Chapter 6
The PM Procedure

Chapter Table of Contents

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Overview

The PM procedure is an interactive procedure that can be used for planning, controlling, and monitoring a project. The syntax and the scheduling features of PROC PM are virtually the same as those of the CPM procedure. However, since the PM procedure is interactive, there are a few extra options that are available and a few other options that have a default behavior that is different from the CPM procedure. These differences are noted in the "Syntax" section on page 637 section. One major difference is that only the Activity-On-Node representation of the project is supported in PROC PM. In other words, TAILNODE and HEADNODE statements are not supported.

For a complete description of the syntax and the scheduling algorithm for the CPM procedure, refer to Chapter 2, "The CPM Procedure."

When PROC PM is invoked with the activity network representation, an interactive window is opened that displays a Table View of the project on the left and a Gantt View of the project on the right. You can add activities and edit the project data using the Table View. You can also use the Gantt View to move activities, change the durations of the activities, and add precedence constraints between the activities. These features are described in the "PM Window" section on page 639.

The PM procedure is designed to facilitate its inclusion in a Project Management application, such as PROJMAN. Any changes that are made to the activity network or to the activity durations, resource requirements, alignment specifications, and other activity information need to be saved in the resulting Schedule Output data set. Further, you should be able to use this output data set as input to a future invocation of PROC PM and continue to manage the project. Thus, there are some differences in the design of the Schedule Output data set (defined in PROC CPM) to allow the integration of PROC PM into a Project Management application. The differences between the Schedule data sets in the two procedures are described in the "Schedule Data Set" section on page 658.

Getting Started

Consider the simple Software Development Project described in the "Getting Started" section of Chapter 2, "The CPM Procedure." Recall that the Activity data set, SOFTWARE, contains the activity descriptions, durations, and precedence constraints. The following statements (identical to the PROC CPM invocation) initialize the project data and invoke the PM procedure.

```
data software;
   input Descrpt  $char20.
         Duration 23-24
         Activity $ 27-34
         Succesr1 $ 37-44
         Succesr2 $ 47-54;
   datalines;
Initial Testing       20   TESTING    RECODE
Prel. Documentation   15   PRELDOC    DOCEDREV   QATEST
Meet Marketing        1    MEETMKT    RECODE
Recoding              5    RECODE     DOCEDREV   QATEST
QA Test Approve       10   QATEST     PROD
Doc. Edit and Revise  10   DOCEDREV   PROD
Production            1    PROD
;

proc pm data=software
         out=intro1
         interval=day
         date='01mar99'd;
   id descrpt;
   activity activity;
   duration duration;
   successor succesr1 succesr2;
run;
```

When you invoke the PM procedure, the PM Window appears (see Figure 6.1), consisting of the Table View and the Gantt View of the project. The activities are listed in the order in which they are defined in the Activity data set. The two views are separated by a dividing line that can be dragged to the left or right, controlling the size of the two views. Further, the two views scroll together in the vertical direction but can scroll independently in the horizontal direction.

The Table View contains several editable columns (in white) that can be used to edit the project data as well as add new activites to the project. Some of the columns (in gray), such as the Schedule times, are not editable. The Gantt View contains a Gantt chart of the project and displays the precedence relationships between the activities. You can use the Gantt View to add or delete precedence constraints between activities and to change the durations or alignment constraints of the activities by dragging the schedule bars. Details of the interface are described in the "PM Window" section on page 639.
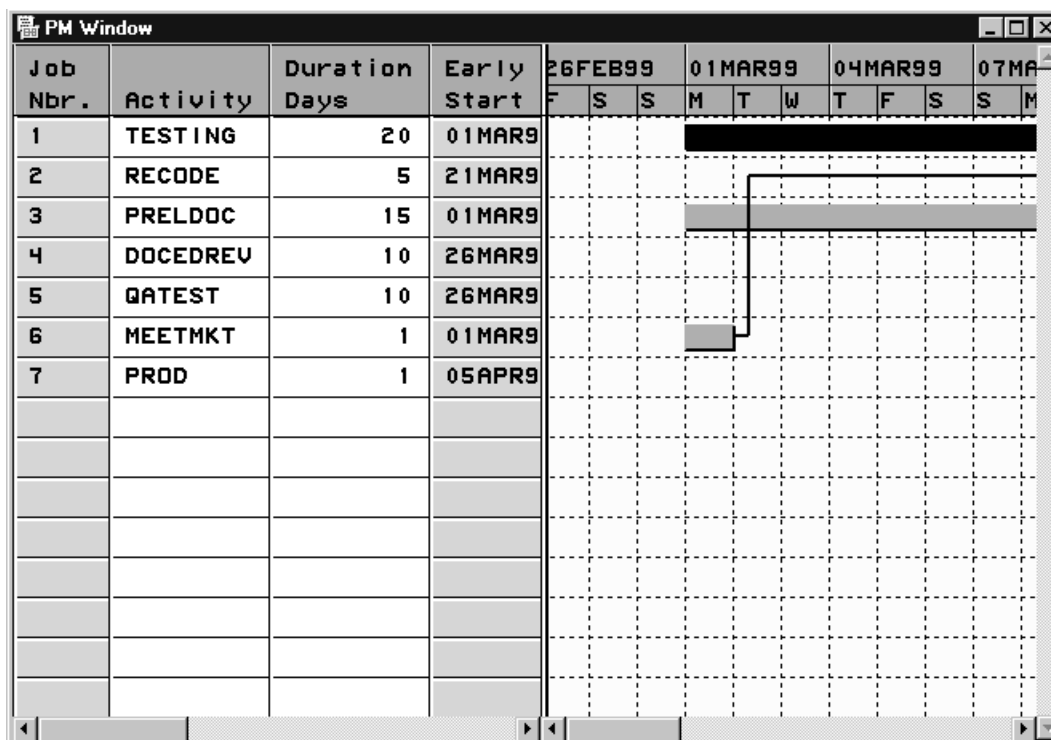
Figure 6.1. Software Development Project

Syntax

The syntax for PROC PM is virtually identical to that for PROC CPM. The main difference is that you replace the PROC CPM statement with the PROC PM statement.

Note also that the TAILNODE and HEADNODE statements are not supported in PROC PM.

The form of the PROC PM statement is

> **PROC PM** *options* **;**

PROC PM Statement

PROC PM options **;**

All the options that are available in the PROC CPM statement can also be specified in the PROC PM statement. However, there are a few additional options available with PROC PM, and some of the other PROC CPM options are not needed as they are the default behavior in PROC PM.

Options Specific to PROC PM

The following options can be specified on the PROC PM statement.

NODISPLAY

invokes the procedure in a noninteractive mode. The schedule for the project is still computed and the requested output data sets are created and saved. However, the

PM Window is not displayed. This option is useful for scheduling large projects that do not need to be updated interactively. Note that invoking PROC PM with the NODISPLAY option is similar to invoking PROC CPM; however, since the format of the Schedule Output data set is different for the two procedures, you may see some differences in the order and content of the observations. See the "Schedule Data Set" section on page 658 for details.

PROJECT=*SAS-data-set*

identifies a SAS data set that can be used to save and restore preferences that control the project view. For example, preferences such as the font, column order, column widths, filters, and so forth, can be saved from one invocation to another. See the "Project Data Set" section on page 659 for more details about this data set and the preferences that can be saved in it.

PROJECTNAME=*'string'*
PROJNAME=*'string'*
NAME=*'string'*

specifies a descriptive string identifying the name of the project. This string is used to label the PM Window.

Default Options in PROC PM

The following options are the default in PROC PM.

ADDACT
ADDALLACT
EXPAND

indicates that an observation is to be added to the Schedule output data set (and the Resource Schedule output data set) for each activity that appears as a value of the variables specified in the SUCCESSOR or PROJECT statements without appearing as a value of the variable specified in the ACTIVITY statement. This option is the default in PROC PM. In other words, the Schedule output data set produced by PROC PM contains one observation for every activity that appears as a value of the ACTIVITY, SUCCESSOR, or PROJECT variables (as long as it has not been deleted in the current invocation of the procedure). It also contains an observation for every activity that is added to the project via the graphical user interface.

AUTOUPDT

requests that the procedure should assume automatic completion (or start) of activities that are predecessors to activities already completed (or in progress). This option is the default in PROC PM.

ESTIMATEPCTC
ESTPCTC
ESTPCTCOMP
ESTPROG

indicates that a variable named PCT_COMP is to be added to the Schedule output data set (and the Resource Schedule output data set) that contains the percent completion time for each activity (for each resource used by each activity) in the project. This option is the default in PROC PM.

SHOWFLOAT

indicates that activities that are completed or in progress should have nonzero float. This option is the default in PROC PM.

XFERVARS

indicates that all relevant variables are to be copied from the Activity data set to the Schedule data set. This option is the default in PROC PM. The procedure carries over to the output data set all the relevant variables from the input data set. Thus, the Schedule output data set contains all the project information that is necessary to schedule it.
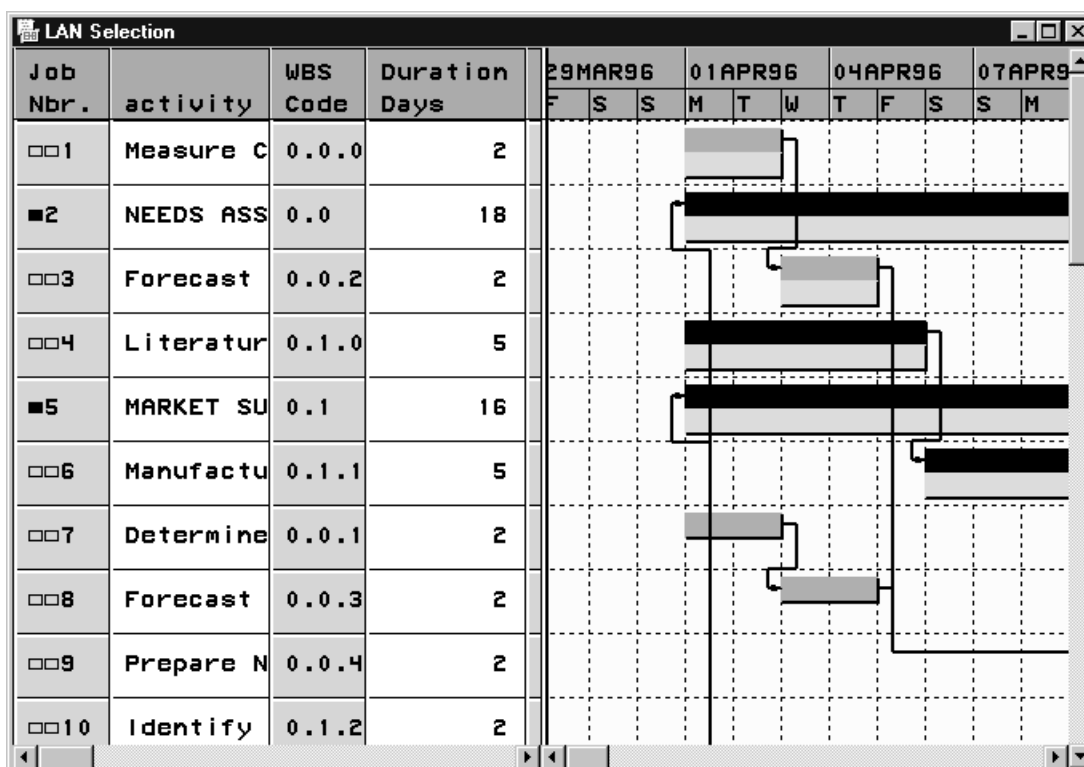
PM Window

Figure 6.2. LAN Selection Project

The PM Window provides the standard editing and viewing functions of a typical project management tool. It can be displayed by invoking the PM procedure or via the Activities Window in the PROJMAN application. For an existing project, the PM Window is populated with the activities in the project. For a new project, the PM window is empty. Figure 6.2 displays the PM Window for one of the sample projects included with the PROJMAN application.

After you have finished editing the project, you can close the PM Window to save the new project data in the Schedule output data set that was specified in the invocation of the PM procedure.

User Interface Features

This section describes some of the typical features of the PM Window's graphical user interface. The PM Window provides both a Gantt View and a Table View of the project. The size of each view can be changed by pointing the cursor at the dividing line between the two views until it changes to a double arrow and dragging it to the right or left.

Only part of the project may be visible in the PM Window; horizontal and vertical scrollbars are provided that enable you to scroll the project data in both directions. Note that the Gantt and the Table Views are attached to each other so that they scroll together vertically. Each view can be scrolled horizontally, independently of the other.

The pull-down menu at the top of the PM Window provides access to several project management functions under the Edit, View, and Project menus. For example, the "Project" pull-down menu is shown in Figure 6.3. The commands available via the pull-down menus are described in detail in the appropriate sections.

Figure 6.3.   Project Pull-down Menu

In addition to the pull-down menus, context sensitive pop-up menus are available in the Table and Gantt Views, the Time axis, along the arcs, and from select columns in the Table View. Pop-up menus are displayed by positioning the cursor over a particular object and clicking the right mouse button. For example, clicking the right mouse button on an arc in the Gantt View displays the arc pop-up menu shown in Figure 6.4.
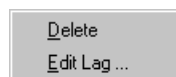

Figure 6.4.   Arc Pop-up Menu

In some situations, the pop-up menu selection can lead to a dialog box that requires you to type in a value in one or more of the fields in the box. For example, selecting "Edit Lag..." from the arc pop-up menu leads to the dialog box displayed in Figure 6.5. (See the "Create Nonstandard Precedence Relationships" section on page 652 for a discussion of nonstandard precedence constraints.)
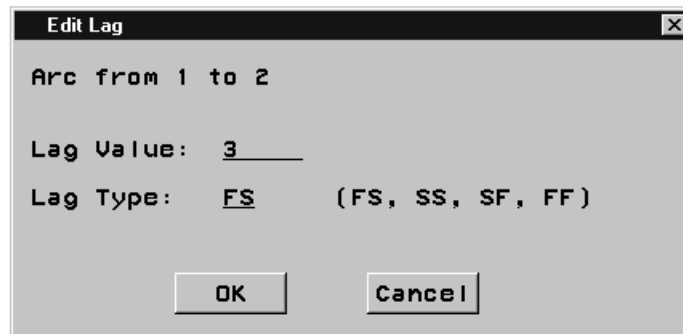
```
┌─────────────────────────────────────────────┐
│ Edit Lag                                  ☒  │
│                                              │
│  Arc from 1 to 2                             │
│                                              │
│                                              │
│  Lag Value:    3____                         │
│                                              │
│  Lag Type:    FS      (FS, SS, SF, FF)       │
│                                              │
│                                              │
│           ┌──────┐      ┌────────┐           │
│           │  OK  │      │ Cancel │           │
│           └──────┘      └────────┘           │
│                                              │
└─────────────────────────────────────────────┘
```

Figure 6.5.   Edit Lag Dialog Box

The Table View displays project data in a tabular format. Some of the columns are editable (white background) while other columns, which are computed by the procedure, are not editable (gray background). The Gantt View always displays the early start schedule of the project. In addition, it also displays the resource-constrained schedule (if resources are present), the actual schedule (if the project has started and is in progress), and the baseline schedule (if a baseline schedule is saved for the project.) The display of all the schedule bars (except the Early Schedule bar) can be toggled on or off using the pop-up menu from the Gantt View.

