Chapter 11 Running the Model

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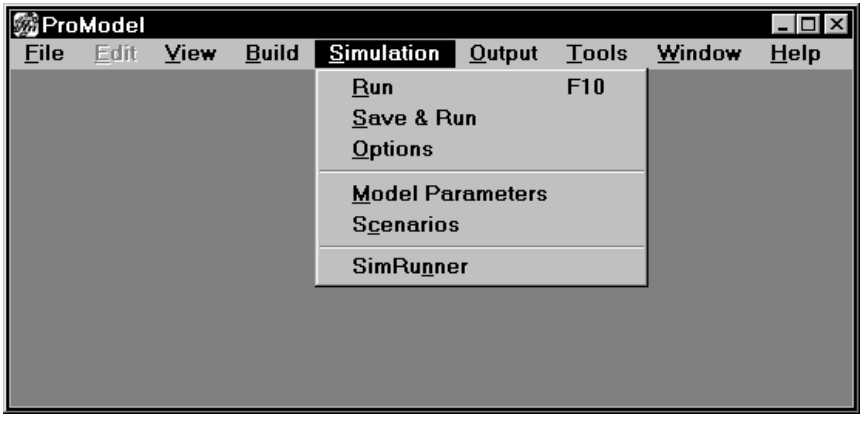
11.0.1 Simulation Menu

All of the run-time controls are accessed through the Simulation menu located on the menu bar. This menu contains options for running a model, specifying multiple replication statistics, defining scenario data, and other extended run-time options.



How To **Access the Simulation Menu:**

- Select **Simulation** from the menu bar.

Each of the selections available on the Simulation menu is explained below.

Run Choose Run to begin simulating the current model using the options previously selected in the Simulation Options dialog box. Choosing Run does not save the models to the current model file. However, the model data will be saved to the file autosave.mod. To run several scenarios, you must select Run Scenarios from the Scenarios dialog mentioned below. Otherwise, it will run the RTI default values.

Save & Run Saves the current model, then runs it.

Options Select Options to bring up the Simulation Options dialog box used to specify important run-time information such as run length, warm-up period, number of replications, multiple replication statistics, and costing. (See *Simulation Options* on page 569.)

Model Parameters Choose Model Parameters to open the Model Parameters dialog box. The dialog box allows you to modify the current settings for the RTI (Run-Time Interface) parameters defined in the Macros module. (See *Run-Time Interface* on page 443.)

Scenarios Select Scenarios to open the Scenarios dialog box. The dialog box allows you to define different scenarios using defined RTI (Run-Time Interface) parameters. (See *Scenarios* on page 576.)

11.1 Simulation Options

The Simulations Options dialog provides you with a number of options to control the simulation, such as run length, warm-up time, clock precision, and the output. You also control the type of statistics reporting you want from the simulation which includes period length and number of replications.

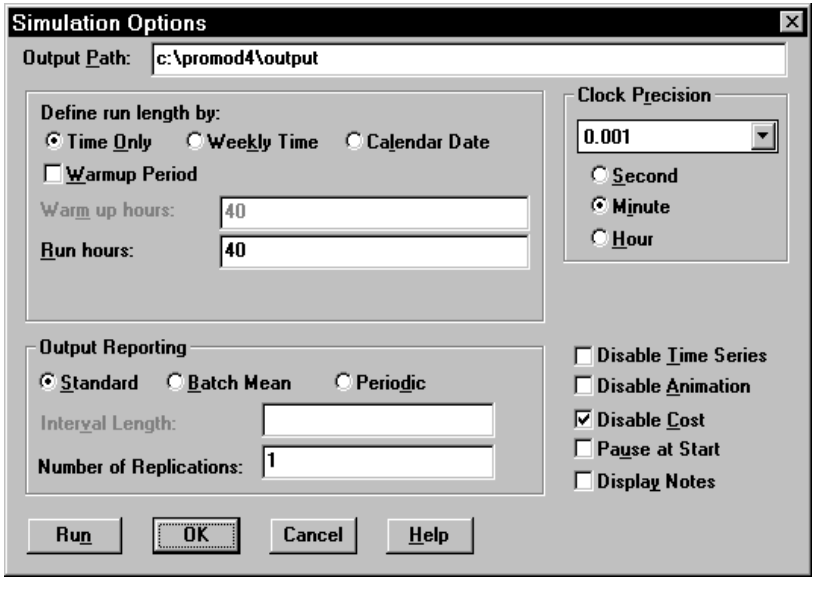
In addition to reporting standard statistics based on one or more replications of a simulation, ProModel now allows you to average statistics across intervals of a single replication (batch mean) for analyzing steady-state systems or take the average of the average statistics for specific time periods over multiple replications (periodic) for non-steady-state systems. You may choose from three statistical reporting options.

Note Replication statistics no longer need to be defined before running a model. All statistics are collected during multiple replication runs.

How To

Open the Simulation Options dialog:

1. Select the **Simulation** option from the menu bar.
2. Select **Options** to open the Simulation Options dialog.

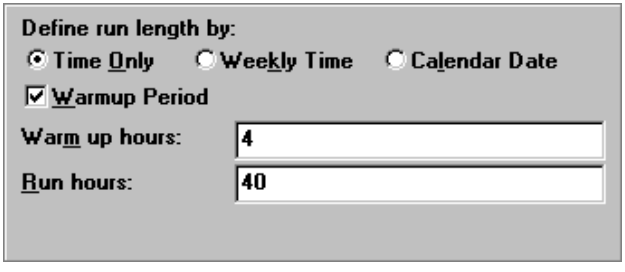


11.1.1 General Options & Settings

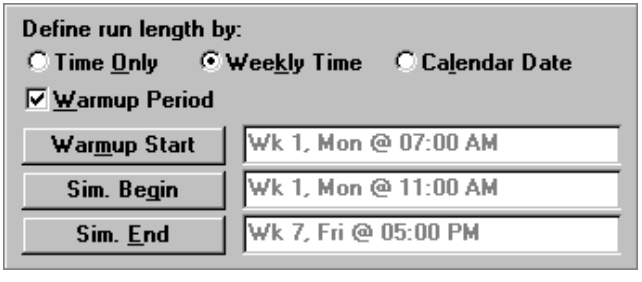
Output Path Contains the path of the output file (the name of the file is automatically created using the name of the model). ProModel records all statistical output in this file for your analysis. When you change the default path, be sure the path you enter actually exists, or an error will occur at run time.

Define Run Length by ProModel allows you to define a run length for you model based on the duration you will test.

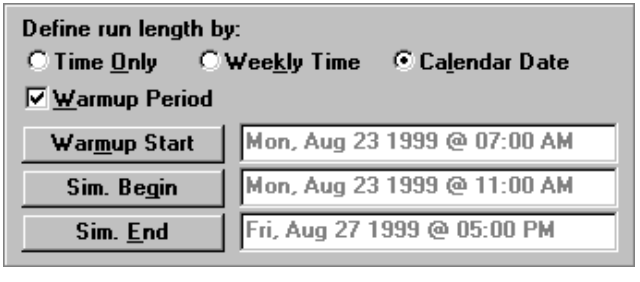
- **Time Only** The total run length in hours.



- **Weekly Time** The total run length by week, day, and time.

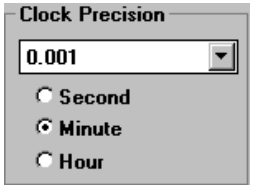


- **Calendar Date** The total run length by a specific calendar date and time.



- **Warm-up Period** The amount of time to run the simulation before collecting statistics. Usually this is the amount of time it takes for the model to reach steady state. The warm-up period uses the same units as the run length.

Clock Precision Select the clock precision value from the drop down box. Then click the radio button for the clock units you want to display at run time.



Note The maximum run length depends on the clock precision and time unit selected. The following table shows the maximum run hours for each precision setting.

	CLOCK PRECISION			
TIME UNIT	**.01**	**.001**	**.0001**	**.00001**
Seconds (sec)	11,930 hrs	1,193 hrs	119 hrs	11 hrs
Minutes (min)	715,827 hrs	71,582 hrs	7,158 hrs	715 hrs
Hours (hr)	42,949,672 hrs	4,294,967 hrs	429,496 hrs	42,949 hrs

The following table shows the default precision selections based on the time unit selected in the General Information dialog.

	DEFAULT CLOCK PRECISION SELECTIONS		
TIME UNIT	**Clock Unit**	**Clock Precision**	**Maximum Run**
Seconds (sec)	Seconds	.01	11,930 hrs
Minutes (min)	Minutes	.001	71,582 hrs
Hours (hr)	Hours	.001	4,294,967 hrs
Days	Hours	.001	4,294,967 hrs

Disable Time Series Use this option to improve run-time speed by foregoing time series statistics. This also saves disk space used to store the collected statistics.

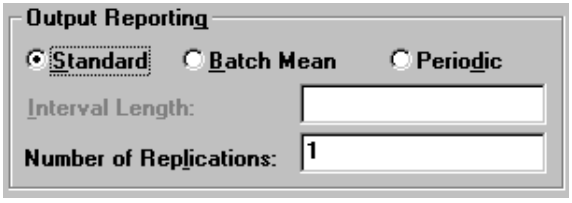
Disable Animation Use this option to improve run-time speed by shutting down the animation.

Disable Cost When you select this option, ProModel disables all cost information collection for in the model.

