CHAPTER 5

The CALENDAR Procedure

Overview

The CALENDAR procedure displays data from a SAS data set in a monthly calendar format. You can produce a *schedule calendar*, which schedules events around holidays and nonwork periods. Or you can produce a *summary calendar*, which summarizes data and displays only one-day events and holidays. When you use PROC CALENDAR you can

- □ schedule work around holidays and other nonwork periods
- □ display holidays
- □ process data about *multiple calendars* in a single step and print them in a separate, mixed, or combined format
- □ apply different holidays, weekly work schedules, and daily work shifts to multiple calendars in a single PROC step
- □ produce a mean and a sum for variables based on either the number of days in a month or the number of observations.

PROC CALENDAR also contains features specifically designed to work with PROC CPM in SAS/OR software, a project management scheduling tool.

Simple Schedule Calendar – 7-Day Default Calendar

Output 5.1 on page 87 illustrates the simplest kind of schedule calendar that you can produce. This calendar output displays activities planned by a banking executive. The following statements produce Output 5.1 on page 87.

```
options nodate pageno=1 linesize=132 pagesize=60;

proc calendar data=allacty;
   start date;
   dur long;
run;
```

For the activities data set shown in this calendar, see Example 1 on page 120.

Output 5.1 Simple Schedule Calendar

This calendar uses one of the two default calendars, the 24-hour-day, 7-day-week calendar.

```
                                                         The SAS System                                                          1

-------------------------------------------------------------------------------------------------------------------------------
|                                                                                                                             |
|                                                         July  1996                                                          |
|                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------|
|     Sunday      |     Monday      |     Tuesday     |    Wednesday    |    Thursday     |     Friday      |    Saturday     |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|                 |        1        |        2        |        3        |        4        |        5        |        6        |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |+=Interview/JW==+|                 |                 |                 |
|                 |+Dist. Mtg./All=+|+====Mgrs. Meeting/District 6=====+|                 |+VIP Banquet/JW=+|                 |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|        7        |        8        |        9        |       10        |       11        |       12        |       13        |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |+Planning Counci+|+=Seminar/White=+|                 |
|                 |+==================Trade Show/Knox==================+|+====Mgrs. Meeting/District 7=====+|                 |
|                 |+================================Sales Drive/District 6=================================+|                 |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|       14        |       15        |       16        |       17        |       18        |       19        |       20        |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |+NewsLetter Dead+|+Co. Picnic/All=+|                 |
|                 |                 |+==Dentist/JW===+|+Bank Meeting/1s+|+Planning Counci+|+=Seminar/White=+|                 |
|                 |+================================Sales Drive/District 7=================================+|                 |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|       21        |       22        |       23        |       24        |       25        |       26        |       27        |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |+=Birthday/Mary=+|+======Close Sale/WYGIX Co.=======+|                 |
|                 |+===============Inventors Show/Melvin===============+|+Planning Counci+|                 |                 |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|       28        |       29        |       30        |       31        |                 |                 |                 |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |                 |                 |                 |
|                 |                 |                 |                 |                 |                 |                 |
-------------------------------------------------------------------------------------------------------------------------------
```

Advanced Schedule Calendar

Output 5.2 on page 89 is an advanced schedule calendar produced by PROC CALENDAR. The statements that create this calendar

- □ schedule activities around holidays
- □ identify separate calendars
- □ print multiple calendars in the same report
- □ apply different holidays to different calendars

□ apply different work patterns to different calendars.

For an explanation of the program that produces this calendar, see Example 4 on page 132.

Output 5.2 Advanced Schedule Calendar

```
                                         Well Drilling Work Schedule: Combined Calendars                                          1

          ------------------------------------------------------------------------------------------------------------------------
          |                                                                                                                      |
          |                                                      July  1996                                                      |
          |                                                                                                                      |
          |----------------------------------------------------------------------------------------------------------------------|
          |     Sunday     |     Monday     |    Tuesday     |   Wednesday    |    Thursday    |     Friday     |    Saturday    |
----------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |                |       1        |       2        |       3        |       4        |       5        |       6        |
|.........|................|................|................|................|................|................|................|
| CAL1    |                |                |                |                |**Independence**|+Assemble Tank/>|                |
|         |                |                |                |                |                |+Lay Power Line>|                |
|         |                |+==============Drill Well/$1,000.00==============>|                |<Drill Well/$1,+|                |
|.........|................|................|................|................|................|................|................|
| CAL2    |                |                |                |+=======================Excavate/$3,500.00========================>|
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       7        |       8        |       9        |       10       |       11       |       12       |       13       |
|.........|................|................|................|................|................|................|................|
| CAL1    |                |+===================Build Pump House/$2,000.00====================+|                |                |
|         |                |<=====================Assemble Tank/$1,000.00=====================+|                |                |
|         |                |<===Lay Power Line/$2,000.00====+|                |+===Pour Foundation/$1,500.00===>|                |
|.........|................|................|................|................|................|................|................|
| CAL2    |                |<Excavate/$3,50>|****Vacation****|<Excavate/$3,50+|                |                |                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       14       |       15       |       16       |       17       |       18       |       19       |       20       |
|.........|................|................|................|................|................|................|................|
| CAL1    |                |+===============================Install Pump/$500.00===============================+|                |
|         |                |<===========Pour Foundation/$1,500.00============+|                |+Install Pipe/$>|                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       21       |       22       |       23       |       24       |       25       |       26       |       27       |
|.........|................|................|................|................|................|................|................|
| CAL1    |                |+==============================Erect Tower/$2,500.00===============================>|                |
|         |                |<====Install Pipe/$1,000.00=====+|                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       28       |       29       |       30       |       31       |                |                |                |
|.........|................|................|................|................|................|................|................|
| CAL1    |                |<Erect Tower/$2+|                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
----------------------------------------------------------------------------------------------------------------------------------
```

More Advanced Scheduling and Project Management Tasks

For more complex scheduling tasks, consider using the CPM procedure in SAS/OR software. PROC CALENDAR requires that you specify the starting date of each activity. When the beginning of one task depends on the completion of others and a date slips in a schedule, recalculating the schedule can be time-consuming. Instead of manually recalculating dates, you can use PROC CPM to calculate dates for project activities based on an initial starting date, activity durations, and which tasks are identified as *successors* to others. For an example, see Example 6 on page 140.

Simple Summary Calendar

Output 5.3 on page 90 shows a simple summary calendar that displays the number of meals served daily in a hospital cafeteria:

```
options nodate pageno=1 linesize=132 pagesize=60;

proc calendar data=meals;
   start date;
   sum brkfst lunch dinner;
   mean brkfst lunch dinner;
run;
```

In a summary calendar, each piece of information for a given day is the value of a variable for that day. The variables can be either numeric or character, and you can format them as necessary. You can use the SUM and MEAN options to calculate sums and means for any numeric variables. These statistics appear in a box below the calendar, as shown in Output 5.3 on page 90. The data set shown in this calendar is created in Example 7 on page 146.

Output 5.3 Simple Summary Calendar

```
                                              The SAS System                                                        1

--------------------------------------------------------------------------------------------------------------
|                                                                                                            |
|                                              December  1996                                                |
|                                                                                                            |
|------------------------------------------------------------------------------------------------------------|
|    Sunday    |    Monday    |   Tuesday    |  Wednesday   |   Thursday   |    Friday    |   Saturday   |
|--------------+--------------+--------------+--------------+--------------+--------------+--------------|
|       1      |       2      |       3      |       4      |       5      |       6      |       7      |
|              |              |              |              |              |              |              |
|              |          123 |          188 |          123 |          200 |          176 |              |
|              |          234 |          188 |          183 |          267 |          165 |              |
|              |          238 |          198 |          176 |          243 |          177 |              |
|--------------+--------------+--------------+--------------+--------------+--------------+--------------|
|       8      |       9      |      10      |      11      |      12      |      13      |      14      |
|              |              |              |              |              |              |              |
|              |          178 |          165 |          187 |          176 |          187 |              |
|              |          198 |          176 |          176 |          187 |          187 |              |
|              |          187 |          187 |          231 |          222 |          123 |              |
|--------------+--------------+--------------+--------------+--------------+--------------+--------------|
|      15      |      16      |      17      |      18      |      19      |      20      |      21      |
|              |              |              |              |              |              |              |
|              |          176 |          156 |          198 |          178 |          165 |              |
|              |          165 |            . |          143 |          198 |          176 |              |
|              |          177 |          167 |          167 |          187 |          187 |              |
|--------------+--------------+--------------+--------------+--------------+--------------+--------------|
|      22      |      23      |      24      |      25      |      26      |      27      |      28      |
|              |              |              |              |              |              |              |
|              |          187 |              |              |              |              |              |
|              |          187 |              |              |              |              |              |
|              |          123 |              |              |              |              |              |
|--------------+--------------+--------------+--------------+--------------+--------------+--------------|
|      29      |      30      |      31      |              |              |              |              |
|              |              |              |              |              |              |              |
|              |              |              |              |              |              |              |
|              |              |              |              |              |              |              |
|              |              |              |              |              |              |              |
--------------------------------------------------------------------------------------------------------------

                               --------------------------------------------
                               |          |      Sum      |      Mean      |
                               |          |               |                |
                               | Brkfst   |          2763 |        172.688 |
                               | Lunch    |          2830 |        188.667 |
                               | Dinner   |          2990 |        186.875 |
                               --------------------------------------------
```

Procedure Syntax

Required: You must use a START statement.

Required: For schedule calendars, you must also use a DUR or a FIN statement.

Tip: If you use a DUR or FIN statement, PROC CALENDAR produces a schedule calendar.

Tip: Supports the Output Delivery System (see Chapter 2, “Fundamental Concepts for Using Base SAS Procedures”)

Reminder: You can use the FORMAT, LABEL, and WHERE statements as well as any global statements.

PROC CALENDAR <*option(s)*>;

START *variable*;

BY <DESCENDING> *variable-1*
<...<DESCENDING> *variable-n*>
<NOTSORTED>;

CALID *variable*
</ OUTPUT=COMBINE | MIX | SEPARATE>;

DUR *variable*;

FIN *variable*;

HOLISTART *variable*;
HOLIDUR *variable*;
HOLIFIN *variable*;
HOLIVAR *variable*;

MEAN *variable(s)* </ FORMAT=*format-name*>;

OUTSTART *day-of-week*;
OUTDUR *number-of-days*;
OUTFIN *day-of-week*;

SUM *variable(s)* </ FORMAT=*format-name*>;

VAR *variable(s)*;

The following table lists the statements and options available in the CALENDAR procedure according to function.

To do this	Use this statement
Create summary calendar	MEAN SUM
Create schedule calendar	DUR or FIN
Create multiple calendars	CALID
Specify holidays	HOLISTART HOLIDUR HOLIFIN HOLIVAR
Control display	OUTSTART OUTDUR OUTFIN
Specify grouping	BY CALID

PROC CALENDAR Statement

PROC CALENDAR <*option(s)*>;

To do this	Use this option
Specify data sets containing	
weekly work schedules	CALEDATA=
activities	DATA=
holidays	HOLIDATA=
unique shift patterns	WORKDATA=
Control printing	
display all months, even if no activities exist	FILL
define characters used for outlines, dividers, and so on	FORMCHAR=
specify the type of heading for months	HEADER=
specify how to show missing values	MISSING
suppress the display of Saturdays and Sundays	WEEKDAYS
Specify time or duration	
specify that START and FIN variables are in DATETIME format	DATETIME
specify the number of hours in a standard work day	DAYLENGTH=
specify the units of the DUR and HOLIDUR variables	INTERVAL=
Control summary information	
identify variables in the calendar	LEGEND
specify the type of mean to calculate	MEANTYPE=

Options

CALEDATA=*SAS-data-set*
specifies the *calendar data set*, a SAS data set that contains weekly work schedules for multiple calendars.

Default: If you omit the CALEDATA= option, PROC CALENDAR uses a default work schedule, as described in "The Default Calendars" on page 110.

Tip: A calendar data set is useful if you are using multiple calendars or a nonstandard work schedule.

See also: "Calendar Data Set" on page 116

Featured in: Example 3 on page 128

DATA=*SAS-data-set*
specifies the *activities data set*, a SAS data set that contains starting dates for all activities and variables to display for each activity. Activities must be sorted or indexed by starting date.

Default: If you omit the DATA= option, the most recently created SAS data set is used.

See also: "Activities Data Set" on page 114

Featured in: All examples. See "Examples" on page 120

DATETIME
specifies that START and FIN variables contain values in DATETIME. format.

Default: If you omit the DATETIME option, PROC CALENDAR assumes that the START and FIN values are in the DATE. format.

Featured in: Example 3 on page 128

DAYLENGTH=*hours*
gives the number of hours in a standard working day. The hour value must be a SAS TIME value.

Default: 24 if INTERVAL=DAY (the default), 8 if INTERVAL=WORKDAY.

Restriction: DAYLENGTH= applies only to schedule calendars.

Interaction: If you specify the DAYLENGTH= option and the calendar data set contains a D_LENGTH variable, PROC CALENDAR uses the DAYLENGTH= value only when the D_LENGTH value is missing.

Interaction: When INTERVAL=DAY and you have no CALEDATA= data set, specifying a DAYLENGTH= value has no effect.

Tip: The DAYLENGTH= option is useful when you use the DUR statement and your work schedule contains days of varying lengths, for example, a 5 1/2-day work week. In a work week with varying day lengths, you need to set a standard day length to use in calculating duration times. For example, an activity with a duration of 3.0 workdays lasts 24 hours if DAYLENGTH=8:00 or 30 hours if DAYLENGTH=10:00.

Tip: Instead of specifying the DAYLENGTH= option, you can specify the length of the working day by using a D_LENGTH variable in the CALEDATA= data set. If you use this method, you can specify different standard day lengths for different calendars.

See also: "Calendar Data Set" on page 116 for more information on setting the length of the standard workday

FILL
displays all months between the first and last activity, start and finish dates inclusive, including months that contain no activities.

Default: If you do not specify FILL, PROC CALENDAR prints only months that contain *activities*. (Months that contain only *holidays* are not printed.)

Featured in: Example 5 on page 137

FORMCHAR <(*position(s)*)>='*formatting-character(s)*'
defines the characters to use for constructing the outlines and dividers for the cells in the calendar as well as all identifying markers (such as asterisks and arrows) used to indicate holidays or continuation of activities in PROC CALENDAR output.

position(s)
identifies the position of one or more characters in the SAS formatting-character string. A space or a comma separates the positions.

Default: Omitting (*position(s)*) is the same as specifying all 20 possible system formatting characters, in order.

Range: PROC CALENDAR uses 17 of the 20 formatting characters that SAS provides. Table 5.1 on page 95 shows the formatting characters that PROC CALENDAR uses. Figure 5.1 on page 96 illustrates their use in PROC CALENDAR output.

formatting-character(s)
lists the characters to use for the specified positions. PROC CALENDAR assigns characters in *formatting-character(s)* to *position(s)*, in the order that they are listed. For instance, the following option assigns an asterisk (*) to the twelfth position, assigns a single dash (-) to the thirteenth, and does not alter remaining characters:

```
formchar(12 13)='*-'
```

These new settings change the activity line from this:

```
   +================ACTIVITY===============+
```

to this:

```
   *-----------------ACTIVITY--------------*
```

Interaction: The SAS system option FORMCHAR= specifies the default formatting characters. The SAS system option defines the entire string of formatting characters. The FORMCHAR= option in a procedure can redefine selected characters.