Note that each row of the combined Table View and Gantt View represents one activity (also referred to as *task* in this chapter). Any change in data or movement of a row in one view is also reflected in the other.

In addition to the pull-down and pop-up menu actions, several drag-and-drop type of actions are available within the PM Window. You can move the columns and rows of the Table View by selecting a row or column and dragging to the desired position. You can also change the width of the columns by dragging the column dividers in the Table header region.

You can manipulate the durations of the tasks by changing the length of the Early Schedule bar in the Gantt View. You can also move the task in time by dragging the Early Schedule bar over to a new position. This affects the Target Date for the associated task.

Any of the preceding tasks may result in a change to the project schedule that is immediately reflected in the Table and Gantt Views. All editing abilities and the corresponding changes to the schedule are described in detail in the following sections.

Project Hierarchy

The PM procedure displays a hierarchical project structure if it is invoked with the PROJECT statement. If the procedure is invoked without a PROJECT statement, the supertask and subtask relationship is not supported, and all the activities are considered to be at the same level, belonging to a single project. Note that, in the PROJMAN application, the PM procedure is always invoked with the PROJECT statement.

If the PROJECT statement is used, then a task's level in the project hierarchy is indicated in the Table View by using small square boxes to the left of the activity number in the Job Nbr column. Empty boxes indicate that the activity does not have

any subtasks (it is a *leaf* activity), while filled boxes indicate that the activity is a supertask. Further, a Project Summary task is included to represent the root task (or Summary Task) of the project. This task is positioned at the top of the list of activities, and its display can be toggled on or off by selecting "Display Summary Task" from the "View" pull-down menu (see Figure 6.6).
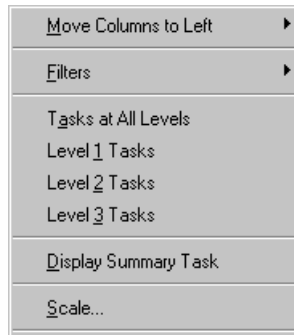

Figure 6.6. View Pull-down Menu

In the Gantt View, supertasks are indicated by vertical cones at the end of their corresponding schedule bars.

Note that the durations of the supertasks are determined by the overall duration of their subtasks. Thus, you cannot change the duration of a supertask.

If there is no PROJECT statement, all menu selections that correspond to the multi-project structure are grayed out and are unavailable for selection. For example, the "Display Summary Task" selection in Figure 6.6 will be grayed out.

Table View

The Table View displays information about a project in tabular form. It displays activities along with their descriptions, various activity schedules, resource requirements, calendars, and target dates. The hierarchical information about an activity is provided in the Job Nbr column by a number of small square boxes to the left of the activity number. The number of square boxes corresponds to the level of the activity in the project hierarchy. Empty boxes indicate that the activity does not have any subtasks or that it is a leaf activity, while filled boxes indicate that the activity is a supertask. Some columns in the Table View are editable while others are write-protected. The editable columns are lighter in color than the noneditable ones. In general, a user can type into all columns that provide input to the project while all other columns that contain output values from PROC PM are write-protected. For example, in Figure 6.2, the WBS Code column cannot be edited while the activity and Duration columns can be edited.

In the Table View you can add or delete activities, add subtasks, change the order of the columns or the activities, edit activity information, and so on. These tasks are described in the following sections.

Add/Copy/Delete Tasks

Clicking with the right mouse button on any task in the Table View displays the pop-up menu shown in Figure 6.7. From this pop-up menu, you can Add/Copy/Delete the selected task. If the "Add Task" menu item is selected, the new task is added immediately following the selected task. If the PM procedure is invoked with the PROJECT statement (as is always the case if you use PROJMAN), you can also add a subtask to the selected task. If the "Copy Task" menu item is selected, a copy of the selected task is added to the bottom of the Table View. The new task has the same duration and calendar as the selected task. If the selected task is a supertask, all its subtasks (and any internal precedence constraints) are copied as well.
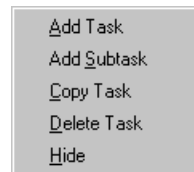
Figure 6.7. Table View Pop-up Menu

Change Column Width

The width of a column in the Table View can be increased or decreased by dragging (with the left mouse button) the column dividers in the Table Header region of the Table View. When the cursor is positioned on the column divider, it changes to a double arrow. Dragging it to the right or left increases or decreases the width of the column.
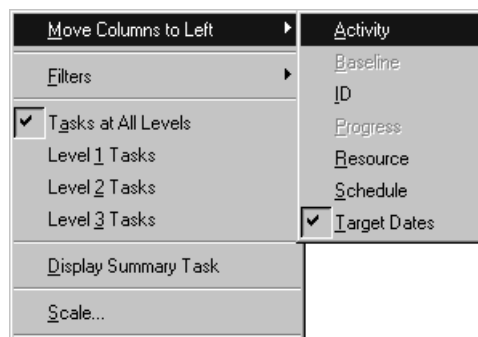
Change the Order of the Columns

Figure 6.8. Move Columns Pull-down Menu

The display order of columns in the Table View can be changed in several ways:

- Drag the column in the header row and drop it to the destination.
- Select "View" from the pull-down menu and then choose "Move Columns to Left" (see Figure 6.8). Choosing any of the available options moves the corresponding columns to the leftmost portion of the Table View.

Edit Durations

To change the duration of an activity, edit the Duration column in the Table View. Note that changing an activity's duration to 0 changes the activity into a Milestone. Activity durations can also be changed in the Gantt View.

Edit Alignment Constraints

Scroll to columns named Target Date and Target Type. Enter one of either SGE, SLE, MS, MF, FGE or FLE in the Target Type column. You can either type the values or select them from the pop-up menu displayed by pressing the right mouse button in the Target Type column (see Figure 6.9). Enter the appropriate date in the Target Date column. You can also view these columns by selecting View->Move Columns to Left->Target Dates from the pull-down menu (Figure 6.8). You can also change an activity's alignment constraints in the Gantt View.

Figure 6.9. Target Type Pop-up Menu

Edit Calendars

To change an activity's calendar, you can enter the calendar number in the Activity Calendar column or the calendar description in the Calendar Name column. Note that the calendars that can be assigned to an activity are predefined in the Calendar data set. To see a list of the calendars, you can click in one of the calendar columns with the right mouse button. This will pop up a list of calendars, from which you can select the activity's calendar. See Figure 6.10 for an example of a calendar pop-up menu with two calendars.
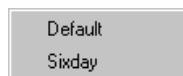

Figure 6.10. Calendar Pop-up Menu

Edit Resource Requirements

You can change the amount of resources required for an activity by editing the Resource columns in the Table View. Changing the resource requirement causes the project to be rescheduled using the new resource specifications. See the "Edit Resource Requirements" section on page 653.

Edit Progress Information

You can edit the Actual Start, Actual Finish, Percent Complete or Remaining Duration for an activity by editing one of the Progress Information columns in the Table

View. Note that by changing one of these columns, all the other related progress columns may also be affected. For example, entering 100 in the Percent Complete column for an activity that is in progress updates the Remaining Duration column to 0, and the Actual Finish column is filled in appropriately. You can also modify the progress information of an activity in the Gantt View.

Expand/Collapse Supertasks

Double clicking on a supertask in the Table View toggles the expand/collapse switch. This action enables you to either view or hide all the subtasks of the supertask.

Hide Tasks

An individual task can be hidden by clicking the right mouse button over the task in the Table View and choosing "Hide" from the menu shown in Figure 6.7. Tasks can also be hidden from view using several filters described in the "Setting Activity Filters" section on page 654.

Move Tasks

Drag with the left mouse button anywhere in the row corresponding to an activity you want to move and drop it to the destination.

Gantt View

In the Gantt View, activity schedules are pictorially depicted by horizontal bars. There is one bar for each of the early, resource, actual, and baseline schedules. For the Early Schedule bar, critical activities are marked in different colors than the noncritical activities. Weekends are marked by shaded vertical rectangles running through the chart. Supertasks are differentiated from leaf activities by anchoring vertical cones at the ends of their Early Schedule bars.

The Gantt View is displayed with a rectangular grid that can be turned on or off by selecting "Grid" from the pop-up menu (see Figure 6.11) that is displayed by clicking anywhere in the Gantt View with the right mouse button.

```
Actual Schedule
Resource Schedule
Baseline Schedule
Grid
```
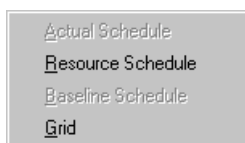
Figure 6.11.   Gantt View Pop-up Menu

The pop-up menu in the Gantt View also enables you to toggle the display of the Actual, Resource, or Baseline Schedule bars. Note that these bars can be displayed in the Gantt View only if the project data contain the actual, resource-constrained, or baseline schedules, respectively.

In addition to displaying the activity schedules in an easy-to-view format, the Gantt View in the PM Window can also be used to change the durations of the activities, add or delete precedence constraints, set activity alignment constraints, or set progress information.

You can also change several of the display attributes of the Gantt View by using the Time Axis pop-up menu (see Figure 6.12) to set the scale of the axis, format the time axis labels, set the units of display, and so forth. All of these tasks are described in the following sections.
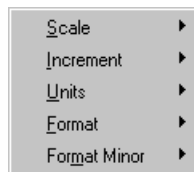

Figure 6.12. Time Axis Pop-up Menu

Change the Format of the Time Axis

The format of the major axis can be changed by clicking with the right mouse button on the header row of the Gantt View and choosing "Format" for the major axis. For the minor axis, choose "Format Minor." The selections available for the formats are shown in Figure 6.13 and Figure 6.14. In addition to the formats explicitly listed for the major axis, you can specify any valid numeric format by selecting "Other..." and filling in the appropriate fields in the dialog box that is opened as a result.
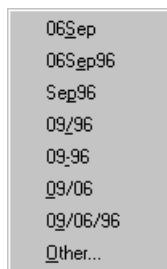

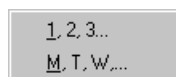**Figure 6.13.** Major Axis Format Pop-up Menu

Figure 6.14. Minor Axis Format Pop-up Menu

Change Increments

Increments in the Gantt View define the number of tick marks on the minor axis per tick mark on the major axis. They can be changed by clicking with the right mouse button on the header area and choosing "Increment" from the pop-up menu. The available selections are shown in Figure 6.15.
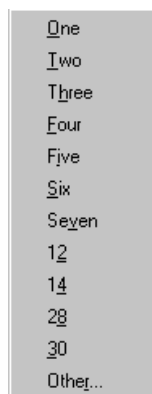
Figure 6.15. Increment Pop-up Menu

Change the Scale of the Time Axis

Point the mouse to a tick mark on the major axis in Gantt View. The cursor changes to a double arrow. Drag the tick mark horizontally to change the scale. You can also change the scale using the "Scale" pop-up menu (see Figure 6.16) from the Time Axis pop-up menu.
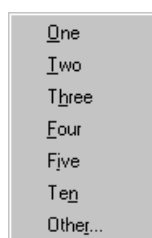
Figure 6.16. Scale Pop-up Menu

Change Units

The Time Axis Units in the Gantt View can be changed by clicking with the right mouse button on the header bar in the Gantt View and selecting "Units" (see Figure 6.17). The default value of the units used for display is based on the specification of the INTERVAL= parameter in the invocation of the PM procedure.

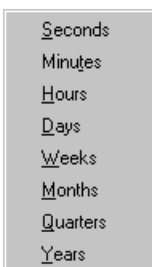**Figure 6.17.** Units Pop-up Menu

Display/Hide Selected Schedules

A display/hide switch for a given schedule can be toggled by clicking with the right mouse button in the main panel of the Gantt View and choosing the desired schedule (see Figure 6.18).
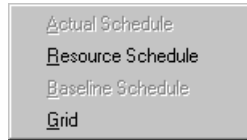
Figure 6.18. Gantt View Pop-up Menu

Modify Activity Alignment Constraints

An activity's Early Schedule bar can be moved using the left mouse button. When the mouse is positioned over the activity bar, the cursor changes to a cross hair type. You can then drag the bar horizontally and move it to a new position. This sets an alignment constraint of type 'SGE' for the selected activity with the align date corresponding to the one at the left edge of the bar's new position. Other types of alignment constraints can be entered by editing the Target Date and Target Type columns as described in the "Edit Alignment Constraints" section on page 644.

Modify Durations

To change the duration of an activity, point to the right edge of the activity's Early Schedule bar with the left mouse button, and drag to the left or the right depending on whether you want to decrease or increase the duration. You can also edit activity durations in the Table View.

Modify Precedence Information

You can add precedence constraints by depressing the left mouse button at either end of the predecessor activity bar and releasing it at either end of the successor activity bar. The type of constraint (FS, FF, SS, SF) depends on which end of the bars the constraints are drawn from.

You can delete precedence constraints by clicking on the arc with the right mouse button and selecting "Delete" (see Figure 6.19).
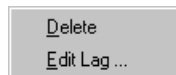
Figure 6.19. Arc Pop-up Menu

You can modify the type of the precedence constraint or the lag value associated with the precedence constraint by clicking on the arc with the right mouse button and selecting "Edit Lag." The ensuing dialog box is shown in Figure 6.20. Enter the value of the lag duration in the first field and the type of the lag in the second field. Valid values of lag are Finish-to-Start (FS), Start-to-Start (SS), Start-to-Finish (SF), and Finish-to-Finish (FF).

Figure 6.20. Edit Lag Dialog Box

If calendars are defined in the project, the "Edit Lag" dialog includes the lag calendar associated with the selected precedence constraint. You can change the lag calendar by selecting from the list of available calendars that is displayed within the Edit Lag dialog shown in Figure 6.21.

Figure 6.21. Edit Lag Dialog Box (Multiple Calendars)

Modify Progress Information

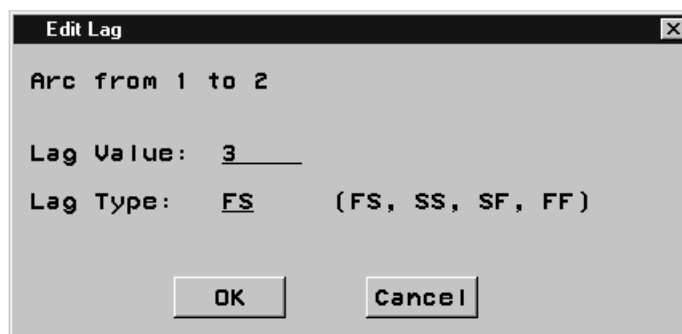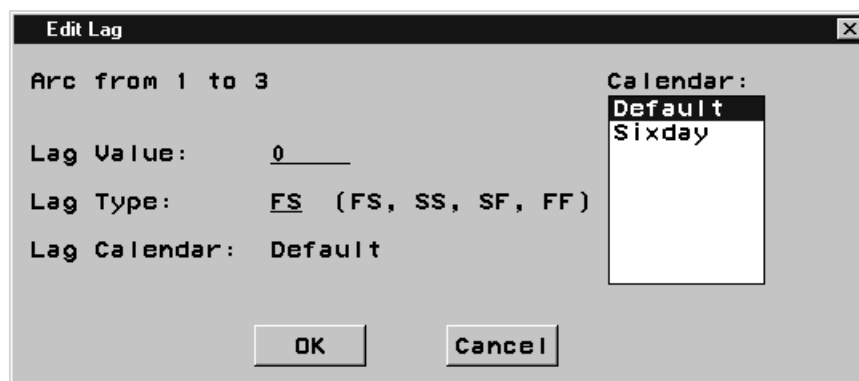To modify the Progress using the Gantt View, you must include the Actual Schedule in the view. You can drag the actual schedule bar for the activity to change the amount of progress on the activity; you can also move the activity's actual bar to change the Actual Start of the activity.