Pause at Start To pause the simulation at the start of the run, use this option. The simulation will pause until you select Resume from the Simulation menu in the Simulation module.

Display Notes Use this option to display the notes from the General Information dialog at the beginning of the simulation.

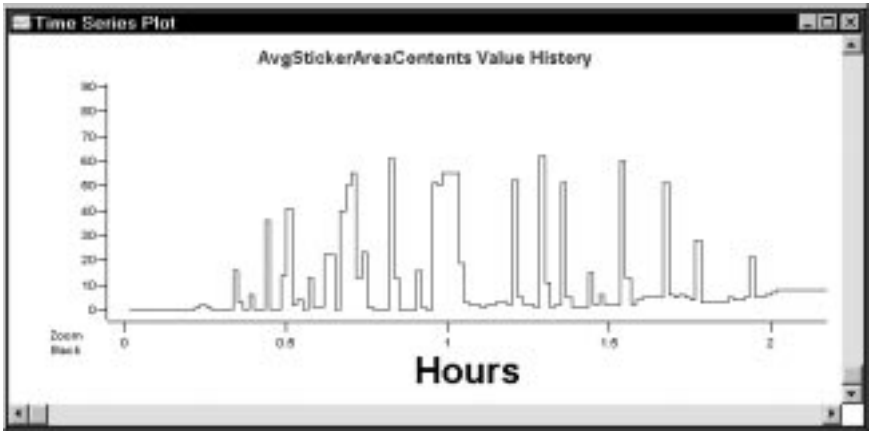
11.1.2 Output Reporting Options



Standard When you select Standard output reporting, ProModel collects output statistics for one or more replications. No interval length can be specified when using this option. From the output program, statistics can be viewed for each replication; although, by default they are displayed as an average over all the replications.

Batch Mean The method of batch means, or interval batching, is a way to collect independent samples when simulating steady-state systems as an alternative to running multiple replications. The advantage over running multiple replications is that the warm-up period runs only once. When you select Batch Mean output reporting, the output statistics are collected for each time interval indicated in the Interval Length field. The number of intervals is determined by dividing the run length by the interval length. The interval length may be an expression but will only be evaluated once at model translation, so it is always a fixed interval. The Number of Replications edit field is not used when this option is selected since it replaces the need for running multiple replications.

☞ **Example** The Content History graph below shows that the contents of Lathe1 varied throughout the simulation. The interval length was set to 0.5 hours and the simulation ran a little over 3 intervals (1 1/2 hours). The average or mean of the intervals were 2.7, 3.09, and 3.15, so the average of the interval averages is the batch mean or 2.98.



Periodic Useful primarily in terminating or non-steady state simulations where you are interested in the system behavior during different periods (e.g., peak or lull periods) of activity.

When you select Periodic output reporting, the output statistics are collected by period where the length of a period is defined in the interval length field.

The interval length may be an expression but will only be evaluated once at model translation, so it is always a fixed interval. To define unequal intervals, see Customized Reporting which follows.

You may gather statistics for a periodic report over multiple replications. From the output program, you can view each replication averaged over the periods, each period averaged over the replications, or the pooled average (the average for each period averaged over all of the replications).

☞ **Example** The content history table below shows how the contents of Lathe1 varied throughout the simulation and from one replication to the other. The interval length was set to 0.5 hours and the simulation ran a little over 3 periods (11/2 hours) with two replications. The results are shown below.

Periodic Output	Period 1	Period 2	Period 3
Replication 1 Avg.	2.70	3.09	3.15
Replication 2 Avg.	2.20	3.13	3.01
Pooled Average	2.45	3.11	3.08

Interval Length Enter the interval length as the number of time units for each interval or period. The interval length may be an expression but will only be evaluated once at model translation, so it is always a fixed interval. To define unequal intervals, see Customized Reporting which follows. The time unit is defined in the General Information dialog. The interval length need only be specified when using Batch Mean or Periodic reporting.

Number of Replications Enter the number of replications you want the simulation to run in this field. Number of replications only needs to be specified when using Standard or Periodic reporting.

11.1.3 Running a Specific Replication

ProModel allows you to run a specific replication in order to produce time series graphs in the Output Program. To run a specific replication, enter the "@" symbol in the "Number of Replications" box followed by the replication number. For example, "@5" will run only the fifth replication.

11.1.4 Customized Reporting

For customized reporting, you may want to take advantage of the following statements: REPORT, RESET STATS, and WARMUP. See *Report* on page 211, *Reset Stats* on page 215, and *Warmup* on page 250 of the *ProModel Reference Guide* for syntax and examples.

REPORT A general statement called from any logic. When the statement is called, a full set of statistics is saved to be viewed as a snapshot report in the output processor. Optionally, the statement optionally allows you to reset the statistics after the report is saved, giving you a batch or period for any time interval you define.

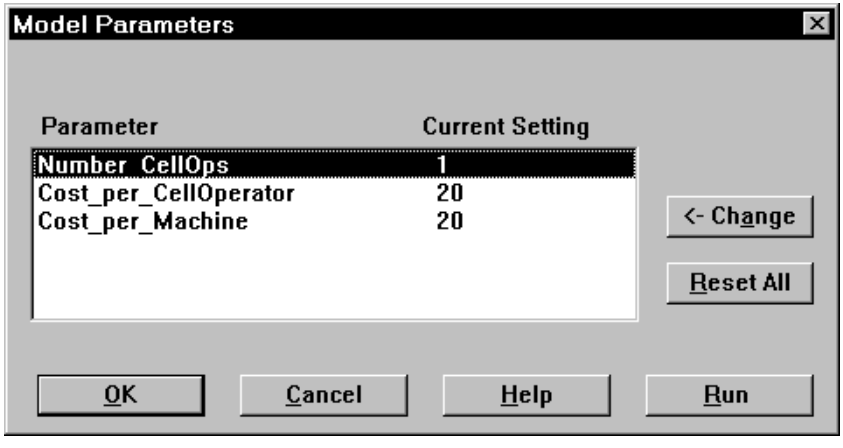
RESET STATS A general statement called from any logic and is generally used in connection with the REPORT statement. When this statement is used, all statistics are set to zero. The output database is not erased (see WARMUP).

WARMUP A general statement called from any logic. When this statement is used, all statistics are set to zero and the output database is erased. Use this statement in conjunction with the WAIT UNTIL statement to wait until specific parameters in the system being modeled are at a steady state or other conditions are appropriate to declare the warm-up period over.

11.2 Model Parameters & Scenarios

11.2.1 Model Parameters

The Model Parameters dialog box allows you to modify the current settings for the Run-Time Interface (RTI) parameters defined in the macros module. This provides a convenient interface for making model changes without using the Build modules. To define and run multiple scenarios using RTI parameters, select the Scenarios option from the Simulation menu (see discussion on Scenarios later in this section). Model parameter settings are saved with the model for future use.



Parameter The name of the macro defined in the model as the RTI (Run-Time Interface) parameter. The parameter name does not need to be the same name as the macro.

Current Setting The current setting of the parameter.

Change Allows you to change the current setting of the parameter.

Reset All Resets all parameters to the default RTI setting defined in the Macros module.

Run Runs the model with the defined current model parameter settings.

How To

Define an RTI parameter:

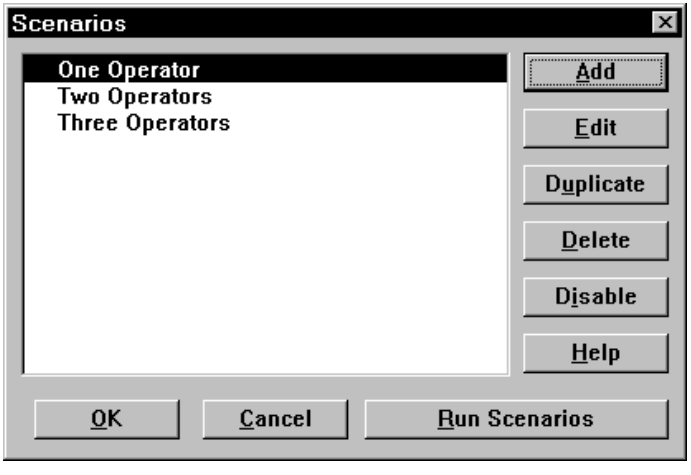
1. Choose **More Elements** from the **Build** menu.
2. Choose **Macros**.
3. Type the macro name, choose the RTI button, and select Define.

4. Define the Parameter Name.
5. Enter the Prompt (optional).
6. Select the parameter type, Unrestricted Text or Numeric Range.
7. If defining a Numeric Range, enter the lower and upper boundary for the range.
8. Click **OK**.
9. Use the macro ID in the model (e.g., operation time, resource usage time, etc.).

Note For more information on RTI, see *Run-Time Interface* on page 443.

11.2.2 Scenarios

ProModel gives you the option of defining several scenarios for a model using RTI parameters specified for the model. A scenario is a set of run-time parameters with settings defined by the user. Using scenarios allows you to alter various model parameters to run a series of "what-if" scenarios without changing the model directly. This technique makes it easy for people who have no interest in dealing with the modeling logic to efficiently make changes to the model and learn what would happen under a variety of circumstances. Scenarios are saved with the model for future use.



Add Opens the Scenario Parameters dialog box to add a scenario.

