIN PAGES
 32  AVLEXTMX  NUM   5                  AVAILABLE*EXT STORAGE*MAX PAGES
 33  BLKPAGE   NUM   5   5.1            BLOCKED*PAGES*PAGED IN*PER SEC
  7  BLKSAUIN  NUM   5                  BLOCKS*PAGED IN/SEC*FROM AUX*PER SEC
 34  COMPAGE   NUM   5   5.1            TOTAL*COMMON*PAGING RATE
 35  CPUPAGTM  NUM   5   TIME12.2       CPU TIME*FOR PAGE MOVEMENT*IN CSTORE

   ..
   ..hundreds of additional variables

   ..
 3  ZDATE     NUM   4  DATE9.          ZEE DATE*ZEE OBS*WAS CREATED


                          SORT INFORMATION

            SORTEDBY       SYSPLEX SYSTEM SYSNAME STARTIME SMFTIME
            VALIDATED      YES
            CHARACTER SET  EBCDIC
            SORT OPTION    NODUPREC
```

SAS PROGRAM PREPARATION

The program code is displayed on the next page in Figure #5. Since the SAS/GRAPH plot will be produced using PROC GPLOT with "BY" variables and "BY" values placed in the titles, the NOBYLINE option is used to keep the default byline from displaying in the graph. This makes for a more professional looking graph.

SAS program maintenance for the program is simplified by the use of &LET statements. This is done to identify the input dataset. Referencing the TYPE71 dataset via the %LET statement, minimizes possible errors in referencing the dataset through the program, and the dataset name can be displayed in the footnotes of the graphics output without error. This is a great feature and makes the program code useful for charting several other datasets and variables.

The path to store the graph is defined at the beginning of the program by using a user macro named SET_USER_PATH. An input parameter from the JCL is used via the &SYSPARM automatic macro variable to select the user path desired, i.e. for test graphs or SGF graphs as needed. The macro variable &USERPATH is then created with the actual path and made available to the program. It is up to the user to make sure the paths defined actually exist. This example defines a path to a UNIX type directory on the z/OS system with the day of the month concatenated to the daily path.

The example reads the PDB.TYPE71 data and creates a working TYPE71 dataset i.e. WORK**.**TYPE71. The "WORK" part of the dataset name is a default and doesn't have to be specified in the references that follow. This dataset contains information on the TYPE71 observations, plus the time and date variables extracted from the STARTIME variable. While it is technically possible to plot the data using the STARTIME variable, the charts are easier to read and more acceptable to most managers, if the date is in the title and time is used for the horizontal axis.

MXG calculates the slot utilization variable of SLOTUTIL using the SLOTLOMN and SLOTUNMN variables. Thus this example uses the SLOTLOMN and SLOTUNMN variables to calculate a new variable labeled "slots used up" to view the local page slot usage. The plot variables are input to the USER_TYPE71_PLOT and plotted on an overlay graph. The peak SLOTUTIL and time of the peak is also displayed in the annotated plot.

A threshold of twenty-five percent of SLOTLOMN is calculated and displayed in the graph. The 25% slot usage is a technical MXG recommendation or guideline, reference MXG change 15.064 in the MXG newsletters or member CHANGESS. Since page slot usage of above that threshold starts to degrade the paging processing time and slows most everything on the z/OS system. Depending on the situation, more page datasets or larger page datasets might be needed to lower the utilization.

The user plotting macro USER_TYPE71_PLOT for the TYPE71 data is in the SGFMACS member in the user sourclib dataset as is the macro SET_USER_PATH. The macro's are made available to the SAS program via the sourclib statement in the JCL and the %INCLUDE statement in the SAS program. The first plot variable PLOTVAR1 of the macro is used for the red star "y" axis annotation. The source code for both macros is available in the appendix.

After the SAS/GRAPH plot on local page slot utilization is produced, the macro can be used again to produce additional plots using different variables from the TYPE71 data.

Figure #5   SAS CODE - IDENTIFY THE INPUT FILE AND VARIABLES TO PLOT

```
/**  SLOTUSED  -  PLOT DAILY LOCAL PAGE SLOT USAGE INFORMATION **/
OPTIONS  NODATE NONUMBER NOBYLINE;       /** SAS OPTIONS        **/
%INCLUDE SOURCLIB(SGFMACS) ;             /** INCLUDE MY MACROS   **/