Tip: You can use any character in *formatting-characters*, including hexadecimal characters. If you use hexadecimal characters, you must put an **x** after the closing quote. For instance, the following option assigns the hexadecimal character 2D to the third formatting character, the hexadecimal character 7C to the seventh character, and does not alter the remaining characters:

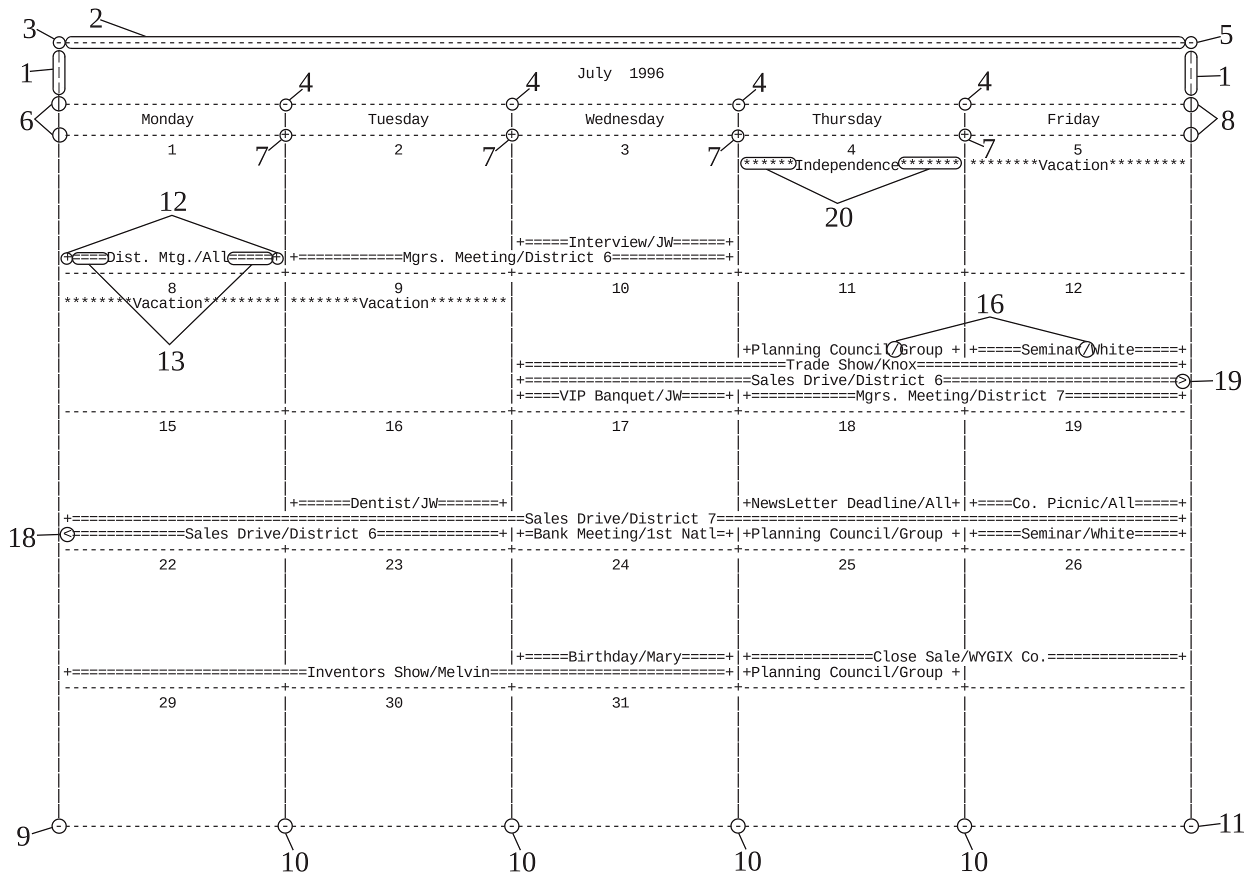
```
formchar(3,7)='2D7C'x
```

See also: For information on which hexadecimal codes to use for which characters, consult the documentation for your hardware.

Table 5.1 Formatting Characters Used by PROC CALENDAR

Position	Default	Used to draw
1	|	vertical bar
2	-	horizontal bar
3	-	cell: upper left corner
4	-	cell: upper middle intersection
5	-	cell: upper right corner
6	|	cell: middle left cell side
7	+	cell: middle middle intersection
8	|	cell: middle right cell side
9	-	cell: lower left corner
10	-	cell: lower middle intersection
11	-	cell: lower right corner
12	+	activity start and finish
13	=	activity line
16	/	activity separator
18	<	activity continuation from
19	>	activity continuation to
20	*	holiday marker

Figure 5.1 Formatting Characters in PROC CALENDAR Output



```
-----------------------------------------------------------------------------------------------------------------------------------
|                                                           July  1996                                                            |
|---------------------------------------------------------------------------------------------------------------------------------|
|         Monday                   Tuesday                 Wednesday                 Thursday                  Friday           |
|-------------------------+-------------------------+-------------------------+-------------------------+-------------------------|
|            1            |            2            |            3            |            4            |            5            |
|                         |                         |                         |******Independence*******|********Vacation*********|
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |+=====Interview/JW======+|                         |                         |
|+====Dist. Mtg./All=====+|+============Mgrs. Meeting/District 6=============+|                         |                         |
|-------------------------+-------------------------+-------------------------+-------------------------+-------------------------|
|            8            |            9            |           10            |           11            |           12            |
|********Vacation*********|********Vacation*********|                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |+Planning Council/Group +|+=====Seminar/White=====+|
|                         |                         |+=============================Trade Show/Knox===============================+|
|                         |                         |+=========================Sales Drive/District 6============================>|
|                         |                         |+====VIP Banquet/JW=====+|+============Mgrs. Meeting/District 7=============+|
|-------------------------+-------------------------+-------------------------+-------------------------+-------------------------|
|           15            |           16            |           17            |           18            |           19            |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |+======Dentist/JW=======+|                         |+NewsLetter Deadline/All+|+====Co. Picnic/All=====+|
|+====================================================Sales Drive/District 7=====================================================+|
|<=============Sales Drive/District 6==============+|+=Bank Meeting/1st Natl=+|+Planning Council/Group +|+=====Seminar/White=====+|
|-------------------------+-------------------------+-------------------------+-------------------------+-------------------------|
|           22            |           23            |           24            |           25            |           26            |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |+=====Birthday/Mary=====+|+==============Close Sale/WYGIX Co.===============+|
|+==========================Inventors Show/Melvin============================+|+Planning Council/Group +|                         |
|-------------------------+-------------------------+-------------------------+-------------------------+-------------------------|
|           29            |           30            |           31            |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
-----------------------------------------------------------------------------------------------------------------------------------
```

HEADER=SMALL | MEDIUM | LARGE
specifies the type of heading to use in printing the name of the month.

SMALL
prints the month and year on one line.

MEDIUM
prints the month and year in a box four lines high.

LARGE
prints the month seven lines high using asterisks (*). The year is included if space is available.

Default: MEDIUM

HOLIDATA=*SAS-data-set*
specifies the *holidays data set*, a SAS data set containing the holidays you want to display in the output. One variable must contain the holiday names and another must contain the starting dates for each holiday. PROC CALENDAR marks holidays in the calendar output with asterisks (*) when space permits.

Interaction: Displaying holidays on a calendar requires a holidays data set and a HOLISTART statement. A HOLIVAR statement is recommended for naming holidays. HOLIDUR is required if any holiday lasts longer than one day.

Tip: The holidays data set does not require sorting.

See also: “Holidays Data Set” on page 115

Featured in: All examples. See “Examples” on page 120

INTERVAL=DAY | WORKDAY
specifies the units of the DUR and HOLIDUR variables to one of two default daylengths:

DAY
specifies the values of the DUR and HOLIDUR variables in units of 24-hour days and specifies the default 7-day calendar. For instance, a DUR value of 3.0 is treated as 72 hours. The default calendar work schedule consists of seven working days, all starting at 00:00 with a length of 24:00.

WORKDAY
specifies the values of the DUR and HOLIDUR variables in units of 8-hour days and specifies that the default calendar contains five days a week, Monday through Friday, all starting at 09:00 with a length of 08:00. When WORKDAY is specified, PROC CALENDAR treats the values of the DUR and HOLIDUR variables in units of working days, as defined in the DAYLENGTH= option, the CALEDATA= data set, or the default calendar. For example, if the working day is 8 hours long, a DUR value of 3.0 is treated as 24 hours.

Default: DAY

Interaction: In the absence of a CALEDATA= data set, PROC CALENDAR uses the work schedule defined in a default calendar.

Interaction: The WEEKDAYS option automatically sets the INTERVAL= value to WORKDAY.

See also: "Calendars and Multiple Calendars" on page 111 and "Calendar Data Set" on page 116 for more information on the INTERVAL= option and the specification of working days; "The Default Calendars" on page 110

Featured in: Example 5 on page 137

LEGEND
prints the names of the variables whose values appear in the calendar. This identifying text, or legend box, appears at the bottom of the page for each month if space permits; otherwise, it is printed on the following page. PROC CALENDAR identifies each variable by name or by label if one exists. The order of variables in the legend matches their order in the calendar.

Restriction: LEGEND applies only to summary calendars.

Interaction: If you use the SUM and MEAN statements, the legend box also contains SUM and MEAN values.

Featured in: Example 8 on page 150

MEANTYPE=NOBS | NDAYS
specifies the type of mean to calculate for each month.

NOBS
calculates the mean over the number of *observations* displayed in the month.

NDAYS
calculates the mean over the number of *days* displayed in the month.

Default: NOBS

Restriction: MEANTYPE= applies only to summary calendars.

Interaction: Normally, PROC CALENDAR displays all days for each month. However, it may omit some days if you use the OUTSTART statement with the OUTDUR or OUTFIN statement.

Featured in: Example 7 on page 146

MISSING
determines how missing values are treated, based on the type of calendar.

Summary Calendar

If there is a day without an activity scheduled, PROC CALENDAR prints the values of variables for that day using the SAS or user-defined format specified for missing values.

Default: If you omit MISSING, days without activities contain no values.

Schedule Calendar

variables with missing values appear in the label of an activity, using the format specified for missing values.

Default: If you do not specify MISSING, PROC CALENDAR ignores missing values in labeling activities.

See also: "Missing Values in Input Data Sets" on page 118 for more information on missing values

WEEKDAYS

suppresses the display of Saturdays and Sundays in the output. It also specifies that the value of the INTERVAL= option is WORKDAY.

Default: If you omit WEEKDAYS, the calendar displays all seven days.

Tip: The WEEKDAYS option is an alternative to using the combination of INTERVAL=WORKDAY and the OUTSTART and OUTFIN statements, as shown here:

Example Code 5.1 Illustration of Formatting Characters in PROC CALENDAR Output

```
proc calendar weekdays;
   start date;
run;

proc calendar interval=workday;
   start date;
   outstart monday;
   outfin friday;
run;
```

Featured in: Example 1 on page 120

WORKDATA=*SAS-data-set*

specifies the *workdays data set*, a SAS data set that defines the work pattern during a standard working day. Each numeric variable in the workdays data set denotes a unique workshift pattern during one working day.

Tip: The workdays data set is useful in conjunction with the calendar data set.

See also: "Workdays Data Set" on page 117 and "Calendar Data Set" on page 116

Featured in: Example 3 on page 128

BY Statement

Processes activities separately for each BY group, producing a separate calendar for each value of the BY variable.

Calendar: both

Main discussion: “BY” on page 68

See also: “CALID Statement” on page 100

BY <DESCENDING> *variable-1*
    <…<DESCENDING> *variable-n*>
    <NOTSORTED>;

Required Arguments

variable
specifies the variable that the procedure uses to form BY groups. You can specify more than one variable, but the observations in the data set must be sorted by all the variables that you specify or have an appropriate index. Variables in a BY statement are called *BY variables*.

Options

DESCENDING
specifies that the observations are sorted in descending order by the variable that immediately follows the word DESCENDING in the BY statement.

NOTSORTED
specifies that observations are not necessarily sorted in alphabetic or numeric order. The observations are grouped in another way, for example, chronological order.

Showing Multiple Calendars in Related Groups

When you use the CALID statement, you can process activities that apply to different calendars, indicated by the value of the CALID variable. Because you can specify only one CALID variable, however, you can create only one level of grouping. For example, if you want a calendar report to show the activities of several departments within a company, you can identify each department with the value of the CALID variable and produce calendar output that shows the calendars for all departments.

When you use a BY statement, however, you can further divide activities into related groups. For example, you can print calendar output that groups departmental calendars by division. The observations for activities must contain a variable that identifies which department an activity belongs to and a variable that identifies the division that a department resides in. Specify the variable that identifies the department with the CALID statement. Specify the variable that identifies the division with the BY statement.

CALID Statement

Processes activities in groups defined by the values of a calendar identifier variable.

Calendar: both

Tip: Useful for producing multiple schedule calendars and for use with SAS/OR software.

See also: "Calendar Data Set" on page 116

Featured in: Example 2 on page 123, Example 3 on page 128, and Example 6 on page 140

CALID *variable*
</ OUTPUT=COMBINE | MIX | SEPARATE>;

Required Arguments

variable
a character or numeric variable that identifies which calendar an observation contains data for.

Requirement: If you specify the CALID variable, both the activities and holidays datasets must contain this variable. If either of them does not contain it, a default calendar is used.

Interaction: SAS/OR software uses this variable to identify which calendar an observation contains data for.

Tip: You do not need to use a CALID statement to create this variable. You can include the default variable _CALID_ in the input data sets.

See also: "Calendar Data Set" on page 116

Options

OUTPUT=COMBINE | MIX | SEPARATE
controls the amount of space required to display output for multiple calendars.

COMBINE
produces one page for each month that contains activities and subdivides each day by the CALID value.

Restriction: The input data must be sorted by or indexed on the START variable.

Featured in: Example 2 on page 123 and Example 4 on page 132

MIX
produces one page for each month that contains activities and does not identify activities by the CALID value.

Restriction: The input data must be sorted by or indexed on the START variable.

Tip: MIX requires the least space for output.

Featured in: Example 4 on page 132

SEPARATE
produces a separate page for each value of the CALID variable.

Restriction: The input data must be sorted by the CALID variable and then by the START variable or must contain an appropriate composite index.

Featured in: Example 3 on page 128 and Example 8 on page 150

Default: COMBINE

DUR Statement

Specifies the variable that contains the duration of each activity.

Alias: DURATION

Calendar: Schedule

Interaction: If you use both a DUR and a FIN statement, DUR is ignored.

Tip: To produce a schedule calendar, you must use either a DUR or FIN statement.

Featured in: All schedule calendars (see "Examples" on page 120)

DUR *variable*;

Required Arguments

variable
contains the duration of each activity in a schedule calendar.

Range: The duration may be a real or integral value.

Restriction: This variable must be in the activities data set.