When the project contains progress information, a Timenow line is drawn in the Gantt View, indicating the TIMENOW date. You can move the Timenow line by dragging it. When you change the value of TIMENOW, the progress information changes for all the activities. A confirmation window requires you to confirm that you do want to change the progress information for all the activities. (See also the "TIMENOW Macro Variable" section on page 660.)

You can also edit the progress columns in the Table View.

Creating and Editing Projects

The PM Window provides an easy to use interface to enter basic project information such as a list of activities, their durations, order of precedence, resource requirements, and so forth. You can also use the "Edit" pull-down menu (see Figure 6.22) to add or delete progress, baseline, and other information. All these functions are described in the following sections.

```
New Task

Add Task
Add Subtask
Copy Task
Delete Task
Hide

Add Progress
Delete Progress

Set Baseline            ▶
Replace Baseline        ▶
Fill Missing Baseline   ▶
Delete Baseline
```
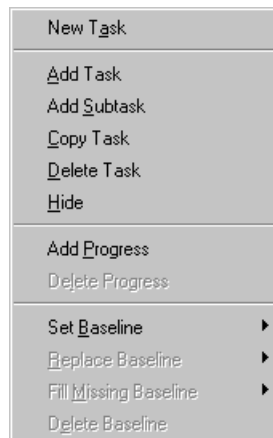
Figure 6.22. Edit Pull-down Menu

Add Activities

An activity (or task) can be added to the Project in the PM Window by clicking the right mouse button in the Table View. If "Add Task" is chosen from the pop-up menu, then an activity is added at the same level as the selected activity. Subtasks of an activity can be added by selecting "Add Subtask." These actions are also available from the "Edit" pull-down menu (Figure 6.22) whenever an activity is selected in the Table View. Note that the selected activity is highlighted.

To add a new task at the topmost level of the project hierarchy, choose "New Task" from the "Edit" pull-down menu.

Add Precedence Constraints

To add precedence constraints, point the cursor at the right edge of the predecessor activity till it changes to a cross hair and drag it vertically up or down to the left edge of the successor activity. By starting and dropping at different ends of the activity bar, you can create nonstandard precedence relationships between the activities.

Add Baseline Information

Baseline information is saved in a project so that the current status of a project can be measured against some base schedule. The baseline information can be set in several different ways; most of the actions relating to the Baseline schedule can be performed using the selections available from the "Edit" pull-down menu (see Figure 6.22).

- If the project data include a Baseline schedule, saved in the variables B_START and B_FINISH, the PM Window displays the Baseline schedule when it is first invoked. This schedule can be replaced choosing "Replace Baseline" from the "Edit" pull-down menu. This selection can be used to reset the Baseline schedule to a new schedule corresponding to one of the current schedules.

- If the project data do not include a Baseline schedule, it can be set in the PM Window by selecting "Set Baseline" from the "Edit" pull-down menu (see Example 6.3). This selection can be used to set the Baseline schedule to one of the current schedules (see Figure 6.23). Thus, selecting "Resource" from the pull-down menu sets the baseline schedule to the current resource-constrained schedule. By saving the current resource-constrained schedule, you can perform some what-if analysis by changing some of the resource requirements or other parameters of the project and comparing the resulting schedule with the saved baseline schedule.

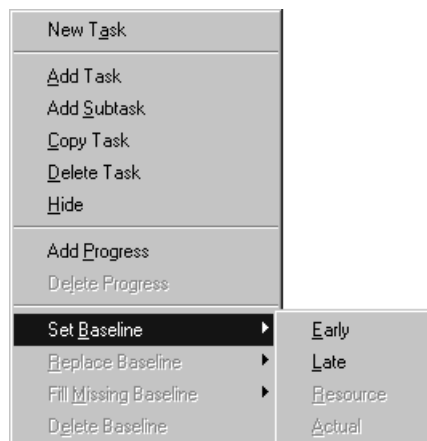**Figure 6.23.** Set Baseline Pull-down Menu

- The individual Baseline values can also be edited in the Table View by changing the values in the Baseline Start and Baseline Finish columns.

- If new activities are added to the project, the Baseline values for the new tasks are missing. These can be set to correspond to the current schedule values by selecting "Fill Missing Baseline" from the "Edit" pull-down menu.

• If you want to delete the Baseline information from the project data, you can select "Delete Baseline" from the "Edit" pull-down menu.

Add Progress Information

Progress information can be included by using the ACTUAL statement, which is similar to the one for PROC CPM. If the PM Window is invoked without the ACTUAL statement, then Progress Information can be added to the Project from the "Edit" pull-down menu (Figure 6.22) by choosing "Add Progress."

Progress Information is updated by dragging the actual schedule bars horizontally (in a manner similar to the one for changing durations) in the Gantt View or by modifying the values in the Progress columns in the Table View. See the "Modify Progress Information" section on page 650 and the "Edit Progress Information" section on page 644.

For details on how the progress information is used to update the project schedule, see the "Progress Updating" section on page 103 in Chapter 2, "The CPM Procedure." See also Example 6.6.

Change Duration

The duration of an activity can be changed either by typing in the Duration column of the Table View or by dragging the activity bar at the right edge by using the left mouse button in the Gantt View.

Copy Activities

An activity (or task) can be copied in the PM Window by clicking the right mouse button in the Table View. If "Copy Task" is chosen from the pop-up menu, then a copy of the selected activity is added at the end of the activities listed in the Table View. The new task has the same duration and calendar as the selected task. If the selected task is a supertask, all its subtasks (and any internal precedence constraints) are copied as well.

Create Milestones

Milestones can be created by adding an activity and assigning it zero duration.

Create Nonstandard Precedence Relationships

A Finish-to-Start relationship between two activities is considered to be a standard precedence constraint. It is created when the precedence constraint is drawn by dragging the cursor from the right end of the predecessor activity bar to the left end of the successor activity bar. Nonstandard precedence constraints are created by starting and ending at different ends of the two activity bars. For example, a Start-to-Finish relationship is created by dragging the cursor from the left end of the predecessor activity bar to the right end of the successor activity bar.

In addition to specifying the type of the precedence constraint, you can also specify a lag or lead time between the two activities. This lag value can be edited from the Gantt View. See the "Modify Precedence Information" section on page 648.

Create Subtasks

Subtasks can be created only if the PM procedure is invoked with the PROJECT statement or from the PROJMAN application. To create a subtask, click the right

mouse button on the parent activity in the Table View. Then choose "Add Subtask" from the background menu. The newly created subtask has one more little square box than the parent task in the Job Nbr column in the Table View. The empty square boxes denote that it is a leaf activity (a task with no subtasks). The number of boxes denote a task's level in the project hierarchy starting with level 0 for the Project Summary task.

Delete Activities

An activity can be deleted in the Table View by clicking the right mouse button anywhere in the task row and choosing "Delete Task." If the selected task is a supertask, all its subtasks are deleted as well. Note that, in this case, a Confirmation Dialog confirms the "Delete Supertask" action.

Delete Precedence Constraints

To delete a precedence constraint, click anywhere on the arc with the right mouse button and choose "Delete" from the pop-up menu.

Edit Activity Alignment Constraints

Activity alignment constraints can be added/modified as described in the "Edit Alignment Constraints" section on page 644 and in the "Modify Activity Alignment Constraints" section on page 648.

Edit Baseline Information

To edit the baseline schedule, scroll to the Baseline Start and Baseline Finish columns, and type in the new values of the baseline start and finish times. Note that you cannot change the baseline values by moving the Baseline Schedule bars. See the "Add Baseline Information" section on page 651.

Edit Calendar Specifications

Calendars are defined by the CALEDATA= option in the PROC PM statement. This option is similar to the corresponding option in PROC CPM. Once calendars are defined in the Project, an activity's calendar can be changed or set in the Table View by editing the Activity Calendar or Calendar Name columns. You can either type the values or select them from the pull-down menu displayed by pressing the right mouse button in either of the Calendar columns. See the "Edit Calendars" section on page 644.

Edit Resource Requirements

The resource requirement information for an activity can be edited in the Table View. A column for a resource is created in the Table View when it is specified in the RESOURCE statement.

The resource requirement information for each activity is displayed and can be edited in the Table View. A column for a resource is created in the Table View when it is specified in the RESOURCE statement of the PROC PM invocation, or it is created by the Resource Manager of PROJMAN. For details about the RESOURCE statement, the Resource data set, and Resource Allocation, see Chapter 2, "The CPM Procedure." Changing the resource requirement causes the project to be rescheduled using the new resources.

Setting Activity Filters

Activity filters can be set by using the project hierarchy or by selecting from a list of activity attributes, as described in this section.
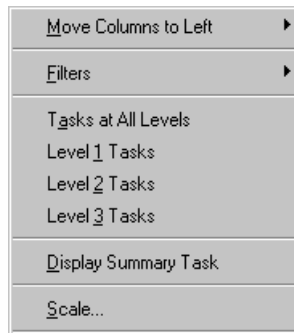

Figure 6.24. View Pull-down Menu

Activities at different levels in the hierarchy can be viewed by selecting "View" from the pull-down menu (Figure 6.24 and choosing the appropriate level of the project hierarchy to filter out the higher level tasks. For example, selecting "Level 2 Tasks" displays only the tasks that are at Level 2 or lower. All activities can be viewed by selecting "Tasks at All Levels" from the "View" pull-down menu.

Activities can also be filtered using different criteria by choosing View->Filters from the "View" pull-down menu (see Figure 6.24). The available filters are shown in (Figure 6.25). By default, no filter is in effect (the selection is "None"); you can save the filter of your choice in the Preference data set (see the "Saving and Restoring Preferences" section on page 654).
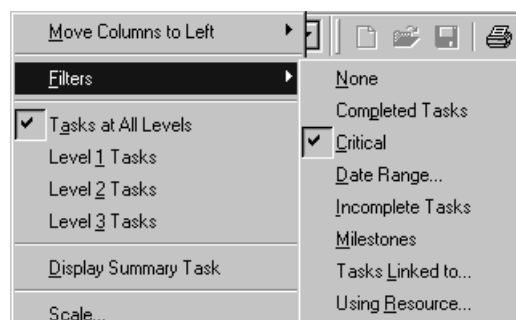
Figure 6.25. Filters Pull-down Menu

Saving and Restoring Preferences

When the PM Window is displayed for the first time for a given project, the order and width of the columns in the Table View, the font used for the display, the size of the window, the boundary between the Table and the Gantt Views, and several other attributes of the display are determined by the procedure. As you add activities and edit the Table View, you can change some of these attributes according to your

preference. You can also choose a different level of display or set some activity filters (see the "Setting Activity Filters" section on page 654).

PROC PM enables you to save the attributes of the display in an indexed data set that is specified in the PROC PM statement, using the PROJECT= option. You can use this data set to save display preferences such as the font, column order, column widths, filters, and so forth. See the "Project Data Set" section on page 659 for details regarding the format of this data set.

You can save and restore the preferences from the "Project" pull-down menu, which contains the Preferences submenu (Figure 6.26). Note that you have to explicitly save the project preferences using the "Save" selection from this pull-down menu. Closing the PM Window saves only the activity data of the project; it does not automatically save the project preferences. When you restore preferences, the state used is the one that was last saved for the project in the specified preference data set.
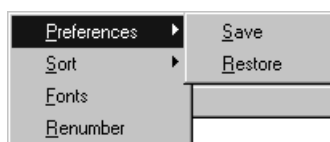
Figure 6.26. Preferences Pull-down Menu

Sorting Activities

Activities can be sorted by activity number, early start, late start, and resource start by choosing Project->Sort from the "Project" pull-down menu (see Figure 6.27). Once the activities are sorted, the Schedule output data set contains the activities in the new sorted order. See the "Renumbering the Activities" section on page 656.
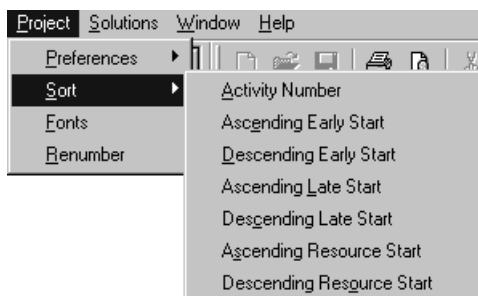
Figure 6.27. Sort Pull-down Menu

Setting the Project Font

When the PM Window is first displayed, the font used in all the text areas of the window is the same as the SAS font used in the Display Manager and other windows. You can use the "Fonts" selection in the "Project" pull-down menu (Figure 6.28) to change the font used in the PM Window. You can choose various fonts and their sizes from the font manager thus obtained. This font can also be saved (and restored) in the Project data set.

Figure 6.28. Project Pull-down Menu

Renumbering the Activities

When the PM Window is first displayed for the specified project, the activities are listed in the order in which they are defined in the Activity data set. The activity numbers displayed in the Job Nbr column correspond to this same order. Even if the activities are rearranged, either by moving selected activites or by sorting, these numbers do not change. Likewise, no renumbering takes place automatically if activities are deleted from the project.

You can use the "Renumber" selection in the "Project" pull-down menu (Figure 6.28) to reassign consecutive numbers to the activities, starting from the first activity displayed.

When you close the PM Window, saving all the activity information to the Schedule data set, the activities are numbered according to the order in which they were displayed at the end of the editing session. In other words, the "Close" action implicitly invokes the "Renumber" command on the project activities. These activity numbers are, in fact, saved as the values of the ACTID variable (see the "Schedule Data Set" section on page 658).

Printing

The PM Window provides functionality to print the Gantt View, the Table View, or both, provided that a printer has been selected and the correct information has been set in the Printer Setup Window. For more information on setting up the printer options, see the SAS companion for your operating environment or contact the SAS Support Consultant at your site for further instructions. Print Preview can be used to view the information before printing, and the printed output can be saved to a file. All the printing functions are available from the "File" pull-down menu (Figure 6.29).
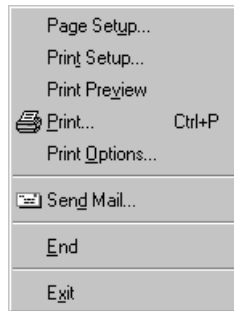
Figure 6.29.   File Pull-down Menu

Preview the Printed Output on the Screen

You can view the printed output on screen before actually printing it by selecting "Print Preview" from the "File" pull-down menu.