/**  IDENTIFY THE MXG PDB DATASET TO PROCESS AND VAR(S)        **/
%LET MY_FILE  = TYPE71;
%LET THRESHOLD = .25;     /** USED UP LOCAL SLOT THRESHOLD       **/
%LET MY_NOTE=
        H=2.3 PCT C=RED FONT=SWISSB
        MOVE=(58,71) "AT 25% THRESHOLD - REVIEW USAGE";

/**  SET THE USERPATH FOR THE PROGRAM GRAPHICS                 **/
%SET_USER_PATH

/**  PROCESS THE PDB FILE BEFORE MOST CHARTS OR PLOTS          **/
DATA &MY_FILE;
LABEL TIME      = 'TIME*OF*DAY'
      SLOTUSED  = 'LOCAL*SLOTS*USED*UP' ;
  SET PDB.&MY_FILE;
    TIME = TIMEPART(STARTIME);
    DATE = DATEPART(STARTIME);
    SLOTUSED  = SLOTLOMN - SLOTUNMN;      /** LOCAL SLOTS USED  **/
    THRESHOLD = SLOTLOMN * &THRESHOLD; /** 25% THRESHOLD LINE**/
  RUN;


 /**  NEXT USE A MACRO TO ANOTATE AND PLOT  DESIRED VARIABLES  **/
 %USER_TYPE71_PLOT ( MXGFILE=&MY_FILE,
                     PLOTVAR1=SLOTUSED,
                     PLOTVAR2=SLOTLOMN,
                     PLOTVAR3=THRESHOLD,
                     ANNO_VAR2=SLOTUTIL,
                     TY71NOTE=&MY_NOTE,
                     TY71PATH=&USERPATH     /** NO COMMA AFTER **/
                     )                      /** LAST ARGUMENT  **/