Edit Opens the Scenario Parameters dialog box to edit an existing scenario.

Duplicate Duplicates the selected scenario and opens the Scenario Parameters dialog box, allowing you to give the newly created scenario a name and edit its data.

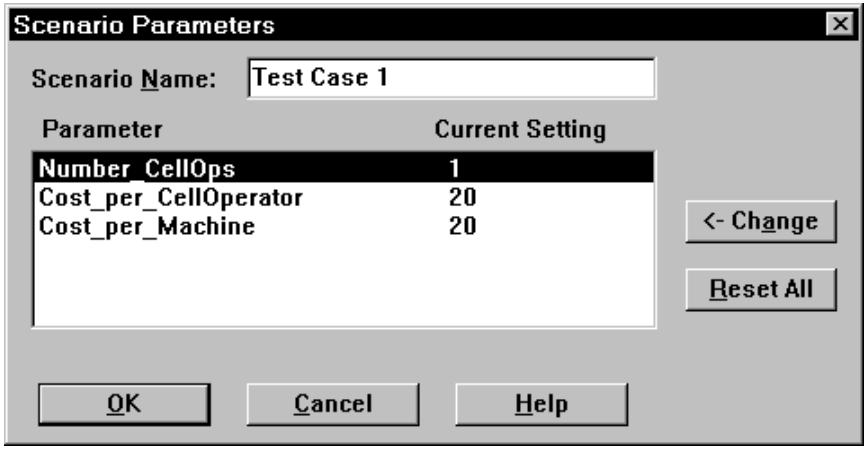
Delete Deletes the selected scenario.

Disable/Enable Disables or enables the selected scenario.

Run Scenarios Runs the model with the defined scenarios. When running several scenarios, clicking on the Abort button during translation will terminate all scenarios instead of just the current scenario.

Scenario Parameters Dialog

The Scenario Parameters dialog box is displayed when choosing Add, Edit, or Duplicate from the Scenarios dialog box. This allows you to control the specifics of a scenario.



Scenario Name The name of the scenario. This name is chosen by the user and may contain any alphanumeric characters.

Parameter The name of the parameter as defined in the RTI (Run-Time Interface) definition dialog box invoked from the Macro editor.

Current Setting The current setting of the parameter.

Change Allows you to change the current setting of the parameter.

Reset All Resets all parameters to their default settings.

Note Only macros defined as RTI parameters will be displayed as parameters for the scenario. (See *Macros* on page 439.)

How To

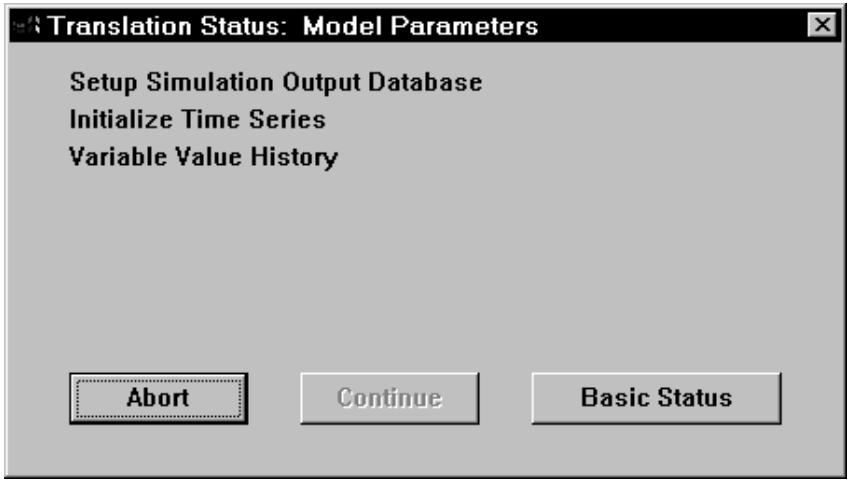
Define a scenario:

1. Choose **Scenarios...** from the **Simulation** menu.
2. Choose the **Add** button.
3. Define the scenario name by typing text in the Scenario Name box.
4. Double-click on the Parameter to bring up the parameter dialog box or select the Parameter and click the **Change** button.
5. Type the text in the box in the Parameter dialog box.
6. Select **OK** in the Parameter dialog box.
7. Repeat for every parameter desired.
8. Select **OK** in the Scenario Parameters dialog box.

11.3 Running the Simulation

Choosing Run begins the simulation of the current model. The model is automatically saved in a file called autosave.mod. Therefore, if the simulation is terminated abnormally for some reason, ProModel will ask you if you would like to load the latest autosave.mod file when you re-open ProModel. If you choose Save & Run the model will be saved in the AUTOSAVE.MOD file as well as the <model name>.mod file.

Once you choose the Run option, a translation status window appears, showing which data is currently being translated. This gives you the option to abort the simulation run at any time. As shown below, the path networks are being mapped.



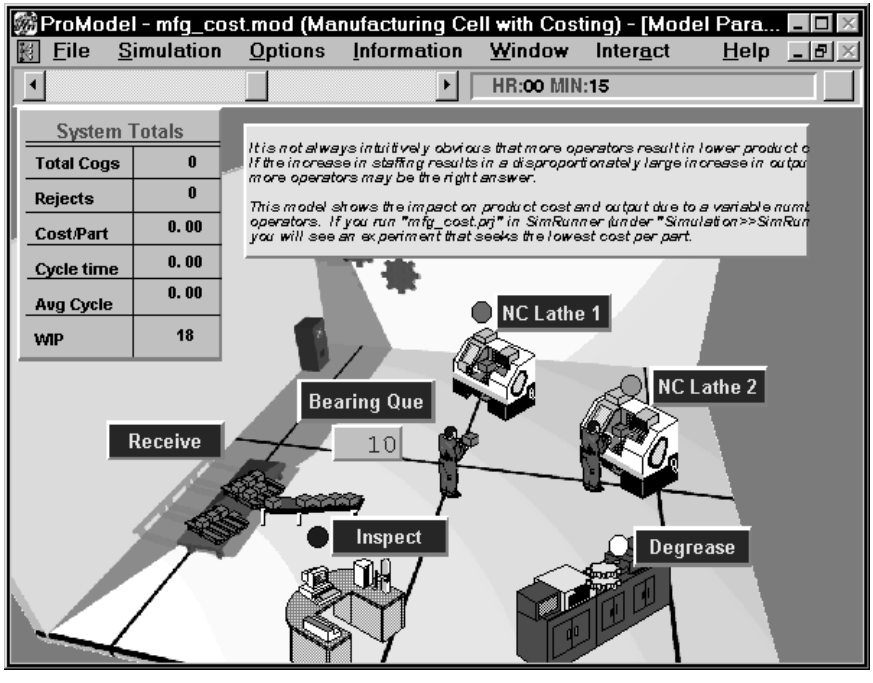
Abort Allows you to cancel model translation at any time during translation.

Continue Allows you to continue model translation when a warning message is displayed.

Detailed Status Allows you to view more specific information about the data in translation.

11.4 Run-Time Menus & Controls

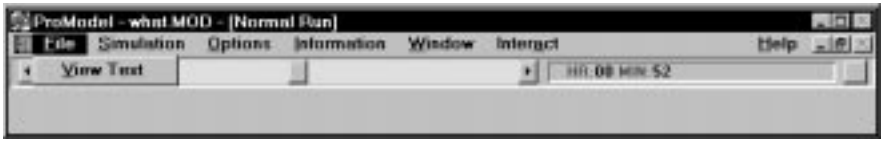
Once a simulation begins, a new menu bar appears at the top of the screen with selections for controlling and interacting with the simulation. As shown below, these menu items appear above the animation speed control bar and simulation clock.



Each of the menu selections and the tools for controlling the animation are described in the remainder of this chapter.

11.4.1 Run-Time File Menu

The run-time File menu contains only one selection: View Text.

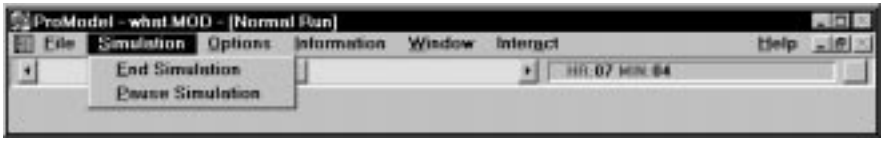


View Text Choose this option to bring up a window with a text listing of the current model. This feature is extremely useful for debugging and verifying models.

Note You may switch back and forth between a full size View Text window and the animation screen by choosing the desired window from the Window menu option.

11.4.2 Run-Time Simulation Menu

The Run-Time Simulation menu has two options: End Simulation and Pause/Resume Simulation.

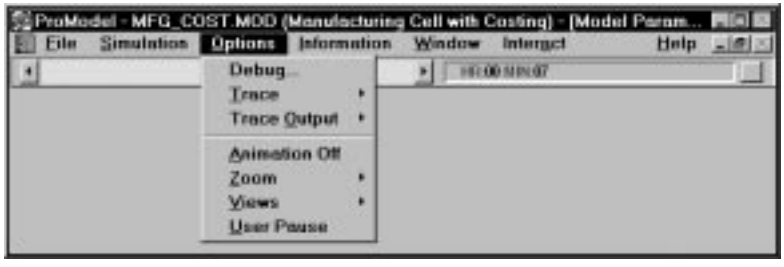


End Simulation Choose this option to end the simulation. You will then be prompted to collect statistics or return to the model editor without collecting statistics. If running multiple scenarios, End Simulation will terminate all scenarios.