Print Options

Select "Print Options" from the "File" pull-down menu. There are options for selecting time and activity axis range and scaling of the printed output. See Figure 6.30.
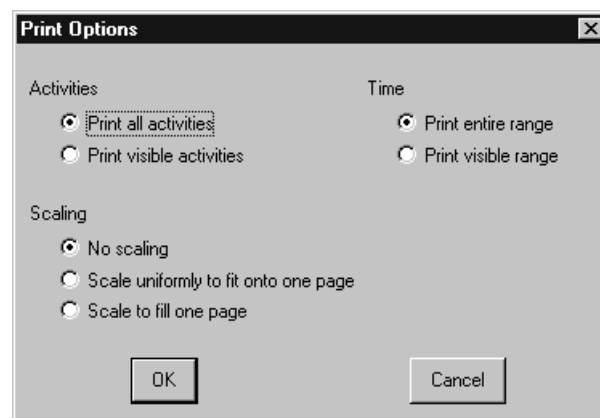
Figure 6.30.   Print Options Dialog Window

Save the Printed Output to a File

The printed output can be saved to a file by selecting File->Print ->Print to File.

Details

The computation of the schedule, the resource constrained scheduling algorithm, the resource usage information, and all other aspects of the scheduling engine for PROC PM are the same as the ones for PROC CPM. Refer to Chapter 2, "The CPM Procedure," for details. A few minor differences in the content of the Schedule Output data set and the Project data set (not available in PROC CPM) are described in the following sections.

Schedule Data Set

The Schedule data set produced by PROC PM is very similar to the Schedule data set produced by PROC CPM. See the OUT= Schedule data set section in the PROC CPM chapter.

However, unlike PROC CPM, the PM procedure is interactive in nature, enabling you to add activities, set precedence constraints, reorder the activities, and so on. Thus, the output data set produced by PROC PM is designed to capture the original project data as well as all the changes that are made to the project in the course of the interactive session.

There are several main differences between the forms of the Schedule output data sets produced by the PM and CPM procedures:

- The PM procedure automatically includes all relevant variables that are needed to define the project. Thus, the ACTIVITY, SUCCESSOR, LAG, DURATION, ALIGNDATE, and ALIGNTYPE variables are included in the output data set by default. If the RESOURCE statement is used, all the resource variables are also included. Likewise, if actual progress is entered for the project during the course of the interactive session, all the progress-related variables are added to the output data set.

- The PM procedure contains two sets of observations, identified by two different values of a new variable, OBS_TYPE. The first set of observations contains one observation for every activity in the project. The value of the OBS_TYPE variable for these observations is 'SCHEDULE'. These observations contain all the activity information such as the duration, the start and finish times, the resource requirements, and so forth. The second set of observations contains one observation for every precedence constraint in the project. The value of the OBS_TYPE variable for these observations is 'LOGIC'. These observations contain all the precedence information such as the activity, successor, and lag information.

- The order of the activities in the Schedule data set produced by PROC PM corresponds to the order in which the activities appear in the Table View at the end of the interactive session. Likewise, when the procedure is first invoked, the order of the activities in the Table View corresponds to the order in which the activities are defined in the Activity input data set. If, during the course of the session, some of the activties are reordered, or deleted, or if some new activities are added, the Schedule output data set contains all the activities that are defined in the Table View at the end of the session.

- The PM procedure also assigns a numeric identifier for each activity. These values are assigned by PROC PM consecutively in the order of the activities in the Table View and saved in a variable called ACTID (see the "Renumbering the Activities" section on page 656). In addition to the ACTID variable, the Schedule data set also contains a numeric variable called SUCCID, which contains the numeric identifier for the succesor activities in the LOGIC observations. If the PROJECT statement is used in the invocation of the PM

procedure, a numeric variable called PNTID is added to the Schedule data set; this variable identifies the parent task for each activity.

Note: If the ACTIVITY variable in the Activity input data set is a character variable, the ACTID, SUCCID, and PNTID variables are added to the Schedule data set in addition to the ACTIVITY, SUCCESSOR, and PROJECT variables. On the other hand, if the ACTIVITY variable in the Activity input data set is numeric, the new ACTID, SUCCID, and PNTID variables replace the numeric ACTIVITY, SUCCESSOR, and PROJECT variables, respectively.

Project Data Set

The Project data set is used to save and restore preferences that control the project view. The following preferences can be saved from one invocation to another:

- text font
- time increment
- time units
- major time axis format
- minor time axis format
- schedule bars displayed (for example, Actual, Baseline, and so forth)
- chart grid
- chart scale
- table column widths
- table column order
- Table View-Gantt View dividing line
- activity filters
- activity level
- project summary
- window dimensions

The Project data set uses three variables to save the preference information:

- PROJATTR – contains a keyword identifying the project attribute; each attribute has either a numeric value or a character value. The length of this variable is 8.
- PRATNVAL – used for numeric data corresponding to the attribute.
- PRATCVAL – used for character data corresponding to the attribute. The length of this variable is 200.

Note that the Project data set is used internally by the PM procedure and is not designed to be altered or edited directly. Its contents may not be meaningful except to the PM procedure.

TIMENOW Macro Variable

The PM Window can be used to add and edit progress information to a project. When progress information is added, the Schedule data set contains all the Progress variables (see the "Progress Updating" section on page 103 in Chapter 2, "The CPM Procedure").

However, all the values of the progress variables are reconciled and revised on the basis of the value of the TIMENOW parameter. Since the PM procedure enables you to move the TIMENOW line as well as implicitly change the value of TIMENOW by updating the Actual Start or Finish times of the activities, the value of TIMENOW at the end of the editing session is an important parameter of the project. This value is saved in a macro variable called TIMENOW and can be used in subsequent editing sessions of the same project. See Example 6.6 for an example of the use of the TIMENOW macro variable.

MDBTOPM Macro

MDBTOPM is a SAS macro that converts Microsoft Project data saved in MDB format to a form that is readable by the PM procedure. In the event of a succesful conversion, the macro proceeds to invoke an instance of the PM procedure using values for the relevant options that were determined during the course of the data conversion. Execution of the MDBTOPM macro requires SAS/ACCESS software.

The MDBTOPM macro has two arguments; one that specifies the location of the .MDB file and another that specifies the location of the directory for storing the SAS data sets. The following SAS data sets are generated by the MDBTOPM macro:

- Activity data set
- Calendar data set
- Holiday data set
- Workday data set
- Resource data set
- Preferences data set

The MDBTOPM macro converts the hierarchical relationships, precedence relationships, time constraints, resource availabilities, resource requirements, project calendars, resource calendars, holiday information, workshift information, actual start and finish times, and baseline start and finish times. In addition, the notes and cost fields are also extracted and stored in the Activity data set.

Note: In order to retain the values of the options used to invoke the PM procedure, you will need to save the preferences by choosing Preferences->Save from the "Project" pull-down menu.

Example 6.1. Defining a New project ⬩ 661

Examples

This section illustrates some of the interactive features of PROC PM using a few simple examples that lead you through different stages of entering and editing project data. A simple software development project is used in all the examples. The output data set from one example is used as input to the next example. Where necessary, additional data sets are created, or the input data set is modified using simple data step code.

You could also use PROJMAN to create the software project and then proceed to each succeeding example using the application to define the calendars, resources, and so forth. The PROJMAN application automatically manages the required data sets.

Example 6.1. Defining a New project

In this example, a simple software development project is built from scratch, starting with an empty Activity data set. PROC PM is invoked with an Activity data set that has no observations and just a few variables that are required to start the procedure. In addition to the Activity data set, a Project data set is also defined that is used to save the display attributes of the PM Window to be used between successive invocations of the procedure. The following program invokes PROC PM and opens a PM Window that enables you to enter project data. The initial window is shown in Output 6.1.1.

Note that the PROJNAME= option is used in the PROC PM statement. This value is used to label the PM Window. Also specified in the PROC PM statement is the PROJECT= option that identifes the project attribute data set. The activities in the project follow a weekday calendar which is indicated to PROC PM by specifying the INTERVAL=WEEKDAY option. In the PM Window, the weekends are shaded gray in the Gantt View.

```
/* Initialize the Activity data set */
data software;
   length activity $20.;
   input activity $ actid succid pntid duration;
datalines;
;

data softattr;
   length projattr $8. pratcval $200.;
   input projattr pratnval pratcval;
datalines;
;

proc pm data=software project=softattr
        date='1mar99'd interval=weekday
        projname='Software Project'
        out=softout1;
   act actid;
   succ succid;
   project pntid;
   duration duration;
```

```
        id activity;
        run;
```

Output 6.1.1.   Initial PM Window

In the PM Window, enter the following tasks with the corresponding durations in the Table View:

```
        Design          5
        Develop         10
        Document        8
        Test            8
        Ship            0
```

As each task is entered, the Schedule columns in the Table View are updated with the early and late start times, and the Early Schedule bars appear in the Gantt View. Output 6.1.2 shows the PM Window after the five tasks have been entered. To view the Schedule columns, you can scroll the Table View to the right or use the "View" pull-down menu (Figure 6.6) to move the Schedule columns to the left.

Example 6.1.   Defining a New project   ⬥   663

Output 6.1.2.   List of Tasks in the Software Project
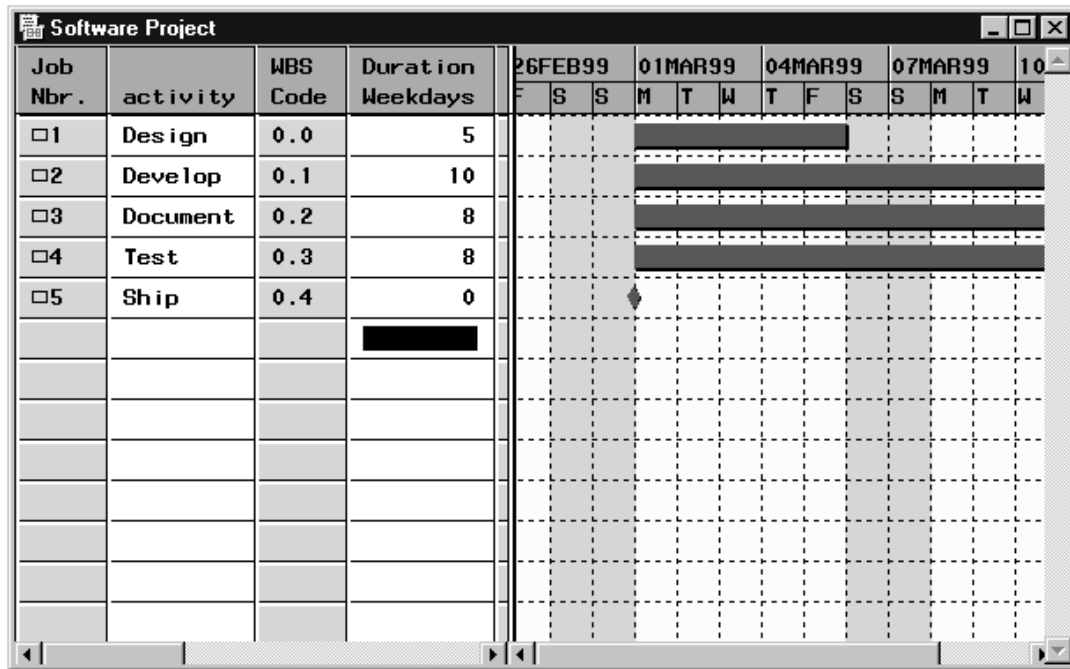
To enter precedence constraints between two activities, such as 'Design' and 'Develop', draw an arc, using the left mouse button, from the end of the predecessor task to the beginning of the successor task. Use the Gantt View to enter the following precedence constraints:

```
Design  --> Develop
Design  --> Document
Develop --> Test
Test    --> Ship
```

Output 6.1.3 shows the Software Project as the last precedence constraint is being drawn. Note that, in this view of the PM Window, the Schedule columns have been moved to the left, the grid lines in the Gantt View have been turned off (using the menu in Figure 6.11), and the Gantt View has been scrolled to the right to bring the end of the schedule bar for 'Test' into view.

Output 6.1.3. Drawing Precedence Constraints
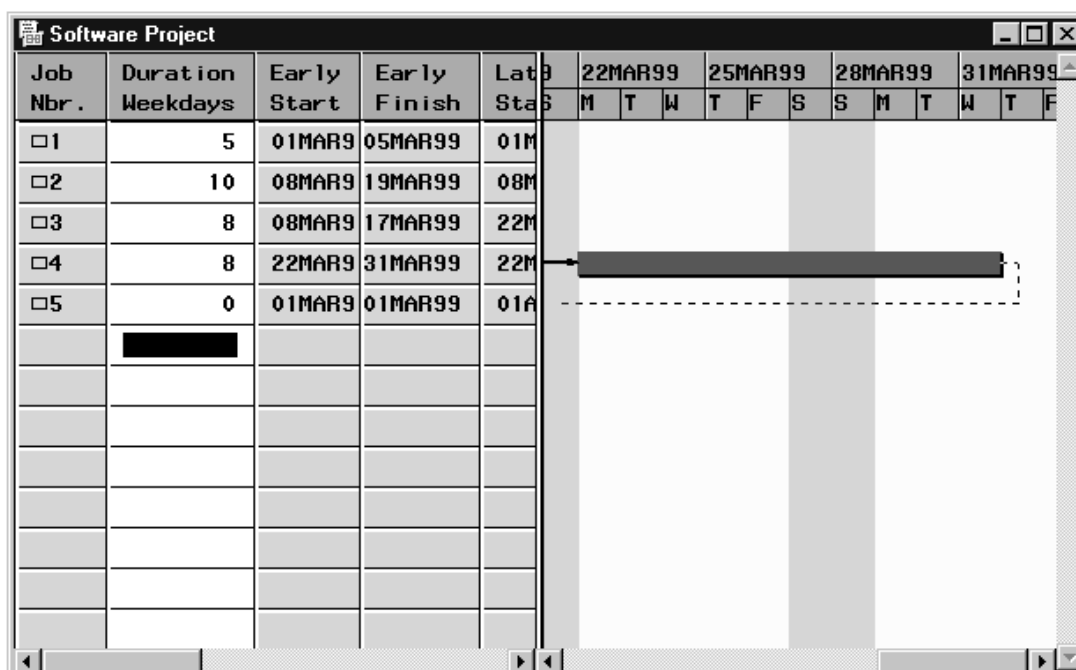
To check the overall project status, you can bring the Project Summary task into view by selecting "Display Summary Task" from the "View" pull-down menu (Figure 6.6). Note that the project duration is 23 days. The critical activities are shown in black while the noncritical activities are gray. The Summary Task is indicated by vertical cones at the end of its schedule bar.

For the next few examples, the units used in the Gantt View are changed to "Weeks" using the Axis pop-up menu shown in Figure 6.12, the Summary Task is displayed at the top of the list of activities, and the Activity description columns are shown in the Table View. The "Project" pull-down menu can be used to save these window settings in the Project data set. The view of the project corresponding to these settings is shown in Output 6.1.4. You can end the interactive editing session by closing the window. All the activity and precedence information is saved in the output data set, SOFTOUT1, displayed in Output 6.1.5. Note the two sets of observations in this data set: the first contains all the schedule information for all the activities, and the second lists all the precedence relationships between activities.