See also: For more information on activity durations, see "Activities Data Set" on page 114 and "Calendar Data Set" on page 116

Duration

- Duration is measured inclusively from the start of the activity (as given in the START variable). In the output, any activity lasting part of a day is displayed as lasting a full day.
- The INTERVAL= option in a PROC CALENDAR statement automatically sets the unit of the duration variable, depending on its own value as follows:

If INTERVAL= . . .	Then the default length of the duration unit is . . .
DAY (the default)	24 hours
WORKDAY	8 hours

- You can override the default length of a duration unit by using
  - the DAYLENGTH= option
  - a D_LENGTH variable in the CALEDATA= data set.

FIN Statement

Specifies the variable in the activities data set that contains the finishing date of each activity.

Alias: FINISH

Calendar: Schedule

Interaction: If you use both a FIN and a DUR statement, FIN is used.

Tip: To produce a schedule calendar, you must use either a FIN or DUR statement.

Featured in: Example 6 on page 140

FIN *variable*;

Required Arguments

variable
contains the finishing date of each activity.

Restrictions: The values of *variable* must be either SAS date or datetime values.

Restrictions: If the FIN variable contains datetime values, you must specify the DATETIME option in the PROC CALENDAR statement.

Restrictions: Both the START and FIN variables must have matching formats. For example, if one contains datetime values, so must the other.

HOLIDUR Statement

Specifies the variable in the holidays data set that contains the duration of each holiday for a schedule calendar.

Alias: HOLIDURATION

Calendar: Schedule

Default: If you do not use a HOLIDUR or HOLIFIN statement, all holidays last one day.

Restriction: Cannot use with a HOLIFIN statement.

Featured in: Example 1 on page 120 through Example 5 on page 137

HOLIDUR *variable*;

Required Arguments

variable
contains the duration of each holiday.

Range: The duration may be a real or integral value.

Restriction: This variable must be in the holidays data set.

Featured in: Example 3 on page 128 and Example 8 on page 150

Holiday Duration

- □ If you use both the HOLIFIN and HOLIDUR statement, PROC CALENDAR uses the HOLIFIN variable value to define each holiday's duration.
- □ Set the *unit* of the holiday duration variable in the same way that you set the unit of the duration variable; use either the INTERVAL= and DAYLENGTH= options or the CALEDATA= data set.
- □ Duration is measured inclusively from the start of the holiday (as given in the HOLISTART variable). In the output, any holiday lasting at least half a day appears as lasting a full day.

HOLIFIN Statement

Specifies the variable in the holidays data set containing the finishing date of each holiday.

Alias: HOLIFINISH

Calendar: Schedule

Default: If you do not use a HOLIFIN or HOLIDUR statement, all holidays last one day.

HOLIFIN *variable*;

Required Arguments

variable
contains the finishing date of each holiday.

Restriction: This variable must be in the holidays data set.

Restriction: Values of *variable* must be in either SAS date or datetime values.

Restriction: If the HOLIFIN variable contains datetime values, you must specify the DATETIME option in the PROC CALENDAR statement.

Holiday Duration

If you use both the HOLIFIN and the HOLIDUR statement, PROC CALENDAR uses only the HOLIFIN variable.

HOLISTART Statement

Specifies a variable in the holidays data set that contains the starting date of each holiday.

Alias: HOLISTA, HOLIDAY

Calendar: both

Requirement: When you use a holidays data set, HOLISTART is required.

Featured in: Example 1 on page 120 through Example 5 on page 137

HOLISTART *variable*;

Required Arguments

variable
contains the starting date of each holiday.

Restriction: Values of *variable* must be in either SAS date or datetime values.

Restriction: If the HOLISTART variable contains datetime values, specify the DATETIME option in the PROC CALENDAR statement.

Details

- The holidays data set need not be sorted.
- All holidays last only one day, unless you use a HOLIFIN or HOLIDUR statement.
- If two or more holidays occur on the same day, PROC CALENDAR uses only the first observation.

HOLIVAR Statement

Specifies a variable in the holidays data set whose values are used to label the holidays.

Alias: HOLIVARIABLE, HOLINAME

Calendar: both

Default: If you do not use a HOLIVAR statement, PROC CALENDAR uses the word **DATE** to identify holidays.

Featured in: Example 1 on page 120 through Example 5 on page 137

HOLIVAR *variable*;

Required Arguments

variable
a variable whose values are used to label the holidays. Typically, this variable contains the names of the holidays.

Range: character or numeric.

Restriction: This variable must be in the holidays data set.

Tip: You can format the HOLIVAR variable as you like.

MEAN Statement

Specifies numeric variables in the activities data set for which mean values are to be calculated for each month.

Calendar: Summary

Tip: You can use multiple MEAN statements.

Featured in: Example 7 on page 146

MEAN *variable(s)* </ FORMAT=*format-name*>;

Required Arguments

variable(s)
numeric variable for which mean values are calculated for each month.

Restriction: This variable must be in the activities data set.

Options

FORMAT=*format-name*
names a SAS or user-defined format to be used in displaying the means requested.

Alias: F=

Default: BEST. format

Featured in: Example 7 on page 146

What Is Displayed and How

- The means appear at the bottom of the summary calendar page, if there is room; otherwise they appear on the following page.
- The means appear in the LEGEND box if you specify the LEGEND option.
- PROC CALENDAR automatically displays variables named in a MEAN statement in the calendar output, even if the variables are not named in the VAR statement.

OUTDUR Statement

Specifies in days the length of the week to be displayed.

Alias: OUTDURATION

Requirement: The OUTSTART statement is required.

OUTDUR *number-of-days*;

Required Arguments

number-of-days
an integer expressing the length in days of the week to be displayed.

Length of Week

Use either the OUTDUR or OUTFIN statement to supply the procedure with information about the length of the week to display. If you use both, PROC CALENDAR ignores the OUTDUR statement.

OUTFIN Statement

Specifies the last day of the week to display in the calendar.

Alias: OUTFINISH

Requirement: The OUTSTART statement is required.

Featured in: Example 3 on page 128 and Example 8 on page 150

OUTFIN *day-of-week*;

Required Arguments

day-of-week
the name of the last day of the week to display. For example,

```
outfin friday;
```

Length of Week

Use either the OUTFIN or OUTDUR statement to supply the procedure with information about the length of the week to display. If you use both, PROC CALENDAR uses only the OUTFIN statement.

OUTSTART Statement

Specifies the starting day of the week to display in the calendar.

Alias: OUTSTA

Default: If you do not use OUTSTART, each calendar week begins with Sunday.

Featured in: Example 3 on page 128 and Example 8 on page 150

OUTSTART *day-of-week*;

Required Arguments

day-of-week
the name of the starting day of the week for each week in the calendar. For example,

```
outstart monday;
```

Interaction with OUTDUR and OUTFIN

By default, a calendar displays all seven days in a week. Use OUTDUR or OUTFIN, in conjunction with OUTSTART, to control how many days are displayed and which day starts the week.

START Statement

Specifies the variable in the activities data set that contains the starting date of each activity.

Alias: STA, DATE, ID

Required: START is required for both summary and schedule calendars.

Featured in: All examples

START *variable*;

Required Arguments

variable
contains the starting date of each activity.

Restriction: This variable must be in the activities data set.

Restriction: Values of *variable* must be in either SAS date or datetime values.

Restriction: If you use datetime values, specify the DATETIME option in the PROC CALENDAR statement.

Restriction: Both the START and FIN variables must have matching formats. For example, if one contains datetime values, so must the other.

SUM Statement

Specifies numeric variables in the activities data set to total for each month.

Calendar: Summary

Tip: To apply different formats to variables being summed, use multiple SUM statements.

Featured in: Example 7 on page 146 and Example 8 on page 150

SUM *variable(s)* </ FORMAT=*format-name*>;

Required Arguments

variable(s)
specifies one or more numeric variables to total for each month.

Restriction: This variable must be in the activities data set.

Options

FORMAT=*format-name*
names a SAS or user-defined format to use in displaying the sums requested.

Alias: F=

Default: BEST. format

Featured in: Example 7 on page 146 and Example 8 on page 150

What Is Displayed and How

- □ The sum appears at the bottom of the calendar page, if there is room; otherwise, it appears on the following page.
- □ The sum appears in the LEGEND box if you specify the LEGEND option.
- □ PROC CALENDAR automatically displays variables named in a SUM statement in the calendar output, even if the variables are not named in the VAR statement.

VAR Statement

Specifies the variables that you want to display for each activity.

Alias: VARIABLE

VAR *variable(s)*;

Required Arguments

variable(s)
specifies one or more variables that you want to display in the calendar.

Range: The values of *variable* can be either character or numeric.

Restriction: These variables must be in the activities data set.

Tip: You can apply a format to this variable.

Details

When VAR Is Not Used

If you do not use a VAR statement, the procedure displays all variables in the activities data set in the order that they occur in the data set, except for the BY, CALID, START, DUR, and FIN variables. All variables are not displayed, however, if the LINESIZE= and PAGESIZE= settings do not allow enough space in the calendar.

Display of Variables

- □ PROC CALENDAR displays variables in the order that they appear in the VAR statement. All variables are not displayed, however, if the LINESIZE= and PAGESIZE= settings do not allow enough space in the calendar.
- □ PROC CALENDAR also displays any variable named in a SUM or MEAN statement for each activity in the calendar output, even if you do not name that variable in a VAR statement.

Concepts

Type of Calendars

PROC CALENDAR can produce two kinds of calendars: schedule and summary.

Use a ...	if you want to ...	and can accept this restriction
schedule calendar	schedule activities around holidays and nonwork periods	cannot calculate sums and means
	schedule activities that last more than one day	
summary calendar	calculate sums and means	activities can last only one day

Note: PROC CALENDAR produces a summary calendar if you do not use a DUR or FIN statement in the PROC step. △

Schedule Calendar

Definition

A report in calendar format that shows when activities and holidays start and end.

Required Statements

You must supply a START statement and either a DUR or FIN statement.

Use this statement . . .	to specify a variable whose value indicates the . . .
START	starting date of an activity
DUR*	duration of an activity
FIN*	ending date of an activity

* Choose one of these. If you do not use a DUR or FIN statement CALENDAR assumes you want to create a summary calendar report.

Examples

See “Simple Schedule Calendar – 7-Day Default Calendar” on page 87, “Advanced Schedule Calendar” on page 88, as well as Example 1 on page 120, Example 2 on page 123, Example 3 on page 128, Example 4 on page 132, Example 5 on page 137, and Example 6 on page 140

Summary Calendar

Definition

A report in calendar format that displays activities and holidays that last only one day and that can provide summary information in the form of sums and means.

Required Statements

You must supply a START statement. This statement identifies the variable in the activities data set that contains an activity’s starting date.

Multiple Events on a Single Day

A summary calendar report can display only one activity on a given date. If more than one activity has the same START value, therefore, only the last observation that was read is used. In such situations, you may find PROC SUMMARY useful in collapsing your data set to contain one activity per starting date.

Examples

See “Simple Summary Calendar” on page 90, Example 7 on page 146, and Example 8 on page 150

The Default Calendars

Description

PROC CALENDAR provides two default calendars for simple applications. You can produce calendars without having to specify detailed workshifts and weekly work patterns if your application can use one of two simple work patterns. Consider using a default calendar if

- □ your application uses a 5-day work week with 8-hour days or a 7-day work week with 24-hour days. See Table 5.2 on page 110.
- □ you want to print all activities on the same calendar.
- □ you do not need to identify separate calendars.

Table 5.2 Default Calendar Settings and Examples

If scheduled work days are	Then set INTERVAL=	By default DAYLENGTH=	So work periods are	Shown in Example
7 (M-Sun)	DAY	24	24-hour days	2
5 (M-F)	WORKDAY	8	8-hour days	1

When You Unexpectedly Produce a Default Calendar

If you want to produce a specialized calendar, but do not provide all the necessary information, PROC CALENDAR attempts to produce a default calendar. These errors cause PROC CALENDAR to produce a calendar with default features:

- □ If the activities data set does not contain a CALID variable, then PROC CALENDAR produces a default calendar.
- □ If *both* the holidays and calendar data sets do not contain a CALID variable, then PROC CALENDAR produces a default calendar *even if the activities data set contains a CALID variable*.
- □ If the activities and calendar data sets contain the CALID variable, but the holidays data set does not, then the default holidays are used.

Examples

See the 7-day default calendar in Output 5.1 on page 87 and the 5-day default calendar in Example 1 on page 120

Calendars and Multiple Calendars

Definitions

calendar
: a logical entity that represents a weekly work pattern, which consists of weekly work schedules and daily shifts. PROC CALENDAR contains two default work patterns: 5-day week with an 8-hour day or a 7-day week with a 24-hour day. You can also define your own work patterns using CALENDAR and WORKDAYS data sets.

calendar report
: a report in calendar format that displays activities, holidays, and nonwork periods. A calendar report can contain multiple calendars in one of three formats

  separate
  : Each identified calendar prints on separate output pages.

  combined
  : All identified calendars print on the same output pages and each is identified.

  mixed
  : All identified calendars print on the same output pages but are not identified as belonging to separate calendars.

multiple calendar
: a logical entity that represents multiple weekly work patterns.

Why Create Multiple Calendars

Create a multiple calendar if you want to print a calendar report that shows activities that follow different work schedules or different weekly work patterns. For example, a construction project report might need to use different work schedules and weekly work patterns for work crews on different parts of the project.

Another use for multiple calendars is to identify activities so that you can choose to print them in the same calendar report. For example, if you identify activities as belonging to separate departments within a division, you can choose to print a calendar report that shows all departmental activities on the same calendar.

And finally, using multiple calendars, you can produce separate calendar reports for each calendar in a single step. For example, if activities are identified by department, you can produce a calendar report that prints the activities of each department on separate pages.

How to Identify Multiple Calendars

Because PROC CALENDAR can process only one data set of each type (activities, holidays, calendar, workdays) in a single PROC step, you must be able to identify for PROC CALENDAR which calendar an activity, holiday, or weekly work pattern belongs to. Use the CALID statement to specify the variable whose values identify the appropriate calendar. This variable can be numeric or character.

You can use the special variable name _CAL_ or you can use another variable name. PROC CALENDAR automatically looks for a variable named _CAL_ in the holiday and calendar data sets, even when the activities data set uses a variable with another name as the CALID variable. Therefore, if you use the name _CAL_, at least in your holiday and calendar data sets, you can more easily reuse these data sets for different calendar applications.

Using Holidays or Calendar Data Sets with Multiple Calendars

When using a holidays or calendar data set with multiple calendars, PROC CALENDAR treats the variable values in the following way:

- Every value of the CALID variable that appears in either the holidays or calendar data sets defines a calendar.
- If a CALID value appears in the HOLIDATA= data set but not in the CALEDATA= data set, the work schedule of the default calendar is used.
- If a CALID value appears in the CALEDATA= data set but not in the HOLIDATA= data set, the holidays of the default calendar are used.
- If a CALID value does not appear in either the HOLIDATA= or CALEDATA= data set, the work schedule and holidays of the default calendar are used.
- If the CALID variable is not found in the holiday or calendar data sets, PROC CALENDAR looks for the default variable _CAL_ instead. If neither the CALID variable nor a _CAL_ variable appears in a data set, the observations in that data set are applied to a default calendar.