Pause/Resume Simulation Choose Pause Simulation to pause the simulation for an indefinite amount of time. With the simulation paused, you may begin a trace, zoom in or out, set up the next pause, examine different locations in the model, or interact with the model in a number of other ways. Choose Resume Simulation when the simulation is paused to continue running the simulation.

11.4.3 Run-Time Options Menu

The Run-Time Options menu has several selections that allow you to interact with the simulation while the model is running. These options are described in the following pages.



Debug Brings up the Debugger Options Dialog box for debugging the model.

Trace Lists events as they happen during a simulation. This listing may be Step by Step or Continuous.

Trace Output Gives the user the option to send the trace to a file (<model name>.TRC) or to the window.

Animation Off/On Turns the animation on or off. Off greatly speeds up the simulation. Animation speed may also be set with the ANIMATE statement. (See *Animate* on page 117 of the *ProModel Reference Guide* for information.)

Zoom Zooms in or out on the animation.

Views Allows you to select a view defined while building the model.

User Pause Allows the user to enter a simulation clock time for the simulation to pause.

11.4.4 Debug Option

Debugging ProModel Logic

The Debugger is a convenient and efficient way to test or follow the processing of any logic defined in your model. The debugger is used to step through logic one statement at a time and examine variables and attributes while a model is running.

Before discussing the details of the Debug option, it is important to understand the following terms:

Statement A statement causes ProModel to take some action or perform some operation. This includes statements such as GET, JOIN, etc. (See *Get* on page 155 and *Join* on page 172 of the *ProModel Reference Guide* for more information.)

Logic A logic is the complete set of statements defined for a particular process record, downtime event, initialization or termination of the simulation, etc.

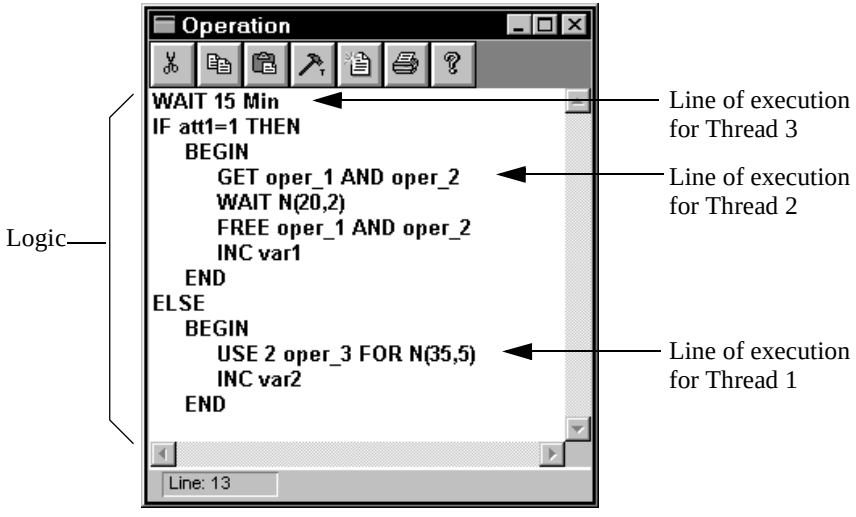
Thread A thread is a specific execution of any logic. A thread is initiated whenever a logic needs to be executed. This can be an entity running through an operation logic, the initialization logic, a resource running a node logic, a downtime logic, or any other logic. Note that the same logic may be running in several threads at the same time. For example, three entities of the same type being processed simultaneously at the same multi-capacity location would constitute three threads.

A thread or logic execution can be suspended by any statement, causing simulation time to pass (e.g., GET Res1, WAIT 5, etc.) After such a statement completes its task, the thread is resumed. During the time a thread is suspended, other threads may be initiated, suspended, resumed, or completed. This is called thread switching.

Note Even though there can be several threads executing the same logic at the same current time in the simulation, the simulation processor can only process them one at a time. So there is really only one current thread while all other threads are suspended (either scheduled for some future simulation time, or waiting to be executed after the current thread at the same simulation instant).

Example

To better explain the above concepts, consider the following operation logic for a multi-capacity location.



The logic includes all statements shown on previous page. Let's assume that there are three different entities currently executing this operation logic. Each executing entity constitutes a thread. A possible scenario for this case is the following: Thread 1 is an entity using two units of resource Oper_3 for N(35,5) minutes. Thread 2 is an entity waiting for resource Oper_1 to become available. The last thread is a different entity which has completed 10 minutes of the 15 minute wait executed at the beginning of the logic. Note that two entities arriving at a multi-capacity location at nearly the same time could both execute the same WAIT or USE time in the logic, only in different threads.

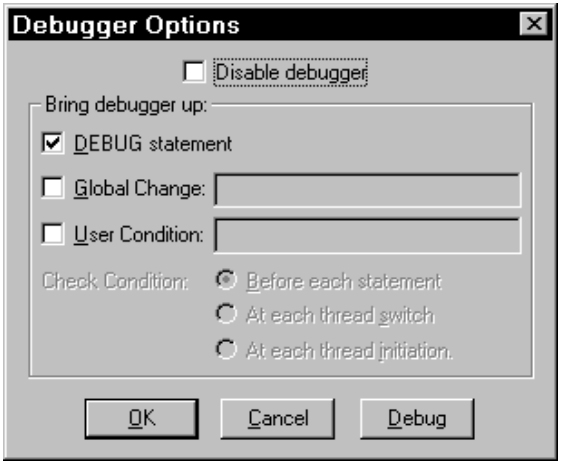
In general, for a logic block containing statements that pass simulation time, any number of threads can wait for the required simulation time to elapse, corresponding to each time elapsing statement. These threads are scheduled to resume at some future simulation time.

There can also be many threads (any number of threads corresponding to each of the time elapsing statements within the logic) which have completed their waiting time, but await their turn to continue execution. These threads are on hold because the simulation engine is busy with another thread scheduled for the same simulation time instant. There is only one thread executed at any real time instant by the simulation engine.

The debugger window will display a unique identification number for the current, active thread. This thread ID number will help you differentiate between different instances of the same logic block while you are debugging your models.

Debugger Options Dialog Box

The Debugger Options dialog box allows the user to specify when to display the Debugger dialog box during the simulation run.



Disable debugger Disables the debugger completely. By default, the debugger is enabled. Running the model with the debugger disabled increases the run speed. When running multiple replications or scenarios, or when the animation is disabled, the debugger will automatically be disabled.

DEBUG statement Displays the Debugger dialog box every time a DEBUG statement is encountered in an enabled process while running the simulation. See DEBUG statement in the *ProModel Reference Guide* for more information.

Global Change Displays the Debugger dialog box every time a global change occurs to a specified variable, attribute (entity or location), or array. The Debugger dialog box shows the original and new value of the element. Only one global name can be specified in this box.

User Condition Displays the Debugger dialog box when a defined user condition written as a Boolean expression becomes true, for example, when Var1=5. Only one expression can be specified in this box, although several conditions can be tested by using the OR operator. See the *Boolean Expressions on page 71* of the *ProModel Reference Guide* for more information.

Check Condition Allows the user to define how often to check the user condition. The options include:

- **Before each statement** The condition, such as Var1=1, will be checked before each statement is executed. This option is the most precise way to tell

exactly when the user condition becomes true, but slows down the simulation the most.

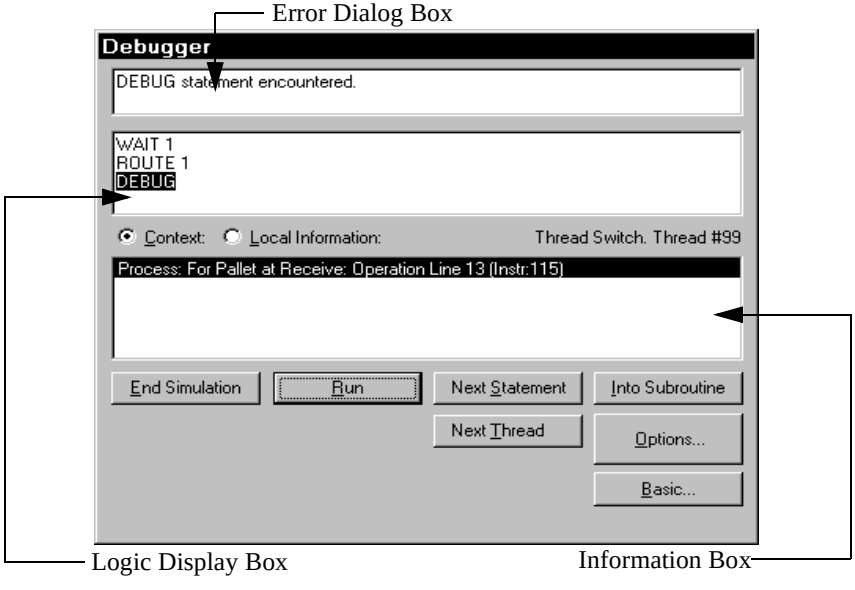
- **At each thread switch** The condition, such as Var3>17, will be checked only if a statement from a different thread follows the current statement being executed.
- **At each thread initiation** The condition, such as Att1=5, will be checked only if the next statement to be executed is the first statement in a thread (the first statement in a thread is also the first statement of a logic).