 /**  PRODUCE ANOTHER TYPE71 PLOT  USING DIFFERENT VARIABLES   **/
 %USER_TYPE71_PLOT ( MXGFILE=&MY_FILE,
                     PLOTVAR1=HIUICMX,
                     PLOTVAR2=HIUICMN,
                     PLOTVAR3=HIUICAV,
                     TY71PATH=&USERPATH
                     )
 RUN;
```

REVIEW THE ANNOTATED SAS/GRAPH GPLOT OUTPUT

The annotation will place a red star at the maximum slot utilization, i.e. the maximum slots used up value, i.e. &PLOTVAR1 value. The PROC SORT by MVSLEVEL, SYSPLEX, SYSTEM, SYSNAME and DATE places the maximum &PLOTVAR1 as the first observation of the "BY" variables in the sorted annotation dataset. Thus, if the input data includes multiple systems, dates, etc, they will be sorted and the maximum &PLOTVAR1 will be the first observation in the annotation dataset for each.

Figure #6   ANNOTATED SAS/GRAPH PROC GPLOT OUTPUT
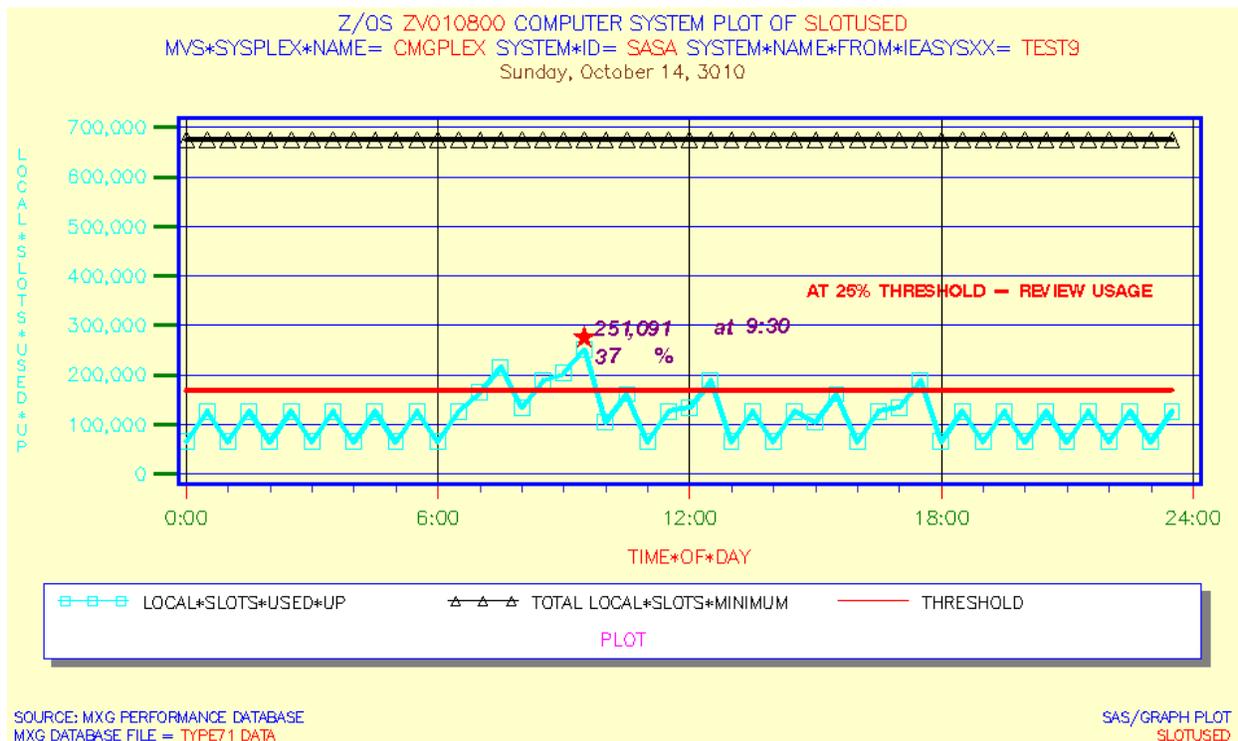
Annotated Plot of z/OS® Auxiliary Storage Local Page Slot Allocation

Using simulated data, the above graph displays the local page slot usage and highlights the time of the peak usage. The Z/OS version is displayed in the title along with the sysplex name, system id, and system name, and finally the date in weekdate29 format. All the above information is taken from the data in the PDB.TYPE71 file, eliminating the need for special edits or code to update the graph for special management reports.

The peak slot utilization in the graph occurred at 9:30 am with a value of 37%. That is above the 25% recommended threshold, and some additional local page slots could be used. The footnotes contain the MXGFILE i.e. &MY_FILE and &PLOTVAR1. This helps to document the graphic plot specifics, the input MXG database file and to minimize any confusion about what the graph is about.

CONCLUSION

The z/OS Base SAS JCL procedure is used in this example, and a daily job is scheduled by automated software to produce the daily annotated plot of z/OS® auxiliary storage local page slot usage. Using SAS and MXG software for monitoring auxiliary storage usage that approaches known set thresholds is an efficient use of our computer resources, software and personnel

Producing SAS/GRAPH output via SAS Output Delivery System (ODS) in GIF format for viewing via an intranet Web browser is also appealing to many staff members and management.   The display of graphs on the intranet web server improved ease of use in reviewing performance data and increased the use of MXG and SAS/GRAPH software. Overall productivity increased by making the charts and reports more easily available for review by the staff and managers needing access to the information

REFERENCES

IBM z/OS - MVS System Management Facilities (SMF) – SA22-7630-17
IBM z/OS – Resource Measurement Facility (RMF) User's Guide – SC33-7990-11
IBM Redbooks at http://www.redbooks.ibm.com/redbooks.nsf/redbooks/
Merrill's Expanded Guide to Computer Performance Evaluation Using the SAS System
Merrill's Expanded Guide Supplement and Technical Newsletters for Users of MXG®
MXG Archives at WWW.MXG.COM
Computer Measurement Group Information at http://www.cmg.org/
SHARE Information at http://www.share.org
Philadelphia SAS Users Group Presenter Information at http://www.philasug.org/call4pap.htm
NorthEast SAS Users Group information and proceedings at http://www.nesug.org
SAS Technical Support at http://support.sas.com
SAS-L archives at http://www.listserv.uga.edu
SAS Online Documentation at http://support.sas.com/documentation/onlinedoc
SAS Proceedings at http://support.sas.com/events/sasglobalforum/previous/online.html
SAS Global Forum Guidelines http://support.sas.com/events/sasglobalforum/2011/package.html

CONTACT INFORMATION

Your comments and questions are welcome.

Neal Musitano Jr.
Department of Veterans Affairs
Information Technology Center-284/31
P. O. BOX 7545
Philadelphia, PA. 19101-7545

Phone 215-842-2000 ext. 4102   EMAIL Neal.Musitano@va.gov

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.

Note: A modified test MXG/PDB was used for the information displayed, not to include the actual values of detailed production computer performance data in the paper.

APPENDIX – MACRO CODE.

Text can be copied from the PDF document by using the **'select text tool'** icon on the PDF toolbar, or by a mouse right click and selecting the select tool.