Types of Reports That Contain Multiple Calendars

Because you can associate different observations with different calendars, you can print a calendar report that shows activities that follow different work schedules or different work shifts or that contain different holidays. You can

- print separate calendars on the same page and identify each one.
- print separate calendars on the same page without identifying them.
- print separate pages for each identified calendar.

As an example, consider a calendar that shows the activities of all departments within a division. Each department can have its own calendar identification value and, if necessary, can have individual weekly work patterns, daily work shifts, and holidays.

If you place activities associated with different calendars in the same activities data sets, you use PROC CALENDAR to produce calendar reports that print

- the schedule and events for each department on a separate pages (separate output)

- □ the schedule and events for the entire division, each identified by department (combined output)
- □ the schedule and events for the entire division, but *not* identified by department (mixed output).

The multiple-calendar feature was added specifically to enable PROC CALENDAR to process the output of PROC CPM in SAS/OR software, a project management tool. See Example 6 on page 140.

How to Identify Calendars with the CALID Statement and the Special Variable _CAL_

To identify multiple calendars, you must use the CALID statement to specify the variable whose values identify which calendar an event belongs with. This variable can be numeric or character.

You can use the special variable name _CAL_ or you can use another variable name. PROC CALENDAR automatically looks for a variable named _CAL_ in the holiday and calendar data sets, even when the activities data set uses a variable with another name as the CALID variable. Therefore, if you use the name _CAL_, at least in your holiday and calendar data sets, you can more easily reuse these data sets for different calendar applications.

When You Use Holidays or Calendar Data Sets

When you use a holidays or calendar data set with multiple calendars, PROC CALENDAR treats the variable values in the following way:

- □ Every value of the CALID variable that appears in either the holidays or calendar data sets defines a calendar.
- □ If a CALID value appears in the HOLIDATA= data set but not in the CALEDATA= data set, the work schedule of the default calendar is used.
- □ If a CALID value appears in the CALEDATA= data set but not in the HOLIDATA= data set, the holidays of the default calendar are used.
- □ If a CALID value does not appear in either the HOLIDATA= or CALEDATA= data set, the work schedule and holidays of the default calendar are used.
- □ If the CALID variable is not found in the holiday or calendar data sets, PROC CALENDAR looks for the default variable _CAL_ instead. If neither the CALID variable nor a _CAL_ variable appear in a data set, the observations in that data set are applied to a default calendar.

Examples

Example 2 on page 123, Example 3 on page 128, Example 4 on page 132, and Example 8 on page 150

Input Data Sets

You may need several data sets to produce a calendar, depending on the complexity of your application. PROC CALENDAR can process one of each of four data sets. See Table 5.3 on page 114.

Table 5.3 Four Possible Input Data Sets for PROC CALENDAR

Data Set	Description	Specify with the . . .
activities	Each *observation* contains information about a single activity.	DATA= option
holidays	Each *observation* contains information about a holiday	HOLIDATA= option
calendar	Each *observation* defines one weekly work schedule.	CALEDATA= option
workdays	Each *variable* represents one daily schedule of alternating work and nonwork periods.	WORKDATA= option

Activities Data Set

Purpose

The activities data set, specified with the DATA= option, contains information about the activities to be scheduled by PROC CALENDAR. Each observation describes a single activity.

Requirements and Restrictions

- An activities data set is required. (If you do not specify one with the DATA= option, PROC CALENDAR uses the _LAST_ data set.)
- Only one activities data set is allowed.
- The activities data set must always be sorted or indexed by the START variable.
- If you use a CALID (calendar identifier) variable and want to produce output that shows multiple calendars on separate pages, the activities data set must be sorted by or indexed on the CALID variable and then by the START variable.
- If you use a BY statement, the activities data set must be sorted by or indexed on the BY variables.

Structure

Each observation in the activities data set contains information about one activity. One variable must contain the starting date. If you are producing a schedule calendar, another variable must contain either the activity duration or finishing date. Other variables can contain additional information about an activity.

If a variable contains an activity's . . .	Specify it with the . . .	For this type of calendar. . .
starting date	START statement	Schedule Summary
duration	DUR statement	Schedule
finishing date	FIN statement	Schedule

Multiple Activities per Day in Summary Calendars

A summary calendar can display only one activity on a given date. If more than one activity has the same START value, therefore, only the last observation read is used. In such situations, you may find PROC SUMMARY useful to collapse your data set to contain one activity per starting date.

Examples

Every example in the Examples section uses an activities data set.

Holidays Data Set

Purpose

You can use a holidays data set, specified with the HOLIDATA= option, to

□ identify holidays on your calendar output

□ identify days that are not available for scheduling work. (In a schedule calendar, PROC CALENDAR does not schedule activities on these days.)

Structure

Each observation in the holidays data set must contain at least the holiday starting date. A holiday lasts only one day unless a duration or finishing date is specified. Supplying a holiday name is recommended, though not required. If you do not specify which variable contains the holiday name, PROC CALENDAR uses the word **`DATE`** to identify each holiday.

If a variable contains a holiday's . . .	Then specify it with this statement . . .
starting date	HOLISTART
name	HOLIVAR
duration	HOLIDUR
finishing date	HOLIFIN

No Sorting Needed

You do not need to sort or index the holidays data set.

Using SAS Date Versus SAS Datetime Values

PROC CALENDAR calculates time using SAS datetime values. Even when your data are in DATE. format, the procedure automatically calculates time in minutes and seconds. If you specify only date values, therefore, PROC CALENDAR prints messages similar to the following ones to the SAS log:

```
NOTE: All holidays are assumed to start at the      time/date specified for the holiday varia
WARNING: The units of calculation are SAS datetime         values while all the holiday varia
```

Create a Generic Holidays Data Set

If you have many applications that require PROC CALENDAR output, consider creating a generic holidays data set that contains standard holidays. You can begin with the generic holidays and add observations that contain holidays or nonwork events specific to an application.

CAUTION:

Do not schedule holidays during nonwork periods. Holidays defined in the HOLIDATA= data set cannot occur during nonwork periods defined in the work schedule. For example, you cannot schedule Sunday as a vacation day if the work week is defined as Monday through Friday. When such a conflict occurs, the holiday is *rescheduled to the next available working period* following the nonwork day. △

Examples

Every example in the Examples section uses a holidays data set.

Calendar Data Set

Purpose

You can use a calendar data set, specified with the CALEDATA= option, to specify work schedules for different calendars.

Structure

Each observation in the calendar data set defines one weekly work schedule. The data set created in the DATA step shown below defines weekly work schedules for two calendars, CALONE and CALTWO.

```
data cale;
   input _sun_ $ _mon_ $ _tue_ $ _wed_ $ _thu_ $ /
         _fri_ $ _sat_ $ _cal_ $ d_length time6.;
   datalines;
holiday workday workday workday workday
workday holiday calone 8:00
holiday shift1 shift1 shift1 shift1
shift2 holiday caltwo 9:00
;
```

The variables in this calendar data set consist of

SUN through _SAT_
the name of each day of the week that appears in the calendar. The values of these variables contain the name of workshifts. Valid values for workshifts are

- **WORKDAY** (the default workshift)
- **HOLIDAY** (a nonwork period)
- names of variables in the WORKDATA= data set (in this example, **SHIFT1** and **SHIFT2**).

CAL

the CALID (calendar identifier) variable. The values of this variable identify different calendars. If this variable is not present, the first observation in this data set defines the work schedule that is applied to all calendars in the activities data set.

If the CALID variable contains a missing value, the character or numeric value for the default calendar (**DEFAULT** or 0) is used. See "The Default Calendars" on page 110 for further details.

D_LENGTH

the daylength identifier variable. Values of D_LENGTH indicate the length of the standard workday to be used in calendar calculations. You can set the workday length either by placing this variable in your calendar data set or by using the DAYLENGTH= option.

Missing values for this variable default to the number of hours specified in the DAYLENGTH= option; if the DAYLENGTH= option is not used, the day length defaults to 24 hours if INTERVAL=DAY, or 8 hours if INTERVAL=WORKDAY.

Using Default Workshifts Instead of a Workdays Data Set

You can use a calendar data set with or without a workdays data set. Without a workdays data set, WORKDAY in the calendar data set is equal to one of two standard workdays, depending on the setting of the INTERVAL= option:

If INTERVAL=	Then the work-shift begins at . . .	And the day length is . . .
DAY	00:00	24 hours
WORKDAY	9:00	8 hours

You can reset the length of the standard workday with the DAYLENGTH= option or a D_LENGTH variable in the calendar data set. You can define other work shifts in a workdays data set.

Examples

Example 3 on page 128, Example 4 on page 132, and Example 7 on page 146 feature a calendar data set.

Workdays Data Set

Purpose

You can use a workdays data set, specified with the WORKDATA= option, to define the daily workshifts named in a CALEDATA= data set.

Use Default Work Shifts or Create Your Own?

You do not need a workdays data set if your application can use one of two default work shifts:

If INTERVAL=	Then the work-shift begins at . . .	And the day length is. . .
DAY	00:00	24 hours
WORKDAY	9:00	8 hours

See the INTERVAL= option on page 97.

Structure

Each *variable* in the workdays data set contains one daily schedule of alternating work and nonwork periods. For example, this DATA step creates a data set that contains specifications for two work shifts:

```
data work;
   input shift1 time6. shift2 time6.;
   datalines;
7:00  7:00
12:00 11:00
13:00   .
17:00   .
;
```

The variable SHIFT1 specifies a 10-hour workday, with one nonwork period (a lunch hour); the variable SHIFT2 specifies a 4-hour workday with no nonwork periods.

How Missing Values Are Treated

The missing values default to 00:00 in the first observation and to 24:00 in all other observations. Two consecutive values of 24:00 define a zero-length time period, which is ignored.

Examples

See Example 3 on page 128

Missing Values in Input Data Sets

Table 5.4 on page 118 summarizes the treatment of missing values for variables in the data sets used by PROC CALENDAR.

Table 5.4 Treatment of Missing Values in PROC CALENDAR

Data set	Variable	Treatment of missing values
Activities (DATA=)	CALID	default calendar value is used
	START	observation is not used
	DUR	1.0 is used
	FIN	START value + daylength is used

Data set	Variable	Treatment of missing values
	VAR	if a summary calendar or the MISSING option is specified, the missing value is used; otherwise, no value is used
	SUM, MEAN	0
Calendar (CALEDATA=)	CALID	default calendar value is used
	SUN *through* _SAT_	corresponding shift for default calendar is used
	D_LENGTH	if available, DAYLENGTH= value is used; otherwise, if INTERVAL=DAY, 24:00 is used; otherwise 8:00 is used
	SUM, MEAN	0
Holiday (HOLIDATA=)	CALID	all holidays apply to all calendars
	HOLISTART	observation is not used
	HOLIDUR	if available, HOLIFIN value is used instead of HOLIDUR value; otherwise 1.0 is used
	HOLIFIN	if available, HOLIDUR value is used instead of HOLIFIN value; otherwise, HOLISTART value + day length is used
	HOLIVAR	no value is used
Workdays (WORKDATA=)	any	for the first observation, 00:00 is used; otherwise, 24:00 is used

Results

What Affects the Quantity of PROC CALENDAR Output

The quantity of printed calendar output depends on

- □ the range of dates in the activities data set
- □ whether the FILL option is specified
- □ the BY statement
- □ the CALID statement.

PROC CALENDAR always prints one calendar for every month that contains any activities. If you specify the FILL option, the procedure prints every month between the first and last activities, including months that contain no activities. Using the BY statement prints one set of output for each BY value. Using the CALID statement with OUTPUT=SEPARATE prints one set of output for each value of the CALID variable.

How Size Affects the Format of PROC CALENDAR Output

PROC CALENDAR always attempts to fit the calendar within a single page, as defined by the SAS system options PAGESIZE= and LINESIZE=. If the PAGESIZE= and LINESIZE= values do not allow sufficient room, PROC CALENDAR may print the legend box on a separate page. If necessary, PROC CALENDAR truncates or omits values to make the output fit the page and prints messages to that effect in the SAS log.

What Affects the Lines that Show Activity Duration

In a schedule calendar, the duration of an activity is shown by a continuous line through each day of the activity. Values of variables for each activity are printed on the same line, separated by slashes (/). Each activity begins and ends with a plus sign (+). If an activity continues from one week to another, PROC CALENDAR displays arrows (< >) at the points of continuation.

The length of the activity lines depends on the amount of horizontal space available. You can increase this by specifying

□ a larger linesize with the LINESIZE= option in the OPTIONS statement

□ the WEEKDAYS option to suppress the printing of Saturday and Sunday, which provides more space for Monday through Friday.

Customizing the Calendar Appearance

PROC CALENDAR uses 17 of the 20 SAS formatting characters to construct the outline of the calendar and to print activity lines and to indicate holidays. You can use the FORMCHAR= option to customize the appearance of your PROC CALENDAR output by substituting your own characters for the default. See Table 5.1 on page 95 and Figure 5.1 on page 96.

If your printer supports an *extended character set* (one that includes graphics characters in addition to the regular alphanumeric characters), you can greatly improve the appearance of your output by using the FORMCHAR= option to redefine formatting characters with hexadecimal characters. For information on which hexadecimal codes to use for which characters, consult the documentation for your hardware. For an example of assigning hex values, see FORMCHAR= on page 95.