Debug button Pressing the Debug button displays the Debugger dialog box before the next statement executes.

OK Closes the Debugger Options dialog box and continues to run the simulation model.

Debugger Dialog Box

The Debugger can be used in two modes: Basic and Advanced. The Basic Debugger appears initially with the option of using the Advanced Debugger. The Basic Debugger dialog box is shown below:



Error Display Box Displays the error message or reason why the Debugger dialog box is displayed, such as the User-Condition becoming true.

Logic Display Box Displays the statements of the current logic being executed.

Information Box Displays either the context of the logic or local information as mentioned below.

Context Displays the module, operation, and line number (in which the debugger stopped) in the Information box.

Local Information Displays local variables and entity attributes with non-zero values in the Information box.

End Simulation Choose this option to terminate the simulation. This will prompt you about collecting statistics.

Run Continues to run the simulation, but still checks the debugger options selected in the Debugger Options dialog box.

Next Statement Jumps to the next statement in the current thread. If the last statement executed suspends the thread (e.g., the entity is waiting to capture a resource), another thread meeting the debugger conditions may be displayed as the next statement.

Next Thread Brings up the Debugger at the next initiated or resumed thread.

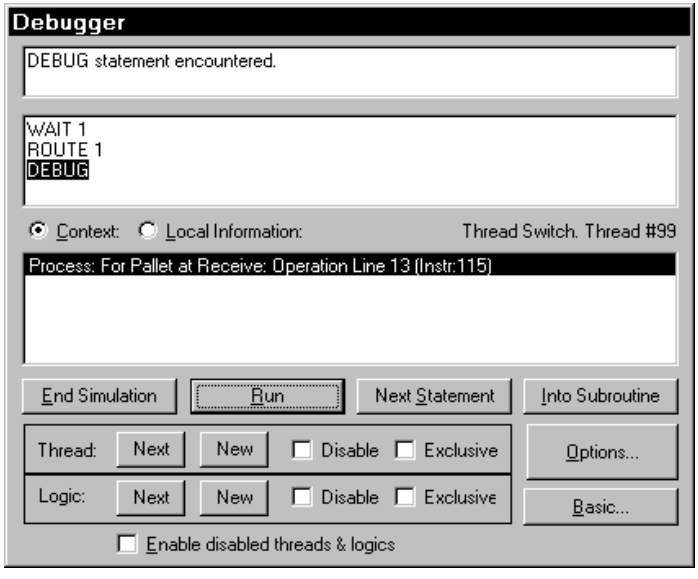
Into Subroutine Steps to the first statement in the next subroutine executed by this thread. Again, if the last statement executed suspends the thread, another thread meeting debugger conditions may be displayed first. If no subroutine is found in the current thread, a message is displayed in the Error Display box.

Options Brings up the Debugger Options dialog box. You may also bring up this dialog box from the Simulation menu.

Advanced Changes the Debugger to Advanced mode, providing additional options discussed next.

Advanced Debugger Dialog Box

The Advanced Debugger contains all options in the Basic Debugger plus a few advanced features.



Next (Thread) Jumps to the next initiated or resumed thread. This button has the same functionality as the Next Thread button in the Basic debugger.

New (Thread) Jumps to the next initiated thread.

Disable (Thread) Temporarily disables the debugger for the current thread (see also enable).

Exclusive (Thread) The debugger displays the statements executed within the current thread only. When the thread terminates, the exclusive setting is removed.

Next (Logic) Jumps to the next initiated or resumed thread not executing the same logic as the current thread.

New (Logic) Jumps over any resumed threads to the next initiated thread not executing the same logic as the current thread.

Disable (Logic) Temporarily disables the debugger for all threads executing the current logic (see also enable).

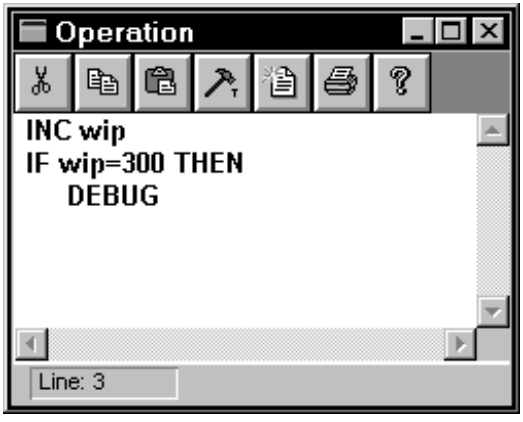
Exclusive (Logic) The debugger displays only the statements executed in any thread executing the current logic.

Enable disabled threads and logics Enables the threads and logics which were disabled previously.

Debugger Options Examples

Debug Statement Example

A simulation model demonstrates a proposed flexible manufacturing system which produces castings. A variable, WIP, is used to track the work in process for the system. Suppose we want to display the Debugger when the variable, WIP, reaches a value of 300. We could place an IF...THEN statement including DEBUG after the statement incrementing the variable, WIP, as shown below:



By checking the box next to the DEBUG statement in the Debugger Options dialog, the Debugger is displayed when the variable, WIP, reaches 300.

Global Change Example

Suppose we want to know when the variable, COUNT, is incremented. We would check the box to the left of Global Change and type COUNT in the Global Change field. This will display the Debugger dialog box each time COUNT changes. It will also display the previous and changed value of COUNT.

User Condition Example

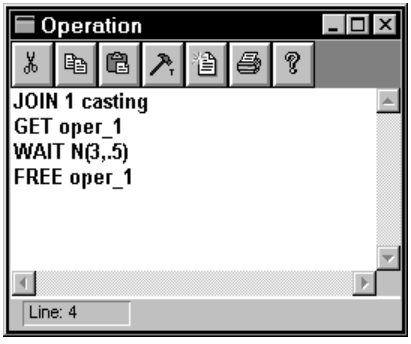
Suppose we want to follow a casting through the entire system (i.e., from when an entity enters the system to when it exits). We would set an attribute equal to a unique number in the arrival logic for a single casting (Att1=3). In other words, only one casting in the system should have Att1=3. We would then check the User Condition box and enter the condition as "Att1=3." We would then select At Each Thread Initiation as the Check Condition. The debugger is displayed each time that particular casting initiates a new thread. For example, the debugger may display the following information:

```
Casting @ Loc1: GET Oper_1
                WAIT N(5,3)
                INC Var1
                FREE Oper_2
Casting @ Loc2: JOIN 1 Fixture
...
...
...
```

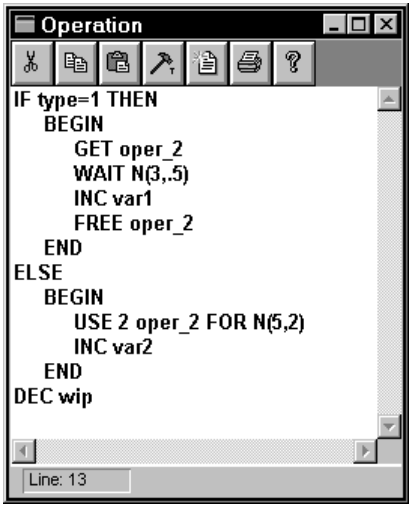
Debugger Dialog Examples

Suppose we have the following logics in the processing table of the model. Both logics are found at multi-capacity locations. Let's assume two castings are being processed at Load_Station while three castings are being processed at Unload_Station at this instant of simulation time.

Logic for Load_Station

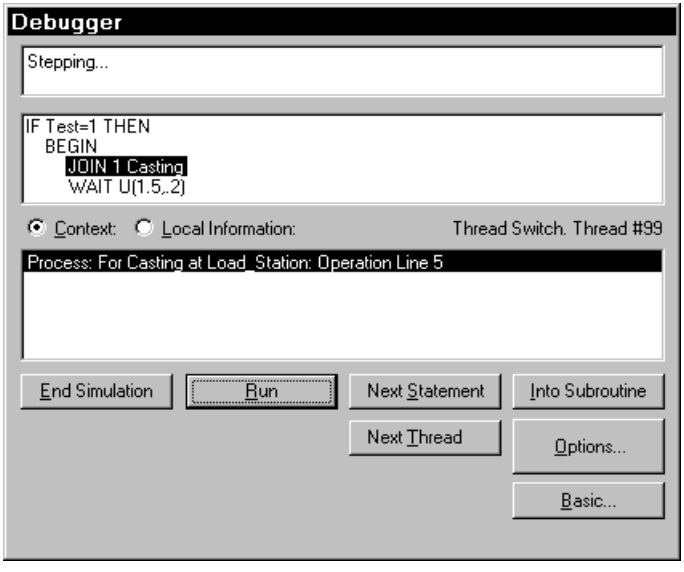


Logic for Unload_Station



Next Statement

If we accessed the Debugger dialog box and the next statement executed was JOIN 1 Casting in the logic for Load_Station, we would see the following dialog box:



If we continued to click on the Next Statement button, it would lead us through the logic statement by statement. Since the JOIN statement may cause some simulation time to elapse, the next statement displayed may be a statement within another thread if that thread matches the requirements of the debugger (e.g., a variable changed, user condition met, etc.) unless:

1. There is already a part waiting for a JOIN request and there are no other threads scheduled for the same simulation instant, or
2. There are no other threads scheduled over the simulation time until after the requested part becomes available

The unique thread ID shown in the middle-right portion of the debugger window will indicate whether we have switched threads or not.