```
%MACRO SET_USER_PATH              /** MACRO TO SET THE USERPATH     **/
  %GLOBAL USERPATH;               /** USERPATH AVAILABLE TO PROGRAM **/
  DATA _NULL_;                    /** DEFINE ODS GRAPHIC USERPATH   **/
    PATH = "&SYSPARM" ;           /** INPUT FROM JCL OPTION         **/
    IF PATH = 'SGFPATH' THEN
      CALL SYMPUT('USERPATH','/u/sgf/'||PUT(DAY(TODAY()-1),Z2.0));
    ELSE IF PATH = 'TESTPATH' THEN
     CALL SYMPUT('USERPATH','/u/tst/'||PUT(DAY(TODAY()-1),Z2.0));
    ELSE CALL SYMPUT('USERPATH','/nopath/');
  RUN;
%MEND SET_USER_PATH;              /** END OF SET USER PATH MACRO    **/

%MACRO USER_TYPE71_PLOT
  (MXGFILE = ,     PLOTVAR1=,     PLOTVAR2=,     PLOTVAR3=,
  ANNO_VAR2=,     TY71NOTE=,     TY71PATH="/u/mxg/01"      );

 /** SORT TO FIND ANNOTATION VARIABLE VALUE FOR ANNOTATION  **/
 PROC SORT DATA=&MXGFILE  OUT=MY_ANNOTATE;
  BY MVSLEVEL SYSPLEX SYSTEM SYSNAME DATE DESCENDING &PLOTVAR1;
  RUN;
/** SELECT FIRST BY VALUE OBSERVATION(S) ANNOTATE MAXIMUM  **/
/** TIME OF MAXIMUM AND INFORMATION FOR ANNOTATION         **/
DATA MY_ANNOTATE ;
  LENGTH FUNCTION STYLE COLOR $ 8 TEXT $27;
  RETAIN XSYS '2' YSYS '2' HSYS '1' WHEN 'a' ;
  SET MY_ANNOTATE ;    BY MVSLEVEL SYSPLEX SYSTEM SYSNAME DATE;
    IF FIRST.MVSLEVEL OR FIRST.SYSPLEX OR FIRST.SYSTEM
    OR FIRST.SYSNAME  OR FIRST.DATE;
    FUNCTION='LABEL';            /** ANNOTATE FUNCTION     **/
    COLOR='RED';                 /** ANNOTATE STAR COLOR   **/
    STYLE='SPECIAL'; TEXT='M';   /** STYLE SELECT FOR STAR**/
    SIZE=10;                     /** SIZE INFORMATION      **/
    X=TIME; Y=&PLOTVAR1;         /** ANNO X,Y LOCATION     **/
    POSITION='B'; OUTPUT;        /** CENTER ABOVE X, Y     **/

    COLOR='PURPLE';              /** ANNOTATE TEXT COLOR   **/
    SIZE=6; ANGLE=1 ;            /** ANNOTATE TEXT INFO    **/
    STYLE='SWISSBI';
    TEXT= ' ' || left(put(&PLOTVAR1,COMMA10.0))
         || ' at ' || left(put(time,time5.0))
    POSITION='3';  OUTPUT ;      /** LEFT CELL ABOVE X, Y **/

     /* MACRO FILTER – IF ANNOTATE VARIABLE2 NOT SPECIFIED     */
    %IF %LENGTH(&ANNO_VAR2)  > 0  %THEN %DO;
    POSITION='6';                /** LEFT CELL ABOVE X, Y **/
    TEXT= ' ' || left(put(&ANNO_VAR2,COMMA4.0))  || ' %';
    OUTPUT;
    %END;
 RUN;

 ODS LISTING CLOSE;                         /** CLOSE LISTING   **/
 ODS HTML PATH="&TY71PATH" (URL=NONE)    /** WEB PATH INFO   **/
    BODY="DAILY_&MXGFILE..&PLOTVAR1..HTML"
     (TITLE="SAS/MXG PLOT &MXGFILE  &PLOTVAR1");
```

```
GOPTIONS  RESET=GLOBAL            /** RESET GRAPHIC OPTIONS**/
GUNIT=PCT   DEVICE=GIF            /** GRAPH UNITS PERCENT  **/
XMAX=10.0IN YMAX=6.0IN            /** GRAPH X Y SIZE       **/
CBACK=CXFFFFCC                    /** GRAPH BACKGRND COLOR **/
FTEXT=SIMPLEX CTEXT=BLUE HTEXT=2.2 ;