Examples

Example 1: Schedule Calendar with Holidays – 5-Day Default

Procedure features:

PROC CALENDAR statement options:

DATA=
HOLIDATA=
WEEKDAYS

DUR statement

HOLISTART statement

HOLIVAR statement
HOLIDUR statement
START statement

Other features:

PROC SORT statement
BY statement
5–day default calendar

This example

- □ creates a schedule calendar
- □ uses one of the two default work patterns: 8-hour day, 5-day week
- □ schedules activities around holidays
- □ displays a 5-day week

Program

Create the activities data set. ALLACTY contains both personal and business activities information for a bank president.

```
data allacty;
   input date : date7. event $ 9-36 who $ 37-48 long;
   datalines;
01JUL96 Dist. Mtg.                  All          1
17JUL96 Bank Meeting                1st Natl     1
02JUL96 Mgrs. Meeting               District 6   2
11JUL96 Mgrs. Meeting               District 7   2
03JUL96 Interview                   JW           1
08JUL96 Sales Drive                 District 6   5
15JUL96 Sales Drive                 District 7   5
08JUL96 Trade Show                  Knox         3
22JUL96 Inventors Show              Melvin       3
11JUL96 Planning Council            Group II     1
18JUL96 Planning Council            Group III    1
25JUL96 Planning Council            Group IV     1
12JUL96 Seminar                     White        1
19JUL96 Seminar                     White        1
18JUL96 NewsLetter Deadline         All          1
05JUL96 VIP Banquet                 JW           1
19JUL96 Co. Picnic                  All          1
16JUL96 Dentist                     JW           1
24JUL96 Birthday                    Mary         1
25JUL96 Close Sale                  WYGIX Co.    2
;
```

Create the holidays data set.

```
data hol;
   input date : date7. holiday $ 11-25 holilong @27;
   datalines;
05jul96   Vacation        3
04jul96   Independence    1
;
```

Sort the activities data set by the variable containing the starting date. You are not required to sort the holidays data set.

```
proc sort data=allacty;
   by date;
run;
```

Set LINESIZE= appropriately. If the linesize is not long enough to print the variable values, PROC CALENDAR either truncates the values or produces no calendar output.

```
options nodate pageno=1 linesize=132 pagesize=60;
```

Create the schedule calendar. DATA= identifies the activities data set; HOLIDATA= identifies the holidays data set. WEEKDAYS specifies that a week consists of five eight-hour work days.

```
proc calendar data=allacty holidata=hol weekdays;
```

The START statement specifies the variable in the activities data set that contains the starting date of the activities; DUR specifies the variable that contains the duration of each activity. Creating a schedule calendar requires START and DUR.

```
   start date;
   dur long;
```

The HOLISTART, HOLIVAR, and HOLIDUR statements specify the variables in the holidays data set that contain the start date, name, and duration of each holiday, respectively. When you use a holidays data set, HOLISTART is required. Because at least one holiday lasts more than one day, HOLIDUR is required.

```
   holistart date;
   holivar holiday;
   holidur holilong;
   title1 'Summer Planning Calendar:  Julia Cho';
   title2 'President, Community Bank';
run;
```

Output

Output 5.4 Schedule Calendar: 5-Day Week with Holidays

```
                                                Summer Planning Calendar:  Julia Cho                                                1
                                                      President, Community Bank

-----------------------------------------------------------------------------------------------------------------------------------
|                                                                                                                                 |
|                                                           July  1996                                                            |
|                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------|
|         Monday          |         Tuesday         |        Wednesday        |        Thursday         |         Friday          |
|-------------------------+-------------------------+-------------------------+-------------------------+-------------------------|
|            1            |            2            |            3            |            4            |            5            |
|                         |                         |                         |******Independence*******|********Vacation*********|
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |+=====Interview/JW======+|                         |                         |
|+====Dist. Mtg./All=====+|+============Mgrs. Meeting/District 6=============+|                         |                         |
|-------------------------+-------------------------+-------------------------+-------------------------+-------------------------|
|            8            |            9            |           10            |           11            |           12            |
|********Vacation*********|********Vacation*********|                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |+Planning Council/Group +|+=====Seminar/White=====+|
|                         |                         |+==============================Trade Show/Knox==============================+|
|                         |                         |+==========================Sales Drive/District 6===========================>|
|                         |                         |+====VIP Banquet/JW=====+|+============Mgrs. Meeting/District 7=============+|
|-------------------------+-------------------------+-------------------------+-------------------------+-------------------------|
|           15            |           16            |           17            |           18            |           19            |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |+======Dentist/JW=======+|                         |+NewsLetter Deadline/All+|+====Co. Picnic/All=====+|
|+====================================================Sales Drive/District 7=====================================================+|
|<=============Sales Drive/District 6==============+|+=Bank Meeting/1st Natl=+|+Planning Council/Group +|+=====Seminar/White=====+|
|-------------------------+-------------------------+-------------------------+-------------------------+-------------------------|
|           22            |           23            |           24            |           25            |           26            |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |+=====Birthday/Mary=====+|+==============Close Sale/WYGIX Co.===============+|
|+===========================Inventors Show/Melvin===========================+|+Planning Council/Group +|                         |
|-------------------------+-------------------------+-------------------------+-------------------------+-------------------------|
|           29            |           30            |           31            |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
|                         |                         |                         |                         |                         |
-----------------------------------------------------------------------------------------------------------------------------------
```

Example 2: Schedule Calendar Containing Multiple Calendars

Procedure features:

CALID statement:

  CAL variable

OUTPUT=COMBINE option
DUR statement
24–hour day, 7–day week

This example builds on Example 1 by identifying activities as belonging to one of two calendars, business or personal. This example

- □ produces a schedule calendar report
- □ prints two calendars on the same output page
- □ schedules activities around holidays
- □ uses one of the two default work patterns: 24-hour day, 7-day week
- □ identifies activities and holidays by calendar name.

Program

Create the activities data set and identify separate calendars. ALLACTY2 contains both personal and business activities for a bank president. The _CAL_ variable identifies which calendar an event belongs to.

```
data allacty2;
  input date:date7. happen $ 10-34 who $ 35-47 _CAL_ $ long;
  datalines;
01JUL96  Dist. Mtg.               All          CAL1   1
02JUL96  Mgrs. Meeting            District 6   CAL1   2
03JUL96  Interview                JW           CAL1   1
05JUL96  VIP Banquet              JW           CAL1   1
06JUL96  Beach trip               family       CAL2   2
08JUL96  Sales Drive              District 6   CAL1   5
08JUL96  Trade Show               Knox         CAL1   3
09JUL96  Orthodontist             Meagan       CAL2   1
11JUL96  Mgrs. Meeting            District 7   CAL1   2
11JUL96  Planning Council         Group II     CAL1   1
12JUL96  Seminar                  White        CAL1   1
14JUL96  Co. Picnic               All          CAL1   1
14JUL96  Business trip            Fred         CAL2   2
15JUL96  Sales Drive              District 7   CAL1   5
16JUL96  Dentist                  JW           CAL1   1
17JUL96  Bank Meeting             1st Natl     CAL1   1
17JUL96  Real estate agent        Family       CAL2   1
18JUL96  NewsLetter Deadline      All          CAL1   1
18JUL96  Planning Council         Group III    CAL1   1
19JUL96  Seminar                  White        CAL1   1
22JUL96  Inventors Show           Melvin       CAL1   3
24JUL96  Birthday                 Mary         CAL1   1
25JUL96  Planning Council         Group IV     CAL1   1
25JUL96  Close Sale               WYGIX Co.    CAL1   2
27JUL96  Ballgame                 Family       CAL2   1
;
```

Create the holidays data set and identify which calendar a holiday affects. The _CAL_ variable identifies which calendar a holiday belongs to.

```
data vac;
   input hdate:date7.  holiday $ 11-25 _CAL_ $ ;
   datalines;
29JUL96   vacation                CAL2
04JUL96   Independence            CAL1
;
```

Sort the activities data set by the variable containing the starting date. When creating a calendar with combined output, you sort only by the activity starting date, not by the CALID variable. You are not required to sort the holidays data set.

```
proc sort data=allacty2;
   by date;
```

```
run;
```

Set LINESIZE= appropriately. If the linesize is not long enough to print the variable values, PROC CALENDAR either truncates the values or produces no calendar output.

```
options nodate pageno=1 pagesize=60 linesize=132;
```

Create the schedule calendar. DATA= identifies the activities data set; HOLIDATA= identifies the holidays data set. By default, the output calendar displays a 7-day week.

```
proc calendar data=allacty2 holidata=vac;
```

The CALID statement specifies the variable that identifies which calendar an event belongs to. OUTPUT=COMBINE places all events and holidays on the same calendar.

```
   calid _CAL_ / output=combine;
```

The START statement specifies the variable in the activities data set that contains the starting date of the activities; DUR specifies the variable that contains the duration of each activity. Creating a schedule calendar requires START and DUR.

```
   start date ;
   dur long;
```

The HOLISTART and HOLIVAR statements specify the variables in the holidays data set that contain the start date and name of each holiday, respectively. HOLISTART is required when you use a holidays data set.

```
   holistart hdate;
   holivar holiday;
   title1 'Summer Planning Calendar:  Julia Cho';
   title2 'President, Community Bank';
   title3 'Work and Home Schedule';
run;
```

Output

Output 5.5 Schedule Calendar Containing Multiple Calendars

```
                                               Summer Planning Calendar:  Julia Cho                                               1
                                                    President, Community Bank
                                                      Work and Home Schedule

          ------------------------------------------------------------------------------------------------------------------------
          |                                                                                                                      |
          |                                                      July  1996                                                      |
          |                                                                                                                      |
          |----------------------------------------------------------------------------------------------------------------------|
          |     Sunday     |     Monday     |    Tuesday     |   Wednesday    |    Thursday    |     Friday     |    Saturday    |
----------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |                |       1        |       2        |       3        |       4        |       5        |       6        |
|.........|................|................|................|................|................|................|................|
| CAL2    |                |                |                |                |                |                |+Beach trip/fam>|
|.........|................|................|................|................|................|................|................|
| CAL1    |                |                |                |+=Interview/JW=+|**Independence**|                |                |
|         |                |+Dist. Mtg./All+|+===Mgrs. Meeting/District 6====+|                |+VIP Banquet/JW+|                |
|         |                |                |                |                |                |                |                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       7        |       8        |       9        |       10       |       11       |       12       |       13       |
|.........|................|................|................|................|................|................|................|
| CAL2    |<Beach trip/fam+|                |+Orthodontist/M+|                |                |                |                |
|.........|................|................|................|................|................|................|................|
| CAL1    |                |                |                |                |+Planning Counc+|+Seminar/White=+|                |
|         |                |+================Trade Show/Knox=================+|+===Mgrs. Meeting/District 7====+|                |
|         |                |+==============================Sales Drive/District 6==============================+|                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       14       |       15       |       16       |       17       |       18       |       19       |       20       |
|.........|................|................|................|................|................|................|................|
| CAL2    |+======Business trip/Fred=======+|                |+Real estate ag+|                |                |                |
|.........|................|................|................|................|................|................|................|
| CAL1    |                |                |                |                |+Planning Counc+|                |                |
|         |                |                |+==Dentist/JW==+|+Bank Meeting/1+|+NewsLetter Dea+|+Seminar/White=+|                |
|         |+Co. Picnic/All+|+==============================Sales Drive/District 7==============================+|                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       21       |       22       |       23       |       24       |       25       |       26       |       27       |
|.........|................|................|................|................|................|................|................|
| CAL2    |                |                |                |                |                |                |+Ballgame/Famil+|
|.........|................|................|................|................|................|................|................|
| CAL1    |                |                |                |+Birthday/Mary=+|+=====Close Sale/WYGIX Co.======+|                |
|         |                |+=============Inventors Show/Melvin==============+|+Planning Counc+|                |                |
|         |                |                |                |                |                |                |                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       28       |       29       |       30       |       31       |                |                |                |
|.........|................|................|................|................|................|................|................|
| CAL2    |                |****vacation****|                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
----------------------------------------------------------------------------------------------------------------------------------
```

Example 3: Multiple Schedule Calendars with Atypical Workshifts (Separated Output)

Procedure features:

PROC CALENDAR statement options:

- CALEDATA=
- DATETIME
- WORKDATA=

CALID statement:

- _CAL_ variable
- OUTPUT=SEPARATE option

DUR statement

OUTSTART statement

OUTFIN statement

This example

- □ produces separate output pages for each calendar in a single PROC step
- □ schedules activities around holidays
- □ displays an 8-hour day, 5 1/2-day week
- □ uses separate work patterns and holidays for each calendar.

Producing Different Output for Multiple Calendars

This example and Example 4 on page 132 use the same input data for multiple calendars to produce different output. The only differences in these programs are how the activities data set is sorted and how the OUTPUT= option is set.

To print . . .	Sort the activities data set by . . .	And set OUTPUT= to	See Example
Separate pages for each calendar	calendar id and starting date	SEPARATE	3, 8
All activities on the same page and identify each calendar	starting date	COMBINE	4, 2
All activities on the same page and NOT identify each calendar	starting date	MIX	4

Program

Specify a library so that you can permanently store the activities data set.

```
libname well 'SAS-data-library';
```

Create the activities data set and identify separate calendars. WELL.ACT is a permanent SAS data set that contains activities for a well construction project. The _CAL_ variable identifies the calendar that an activity belongs to.

```
data well.act;
   input task & $16. dur : 5. date : datetime16.  _cal_ $ cost;
   datalines;
Drill Well          3.50  01JUL96:12:00:00  CAL1   1000
Lay Power Line      3.00  04JUL96:12:00:00  CAL1   2000
Assemble Tank       4.00  05JUL96:08:00:00  CAL1   1000
Build Pump House    3.00  08JUL96:12:00:00  CAL1   2000
Pour Foundation     4.00  11JUL96:08:00:00  CAL1   1500
Install Pump        4.00  15JUL96:14:00:00  CAL1    500
Install Pipe        2.00  19JUL96:08:00:00  CAL1   1000
Erect Tower         6.00  20JUL96:08:00:00  CAL1   2500
Deliver Material    2.00  01JUL96:12:00:00  CAL2    500
Excavate            4.75  03JUL96:08:00:00  CAL2   3500
;
```

Create the holidays data set. The _CAL_ variable identifies the calendar that a holiday belongs to.

```
data well.hol;
   input date date. holiday $ 11-25 _cal_ $;
   datalines;
09JUL96   Vacation            CAL2
04JUL96   Independence        CAL1
;
```

Create the calendar data set. Each observation defines the workshifts for an entire week. The _CAL_ variable identifies to which calendar the workshifts apply. CAL1 uses the default 8-hour workshifts for Monday through Friday. CAL2 uses a half day on Saturday and the default 8-hour workshift for Monday through Friday.

```
data well.cal;
   input _sun_ $ _sat_ $ _mon_ $ _tue_ $ _wed_ $ _thu_ $
         _fri_ $ _cal_ $;
   datalines;
Holiday Holiday  Workday Workday Workday Workday Workday CAL1
Holiday Halfday  Workday Workday Workday Workday Workday CAL2
;
```

Create the workdays data set. This data set defines the daily workshifts that are named in the calendar data set. Each variable – not observation – contains one daily schedule of alternating work and nonwork periods. The HALFDAY workshift lasts 4 hours.

```
data well.wor;
   input halfday time5.;
   datalines;
08:00
12:00
```

```
;
```

Sort the activities data set by the variables containing the calendar identification and the starting date, respectively. You are not required to sort the holidays data set.

```
proc sort data=well.act;
   by _cal_ date;
run;
```

Set LINESIZE= appropriately. If the linesize is not long enough to print the variable values, PROC CALENDAR either truncates the values or produces no calendar output.

```
options nodate pageno=1 linesize=132 pagesize=60;
```

Create the schedule calendar. DATA= identifies the activities data set; HOLIDATA= identifies the holidays data set; CALEDATA= identifies the calendar data set; WORKDATA= identifies the workdays data set. DATETIME specifies that the variable specified with the START statement contains values in SAS datetime format.

```
proc calendar data=well.act
              holidata=well.hol
              caledata=well.cal
              workdata=well.wor
              datetime;
```

The CALID statement specifies that the _CAL_ variable identifies calendars. OUTPUT=SEPARATE prints information for each calendar on separate pages.

```
   calid _cal_ / output=separate;
```

The START statement specifies the variable in the activities data set that contains the activity starting date; DUR specifies the variable that contains the activity duration. START and DUR are required for a schedule calendar.

```
   start date;
   dur dur;
```

HOLISTART and HOLIVAR specify the variables in the holidays data set that contain the start date and name of each holiday, respectively. HOLISTART is required when you use a holidays data set.

```
   holistart date;
   holivar holiday;
```

OUTSTART and OUTFIN specify that the calendar display a 6-day week, Monday through Saturday.

```
   outstart Monday;
   outfin Saturday;
   title1 'Well Drilling Work Schedule: Separate Calendars';
   format cost dollar9.2;
run;
```