Note If you are using the Next Statement button in multiple threads simultaneously, all threads will be shown in the order in which the statements are executed in simulation time.

Next Thread

If we clicked on the Next Thread button, it would automatically switch us to the next thread executed during the simulation run. The next thread may or may not be using the same logic. For example, suppose the Debugger dialog box shows that we are in the logic for Unload_Station at "Use 2 Oper_2 for N(5,2)." Selecting the Next Thread button may show us another entity at Unload_Station while executing a different statement within the same logic such as "Get Oper_2." This is the next thread because it refers to a different entity, although the entities may have the same name. In fact, two entities could execute the very same line of logic using different threads.

New Thread

Consider a situation where you are using the debugger and have concluded that all the current threads are executing properly. You want to go to a new thread which has not yet been initiated. For example, you may have six entities, three EntA's and three EntB's, in a system which are executing logic as intended. Choosing New Thread may display the information for an entity, EntC, which has just arrived into the system and is creating a new thread. It may also display information about other EntA's or EntB's which may arrive at any location or thread related to resource downtimes or node entry/exit logics.

Next Logic

When a logic is functioning well in all its various threads and you are not interested in examining that logic any more, choosing the Next Logic option will hide the Debugger until ProModel switches to a thread of a different, possibly already running logic. For example, you may be currently viewing the logic for Load_Station but wish to look at a logic elsewhere in the model, possibly at Unload_Station. Selecting the Next Logic button would jump to the next thread (resumed or initiated) not executing the current logic.

New Logic

New Logic will jump to a newly initiated thread that will not execute the current logic. If there are two entities at Load_Station and, while executing the logic at Load_Station you choose new logic, you will jump to the logic at a location in which the logic is not currently executing.

Exclusive Thread

To debug the model and ensure castings are traveling through the system as planned, we can follow a single thread completely through the logic. To do this, check the Exclusive box next to Thread. This option will follow the current thread through the end of the logic. There may be 50 entities in the system at a particular time, but choosing the Exclusive box will follow only one of the 50 entities. That is, the thread ID number displayed in the debugger window will stay the same until the current thread is disposed.

Exclusive Logic

To ensure a particular logic is executing as planned, use exclusive logic to check the behavior of several entities for a specific operation logic or several units of resources for a specific resource downtime logic. For example, there may be three entities executing the logic at the Unload_Station location. Selecting exclusive logic will show the three different threads executed for the three entities at the location because those threads are separate instances of the same logic.

This may be particularly useful for long logics with several IF...THEN statements based on attribute values. Suppose a logic contains ten IF...THEN statements based on attribute values, Att1=1, 2, 3,...10. Depending on the attribute value, a different processing time is executed with different resources. If you want to follow the logic at this location to ensure it is executing properly, use exclusive logic.

11.4.5 Trace Options

A trace is a list of events occurring over the course of a simulation. For example, a trace statement might state “EntA arrives at Loc1, Downtime for Res1 begins.” A trace listing also displays assignments, such as variable and array element assignments. A trace listing of a simulation run may be viewed in several ways through the trace options provided.

Trace Mode

A trace listing is generated in one of two modes, Step or Continuous.

Off Select this option to discontinue a current trace.

Step Select this option to step through the trace listing one event at a time. Each time you click the left mouse button, the trace will advance one event. Clicking and holding the right mouse button while in this mode generates a continuous trace.

Continuous Select this option to write the trace continuously to the output device selected from the Trace Output submenu. This is useful when you do not know exactly where to begin or end the trace. Clicking and holding the right mouse button stops the trace until you release the button.

Trace Output

A trace may be sent to one or more output devices by checking each desired output. For example, you may select “To Window” and “To File” to see a listing on your screen and also save the information in a text file.

To Window Select this option to view the trace in an on-screen trace window. You may size the trace window to your liking to see more or less of the trace listing.

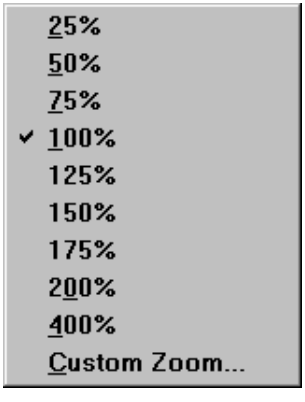
To File Select this option to send the trace listing to a text file. Trace statements are automatically written to a <model name>.TRC file.

11.4.6 Animation Options

In addition to the debug and trace options, animation options allow you to control the animation screen.

Animation Off Choose this option to temporarily suspend the animation. To resume the animation, select this option again. (The selection automatically changes to “Animation On.”) Note that running with animation off greatly increases the run speed, especially for models with a large amount of graphic detail. To increase the run speed to an even faster rate, check the Disable Animation in the Simulation Options before running the model (see *Simulation Options* on page 569).

Zoom Select this option to Zoom in or out on the animation. When this option is selected, you may choose a preset zoom level, enter your own zoom level, or choose Zoom Full to fit the entire animation on one screen. The Zoom function zooms to the center of the screen. If the zoom factor causes the model layout to appear outside the layout window, the zoom function will automatically pan to show at least part of the layout.

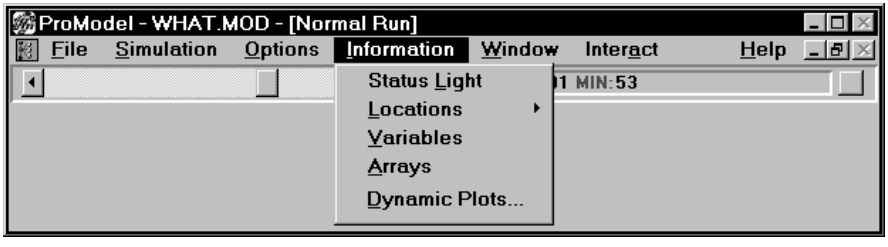


Views Click on this menu item to display the available views. Select the desired view.

User Pause Choose this option to enter a time for the simulation to pause. The proper format for specifying a user pause is hh:mm.xx where hh represents hours, mm represents minutes, and xx represents hundredths of a minute.

11.4.7 Run-Time Information Menu

The Run-Time Information menu allows you to see the status of locations in two different ways. In addition, you may view the current state of all variables and array elements. Each of these options is defined in the following pages.



Status Light Select this option to bring up the Status Light Legend shown on the following page.

Locations Select this option and choose a location to view an information box with real time information about the location. Information for all locations may also be displayed.

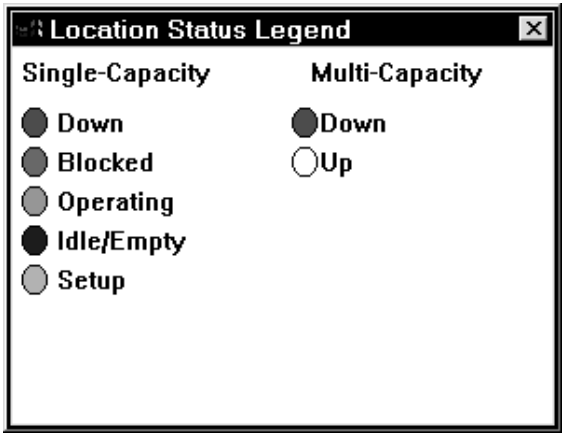
Variables Select this option to show the current state of all real and integer global variables.

Arrays Select this option to show the current value of all cells for arrays of up to three dimensions.

Dynamic Plots Allows you to graphically monitor the performance of model elements during run time and store statistical data in an Excel® spreadsheet.

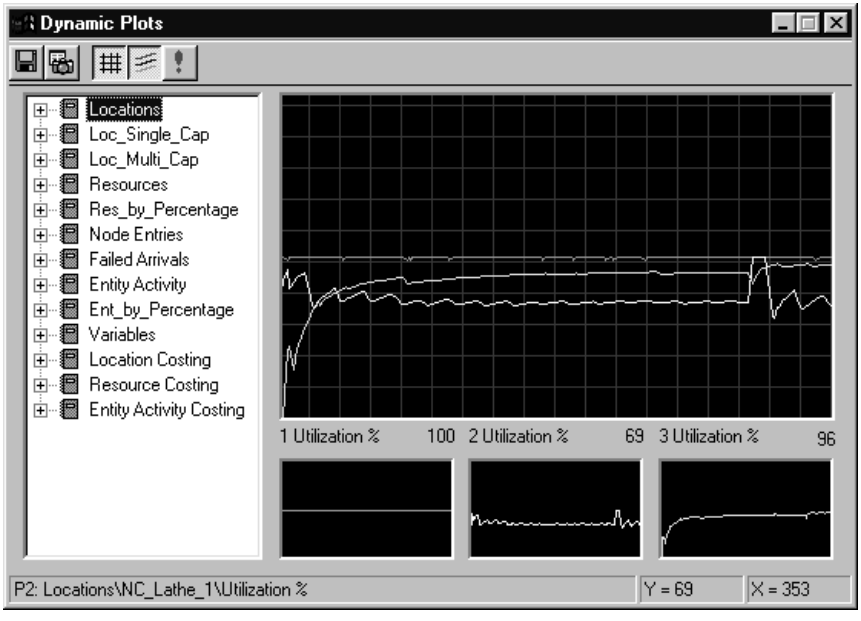
Location Status Legend

The Location Status Legend shows the different colors of a location status light and the meaning of each color. Single capacity locations may be in any of several states, while multi-capacity locations appear only as up or down. This window may remain open during the simulation.