Example 6.2. Adding Subtasks to a Project ♦ 665

Output 6.1.4. Project Schedule
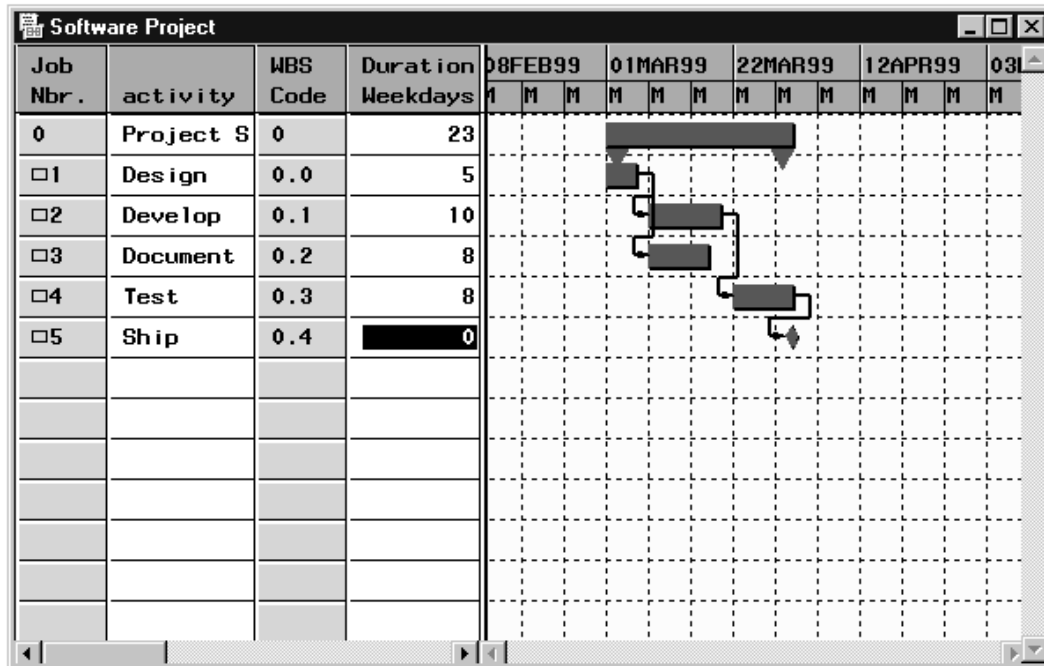
Output 6.1.5. Schedule Data Set

```
                         Schedule Data Set

        O         P P W       d              a           S
        B         R R B       u              c           U
        S         O O S    S  r       P      t           C
        _      P  J J _  A U  a       A      i           C
        T      N  _ _ C  C C  t       R      v           E
   O    Y      T  D L O  T C  i       E      i           S
   b    P      I  U E D  I I  o       N      t           S
   s    E      D  R V E  D D  n       T      y           R

   1 SCHEDULE . 23 0 0    0 . 23              Project Summary
   2 SCHEDULE 0  . 1 0.0 1 .  5 Project Summary Design
   3 SCHEDULE 0  . 1 0.1 2 . 10 Project Summary Develop
   4 SCHEDULE 0  . 1 0.2 3 .  8 Project Summary Document
   5 SCHEDULE 0  . 1 0.3 4 .  8 Project Summary Test
   6 SCHEDULE 0  . 1 0.4 5 .  0 Project Summary Ship
   7 LOGIC    .  . .     1 2  5              Design        Develop
   8 LOGIC    .  . .     1 3  5              Design        Document
   9 LOGIC    .  . .     2 4 10              Develop       Test
  10 LOGIC    .  . .     4 5  8              Test          Ship

           A  A                 E                 L
           L  L        E        _        L        _   T  F     E       L
           G  G        _        F        _        F   _  _  E  S  L  S
           N  N        S        I        S        I   F  F  S  _  S  _
           D  T        T        N        T        N   L  L  _  D  _  D
   O L     A  Y        A        I        A        I   O  O  A  E  A  E
   b A     T  P        R        S        R        S   A  A  S  S  S  S
   s G     E  E        T        H        T        H   T  T  C  C  C  C

   1       .     01MAR99  31MAR99  01MAR99  31MAR99   0  0  0  0  0  0
   2       .     01MAR99  05MAR99  01MAR99  05MAR99   0  0  1  5  1  5
   3       .     08MAR99  19MAR99  08MAR99  19MAR99   0  0  2  4  2  4
   4       .     08MAR99  17MAR99  22MAR99  31MAR99  10 10  3  3  3  3
   5       .     22MAR99  31MAR99  22MAR99  31MAR99   0  0  4  2  4  2
   6       .     01APR99  01APR99  01APR99  01APR99   0  0  5  1  5  1
   7       .        .        .        .        .      .  .  .  .  .  .
   8       .        .        .        .        .      .  .  .  .  .  .
   9       .        .        .        .        .      .  .  .  .  .  .
  10       .        .        .        .        .      .  .  .  .  .  .
```

Example 6.2. Adding Subtasks to a Project

In this example, the output data set from Example 6.1 is used as input to PROC
PM. The following statements bring up the saved view of the project as shown in
Output 6.2.1. Note that this view is identical to the view saved in Output 6.1.4.

```
proc pm data=softout1 project=softattr
        date='1mar99'd interval=weekday
        projname='Software Project'
        out=softout1;
   act actid;
   succ succid;
   project pntid;
   duration duration;
   id activity;
   run;
```

Output 6.2.1. Project Schedule
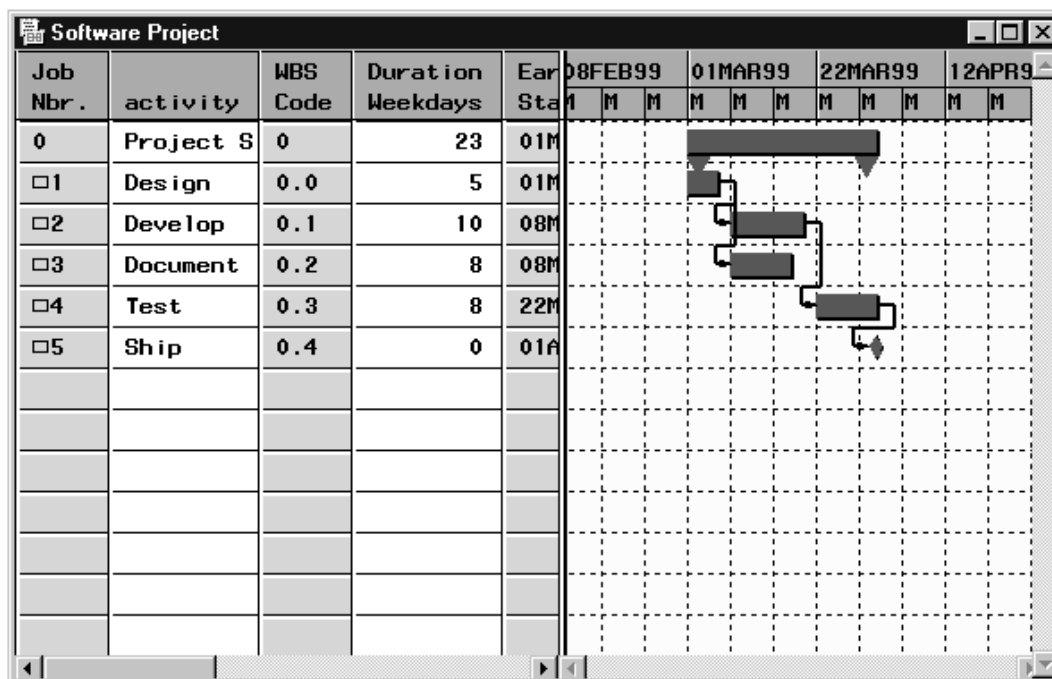
In the invocation of PROC PM, the output data set name is the same as the input data
set. Thus, it is possible to make changes to the Activity data set using PROC PM and
then save the results back to the original data set.

In the current view of the Software Project, you want to add some subtasks to the
'Design' and 'Develop' tasks. Suppose that these two tasks are broken into two
subtasks each, one for 'Module 1' and the other for 'Module 2'. Further, you want
to remove the precedence constraint between the 'Design' and 'Develop' phases and
add constraints between the respective modules. You can accomplish these tasks by
making the following editing changes in the PM Window.

Example 6.2.   Adding Subtasks to a Project ⬧ 667

1. Use the Table View pop-up menu to add the following subtasks to 'Design':

   Module 1:   5 days
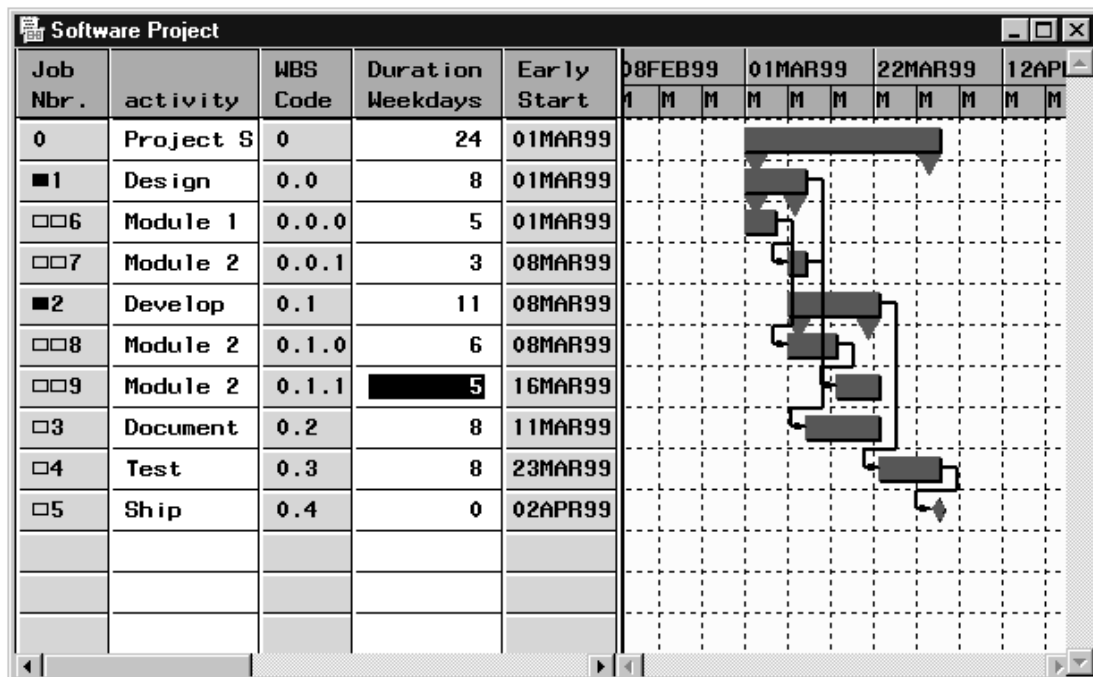   **Module 2:   3 days**

2. Add a link from 'Module 1' to 'Module 2'.

3. Use the Table View pop-up menu to add the following subtasks to 'Develop':

   Module 1:   6 days
   Module 2:   5 days

4. Add a link from 'Module 1' to 'Module 2'.

5. Remove the link between the supertasks 'Design' and 'Develop' by clicking on the arc and selecting "Delete" from the pop-up menu.

6. Add a link from 'Module 1' under 'Design' to 'Module 1' under 'Develop'.

7. Add a link from 'Module 2' under 'Design' to 'Module 2' under 'Develop'.

The resulting project schedule is displayed in Output 6.2.2 and saved in the data set SOFTOUT1. Note that the new project duration is 24 days.

Output 6.2.2.   Project Schedule

| Job Nbr.	activity	WBS Code	Duration Weekdays	Early Start	08FEB99	01MAR99	22MAR99	12APL
0	Project S	0	24	01MAR99				
■1	Design	0.0	8	01MAR99				
□□6	Module 1	0.0.0	5	01MAR99				
□□7	Module 2	0.0.1	3	08MAR99				
■2	Develop	0.1	11	08MAR99				
□□8	Module 2	0.1.0	6	08MAR99				
□□9	Module 2	0.1.1	5	16MAR99				
□3	Document	0.2	8	11MAR99				
□4	Test	0.3	8	23MAR99				
□5	Ship	0.4	0	02APR99				

Example 6.3. Saving and Comparing Baseline Schedules

This example shows you how to save a baseline schedule and use it for comparing new schedules. Recall that in Example 6.2 the Schedule data are saved in the data set SOFTOUT1. Thus, the following invocation of PROC PM displays the Software project in its last saved state (as in Output 6.2.2, but with the WBS codes all filled in). At the end of the editing session, the schedule is saved in the data set SOFTOUT3.

```
proc pm data=softout1 project=softattr
        date='1mar99'd interval=weekday
        projname='Software Project'
        out=softout3;
    act actid;
    succ succid;
    project pntid;
    duration duration;
    id activity;
    run;
```

Use the "Set Baseline" pull-down menu (Figure 6.23) to save the current Early Schedule as a Baseline Schedule. The resulting display is shown in Output 6.3.1. Note that the Gantt View now shows the Baseline schedule, in addition to the Early Schedule. Also, the activities have been numbered to be sequential in the current view (see the "Renumbering the Activities" section on page 656).

Output 6.3.1. Using Baseline Schedules

Example 6.3.   Saving and Comparing Baseline Schedules   ⬩   669
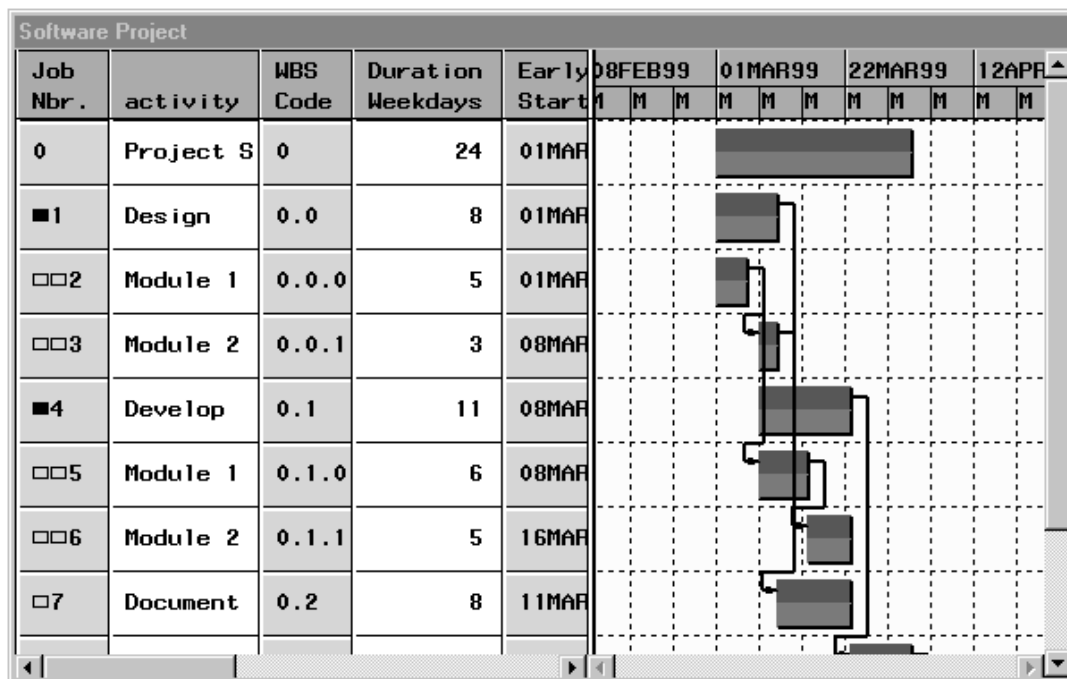
The baseline schedule is useful in determining the effect of changes to the project on the schedule. For example, suppose there is a directive from the Director of your division that all the developers are required to attend a User Interface Standards Meeting before starting the development of Module 2. This meeting has been scheduled to start on March 15, 1999 and is expected to take 3 days. What is the effect of this directive on your project schedule?