Output

Output 5.6 Separate Output for Multiple Schedule Calendars

```
                                          Well Drilling Work Schedule: Separate Calendars                                          1

............................................................ _cal_=CAL1 ...........................................................

  -------------------------------------------------------------------------------------------------------------------------------
  |                                                                                                                             |
  |                                                         July  1996                                                          |
  |                                                                                                                             |
  |-----------------------------------------------------------------------------------------------------------------------------|
  |       Monday       |       Tuesday      |     Wednesday      |      Thursday      |       Friday       |      Saturday      |
  |--------------------+--------------------+--------------------+--------------------+--------------------+--------------------|
  |         1          |         2          |         3          |         4          |         5          |         6          |
  |                    |                    |                    |****Independence****|                    |                    |
  |                    |                    |                    |                    |                    |                    |
  |                    |                    |                    |                    |                    |                    |
  |                    |                    |                    |                    |+Assemble Tank/$1,0>|                    |
  |                    |                    |                    |                    |+Lay Power Line/$2,>|                    |
  |+===================Drill Well/$1,000.00=====================>|                    |<Drill Well/$1,000.+|                    |
  |--------------------+--------------------+--------------------+--------------------+--------------------+--------------------|
  |         8          |         9          |        10          |        11          |        12          |        13          |
  |                    |                    |                    |                    |                    |                    |
  |                    |                    |                    |                    |                    |                    |
  |                    |                    |                    |                    |                    |                    |
  |+==========================Build Pump House/$2,000.00=============================+|                    |                    |
  |<=============================Assemble Tank/$1,000.00=============================+|                    |                    |
  |<=======Lay Power Line/$2,000.00========+|                    |+=======Pour Foundation/$1,500.00=======>|                    |
  |--------------------+--------------------+--------------------+--------------------+--------------------+--------------------|
  |        15          |        16          |        17          |        18          |        19          |        20          |
  |                    |                    |                    |                    |                    |                    |
  |                    |                    |                    |                    |                    |                    |
  |                    |                    |                    |                    |                    |                    |
  |                    |                    |                    |                    |                    |                    |
  |+=========================================Install Pump/$500.00=========================================+|                    |
  |<=================Pour Foundation/$1,500.00==================+|                    |+Install Pipe/$1,00>|                    |
  |--------------------+--------------------+--------------------+--------------------+--------------------+--------------------|
  |        22          |        23          |        24          |        25          |        26          |        27          |
  |                    |                    |                    |                    |                    |                    |
  |                    |                    |                    |                    |                    |                    |
  |                    |                    |                    |                    |                    |                    |
  |                    |                    |                    |                    |                    |                    |
  |+========================================Erect Tower/$2,500.00=========================================>|                    |
  |<========Install Pipe/$1,000.00=========+|                    |                    |                    |                    |
  |--------------------+--------------------+--------------------+--------------------+--------------------+--------------------|
  |        29          |        30          |        31          |                    |                    |                    |
  |                    |                    |                    |                    |                    |                    |
  |                    |                    |                    |                    |                    |                    |
  |                    |                    |                    |                    |                    |                    |
  |                    |                    |                    |                    |                    |                    |
  |                    |                    |                    |                    |                    |                    |
  |<Erect Tower/$2,500+|                    |                    |                    |                    |                    |
  -------------------------------------------------------------------------------------------------------------------------------
```

```
                                      Well Drilling Work Schedule: Separate Calendars                                             2

........................................................... _cal_=CAL2 ...........................................................

 -------------------------------------------------------------------------------------------------------------------------------
 |                                                                                                                             |
 |                                                          July  1996                                                         |
 |                                                                                                                             |
 |-----------------------------------------------------------------------------------------------------------------------------|
 |       Monday       |      Tuesday       |     Wednesday      |      Thursday      |       Friday       |      Saturday      |
 |--------------------+--------------------+--------------------+--------------------+--------------------+--------------------|
 |         1          |         2          |         3          |         4          |         5          |         6          |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |+===============================Excavate/$3,500.00================================>|
 |+==================Deliver Material/$500.00==================+|                    |                    |                    |
 |--------------------+--------------------+--------------------+--------------------+--------------------+--------------------|
 |         8          |         9          |         10         |         11         |         12         |         13         |
 |                    |******Vacation******|                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |<Excavate/$3,500.00>|                    |<Excavate/$3,500.00+|                    |                    |                    |
 |--------------------+--------------------+--------------------+--------------------+--------------------+--------------------|
 |        15          |        16          |         17         |         18         |         19         |         20         |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |--------------------+--------------------+--------------------+--------------------+--------------------+--------------------|
 |        22          |        23          |         24         |         25         |         26         |         27         |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |--------------------+--------------------+--------------------+--------------------+--------------------+--------------------|
 |        29          |        30          |         31         |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 |                    |                    |                    |                    |                    |                    |
 -------------------------------------------------------------------------------------------------------------------------------
```

Example 4: Multiple Schedule Calendars with Atypical Workshifts (Combined and Mixed Output)

Procedure features:

PROC CALENDAR statementoptions:

- CALEDATA=
- DATETIME
- WORKDATA=

CALID statement:

- _CAL_ variable

OUTPUT=COMBINE option
OUTPUT=MIXED option
DUR statement
OUTSTART statement
OUTFIN statement

Data sets:
There are input data sets on page 129.

This example

- □ produces a schedule calendar
- □ schedules activities around holidays
- □ uses separate work patterns and holidays for each calendar
- □ uses an 8-hour day, 5 1/2-day work week
- □ displays and identifies multiple calendars on each calendar page (combined output)
- □ displays *but does not identify* multiple calendars on each calendar page (mixed output).

Two Programs and Two Pieces of Output

This example creates both combined and mixed output. Producing combined or mixed calendar output requires only one change to a PROC CALENDAR step: the setting of the OUTPUT= option in the CALID statement. Combined output is produced first, then mixed output.

Producing Different Output for Multiple Calendars

This example and Example 3 on page 128 use the same input data for multiple calendars to produce different output. The only differences in these programs are how the activities data set is sorted and how the OUTPUT= option is set.

To print . . .	Sort the activities data set by . . .	And set OUTPUT= to	See Example
Separate pages for each calendar	calendar id and starting date	SEPARATE	3, 8
All activities on the same page and identify each calendar	starting date	COMBINE	4, 2
All activities on the same page and NOT identify each calendar	starting date	MIX	4

Program for Combined Calendars

Specify the SAS data library where the activities data set is stored.

```
libname well 'SAS-data-library';
```

Sort the activities data set by the variable containing the starting date. Do not sort by the CALID variable when producing combined calendar output.

```
proc sort data=well.act;
   by date;
run;
```

Set PAGESIZE= and LINESIZE= appropriately. When you combine calendars, check the value of PAGESIZE= to ensure that there is enough room to print the activities from multiple calendars. If LINESIZE= is too small for the variable values to print, PROC CALENDAR either truncates the values or produces no calendar output.

```
options nodate pageno=1 linesize=132 pagesize=60;
```

Create the schedule calendar. DATA= identifies the activities data set; HOLIDATA= identifies the holidays data set; CALEDATA= identifies the calendar data set; WORKDATA= identifies the workdays data set. DATETIME specifies that the variable specified with the START statement contains values in SAS datetime format.

```
proc calendar data=well.act
              holidata=well.hol
              caledata=well.cal
              workdata=well.wor
              datetime;
   title1 'Well Drilling Work Schedule: Combined Calendars';
   format cost dollar9.2;
```

The CALID statement specifies that the _CAL_ variable identifies the calendars. OUTPUT=COMBINE prints multiple calendars on the same page and identifies each calendar.

```
   calid _cal_ / output=combine;
```

The START statement specifies the variable in the activities data set that contains the starting date of the activities; DUR specifies the variable that contains the duration of each activity. START and DUR are required for a schedule calendar.

```
   start date;
   dur dur;
```

HOLISTART and HOLIVAR specify the variables in the holidays data set that contain the start date and name of each holiday, respectively. HOLISTART is required when you use a holidays data set.

```
   holistart date;
   holivar holiday;
run;
```

Output for Combined Calendars

Output 5.7 Multiple Schedule Calendars with Atypical Workshifts (Combined Output)

```
                                      Well Drilling Work Schedule: Combined Calendars                                          1

          ------------------------------------------------------------------------------------------------------------------------
          |                                                                                                                      |
          |                                                     July  1996                                                       |
          |                                                                                                                      |
          |----------------------------------------------------------------------------------------------------------------------|
          |     Sunday     |     Monday     |    Tuesday     |   Wednesday    |    Thursday    |     Friday     |    Saturday    |
----------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |                |       1        |       2        |       3        |       4        |       5        |       6        |
|.........|................|................|................|................|................|................|................|
| CAL1    |                |                |                |                |**Independence**|+Assemble Tank/>|                |
|         |                |                |                |                |                |+Lay Power Line>|                |
|         |                |+=============Drill Well/$1,000.00===============>|                |<Drill Well/$1,+|                |
|.........|................|................|................|................|................|................|................|
| CAL2    |                |                |                |+======================Excavate/$3,500.00=========================>|
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       7        |       8        |       9        |       10       |       11       |       12       |       13       |
|.........|................|................|................|................|................|................|................|
| CAL1    |                |+==================Build Pump House/$2,000.00=====================+|                |                |
|         |                |<====================Assemble Tank/$1,000.00======================+|                |                |
|         |                |<===Lay Power Line/$2,000.00====+|                |+===Pour Foundation/$1,500.00===>|                |
|.........|................|................|................|................|................|................|................|
| CAL2    |                |<Excavate/$3,50>|****Vacation****|<Excavate/$3,50+|                |                |                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       14       |       15       |       16       |       17       |       18       |       19       |       20       |
|.........|................|................|................|................|................|................|................|
| CAL1    |                |+===============================Install Pump/$500.00===============================+|                |
|         |                |<===========Pour Foundation/$1,500.00============+|                |+Install Pipe/$>|                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       21       |       22       |       23       |       24       |       25       |       26       |       27       |
|.........|................|................|................|................|................|................|................|
| CAL1    |                |+==============================Erect Tower/$2,500.00===============================>|                |
|         |                |<====Install Pipe/$1,000.00=====+|                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       28       |       29       |       30       |       31       |                |                |                |
|.........|................|................|................|................|................|................|................|
| CAL1    |                |<Erect Tower/$2+|                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
----------------------------------------------------------------------------------------------------------------------------------
```

Program for Mixed Calendars

To produce mixed output instead of combined, use the same program and change the setting of the OUTPUT= option to OUTPUT=MIX:

```
proc calendar data=well.act
              holidata=well.hol
              caledata=well.cal
              workdata=well.wor
```

```
               datetime;
   calid _cal_ / output=mix;
   start date;
   dur dur;
   holistart date;
   holivar holiday;
   outstart Monday;
   outfin Saturday;
   title1 'Well Drilling Work Schedule: Mixed Calendars';
   format cost dollar9.2;
run;
```

Output for Mixed Calendars

Output 5.8 Multiple Schedule Calendar with Atypical Workshifts (Mixed Output)

```
                                          Well Drilling Work Schedule: Mixed Calendars                                          1

-------------------------------------------------------------------------------------------------------------------------------
|                                                                                                                             |
|                                                        July  1996                                                           |
|                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------|
|       Monday       |      Tuesday       |     Wednesday      |      Thursday      |       Friday       |      Saturday      |
|--------------------+--------------------+--------------------+--------------------+--------------------+--------------------|
|          1         |          2         |          3         |          4         |          5         |          6         |
|                    |                    |                    |                    |                    |                    |
|                    |                    |                    |                    |                    |                    |
|                    |                    |                    |                    |+Assemble Tank/$1,0>|                    |
|                    |                    |+===============================Excavate/$3,500.00================================>|
|+==================Deliver Material/$500.00==================+|****Independence****|+Lay Power Line/$2,>|                    |
|+====================Drill Well/$1,000.00====================>|****Independence****|<Drill Well/$1,000.+|                    |
|--------------------+--------------------+--------------------+--------------------+--------------------+--------------------|
|          8         |          9         |         10         |         11         |         12         |         13         |
|                    |                    |                    |                    |                    |                    |
|                    |                    |                    |                    |                    |                    |
|+===========================Build Pump House/$2,000.00============================+|                    |                    |
|<=============================Assemble Tank/$1,000.00=============================+|                    |                    |
|<=======Lay Power Line/$2,000.00========+|                    |                    |                    |                    |
|<Excavate/$3,500.00>|******Vacation******|<Excavate/$3,500.00+|+=======Pour Foundation/$1,500.00=======>|                    |
|--------------------+--------------------+--------------------+--------------------+--------------------+--------------------|
|         15         |         16         |         17         |         18         |         19         |         20         |
|                    |                    |                    |                    |                    |                    |
|                    |                    |                    |                    |                    |                    |
|                    |                    |                    |                    |                    |                    |
|                    |                    |                    |                    |                    |                    |
|+=========================================Install Pump/$500.00=========================================+|                    |
|<=================Pour Foundation/$1,500.00==================+|                    |+Install Pipe/$1,00>|                    |
|--------------------+--------------------+--------------------+--------------------+--------------------+--------------------|
|         22         |         23         |         24         |         25         |         26         |         27         |
|                    |                    |                    |                    |                    |                    |
|                    |                    |                    |                    |                    |                    |
|                    |                    |                    |                    |                    |                    |
|                    |                    |                    |                    |                    |                    |
|+========================================Erect Tower/$2,500.00=========================================>|                    |
|<========Install Pipe/$1,000.00=========+|                    |                    |                    |                    |
|--------------------+--------------------+--------------------+--------------------+--------------------+--------------------|
|         29         |         30         |         31         |                    |                    |                    |
|                    |                    |                    |                    |                    |                    |
|                    |                    |                    |                    |                    |                    |
|                    |                    |                    |                    |                    |                    |
|                    |                    |                    |                    |                    |                    |
|                    |                    |                    |                    |                    |                    |
|<Erect Tower/$2,500+|                    |                    |                    |                    |                    |
-------------------------------------------------------------------------------------------------------------------------------
```

Example 5: Schedule Calendar, Blank or with Holidays

Procedure features:

PROC CALENDAR statement options:

FILL
HOLIDATA=
INTERVAL=WORKDAY

DUR statement
HOLIDUR statement
HOLISTART statement
HOLIVAR statement

This example produces a schedule calendar that displays only holidays. You can use this same code to produce a set of blank calendars by removing the HOLIDATA= option and the HOLISTART, HOLIVAR, and HOLIDUR statements from the PROC CALENDAR step.

Program

Create the activities data set. Specify one activity in the first month and one in the last, each with a duration of 0. PROC CALENDAR does not print activities with zero durations in the output.

```
data acts;
   input sta : date7. act $ 11-30 dur;
   datalines;
01JAN97   Start                 0
31DEC97   Finish                0
;
```

Create the holidays data set.

```
data holidays;
   input sta : date7. act $ 11-30 dur;
   datalines;
01JAN97   New Year's            1
28MAR97   Good Friday           1
30MAY97   Memorial Day          1
04JUL97   Independence Day      1
01SEP97   Labor Day             1
27NOV97   Thanksgiving          2
25DEC97   Christmas Break       5
;
```

Set PAGESIZE= and LINESIZE= appropriately. To create larger boxes for each day in the calendar output, increase the value of PAGESIZE=.

```
options nodate pageno=1 linesize=132 pagesize=30;
```

Create the calendar. DATA= identifies the activities data set; HOLIDATA= identifies the holidays data set. FILL displays all months, even those with no activities. By default, only months with activities appear in the report. INTERVAL=WORKDAY specifies that activities and holidays are measured in 8-hour days and that PROC CALENDAR schedules activities only Monday through Friday.

```
proc calendar data=acts holidata=holidays fill interval=workday;
```

The START statement specifies the variable in the activities data set that contains the starting date of the activities; DUR specifies the variable that contains the duration of each activity. Creating a schedule calendar requires START and DUR.

```
   start sta;
   dur dur;
```

The HOLISTART, HOLIVAR, and HOLIDUR statements specify the variables in the holidays data set that contain the start date, name, and duration of each holiday, respectively. When you use a holidays data set, HOLISTART is required. Because at least one holiday lasts more than one day, HOLIDUR (or HOLIFIN) is required.

```
   holistart sta;
   holivar act;
   holidur dur;
   title1 'Calendar of Holidays Only';
run;
```

Output

Output 5.9 Schedule Calendars with Holidays Only (Partial Output).

