

The Year 2000: Preparing for the Inevitable

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ABSTRACT

The Year 2000 represents a challenge to application developers and system programmers throughout the computing industry who rely upon dates with years represented by two digits in their applications and programs. This paper discusses various approaches to preparing your SAS® applications and programs to be Year 2000 "ready" and compliant.

INTRODUCTION

Before January 1, 2000, your computing environment needs to be ready to process data that is based on years outside the range of 1900-1999. The advent of the Year 2000 becomes problematic for systems that perform arithmetic operations, comparisons or sorting of date fields containing two-digit years. The business impact of the Year 2000 affects all industries, along all business lines that rely upon data systems and applications.

This discussion will focus upon a tool-based SAS approach to prepare your SAS systems for the Year 2000.

HOW DOES SAS DO DATES?

A closer look at the storage and interpretation of SAS dates can contribute to an understanding of how the SAS System processes dates and how you might select the best programmatic solution to handling SAS dates and the Year 2000. The good news is that the SAS System has *always* been able to process four-digit years. The area of concern for most systems and this study are those processes that reference two-digit years.

A SAS date is considered to be *constant* representing a fixed value. SAS date and time values can be used in many SAS statements, including assignment statements, IF-THEN statements and also as values for certain SAS

system options. The SAS System processes calendar date values by converting dates to integers representing the number of days between January 1, 1960 and a specified date. For example, the following calendar date values represent the date March 16, 1997:

031697	16MAR97	971603
3/16/97	16MAR1997	16 March 1997

The SAS date value representing March 16, 1997, is 13589. The value of 13589 results from calculating the number of days between January 1, 1960 and March 16, 1997. Valid SAS date values can be either positive (dates after January 1, 1960) or negative numbers (dates before January 1, 1960), representing dates ranging from 1582 A.D. (after the adoption of the Gregorian calendar) to 20,000 A.D. The SAS System processes time data in a similar fashion, converting a specific time to an integer representing the number of seconds since midnight of the current day.

The SAS System reads and displays date, time and datetime values using directions received from *informat*s and *format*s. An *informat* *reads* fields relative to a specified width and form, whereas a *format* *writes*, or displays data values according to a specified width and form. In the SAS DATA step, two-digit years can be read using any one of the following *informat*s:

MMDDYY
YYMMDD
DDMMYY
DATE
DATETIME
MONYY
YYQ
JULIAN

The following *functions* are able to process two-digit years:

MDY
YYQ

DATEJUL

Formats are not discussed here since formats operate on SAS date values which are correctly interpreted by the SAS System. However, use of two-digit years in SAS formats may propagate your Year 2000 problem to other applications.

Year 2000 represents a challenge to core business systems who reference two-digit year variable values, informats and formats. How system programmers plan to reconcile the adjustment of two-digit years for Year 2000 compliancy becomes a challenging exercise for testing and reprogramming resources.

CAN THE YEARCUTOFF= OPTION HELP?

All versions of the SAS System, including SAS Release 82, Version 5, and Version 6, represent dates from 1582 A.D. to 20,000 A.D. correctly. The SAS System automatically adjusts for leap years, century, and fourth-century references. However, leap seconds are ignored and there is no adjustment for daylight saving time. The SAS System accepts and displays all the dates in external data sources that contain four-digit years, provided the appropriate informat is used correctly. If dates in external data sources contain two-digit years, the SAS System assumes by default that two-digit years represent dates in the 20th century, that is from 1900 to 1999. This 100-year span is controlled by the **YEARCUTOFF=** SAS system option, introduced in Version 6.06 of the SAS System. The default value of **YEARCUTOFF=** has been set to 1900 since it's inception.

How do you use the **YEARCUTOFF=** option? The **YEARCUTOFF=** option specifies the first year of the 100-year span that is used to determine the century of a two-digit year. Valid values for the first year of the 100-year span are from 1582 to 19900. By default, the 100-year span is started at 1900 in Version 6.06 of the SAS System. Using the **YEARCUTOFF=** option is as easy as including it in an **OPTIONS** statement prior to the **DATA** step or in an **OPTIONS** parameter upon SAS invocation. You should be aware of the **YEARCUTOFF=** option

setting when processing dates with two-digit years with SAS date constants, functions, informats, and formats. For example, if the date function, **MDY**, has a two-digit value of 10 as the year parameter, then the function could produce one of a number of date values, for example, 1910 or 2010, depending on the current value of **YEARCUTOFF=**. Another example involves using the **MMDDYY8.** format to write two-digit year values to an external data source. Using this example, let's suppose a SAS date equivalent to January 15, 1920 is output to an external data source. The **MMDDYY8.** format causes a two-digit year of 20 to be written to the external data source. Colleagues in the 20th century can assume the 20th century and interpret the 20 as 1920. However, with the 21st century looming, the absence of a century prefix can lead to incomplete data values.