To see this, you can make the following changes in the PM Window:

1. Add a new task to the project by selecting "New Task" from the "Edit" pull-down menu.

2. To edit the newly entered task, you may need to scroll down.

3. Type in the name of the task: 'UI Meeting'. Set its duration to 3.

4. In the Gantt View, draw a link from this new task to Task 6 ('Module 2' under 'Develop').

5. Also in the Gantt View, grab the task, 'UI Meeting', using the left mouse button and drag it to the tick mark corresponding to 15Mar99.

The resulting view is shown in Output 6.3.2. Note that the view may differ depending on the display parameters of your device. It is easy to see that, due to the 3-day meeting that is mandated, there is a delay in the project schedule (the project duration is now 26 days).

Output 6.3.2.   Effect of UI Meeting on Schedule
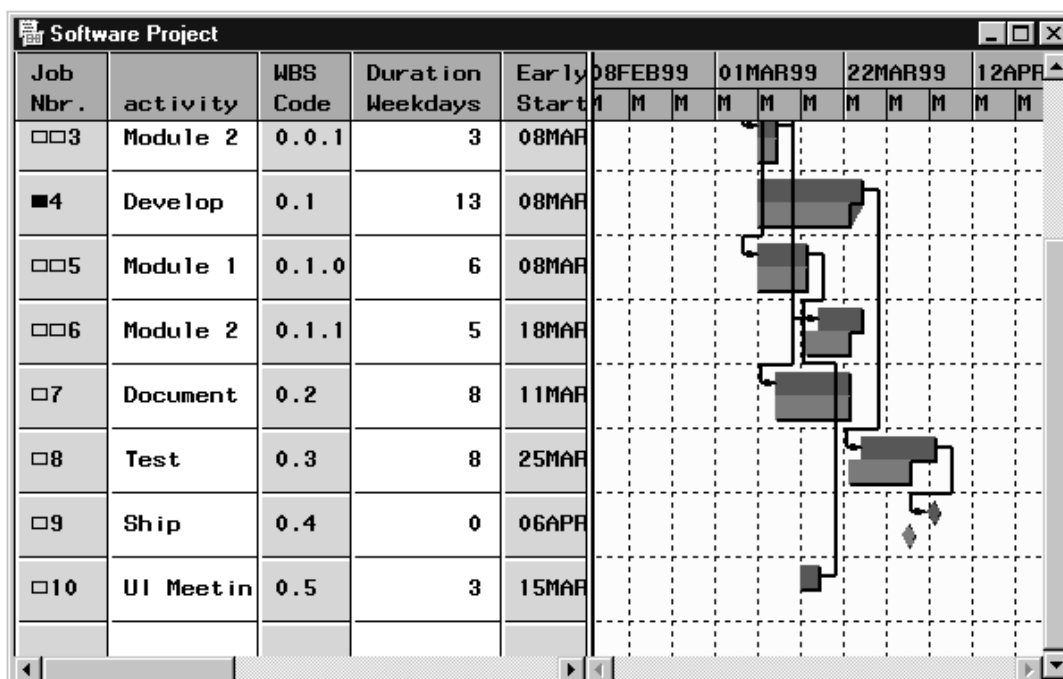
You can get a complete picture of the effect on the schedule by examining all the Schedule columns that are shown in the Table View. Output 6.3.3 shows the Schedule columns, the Baseline columns, and the Target Date and Type columns in the Table View. To obtain this view, some of the columns have been moved and the Baseline Schedule bars (in the Gantt View) have been hidden from the display.

**Output 6.3.3.**   Table View Showing all Schedules

Job Nbr.	activ	Dura Week	Early Start	Early Finish	Late Start	Late Finish	Baselin Start	Baselin Finish	Target Date	Tar 08 Typ 1
0	Proje	26	01MAR99	05APR99	03MAR99	05APR99	01MAR99	01APR99	.	
■1	Desig	8	01MAR99	10MAR99	03MAR99	17MAR99	01MAR99	10MAR99	.	
□□2	Modul	5	01MAR99	05MAR99	03MAR99	09MAR99	01MAR99	05MAR99	.	
□□3	Modul	3	08MAR99	10MAR99	15MAR99	17MAR99	08MAR99	10MAR99	.	
■4	Devel	13	08MAR99	24MAR99	10MAR99	24MAR99	08MAR99	22MAR99	.	
□□5	Modul	6	08MAR99	15MAR99	10MAR99	17MAR99	08MAR99	15MAR99	.	
□□6	Modul	5	18MAR99	24MAR99	18MAR99	24MAR99	16MAR99	22MAR99	.	
□7	Docum	8	11MAR99	22MAR99	25MAR99	05APR99	11MAR99	22MAR99	.	
□8	Test	8	25MAR99	05APR99	25MAR99	05APR99	23MAR99	01APR99	.	
□9	Ship	0	06APR99	06APR99	06APR99	06APR99	02APR99	02APR99	.	
□10	UI Me	3	15MAR99	17MAR99	15MAR99	17MAR99	.	.	15MAR99	SGE

If the project delay resulting from the UI Meeting is of concern, you may want to schedule the Meeting on an earlier date. Suppose the revised start date of the Meeting is March 10, 1999. To see the effect of the change, you can do the following:

1. Revert to the saved project preferences so that both the Table and the Gantt Views are visible.

2. Use the "View" pull-down menu to move the Target Dates columns to the left in the Table View.

3. Scroll down, if necessary, to bring the task 'UI Meeting' into view.

4. Change the Target Date column for this task to '10Mar99'.

The resulting view is displayed in Output 6.3.4. Note that, as a result of this change, all the activities are back on schedule as the new schedule coincides with the saved baseline schedule. The last activity was defined after the baseline schedule had been saved in Example 6.2; hence, there is no baseline schedule bar for this activity. You can use the "Fill Missing Baseline" selection from the pull-down menu shown in Figure 6.22 to set the baseline schedule for the 'UI Meeting' to be the current early schedule.

Example 6.4. *Effect of Calendars* ⬧ 671

Output 6.3.4. Editing Target Date
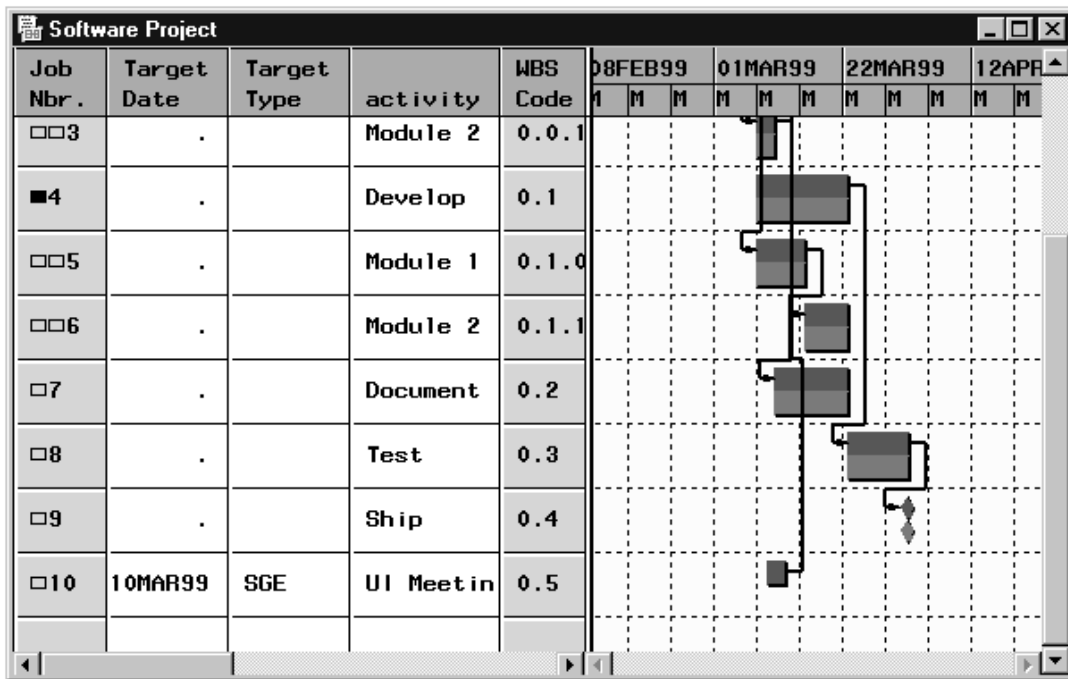
Example 6.4. Effect of Calendars

Continuing with the project scenario in the preceding examples, you want to explore other ways of shortening the project duration. One possible alternative is to work overtime. As the project manager, you would like to see the effect on the schedule if you change the calendar for all the Development tasks to a six-day calendar.

Calendars are defined using the Calendar data set, as in the CPM procedure. Alternately, if you are using the PROJMAN application, you can use the Calendars Window to define a six-day calendar. This example defines a Calendar data set and invokes PROC PM as follows. Note that, in order to use calendars, the Activity data set needs to have a CALID variable, which is added in a simple DATA step.

```
/* Define a Calendar data set identifying */
/* Saturday as a workday                  */
data calendar;
   input calid calname $ _sat_ $;
datalines;
1 Sixday WORKDAY
;

/* Add the CALID variable to the Activity data set */
data softout3;
   set softout3;
   calid=.;
   run;
```

```
/* Use softout3 as the Activity data set and specify */
/* the calendar data set defined above.             */
proc pm data=softout3 project=softattr
        calendar=calendar
        date='1mar99'd interval=weekday
        projname='Software Project'
        out=softout4;
    act actid;
    succ succid;
    project pntid;
    duration duration;
    id activity;
    calid calid;
    run;
```

When the PM procedure initializes the PM Window, it attempts to restore all the display settings using the values in the Project data set, SOFTATTR. However, the new Activity data set has an extra variable, calid, which leads to two new columns in the Table View, one for the Activity Calendar (which displays the Calendar ID) and the other for the Calendar Name. These columns are added at the right end of the Table View and can be seen by scrolling to the right. The resulting view is displayed in Output 6.4.1.

Output 6.4.1. Calendar Columns
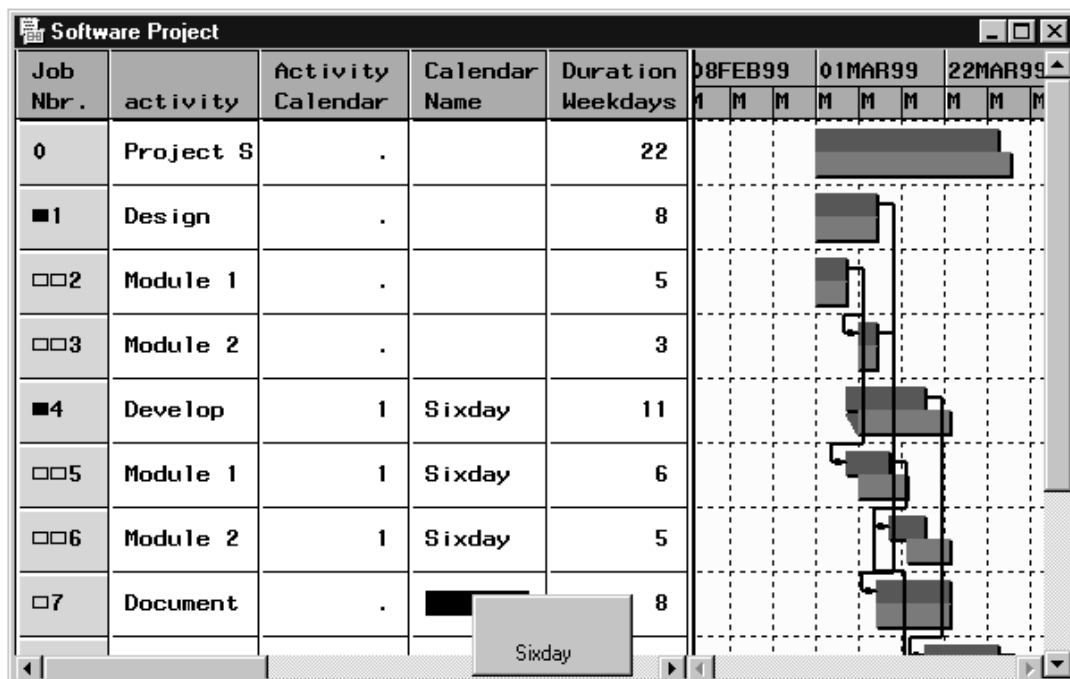
Example 6.4.   Effect of Calendars   ⬥   673
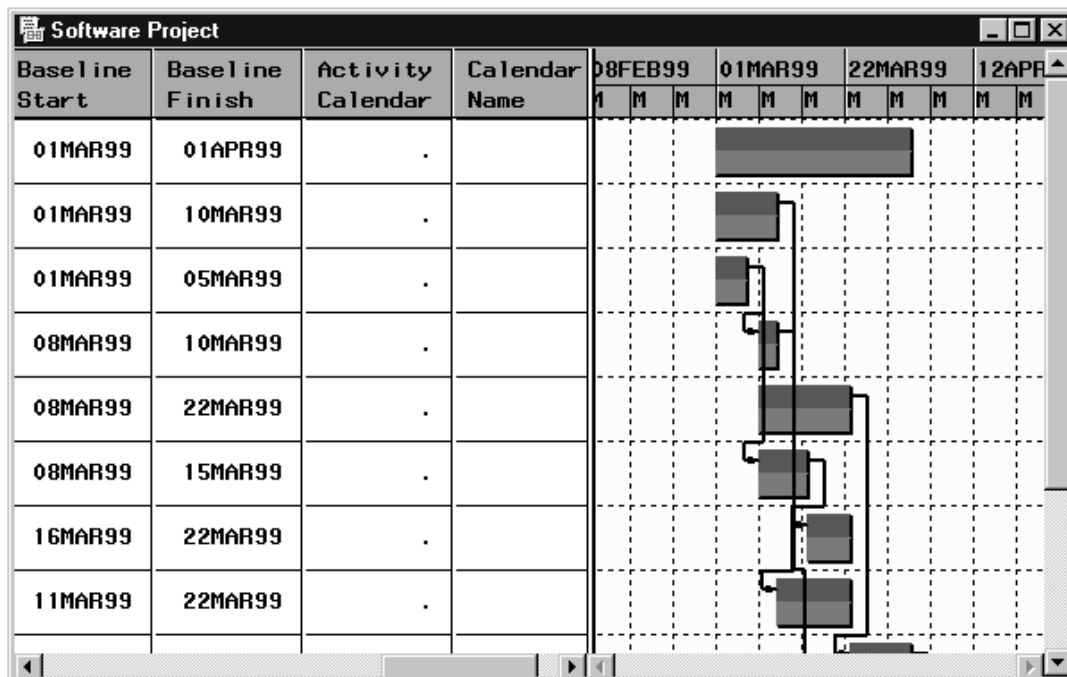
By default, all the activities are assumed to follow the standard 5-day calendar. Now, you want to change the calendar for the supertask 'Develop' and all its subtasks to be the Sixday calendar defined in the data set CALENDAR. Note that, in the calendar definition, it is sufficient to specify that Saturday is a working day. All the other days of the week default to the default calendar's work pattern (see the "Default Calendar" section on page 97 in Chapter 2, "The CPM Procedure").