Without INTERVAL=WORKDAY, the 5-day Christmas break would be scheduled through the weekend.

```
                                                 Calendar of Holidays Only                                                      1

-------------------------------------------------------------------------------------------------------------------------------
|                                                                                                                             |
|                                                       January  1997                                                         |
|                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------|
|     Sunday      |     Monday      |     Tuesday     |    Wednesday    |    Thursday     |     Friday      |    Saturday     |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|                 |                 |                 |        1        |        2        |        3        |        4        |
|                 |                 |                 |***New Year's****|                 |                 |                 |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|        5        |        6        |        7        |        8        |        9        |       10        |       11        |
|                 |                 |                 |                 |                 |                 |                 |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|       12        |       13        |       14        |       15        |       16        |       17        |       18        |
|                 |                 |                 |                 |                 |                 |                 |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|       19        |       20        |       21        |       22        |       23        |       24        |       25        |
|                 |                 |                 |                 |                 |                 |                 |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|       26        |       27        |       28        |       29        |       30        |       31        |                 |
|                 |                 |                 |                 |                 |                 |                 |
-------------------------------------------------------------------------------------------------------------------------------
```

```
                                                   Calendar of Holidays Only                                                      2

-------------------------------------------------------------------------------------------------------------------------------
|                                                                                                                             |
|                                                        February  1997                                                       |
|                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------|
|     Sunday      |     Monday      |     Tuesday     |    Wednesday    |    Thursday     |     Friday      |    Saturday     |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|                 |                 |                 |                 |                 |                 |        1        |
|                 |                 |                 |                 |                 |                 |                 |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|        2        |        3        |        4        |        5        |        6        |        7        |        8        |
|                 |                 |                 |                 |                 |                 |                 |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|        9        |       10        |       11        |       12        |       13        |       14        |       15        |
|                 |                 |                 |                 |                 |                 |                 |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|       16        |       17        |       18        |       19        |       20        |       21        |       22        |
|                 |                 |                 |                 |                 |                 |                 |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|       23        |       24        |       25        |       26        |       27        |       28        |                 |
|                 |                 |                 |                 |                 |                 |                 |
-------------------------------------------------------------------------------------------------------------------------------
```

```
                                                   Calendar of Holidays Only                                                     12

-------------------------------------------------------------------------------------------------------------------------------
|                                                                                                                             |
|                                                        December  1997                                                       |
|                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------|
|     Sunday      |     Monday      |     Tuesday     |    Wednesday    |    Thursday     |     Friday      |    Saturday     |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|                 |        1        |        2        |        3        |        4        |        5        |        6        |
|                 |                 |                 |                 |                 |                 |                 |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|        7        |        8        |        9        |       10        |       11        |       12        |       13        |
|                 |                 |                 |                 |                 |                 |                 |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|       14        |       15        |       16        |       17        |       18        |       19        |       20        |
|                 |                 |                 |                 |                 |                 |                 |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|       21        |       22        |       23        |       24        |       25        |       26        |       27        |
|                 |                 |                 |                 |*Christmas Break*|*Christmas Break*|                 |
|-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------|
|       28        |       29        |       30        |       31        |                 |                 |                 |
|                 |*Christmas Break*|*Christmas Break*|*Christmas Break*|                 |                 |                 |
-------------------------------------------------------------------------------------------------------------------------------
```

Example 6: Calculating a Schedule Based on Completion of Predecessor Tasks

Procedure features:

PROC CALENDAR statement

CALID statement

FIN statement

VAR statement

Other features:

PROC CPM step
PROC SORT step

Automating Your Scheduling Task with SAS/OR Software

When changes occur to a schedule, you have to adjust the activity starting dates manually if you use PROC CALENDAR to produce a schedule calendar. Alternatively, you can use PROC CPM in SAS/OR software to reschedule work when dates change. Even more important, you can provide only an initial starting date for a project and let PROC CPM calculate starting dates for activities, based on identified successor tasks, that is, tasks that cannot begin until their predecessors end.

In order to use PROC CPM, you must

1 create an activities data set that contains activities with durations. (You can indicate nonwork days, weekly work schedules, and workshifts with holidays, calendar, and workshift data sets.)
2 indicate which activities are successors to others (precedence relationships).
3 define resource limitations *if* you want them considered in the schedule.
4 provide an initial starting date.

PROC CPM can process your data to generate a data set that contains the start and end dates for each activity. PROC CPM schedules the activities, based on the duration information, weekly work patterns, workshifts, as well as holidays and nonwork days that interrupt the schedule. You can generate several views of the schedule that is computed by PROC CPM, from a simple listing of start and finish dates to a calendar, a Gantt chart, or a network diagram.

Highlights of This Example

This example

- □ calculates a project schedule containing multiple calendars (PROC CPM)
- □ produces a listing of the PROC CPM output data set (PROC PRINT)
- □ displays the schedule in calendar format (PROC CALENDAR).

This example features PROC CPM's ability to calculate a schedule that

- □ is based on an initial starting date
- □ applies different non-work periods to different calendars, such as personal vacation days to each employee's schedule
- □ includes milestones (activities with a duration of 0).

See Also

This example introduces users of PROC CALENDAR to more advanced SAS scheduling tools. For an introduction to project management tasks and tools and several examples, see *Project Management Using the SAS System*. For more examples, see *SAS/OR Software: Project Management Examples*. For complete reference documentation, see *SAS/OR User's Guide: Project Management, Version 6, First Edition*.

Program

Set appropriate options. If the linesize is not long enough to print the variable values, PROC CALENDAR either truncates the values or produces no calendar output. A longer linesize also makes it easier to view a listing of a PROC CPM output data set.

```
options nodate pageno=1 linesize=132 pagesize=60;
```

Create the activities data set and identify separate calendars. These data identify two calendars: the professor's (the value of _CAL_ is **`Prof.`**) and the student's (the value of _CAL_ is **`Student`**). The Succ1 variable identifies which activity cannot begin until the current one ends. For example **`Analyze Exp 1`** cannot begin until **`Run Exp 1`** is completed. The DAYS value of **`0`** for JOBNUM **`3, 6,`** and **`8`** indicates that these are milestones.

```
data grant;
   input jobnum Task $ 4-22 Days Succ1 $ 27-45 aldate : date7. altype $
         _cal_ $;
   format aldate date7.;
   datalines;
1  Run Exp 1          11  Analyze Exp 1       .      .   Student
2  Analyze Exp 1       5  Send Report 1       .      .   Prof.
3  Send Report 1       0  Run Exp 2           .      .   Prof.
4  Run Exp 2          11  Analyze Exp 2       .      .   Student
5  Analyze Exp 2       4  Send Report 2       .      .   Prof.
6  Send Report 2       0  Write Final Report  .      .   Prof.
7  Write Final Report  4  Send Final Report   .      .   Prof.
8  Send Final Report   0                      .      .   Student
9  Site Visit          1                    18jul96 ms  Prof.
;
```

Create the holidays data set and identify which calendar a nonwork day belongs to. The two holidays are listed twice, once for the professor's calendar and once for the student's. Because each person is associated with a separate calendar, PROC CPM can apply the personal vacation days to the appropriate calendars.

```
data nowork;
   format holista date7. holifin date7.;
   input holista : date7. holifin : date7. name $ 17-32 _cal_ $;
   datalines;
04jul96 04jul96 Independence Day Prof.
02sep96 02sep96 Labor Day        Prof.
04jul96 04jul96 Independence Day Student
02sep96 02sep96 Labor Day        Student
15jul96 16jul96 PROF Vacation    Prof.
15aug96 16aug96 STUDENT Vacation Student
;
```

Calculate the schedule with PROC CPM. PROC CPM uses information supplied in the activities and holidays data sets to calculate start and finish dates for each activity. The DATE= option supplies the starting date of the project. The CALID statement is not required, even though this example includes two calendars, because the calendar identification variable has the special name _CAL_.

```
proc cpm data=grant
         date='01jul96'd
         interval=weekday
         out=gcpm1
         holidata=nowork;
   activity task;
   successor succ1;
   duration days;
   calid _cal_;
   id task;
   aligndate aldate;
   aligntype altype;
   holiday holista / holifin=holifin;
run;
```

Print the output data set created with PROC CPM. This step is not required. PROC PRINT is a useful way to view the calculations produced by PROC CPM. See Output 5.10 on page 144.

```
proc print data=gcpm1;
   title 'Data Set GCPM1, Created with PROC CPM';
run;
```

Sort GCPM1 by the variable that contains the activity start dates before using it with PROC CALENDAR.

```
proc sort data=gcpm1;
   by e_start;
run;
```

Create the schedule calendar. GCPM1 is the activity data set. PROC CALENDAR uses the S_START and S_FINISH dates, calculated by PROC CPM, to print the schedule. The VAR statement selects only the variable TASK to display on the calendar output. See Output 5.11 on page 144.

```
proc calendar data=gcpm1
              holidata=nowork
              interval=workday;
   start e_start;
   fin   e_finish;
   calid _cal_ / output=combine;
   holistart holista;
   holifin   holifin;
   holivar name;
   var task;
   title 'Schedule for Experiment X-15';
   title2 'Professor and Student Schedule';
run;
```

Output

Output 5.10 The Data Set GCPM1

PROC PRINT displays the observations in GCPM1, showing the scheduling calculations created by PROC CPM.

```
                                    Data Set GCPM1, Created with PROC CPM                                   1

 Obs   Task                 Succ1                Days    _cal_    E_START   E_FINISH   L_START   L_FINISH   T_FLOAT   F_FLOAT

   1   Run Exp 1            Analyze Exp 1         11    Student   01JUL96   16JUL96    01JUL96   16JUL96       0         0
   2   Analyze Exp 1        Send Report 1          5    Prof.     17JUL96   23JUL96    17JUL96   23JUL96       0         0
   3   Send Report 1        Run Exp 2              0    Prof.     24JUL96   24JUL96    24JUL96   24JUL96       0         0
   4   Run Exp 2            Analyze Exp 2         11    Student   24JUL96   07AUG96    24JUL96   07AUG96       0         0
   5   Analyze Exp 2        Send Report 2          4    Prof.     08AUG96   13AUG96    08AUG96   13AUG96       0         0
   6   Send Report 2        Write Final Report     0    Prof.     14AUG96   14AUG96    14AUG96   14AUG96       0         0
   7   Write Final Report   Send Final Report      4    Prof.     14AUG96   19AUG96    14AUG96   19AUG96       0         0
   8   Send Final Report                           0    Student   20AUG96   20AUG96    20AUG96   20AUG96       0         0
   9   Site Visit                                  1    Prof.     18JUL96   18JUL96    18JUL96   18JUL96       0         0
```

Output 5.11 Schedule Calendar Based on Output from PROC CPM

PROC CALENDAR created this schedule calendar by using the S_START and S_FINISH dates that were calculated by PROC CPM. The activities on July 24th and August 14th, because they are milestones, do not delay the start of a successor activity. Note that Site Visit occurs on July 18, the same day that Analyze Exp 1 occurs. To prevent this overallocation of resources, you can use **resource constrained scheduling**, available in SAS/OR software.

```
                                                 Schedule for Experiment X-15                                                  2
                                                Professor and Student Schedule

          -----------------------------------------------------------------------------------------------------------------------
          |                                                                                                                     |
          |                                                     July  1996                                                      |
          |                                                                                                                     |
          |---------------------------------------------------------------------------------------------------------------------|
          |     Sunday     |     Monday     |    Tuesday     |   Wednesday    |    Thursday    |     Friday     |    Saturday    |
----------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |                |       1        |       2        |       3        |       4        |       5        |       6        |
|.........|................|................|................|................|................|................|................|
| PROF.   |                |                |                |                |Independence Day|                |                |
|.........|................|................|................|................|................|................|................|
| STUDENT |                |+===================Run Exp 1====================>|Independence Day|<==Run Exp 1===>|                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       7        |       8        |       9        |       10       |       11       |       12       |       13       |
|.........|................|................|................|................|................|................|................|
| STUDENT |                |<===================================Run Exp 1======================================>|                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       14       |       15       |       16       |       17       |       18       |       19       |       20       |
|.........|................|................|................|................|................|................|................|
| PROF.   |                |*PROF Vacation**|*PROF Vacation**|                |+==Site Visit==+|                |                |
|         |                |                |                |+=================Analyze Exp 1==================>|                |
|.........|................|................|................|................|................|................|................|
| STUDENT |                |<===========Run Exp 1===========+|                |                |                |                |
|         |                |                |                |                |                |                |                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       21       |       22       |       23       |       24       |       25       |       26       |       27       |
|.........|................|................|................|................|................|................|................|
| PROF.   |                |<=========Analyze Exp 1=========+|+Send Report 1=+|                |                |                |
|.........|................|................|................|................|................|................|................|
| STUDENT |                |                |                |+===================Run Exp 2====================>|                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       28       |       29       |       30       |       31       |                |                |                |
|.........|................|................|................|................|................|................|................|
| STUDENT |                |<===================Run Exp 2====================>|                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
---------------------------------------------------------------------------------------------------------------------------------
```

```
                                                  Schedule for Experiment X-15                                                   3
                                                 Professor and Student Schedule

          ------------------------------------------------------------------------------------------------------------------------
          |                                                                                                                      |
          |                                                    August  1996                                                      |
          |                                                                                                                      |
          |----------------------------------------------------------------------------------------------------------------------|
          |     Sunday     |     Monday     |    Tuesday     |   Wednesday    |    Thursday    |     Friday     |    Saturday    |
----------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |                |                |                |                |        1       |        2       |        3       |
|.........|................|................|................|................|................|................|................|
| STUDENT |                |                |                |                |<===========Run Exp 2===========>|                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |        4       |        5       |        6       |        7       |        8       |        9       |       10       |
|.........|................|................|................|................|................|................|................|
| PROF.   |                |                |                |                |+=========Analyze Exp 2=========>|                |
|.........|................|................|................|................|................|................|................|
| STUDENT |                |<===================Run Exp 2====================+|                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       11       |       12       |       13       |       14       |       15       |       16       |       17       |
|.........|................|................|................|................|................|................|................|
| PROF.   |                |                |                |+===============Write Final Report===============>|                |
|         |                |<=========Analyze Exp 2=========+|+Send Report 2=+|                |                |                |
|.........|................|................|................|................|................|................|................|
| STUDENT |                |                |                |                |STUDENT Vacation|STUDENT Vacation|                |
|         |                |                |                |                |                |                |                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       18       |       19       |       20       |       21       |       22       |       23       |       24       |
|.........|................|................|................|................|................|................|................|
| PROF.   |                |<Write Final Re+|                |                |                |                |                |
|.........|................|................|................|................|................|................|................|
| STUDENT |                |                |+Send Final Rep+|                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|---------+----------------+----------------+----------------+----------------+----------------+----------------+----------------|
|         |       25       |       26       |       27       |       28       |       29       |       30       |       31       |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
|         |                |                |                |                |                |                |                |
----------------------------------------------------------------------------------------------------------------------------------
```

Example 7: Summary Calendar with MEAN Values By Observation

Procedure features:

CALID statement:

- _CAL_ variable
- OUTPUT=SEPARATE option

FORMAT statement

LABEL statement

MEAN statement
SUM statement
Other features:
PROC FORMAT:
PICTURE statement

This example
- □ produces a summary calendar
- □ displays holidays
- □ produces sum and mean values by business day (observation) for three variables
- □ prints a legend and uses variable labels
- □ uses picture formats to display values.