Regardless of the timeline of your data systems, the best course of action is to record and read dates with four-digit year values in all data processes. If SAS programmers find themselves unable to use four-digit year values, the SAS System allows you to set the optimal setting for the **YEARCUTOFF=** option most appropriate for the data store.

Please note that the **YEARCUTOFF=** SAS system option does not exist in Version 5 or Version 6.04 of the SAS System. All dates with two-digit years used in these releases of the SAS System in date functions and informats are assumed to be in the 1900's.

USING THE YEARCUTOFF= OPTION

Using the **YEARCUTOFF=** SAS system option is simple and straight forward. Consider the following example of reading dates with two-digit and four-digit years. The following explanation shows how the **YEARCUTOFF=** option works when set to 1920.

```
options yearcutoff=1920;
data schedule;
  input @1 jobid $ @6 projdate mmddyy10.;
cards;
A100 01/15/25
A110 03/15/2025
```

```

A200 01/30/96
B100 02/05/00
B200 06/15/2000
;
run;
proc print;
  format projdate mmddyy10.;
run;

```

OUTPUT

OBS JOBID PROJDATE

```

1  A100  01/15/1925
2  A110  03/15/2025
3  A200  01/30/1996
4  B100  02/05/2000
5  B200  06/15/2000

```

Upon input, observation number 1 has a two-digit year of 25, and observation number 2 has a four-digit year of 2025. If the value of YEARCUTOFF= option is 1920, then all two-digit years are mapped into the range 1920 to 2019. A two-digit year of 25 (as in Observation 1) is interpreted as 1925, whereas a two-digit year of 00 (as in Observation 4) results in a year value of 2000.

ARE TWO-DIGIT YEARS LURKING IN YOUR CODE?

Probably one of the largest tasks in preparing your data systems for the Year 2000 is determining the extent to which two-digit years are present in your systems. In addition to the YEARCUTOFF= option, there are two approaches available in the SAS System for preparing SAS applications and programs for the Year 2000.

The first approach offered within the SAS System allows you to interact with 3rd party vendor tools that offer a host of testing scenarios to pin-point a variety of Year 2000 red flags. Some simulate changing the system clock to the 21st century, whereas others identify programmatic problem areas. Products that trap and manipulate date and time values through the SVC11 instruction will be able to do so within the SAS System on MVS by using

the new SAS system option, SVC11/NOSVC11. Introduced in release 6.09E of the SAS System on MVS, the SVC11 option causes SAS to use the SVC11 service to obtain the current date value. 3rd party vendor products, that trap the SVC11 instruction, can then alter date and time values for Year 2000 testing.

CAN YEAR2000CHECK= HELP?

The second approach offered within the SAS System provides a feature for you to detect two-digit year occurrences when running existing SAS applications and programs. Note that this feature is an *experimental* feature that is not available in a current production release, and is not intended to be production in any future release.

You enable this feature by including YEAR2000CHECK= as a parameter on the DEBUG= SAS system option. If you are interested in receiving this functionality, please send email to Rick Langston at sasrdl@unx.sas.com. You will promptly receive an MVS job stream and instructions for creating an *experimental* SASXDTU module for Year 2000 testing purposes. Although the SASXDTU module was originally intended for Year 2000 testing on the MVS platform, this functionality is portable to all other SAS supported platforms. If you are interested in receiving information on this functionality for Year 2000 testing on non-MVS SAS supported platforms, please send email to sasrdl@unx.sas.com, including your name, email address, company, address and platform of interest. Although this functionality is currently only available through email for tracking purposes, we expect to make the feature generally available in the future.

Please note that the *experimental* SASXDTU module is **NOT** intended to be placed into the production library at your site. The *experimental* SASXDTU module should only be invoked from a SASLIB DD statement. **Do not place the load module library into a production cataloged procedure.**

Although the following issues are important, for SAS programmers preparing for Year 2000 compliancy, YEAR2000 checking does not:

- * check for SAS programs that *produce* two-digit year output for use in *later* applications
- * check for two-digit years in **printed output**
- * verify any and all possible scenarios, (that is, this feature offers a run-time facility and does not execute all possible scenarios)
- * provide full data manipulation capability

ACTIVATING YEAR 2000 CHECKING

You activate Year 2000 checking by including the YEAR2000CHECK= parameter on the DEBUG= SAS system option. The value that you specify for the YEAR2000CHECK= parameter is the maximum number of occurrences of two-digit years that will be reported in the SAS log for a given SAS program. The default value of YEAR2000CHECK= is 2000. If you set YEAR2000CHECK= to 0, no occurrences of two-digit years will be reported in the SAS log.