11.4.8 Dynamic Plots

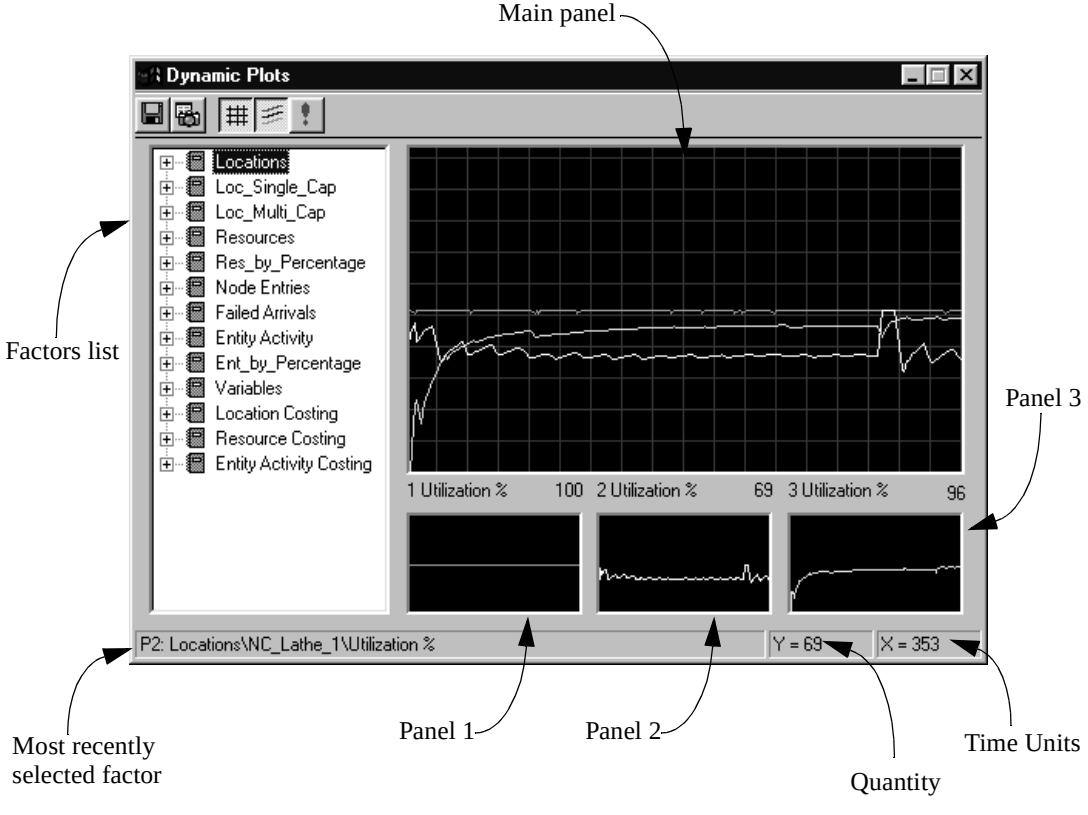
The dynamic plot enables you to graphically observe and record statistical information about the performance of model elements during run time.



Getting to Know the Dynamic Plots Dialog

Windows and controls

The dynamic plot dialog contains a factors list, four panels, and several button controls. The factors list contains each of the available model factors from your model and the panels display performance graphs for the factors you select. You can use the main panel to display a single factor's performance graph or combine the graphs of the factors displayed in panels 1, 2, and 3.



Button controls

Save  Saves a copy of *ALL* model data—from the time you start the dynamic plot to when you click save—to an Excel® spreadsheet. See *Saved Files* on page 607.

Snapshot  Saves a copy of currently displayed, *graphed* model data to an Excel® spreadsheet. See *Snapshot Files* on page 607.

Grid  Turns the main panel grid lines on and off.

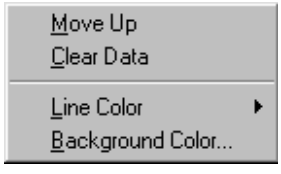
Multi-line  Displays a combined graph of panels 1, 2, and 3.

Refresh  Redraws the graphs.

Right-click menus

Right-click menus for dynamic plots are available for panels 1, 2, 3, and the main panel. When you right click in any of these panels, one of the following menus appears.

Panels 1, 2, and 3



Move Up Places the graph in the main panel.

Clear Data Removes the factor and its graph from panel 1, 2, or 3, *and* the main panel. If you created a multi-line graph, Clear Data removes the selected item from the graph and does not disturb the remaining graph lines.

Line Color Allows you to assign a specific line color to the graph.

Background Color Allows you to define a specific background color for panels 1, 2, and 3.

Main panel

Clear All Data Removes all factors and graphs from panels 1, 2, 3, *and* the main panel.

Remove Line 1, 2, 3 Deletes a specific line from the main panel.

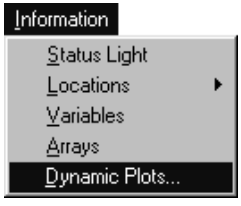
Background Color Allows you to define a specific background color for panels 1, 2, and 3.

Grid Color Allows you to assign a specific line color to the grid.

Basic Operation

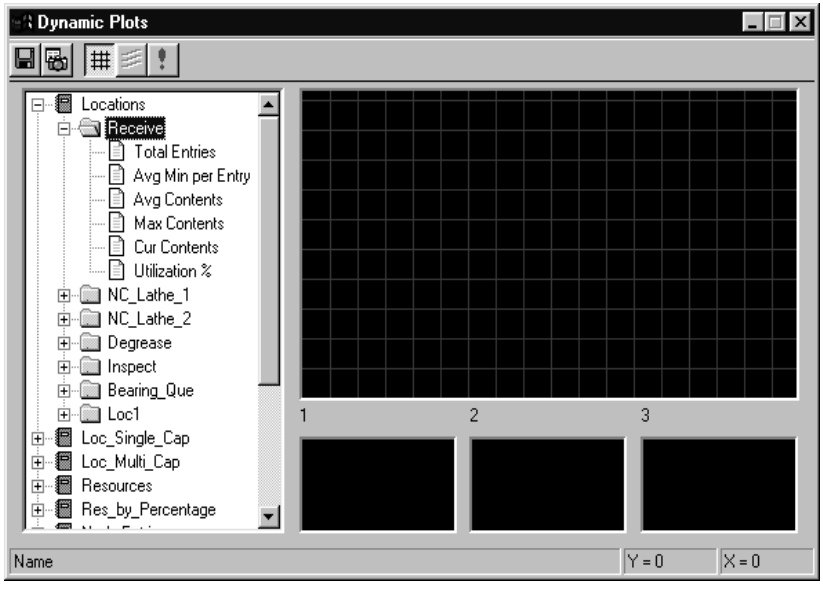
How To **Create a dynamic plot:**

1. Open and simulate the model you wish to examine.
2. Select **Dynamic Plots** from the run-time **Information** menu. The dynamic plots dialog will appear.



Hint To allow you additional time to set up the dynamic plot, pause the simulation.

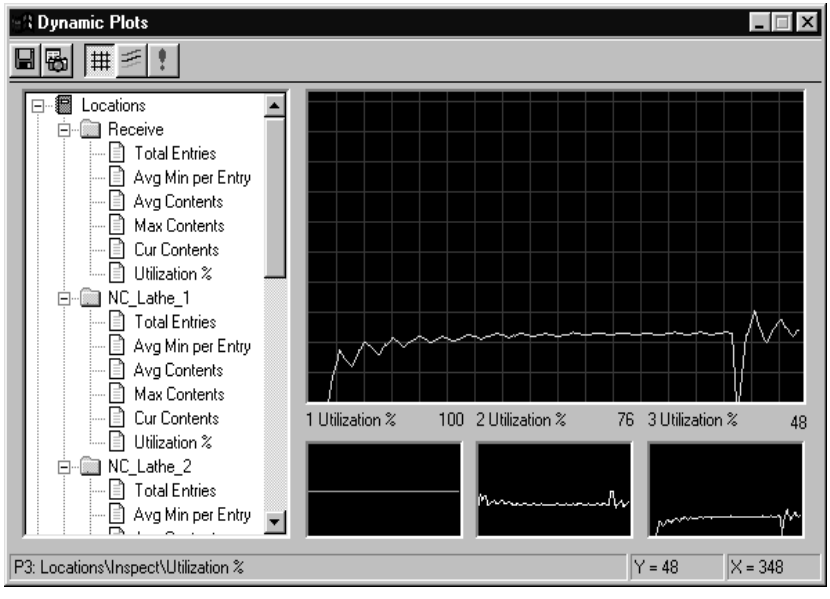
3. Select the model factors you wish to graph from the factors list. To create a plot for a specific item, select the item and right click.



4. From the pop-up dialog that appears, select the panel to which you will display the graph for the item. (Repeat steps 3 and 4 to display graphs in other panels.)