MEAN Values by Number of Days

To produce MEAN values based on *the number of days in the calendar month*, use MEANTYPE=NDAYS. By default, MEANTYPE=NOBS, which calculates the MEAN values according to *the number of days for which data exist*.

Program

Create the activities data set. MEALS records how many meals were served for breakfast, lunch, and dinner on the days that the cafeteria was open for business.

```
data meals;
   input date : date7. Brkfst Lunch Dinner;
   datalines;
02Dec96       123 234 238
03Dec96       188 188 198
04Dec96       123 183 176
05Dec96       200 267 243
06Dec96       176 165 177
09Dec96       178 198 187
10Dec96       165 176 187
11Dec96       187 176 231
12Dec96       176 187 222
13Dec96       187 187 123
16Dec96       176 165 177
17Dec96       156   . 167
18Dec96       198 143 167
19Dec96       178 198 187
20Dec96       165 176 187
23Dec96       187 187 123
;
```

Create the holidays data set.

```
data closed;
   input date date. holiday $ 11-25;
   datalines;
26DEC96   Repairs
27DEC96   Repairs
30DEC96   Repairs
31DEC96   Repairs
24DEC96   Christmas Eve
25DEC96   Christmas
;
```

Sort the activities data set by the activity starting date. You are not required to sort the holidays data set.

```
proc sort data=meals;
   by date;
run;
```

Create picture formats for the variables that indicate how many meals were served.

```
proc format;
   picture bfmt other = '000 Brkfst';
   picture lfmt other = '000 Lunch ';
   picture dfmt other = '000 Dinner';
run;
```

Set PAGESIZE= and LINESIZE= appropriately. The legend box prints on the next page if PAGESIZE= is not set large enough. LINESIZE= controls the width of the cells in the calendar.

```
options nodate pageno=1 linesize=132 pagesize=60;
```

Create the summary calendar. DATA= identifies the activities data set; HOLIDATA= identifies the holidays data set. The START statement specifies the variable in the activities data set that contains the activity starting date; START is required.

```
proc calendar data=meals holidata=closed;
   start date;
```

The HOLISTART and HOLIVAR statements specify the variables in the holidays data set that contain the start date and the name of each holiday, respectively. HOLISTART is required when you use a holidays data set.

```
   holistart date;
   holiname holiday;
```

The SUM and MEAN statements calculate sum and mean values for three variables and print them with the specified format. The LABEL statement prints a legend and uses labels instead of variable names. The FORMAT statement associates picture formats with three variables.

```
   sum brkfst lunch dinner / format=4.0;
   mean brkfst lunch dinner / format=6.2;
   label brkfst = 'Breakfasts Served'
         lunch  = '   Lunches Served'
         dinner = '   Dinners Served';
   format brkfst bfmt.
          lunch lfmt.
          dinner dfmt.;
   title 'Meals Served in Company Cafeteria';
   title2 'Mean Number by Business Day';
run;
```

Output

Output 5.12 Summary Calendar with MEAN Values by Observation

```
                                     Meals Served in Company Cafeteria                                   1
                                        Mean Number by Business Day

                  --------------------------------------------------------------------------------------------
                  |                                                                                          |
                  |                                      December  1996                                      |
                  |                                                                                          |
                  |------------------------------------------------------------------------------------------|
                  |   Sunday   |   Monday   |  Tuesday   | Wednesday  |  Thursday  |   Friday   |  Saturday  |
                  |------------+------------+------------+------------+------------+------------+------------|
                  |     1      |     2      |     3      |     4      |     5      |     6      |     7      |
                  |            |            |            |            |            |            |            |
                  |            | 123 Brkfst | 188 Brkfst | 123 Brkfst | 200 Brkfst | 176 Brkfst |            |
                  |            | 234 Lunch  | 188 Lunch  | 183 Lunch  | 267 Lunch  | 165 Lunch  |            |
                  |            | 238 Dinner | 198 Dinner | 176 Dinner | 243 Dinner | 177 Dinner |            |
                  |------------+------------+------------+------------+------------+------------+------------|
                  |     8      |     9      |     10     |     11     |     12     |     13     |     14     |
                  |            |            |            |            |            |            |            |
                  |            | 178 Brkfst | 165 Brkfst | 187 Brkfst | 176 Brkfst | 187 Brkfst |            |
                  |            | 198 Lunch  | 176 Lunch  | 176 Lunch  | 187 Lunch  | 187 Lunch  |            |
                  |            | 187 Dinner | 187 Dinner | 231 Dinner | 222 Dinner | 123 Dinner |            |
                  |------------+------------+------------+------------+------------+------------+------------|
                  |     15     |     16     |     17     |     18     |     19     |     20     |     21     |
                  |            |            |            |            |            |            |            |
                  |            | 176 Brkfst | 156 Brkfst | 198 Brkfst | 178 Brkfst | 165 Brkfst |            |
                  |            | 165 Lunch  |          . | 143 Lunch  | 198 Lunch  | 176 Lunch  |            |
                  |            | 177 Dinner | 167 Dinner | 167 Dinner | 187 Dinner | 187 Dinner |            |
                  |------------+------------+------------+------------+------------+------------+------------|
                  |     22     |     23     |     24     |     25     |     26     |     27     |     28     |
                  |            |            |Christmas Ev|*Christmas**|**Repairs***|**Repairs***|            |
                  |            | 187 Brkfst |            |            |            |            |            |
                  |            | 187 Lunch  |            |            |            |            |            |
                  |            | 123 Dinner |            |            |            |            |            |
                  |------------+------------+------------+------------+------------+------------+------------|
                  |     29     |     30     |     31     |            |            |            |            |
                  |            |**Repairs***|**Repairs***|            |            |            |            |
                  |            |            |            |            |            |            |            |
                  |            |            |            |            |            |            |            |
                  |            |            |            |            |            |            |            |
                  --------------------------------------------------------------------------------------------

                                           -------------------------------------
                                           |                   | Sum  |  Mean  |
                                           |                   |      |        |
                                           | Breakfasts Served | 2763 | 172.69 |
                                           |    Lunches Served | 2830 | 188.67 |
                                           |    Dinners Served | 2990 | 186.88 |
                                           -------------------------------------
```

Example 8: Multiple Summary Calendars with Atypical Workshifts (Separated Output)

Procedure features:

PROC CALENDAR statementoptions:

- DATETIME
- LEGEND

CALID statement:

- _CAL_ variable

OUTPUT=SEPARATE option
OUTSTART statement
OUTFIN statement
SUM statement

Data sets:
WELL.ACT on page 129 and WELL.HOL on page 129.

This example

- □ produces a summary calendar for multiple calendars in a single PROC step
- □ prints the calendars on separate pages
- □ displays holidays
- □ uses separate work patterns, work shifts, and holidays for each calendar

Producing Different Output for Multiple Calendars

This example produces separate output for multiple calendars. To produce combined or mixed output for these data, you need to change only two things:

- □ how the activities data set is sorted
- □ how the OUTPUT= option is set.

To print . . .	Sort the activities data set by . . .	And set OUTPUT= to	See Example
Separate pages for each calendar	calendar id and starting date	SEPARATE	3, 8
All activities on the same page and identify each calendar	starting date	COMBINE	4, 2
All activities on the same page and NOT identify each calendar	starting date	MIX	4

Program

Specify the SAS data library where the activities data set is stored.

```
libname well 'SAS-data-library';
run;
```

Sort the activities data set by the variables containing the calendar identification and the starting date, respectively.

```
proc sort data=well.act;
   by _cal_ date;
run;
```

Set PAGESIZE= and LINESIZE= appropriately. The legend box prints on the next page if PAGESIZE= is not set large enough. LINESIZE= controls the width of the boxes.

```
options nodate pageno=1 linesize=132 pagesize=60;
```

Create the summary calendar. DATA= identifies the activities data set; HOLIDATA= identifies the holidays data set; CALDATA= identifies the calendar data set; WORKDATA= identifies the workdays data set. DATETIME specifies that the variable specified with the START statement contains a SAS datetime value. LEGEND prints text that identifies the variables.

```
proc calendar data=well.act
              holidata=well.hol
              datetime legend;
```

The CALID statement specifies that the _CAL_ variable identifies calendars. OUTPUT=SEPARATE prints information for each calendar on separate pages.

```
   calid _cal_ / output=separate;
```

The START statement specifies the variable in the activities data set that contains the activity starting date. The HOLISTART and HOLIVAR statements specify the variables in the holidays data set that contain the start date and name of each holiday, respectively. These statements are required when you use a holidays data set.

```
   start date;
   holistart date;
   holivar holiday;
```

The SUM statement totals the COST variable for all observations in each calendar.

```
   sum cost / format=dollar10.2;
```

OUTSTART and OUTFIN specify that the calendar display a 6-day week, Monday through Saturday.

```
   outstart Monday;
   outfin Saturday;
   title 'Well Drilling Cost Summary';
   title2 'Separate Calendars';
   format cost dollar10.2;
run;
```

Output

Output 5.13 Separated Output for Multiple Summary Calendars

```
                                                Well Drilling Cost Summary                                               1
                                                   Separate Calendars

............................................................ _cal_=CAL1 ............................................................

        -------------------------------------------------------------------------------------------------------------------
        |                                                                                                                 |
        |                                                   July  1996                                                    |
        |                                                                                                                 |
        |-----------------------------------------------------------------------------------------------------------------|
        |      Monday      |     Tuesday      |    Wednesday     |     Thursday     |      Friday      |     Saturday     |
        |------------------+------------------+------------------+------------------+------------------+------------------|
        |        1         |        2         |        3         |        4         |        5         |        6         |
        |                  |                  |                  |***Independence***|                  |                  |
        | Drill Well       |                  |                  | Lay Power Line   | Assemble Tank    |                  |
        |              3.5 |                  |                  |                3 |                4 |                  |
        |        $1,000.00 |                  |                  |        $2,000.00 |        $1,000.00 |                  |
        |------------------+------------------+------------------+------------------+------------------+------------------|
        |        8         |        9         |        10        |        11        |        12        |        13        |
        |                  |                  |                  |                  |                  |                  |
        | Build Pump House |                  |                  | Pour Foundation  |                  |                  |
        |                3 |                  |                  |                4 |                  |                  |
        |        $2,000.00 |                  |                  |        $1,500.00 |                  |                  |
        |------------------+------------------+------------------+------------------+------------------+------------------|
        |        15        |        16        |        17        |        18        |        19        |        20        |
        |                  |                  |                  |                  |                  |                  |
        | Install Pump     |                  |                  |                  | Install Pipe     | Erect Tower      |
        |                4 |                  |                  |                  |                2 |                6 |
        |          $500.00 |                  |                  |                  |        $1,000.00 |        $2,500.00 |
        |------------------+------------------+------------------+------------------+------------------+------------------|
        |        22        |        23        |        24        |        25        |        26        |        27        |
        |                  |                  |                  |                  |                  |                  |
        |                  |                  |                  |                  |                  |                  |
        |                  |                  |                  |                  |                  |                  |
        |                  |                  |                  |                  |                  |                  |
        |------------------+------------------+------------------+------------------+------------------+------------------|
        |        29        |        30        |        31        |                  |                  |                  |
        |                  |                  |                  |                  |                  |                  |
        |                  |                  |                  |                  |                  |                  |
        |                  |                  |                  |                  |                  |                  |
        |                  |                  |                  |                  |                  |                  |
        -------------------------------------------------------------------------------------------------------------------


                                                     -------------------------
                                                     |  Legend  |    Sum     |
                                                     |          |            |
                                                     | task     |            |
                                                     | dur      |            |
                                                     | cost     | $11,500.00 |
                                                     -------------------------
```

```
                                        Well Drilling Cost Summary                                          2
                                           Separate Calendars

.............................................................. _cal_=CAL2 .............................................................

        ----------------------------------------------------------------------------------------------------------------------
        |                                                                                                                    |
        |                                                     July  1996                                                     |
        |                                                                                                                    |
        |--------------------------------------------------------------------------------------------------------------------|
        |     Monday      |     Tuesday      |    Wednesday     |     Thursday     |      Friday      |     Saturday      |
        |-----------------+------------------+------------------+------------------+------------------+-------------------|
        |        1        |        2         |        3         |        4         |        5         |        6          |
        |                 |                  |                  |                  |                  |                   |
        | Deliver Material |                 | Excavate         |                  |                  |                   |
        |               2 |                  |             4.75 |                  |                  |                   |
        |         $500.00 |                  |        $3,500.00 |                  |                  |                   |
        |-----------------+------------------+------------------+------------------+------------------+-------------------|
        |        8        |        9         |       10         |       11         |       12         |       13          |
        |                 |*****Vacation*****|                  |                  |                  |                   |
        |                 |                  |                  |                  |                  |                   |
        |                 |                  |                  |                  |                  |                   |
        |                 |                  |                  |                  |                  |                   |
        |-----------------+------------------+------------------+------------------+------------------+-------------------|
        |       15        |       16         |       17         |       18         |       19         |       20          |
        |                 |                  |                  |                  |                  |                   |
        |                 |                  |                  |                  |                  |                   |
        |                 |                  |                  |                  |                  |                   |
        |                 |                  |                  |                  |                  |                   |
        |-----------------+------------------+------------------+------------------+------------------+-------------------|
        |       22        |       23         |       24         |       25         |       26         |       27          |
        |                 |                  |                  |                  |                  |                   |
        |                 |                  |                  |                  |                  |                   |
        |                 |                  |                  |                  |                  |                   |
        |                 |                  |                  |                  |                  |                   |
        |-----------------+------------------+------------------+------------------+------------------+-------------------|
        |       29        |       30         |       31         |                  |                  |                   |
        |                 |                  |                  |                  |                  |                   |
        |                 |                  |                  |                  |                  |                   |
        |                 |                  |                  |                  |                  |                   |
        |                 |                  |                  |                  |                  |                   |
        ----------------------------------------------------------------------------------------------------------------------

                                                 -------------------------
                                                 |  Legend  |    Sum     |
                                                 |          |            |
                                                 | task     |            |
                                                 | dur      |            |
                                                 | cost     |  $4,000.00 |
                                                 -------------------------
```

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