To facilitate the editing of the calendar values and to see the effect on the project duration, reorder the columns (using the left mouse to drag the columns in the Table Header) to display the activity, Activity Calendar, Calendar Name, and Duration columns in the Table View. You may need to move the dividing line between the Table and Gantt Views.

You can enter the Calendar values by typing in the number, 1, in the Activity Calendar column or the value 'Sixday' in the Calendar Name column. You can also use the Calendar pop-up menu in one of the calendar columns to select the desired calendar (see Output 6.4.2). Note that the project duration has reduced to 22 days as a result of the 6-day calendar.

Output 6.4.2.   Effect of Sixday Calendar

To see the effect on the individual activities, change the units to "Days" in the Gantt View and enlarge the Gantt View, as shown in Output 6.4.3.

Output 6.4.3. Gantt View of Calendar Effect
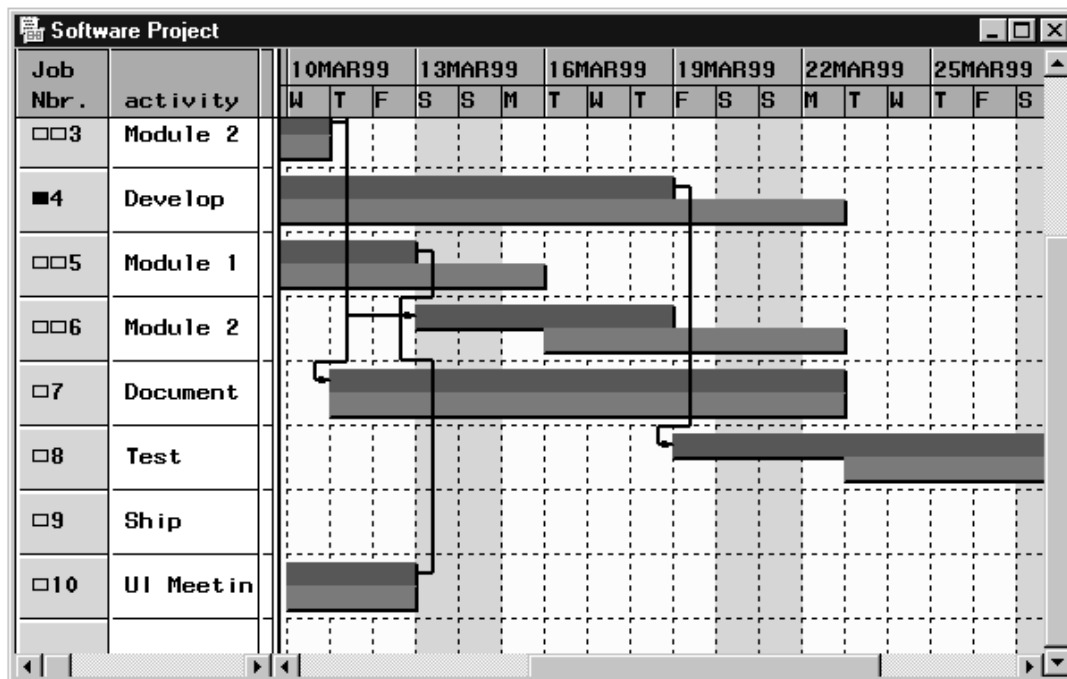
Example 6.5. Defining Resources

In all the preceding examples, it was assumed that you had enough resources to work
on the different tasks. Unfortunately, as a project manager you need to schedule your
project using the limited set of resources available to you. In this example, you will
assign some project resources and schedule the project subject to resource constraints.

In order to assign resources to the tasks, you need to add resource variables to the
Activity data set as well as define a resource availability (Resource) data set.

Suppose that the resources that you are interested in are Tester and Programmer. The
following statements set up the project data needed to perform resource constrained
scheduling with PROC PM using the output data produced in Example 6.4.

```
/* Define a Resource data set specifying */
/* 1 Tester and 1 Programmer as the      */
/* available resources                   */
data resources;
   input _date_ date7. Tester  Programmer;
datalines;
01jan99 1  1
;

/* Add the resource variables Tester and */
/* Programmer to the Activity data set    */
/* (the output data set saved in last example) */
data softout4;
   set softout4;
```

Example 6.5. Defining Resources ◆ 675

```
        Tester=.;
        Programmer=.;
        run;

    /* Use softout4 as the Activity data set and     */
    /* specify the Resource data set defined above.  */
    /* Save the schedule in softout5.                */
    proc pm data=softout4 project=softattr
            calendar=calendar
            resourcein=resources
            date='1mar99'd interval=weekday
            projname='Software Project'
            out=softout5;
        act actid;
        succ succid;
        project pntid;
        duration duration;
        id activity;
        calid calid;
        resource Tester Programmer / per=_date_;
        run;
```
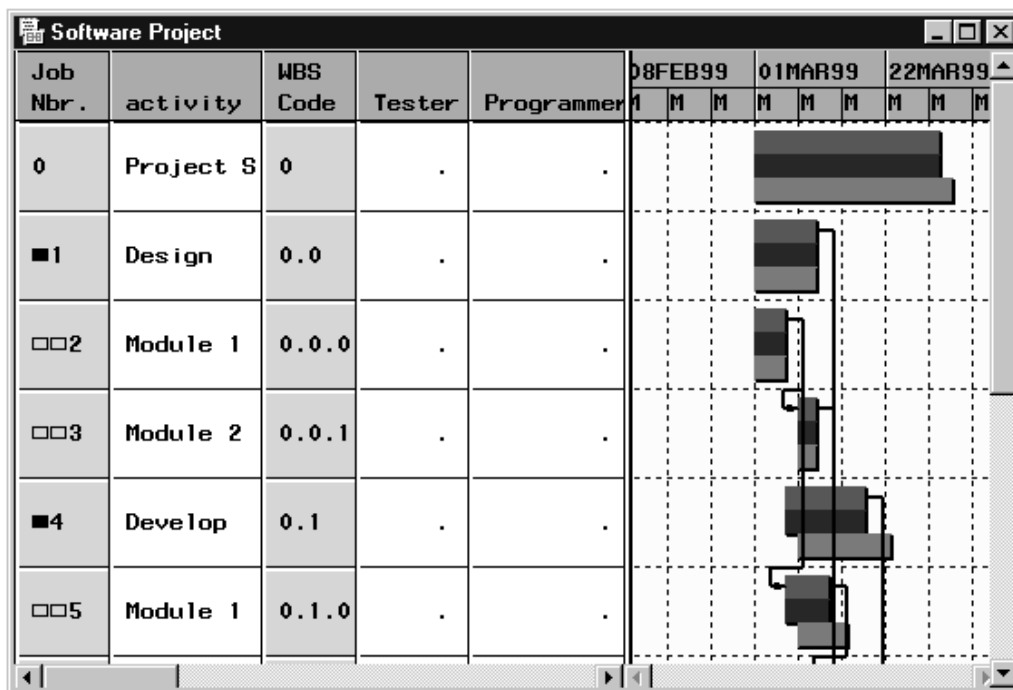
Output 6.5.1. Adding Resources to the Project

Output 6.5.1 shows the Table and Gantt Views of the project after rearranging some of the columns, moving the dividing line to show the resource columns, and bringing the Resource Schedule bar into display. The Resource Schedule bar is shown be-tween the Early Schedule bar and the Baseline Schedule bar. Note that the resource schedule coincides with the early schedule because no resource requirements have been specified for either of the two resources.

You can now use the Table View to enter the resource requirements for each task. Set the requirement for the resource Tester to '1' for the tasks 'Document' and 'Test', and the requirement for the resource Programmer to '1' for the tasks numbered '2', '3', '5', and '6'. The resulting schedule is displayed in Output 6.5.2. In this view, the baseline schedule is not displayed. You can see that several of the tasks have been delayed, resulting in lengthening the project duration to 29 weekdays.

Output 6.5.2.   Editing Resource Requirements
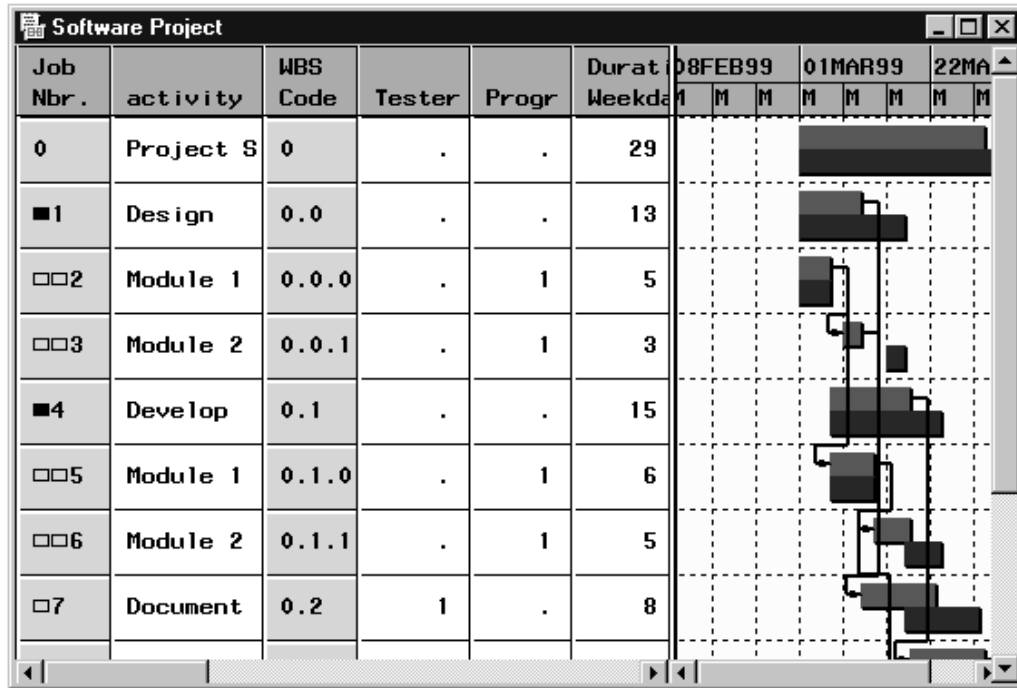
You can set the resource constrained schedule as a baseline to do some "what-if" analysis. For example, suppose you would like to determine the effect of adding another programmer to the project. In order to change the resource availability, you need to save the current project, edit the Resource availability data set to add another programmer, and then reinvoke the PM procedure.

First, in the PM Window displayed in Output 6.5.2, do the following:

1. Re-display the Baseline Schedule bar.
2. Use the "Replace Baseline" selection from the "Edit" pull-down menu to select the Resource Schedule as the new baseline schedule.
3. Save the project preferences.
4. Close the PM Window.

Reinvoke PROC PM after defining a new resource availability:

```
/* Change the resource availability for Programmer to 2 */
data resources;
    input _date_ date7. Tester  Programmer;
```

Example 6.6.   Editing Progress   ⬧   677

```
        datalines;
        01jan99 1   2
        ;

        /* Use softout5 as the Activity data set and specify */
        /* the Resource data set defined above.              */
        /* Save the schedule back to softout5.               */
        proc pm data=softout5 project=softattr
                calendar=calendar
                resourcein=resources
                date='1mar99'd interval=weekday
                projname='Software Project'
                out=softout5;
            act actid;
            succ succid;
            project pntid;
            duration duration;
            id activity;
            calid calid;
            resource Tester Programmer / per=_date_;
            run;
```
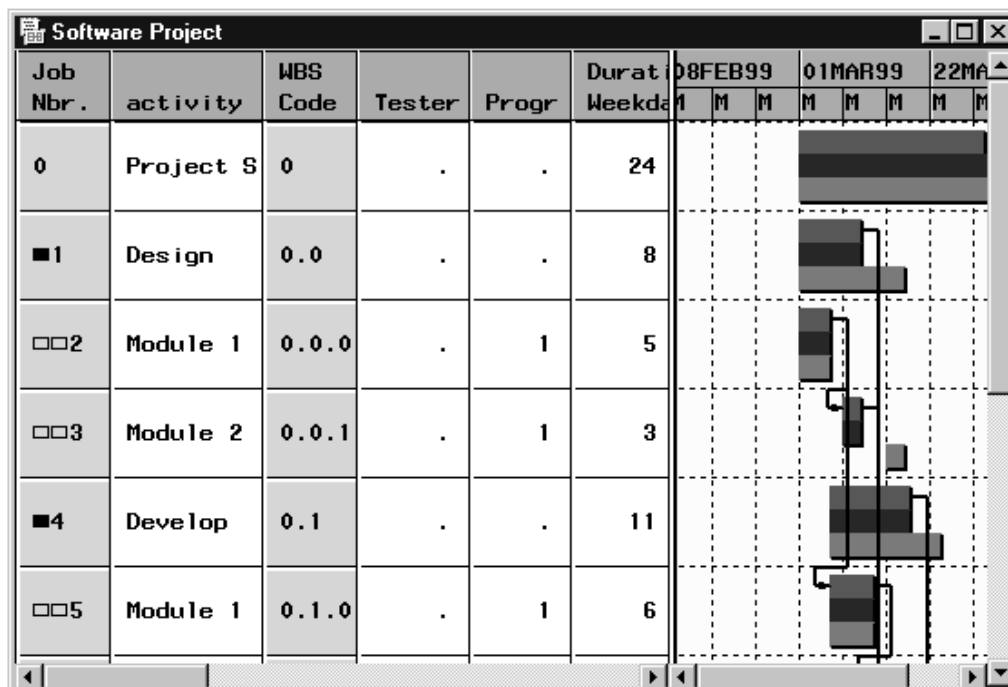
Using the new resource availability, you reduced the project duration by 5 days. The resulting schedule is displayed in Output 6.5.3, which also shows the baseline schedule corresponding to the earlier resource availability data set.

Output 6.5.3.   Comparison of Two Resource Schedules

Example 6.6. Editing Progress

Once a project plan has been established and the project is under way, a major part of a project manager's responsibility is to monitor the project as it progresses. This example uses the PM Window to add progress information to the project and discusses some of the related editing functions.

In the final window of Example 6.5, do the following:

1. Delete the baseline schedule using the "Edit" pull-down menu.
2. From the "Edit" pull-down menu, select "Add Progress".

The resulting display is shown in Output 6.6.1. The Gantt View now shows the Actual Schedule bar between the Early Schedule bar and the Resource Schedule bar. It also displays a Timenow Line. Since no progress information has been entered, the Timenow Line is drawn at the beginning of the project and all the Actual Schedule bars show only a handle that can be used to drag progress for a particular task.