PROC GPLOT  DATA=&MXGFILE ; BY MVSLEVEL SYSPLEX SYSTEM SYSNAME DATE;
FORMAT DATE       WEEKDATE29.
       TIME       TIME5.0
       &PLOTVAR1  COMMA9.0;


TITLE1 HEIGHT=3.0 C=BLUE 'Z/OS'  C=RED ' #BYVAL1 '
                  C=BLUE 'COMPUTER SYSTEM PLOT OF'
                  C=RED " &PLOTVAR1";
TITLE2 HEIGHT=3.0 C=BLUE '#BYVAR2= '  C=RED '#BYVAL2'
                  C=BLUE ' #BYVAR3= ' C=RED '#BYVAL3'
                  C=BLUE ' #BYVAR4= ' C=RED '#BYVAL4';
TITLE3 HEIGHT=2.8 C=VIRO '#BYVAL5';


AXIS1 WIDTH=2 COLOR=BLUE          /** VERT RESPONSE AXIS   **/
      LABEL=(H=2.2 COLOR=CYAN ROTATE=90 ANGLE=-90)
      MAJOR=(H=2 C=GREEN W=2)     /** AXIS MAJOR TICK MARK **/
      MINOR=NONE                  /** MINOR TICK MARKS     **/
      VALUE=(H=2.8 COLOR=CYAN);   /** RESPONSE VALUE INFO  **/

AXIS2 WIDTH=2                     /** HORIZONTAL TIME AXIS **/
      LABEL=(HEIGHT=2.9 C=RED)    /** TIME*OF*DAY LABEL    **/
      MAJOR=(HEIGHT=2 C=RED)      /** AXIS MAJOR TICK MARKS**/
      MINOR=(H=1 N=5 C=BIB)       /** AXIS MINOR TICK MARKS**/
      ORDER=('00:00'T TO '24:00'T BY '06:00'T)
      VALUE=(H=2.9 C=GREEN);      /** TIME*OF*DAY VALUES   **/

FOOTNOTE1 HEIGHT=2.2             /** FIRST GRAPH FOOTNOTE **/
      J=L ' SOURCE: MXG PERFORMANCE DATABASE'
      J=R 'SAS/GRAPH PLOT ';
FOOTNOTE2 HEIGHT=2.2             /** SECOND GRAPH FOOTNOTE**/
      J=L " MXG DATABASE FILE = " COLOR=RED "&MXGFILE DATA"
      J=R "&PLOTVAR1 ";

SYMBOL1 INTERPOL=JOIN C=CYAN  L=1 W=3 VALUE=SQUARE   H=4;
SYMBOL2 I=JOIN        C=BLACK L=1 W=3 V=TRIANGLE     H=4;
SYMBOL3 I=JOIN        C=RED   L=1 W=3  ;

LEGEND1 VALUE=(H=2.6 C=BLACK)   /**GRAPH LEGEND STATEMENT**/
        ACROSS=3 CFRAME=WH CBORDER=BLUE CSHADOW=GREY
        LABEL=(H=2.8 C=MAGENTA POSITION=(BOTTOM CENTER));
NOTE ' ' &TY71NOTE ;

PLOT (&PLOTVAR1 &PLOTVAR2 &PLOTVAR3)*TIME / OVERLAY
     AUTOVREF                    /** REF LINES VERTI AXIS   **/
     AUTOHREF                    /** REF LINES HORIZ AXIS   **/
     NAME="&PLOTVAR1"            /** NAME OF THE PLOT GIF   **/
     ANNOTATE=MY_ANNOTATE        /** IDENTIFY ANNO DATASET  **/
     HAXIS=AXIS2                 /** USE AXIS2 FOR HAXIS     **/
     VAXIS=AXIS1                 /** USE AXIS1 FOR VAXIS     **/
     VZERO                       /** START AXIS AT ZERO      **/
     LEGEND=LEGEND1;             /** USE AND IDENTIFY LEGEND**/
  RUN; QUIT;                     /** RUN AND CLOSE GPLOT    **/
  ODS HTML CLOSE;                /** CLOSE HTML             **/
  ODS LISTING;                   /** LISTING RESET OPEN     **/
  RUN;
 %MEND USER_TYPE71_PLOT;         /*  END OF THE MACRO       */
```