You can set YEAR2000CHECK= either at the time SAS is invoked or during a SAS session. To set YEAR2000CHECK= when you invoke SAS using a cataloged procedure on MVS, code your EXEC statement as follows:

```
//EXEC SAS,OPTIONS='DEBUG= "YEAR2000CHECK=100"'
```

To enable YEAR2000 checking during a SAS session, use the following OPTIONS statement:

```
OPTIONS DEBUG='YEAR2000CHECK=100';
```

Note that you can only include YEAR2000CHECK= as a parameter to the DEBUG= option. For example, if you try to specify OPTIONS YEAR2000CHECK=100; during a SAS session, you will receive an error indicating that YEAR2000CHECK is an invalid option name.

MESSAGES GENERATED BY YEAR 2000 CHECKING

Once YEAR 2000 checking is enabled, certain functions and informats will include checking for two-digit years, printing a special error message in the SAS log for each one detected. Calls to the following functions with two-digit years:

MDY
YYQ
DATEJUL

cause a special error message to be written to the SAS log. For example, in the case of MDY, the message is:

```
WARNING: TWO DIGIT YEAR CHECK: MONTH=m DAY=d  
YEAR=Y - called from function MDY
```

Calls to the following informats with two-digit years:

MMDDYY
YYMMDD
DDMMYY
DATE
DATETIME
MONYY
YYQ
JULIAN

cause a special error message to be written to the SAS log. For MMDDYY, the message is:

```
WARNING: TWO DIGIT YEAR CHECK: MONTH=m DAY=d  
YEAR=y - called from informat MMDDYY
```

SAMPLE LOG OUTPUT

```
6  options debug='year2000check=100';
7  data _null_;
8      *----DATE informat----*;
9      x=input('01jan97',date7.); put x=date9.;
10     *----YYMMDD informat----*;
11     x=input('970304',yymmdd6.); put x=date9.;
12     *----MMDDYY informat----*;
13     x=input('030497',mmddyy6.); put x=date9.;
14     *----DDMMYY informat----*;
15     x=input('040397',ddmmyy6.); put x=date9.;
16     *----DATE informat via date literal----*;
17     x='02jan97'd; put x=date9.;
    WARNING: TWO DIGIT YEAR CHECK: MONTH=1
    DAY=2 YEAR=97 - called from DATE informat
18     *----DATE informat via datetime literal----*;
19     x='03jan97:12:34:56'dt; put x=datetime20.;
    WARNING: TWO DIGIT YEAR CHECK: MONTH=1
    DAY=3 YEAR=97 - called from DATE informat
20
21     *----MDY function----*;
22     *x=mdy(2,2,98); put x=date9.;
23
24     *----DATEJUL function----*;
25     *x=datejul(97001); put x=date9.;
26     *----DATEJUL function via the JULIAN informat*;
27     *x=datejul(97001,julian5.); put x=date9.;
28     run;
```

WARNING: TWO DIGIT YEAR CHECK: MONTH=1
 DAY=1 YEAR=97 - called from DATE informat
 X=01JAN1997
 WARNING: TWO DIGIT YEAR CHECK: MONTH=3
 DAY=4 YEAR=97 - called from YYMMDD
 informat X=04MAR1997
 WARNING: TWO DIGIT YEAR CHECK: MONTH=3
 DAY=4 YEAR=97 - called from MMDDYY
 informat X=04MAR1997
 WARNING: TWO DIGIT YEAR CHECK: MONTH=3
 DAY=4 YEAR=97 - called from DDMMYY
 informat X=04MAR1997 X=02JAN1997
 X=03JAN1997:12:34:56
 WARNING: TWO DIGIT YEAR CHECK: MONTH=2
 DAY=2 YEAR=98 - called from MDY function
 X=02FEB1998
 WARNING: TWO DIGIT YEAR CHECK: Julian date
 is 97001. X=01JAN1997
 WARNING: TWO DIGIT YEAR CHECK: Julian date
 is 97001. X=01JAN1997
 NOTE: The DATA statement used 0.09 CPU
 seconds and 3798K.

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CONCLUSION

The scope of the Year 2000 challenge spans all enterprises within any organization that relies upon any and all date references in their data stores. As IT organizations begin to feel the urgency to ready their systems for the Year 2000, the need for tools to assist the Year 2000 challenge will become valued assets within their organization. The SAS System is ready to offer you robust tools for testing and preparing mission critical applications and systems for the Year 2000.

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