**Output 6.6.1.** Adding Progress Information to Project
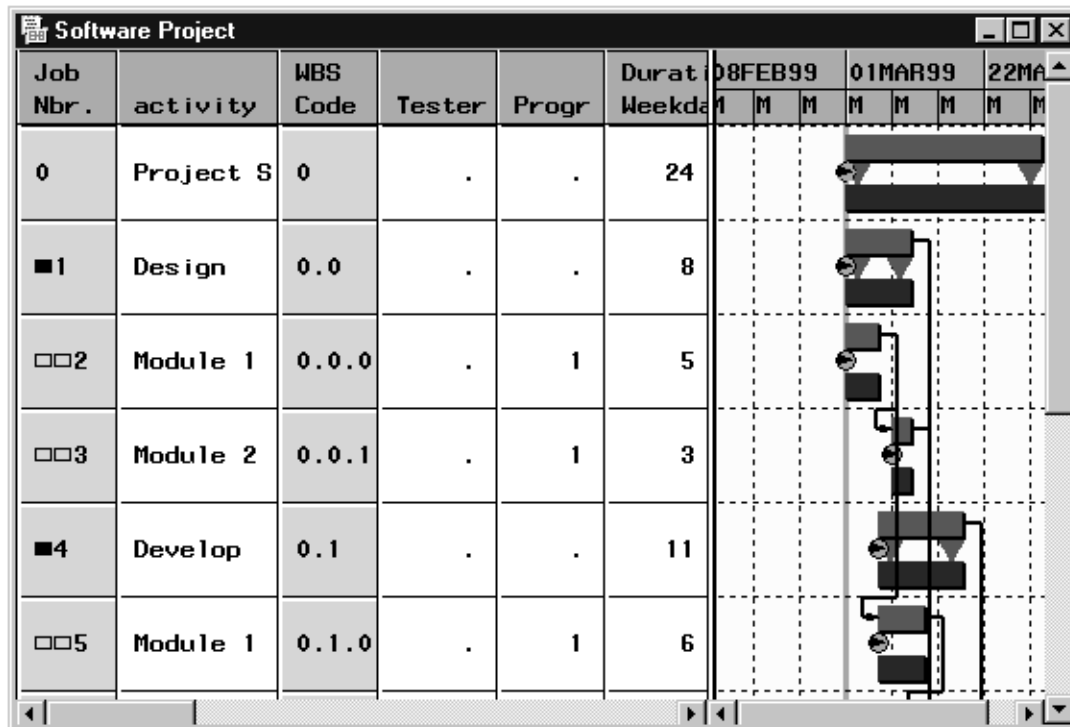
You can enter progress information in several ways:

- Drag the Timenow Line to update progress information for several tasks at once. The actual start and finish times (until the Timenow date) are set assuming that the tasks follow the resource constrained schedule. (If there are no resource constraints, the tasks are assumed to follow the early schedule.)

Example 6.6. Editing Progress ⬧ 679

- Use the handle on the Actual Schedule bar for a given task to drag the progress bar using the left mouse button.

- Bring the Progress columns into view in the Table View and edit one of the Progress columns.

As an example, use the left mouse button to drag the Timenow Line to the tick mark corresponding to 15MAR99. The resulting window (after reordering and resizing some columns and scrolling the Gantt View) is shown in Output 6.6.2.

Output 6.6.2. Moving the Timenow Line
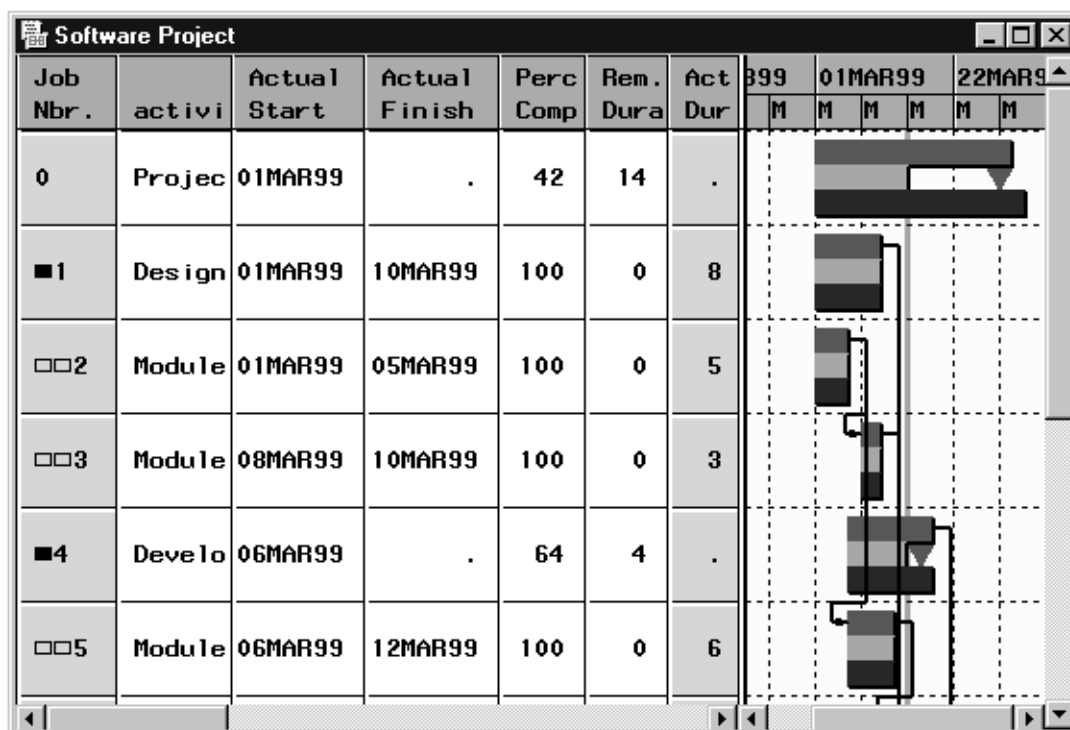
Note that some of the activities are completed while others are still in progress. If the project data are saved at this point, the Schedule data set will have all the Progress variables (A_START, A_FINISH, PCT_COMP, and REM_DUR). However, for the PM procedure to be able to recapture the exact state of the schedule as it was saved, it also needs to know the value of TIMENOW when the project data was last saved. This value (15Mar99 for the current example) is saved as a macro variable named TIMENOW (see the "TIMENOW Macro Variable" section on page 660).

To see how the Actual information can be used from one invocation of PROC PM to the other, save the project as displayed in Output 6.6.2 and then reinvoke PROC PM to continue editing the progress information. Note that if you are using the PROJMAN application, the value of TIMENOW is automatically saved by the application and used in subsequent editing of the project.

Recall from the last invocation of PROC PM that the data are saved in the data set SOFTOUT5. To use the saved progress information, invoke PROC PM as follows:
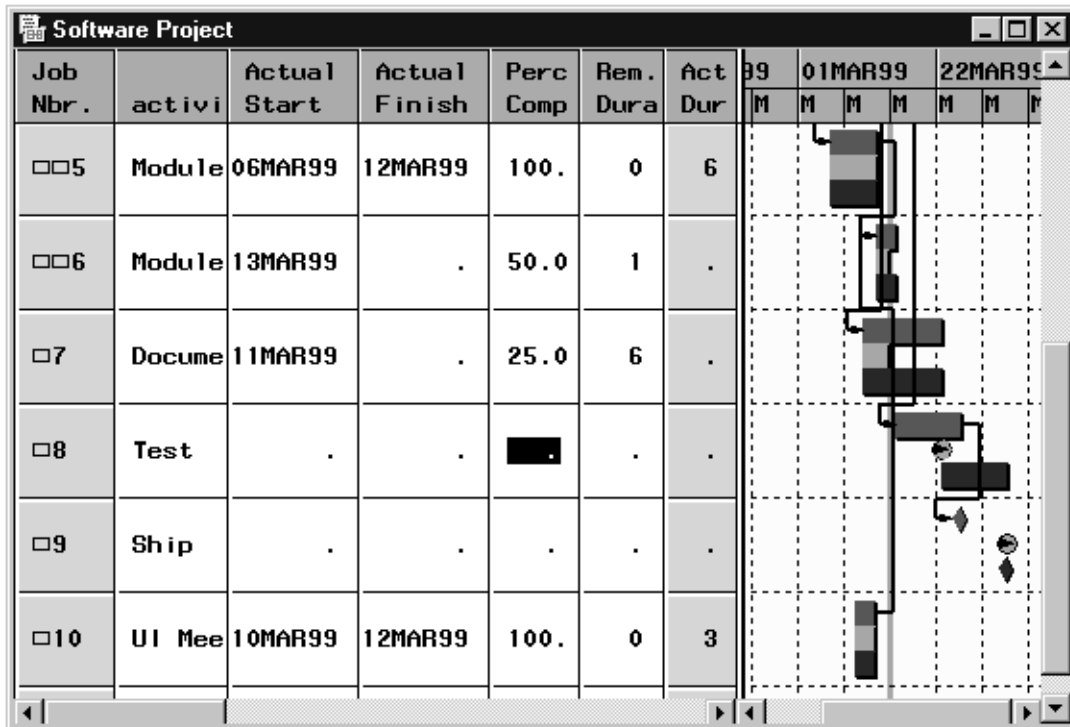
```
/* Use softout5 as the Activity data set and specify */
/* the Resource data set defined in the last example.*/
/* Save the schedule in softout6.                     */
proc pm data=softout5 project=softattr
        calendar=sasuser.calendar
        resourcein=resources
        date='1mar99'd interval=weekday
        projname='Software Project'
        out=softout6;
    act actid;
    succ succid;
    project pntid;
    duration duration;
    id activity;
    calid calid;
    /* Use the ACTUAL statement to specify the Progress */
    /* variables and the value of TIMENOW saved from the*/
    /* previous invocation                              */
    actual / as=a_start af=a_finish
             remdur=rem_dur pctcomp=pct_comp
             timenow=&timenow;
    resource Tester Programmer / per=_date_;
    run;
```
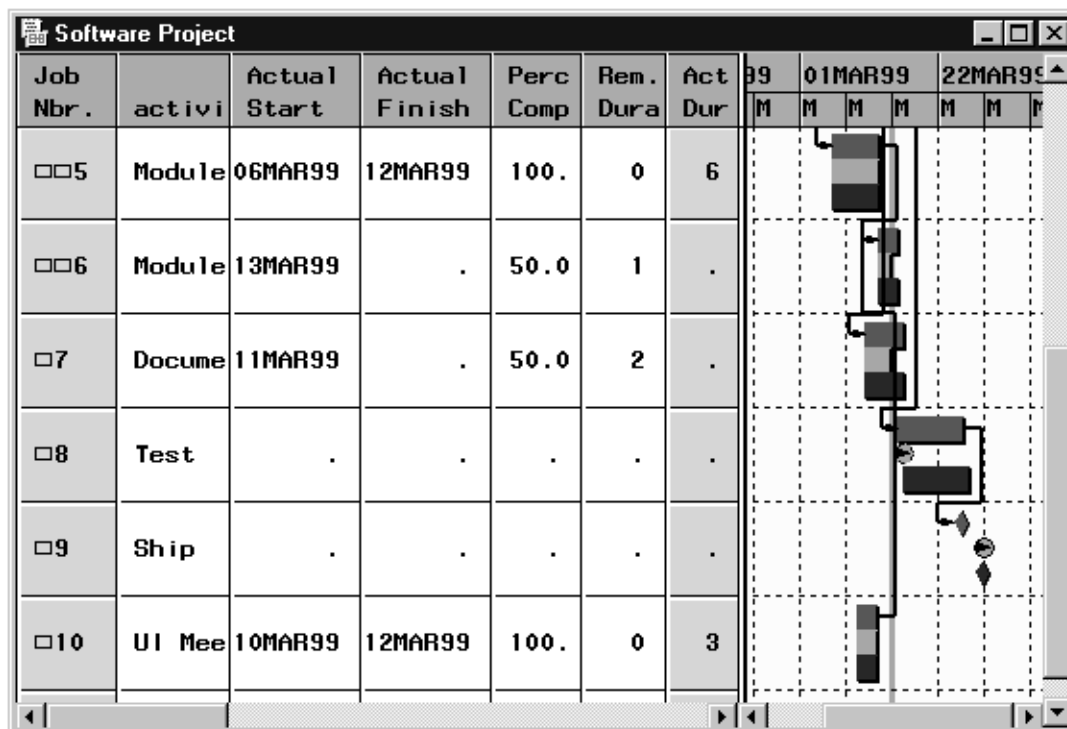
The preceding program displays the PM Window for the updated Software project. Now use the Table View to edit some of the Progress columns. To do so, you can either scroll to the Progress Columns or move these columns to the left in the Table View using the appropriate selection from the "View" pull-down menu (Figure 6.8).

Task number 6 ('Module 2' under 'Develop') has a Remaining Duration value of 4. At this point in time, you may notice that you have misjudged the amount of work involved and that you need only one more day to finish the task. Enter 1 in the Remaining Duration column. This editing change immediately causes the Percent Complete column to update to 50, indicating that 50% of the work is completed. The resulting effect on the project schedule is shown in Output 6.6.3 (the window has been scrolled down to allow the second half of the project to be visible). Note that reducing the duration of the 'Module' task did not affect the project end date. The duration of the project is still 24 days. Studying the schedule of the 'Document' and 'Test' tasks, you notice that the delay to the project is caused by the fact that the resource-constrained schedule of the task 'Test' is delayed due to resource constraints.

Example 6.6.   Editing Progress   ⬥   681

Output 6.6.3.   Editing the Remaining Duration Column

Job Nbr.	activi	Actual Start	Actual Finish	Perc Comp	Rem. Dura	Act Dur	99 M	01MAR99 M	M	M	22MAR99 M	M	M
□□5	Module	06MAR99	12MAR99	100.	0	6							
□□6	Module	13MAR99		50.0	1	.							
□7	Docume	11MAR99	.	25.0	6	.							
□8	Test	.	.	■■ .	.	.							
□9	Ship	.	.	.	.	.							
□10	UI Mee	10MAR99	12MAR99	100.	0	3							

In addition to revising the progress information for 'Module 2', you also realize that the 'Document' task is 50% complete as of the Timenow date. Edit the Percent Complete column in the Table View, changing the value from 25.0 to 50.0. Immediately, the Remaining Duration column changes to 2. The resulting window is shown in Output 6.6.4. The project end date (for the resource constrained schedule) is 28Mar99. Thus, the project duration is now reduced to 20 days.

Output 6.6.4. Editing the Percent Complete Column

Job Nbr.	activi	Actual Start	Actual Finish	Perc Comp	Rem. Dura	Act Dur
☐☐5	Module	06MAR99	12MAR99	100.	0	6
☐☐6	Module	13MAR99		50.0	1	.
☐7	Docume	11MAR99		50.0	2	.
☐8	Test	.	.	.	.	.
☐9	Ship	.	.	.	.	.
☐10	UI Mee	10MAR99	12MAR99	100.	0	3

SAS/OR User's Guide: Project Management, Version 8