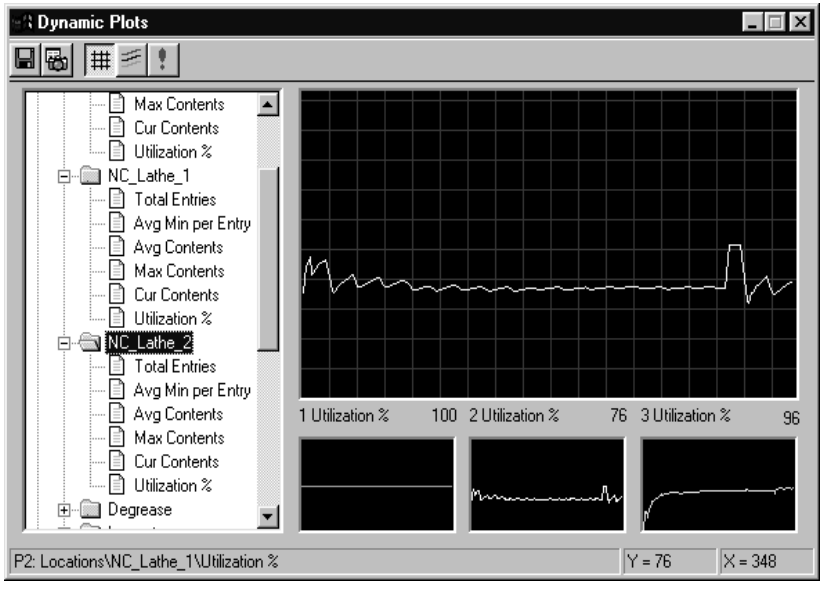
Note If you double click on an item in the factors list, the factor will display in Panel 1.

5. Once you identify the factors you wish to observe, graphs for these factors will appear in the panels you assign.



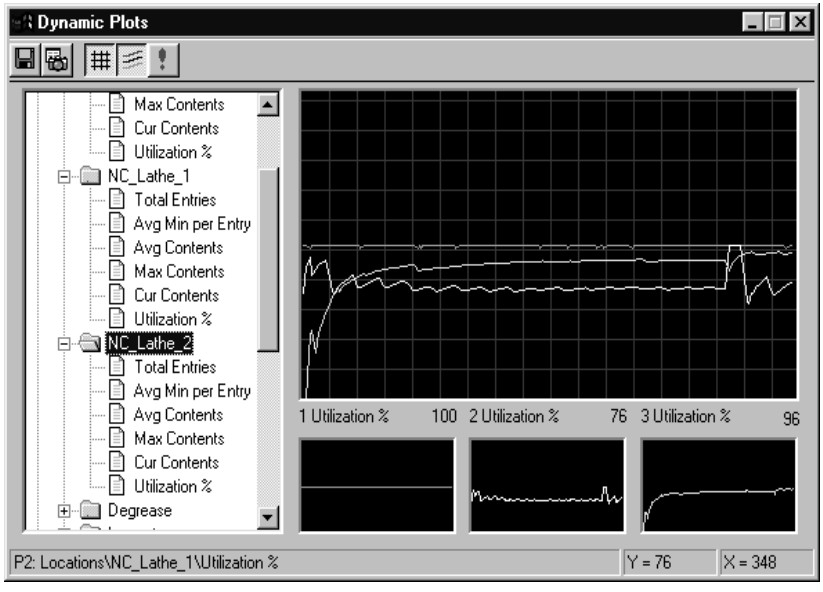
How To **Graph a single factor to the main panel:**

- Right click in panel 1, 2, or 3 and select **Move Up** (or double click). The graph for the item will appear in the main graph panel.



How To **Graph multiple factors to the main panel:**

- After you define the factors for panels 1, 2, and 3, click the multi-line button.



Output Results

ProModel places spreadsheets recorded from your model into the same location as your original model file.

Saved Files

If you record model data files using the save command, ProModel saves a copy of *ALL* model data—from the time you start the dynamic plot to when you click save—to an Excel® spreadsheet. To help you identify this file, ProModel uses the model filename followed by DP (for Dynamic Plots) and an XLS (for Excel®) extension. For example, the spreadsheet for "My_Model.mod" is:

My_ModelDP.XLS

Note If you save multiple files, you have the option to save each file under a different name.

Snapshot Files

When you record statistics using the snapshot command, ProModel creates an Excel® spreadsheet using the model filename followed by SNP (for Snapshot) and an XLS (for Excel®) extension. For example, the spreadsheet for "My_Model.mod" is:

My_ModelSNP.XLS

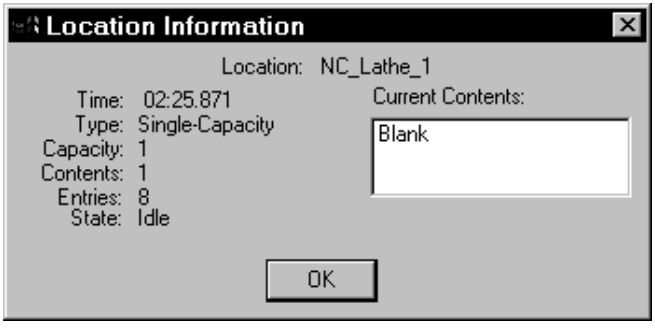
If you take multiple snapshots during the simulation, ProModel appends the information to the file (i.e., sheet 2, sheet 3, sheet 4).

When you run the simulation again and create a new spreadsheet, ProModel changes the old spreadsheet to a backup file and creates a new SNP.XLS file. Since ProModel retains only two snapshot files (XLS and BAK), new files replace old files.

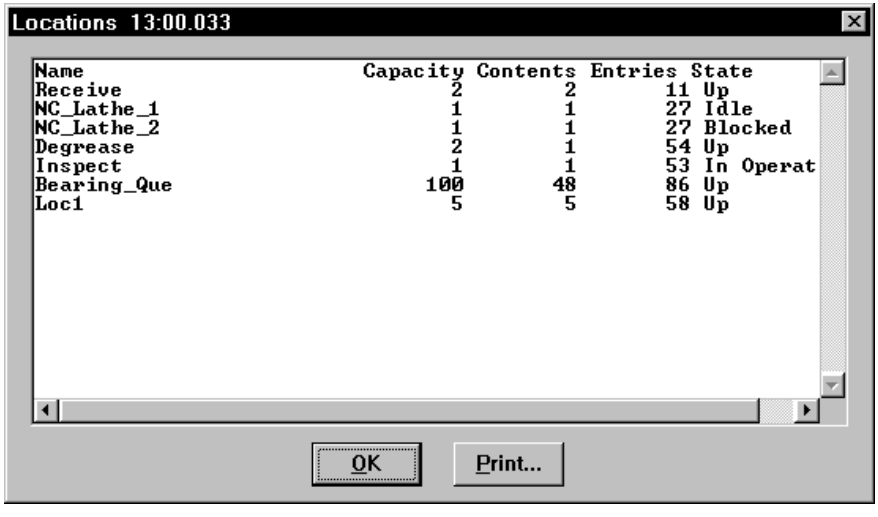
My_ModelSNP.BAK*(the old SNP.XLS file)*
My_ModelSNP.XLS*(the new SNP.XLS file)*

Location Information Windows

A Location Information Window gives real-time information regarding the status of a location including the current contents, operational state, total entries, and entity types. This window may remain open during the simulation.



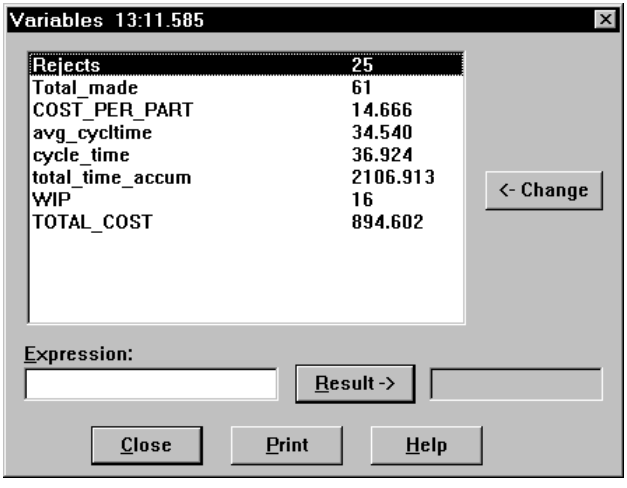
You may also view information for all locations at the same time. To view information for all locations, select All Locations at the Locations submenu.



Note If the location's statistics field is set to none, the number of entries will not be available, so the entries field will show N/A.

Variables Display Option

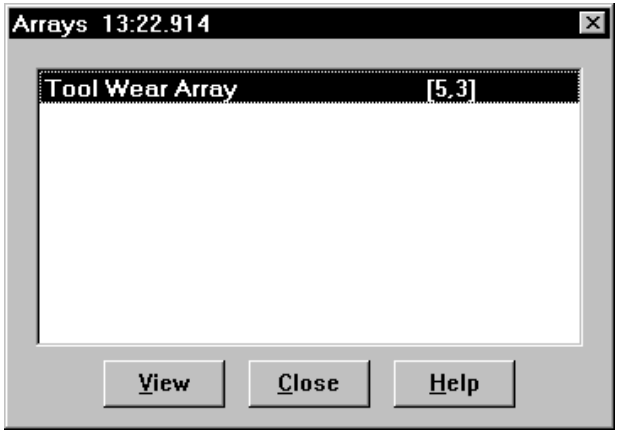
The variables display option allows you to view the current state of all global variables at any point in the simulation. You also have the option to evaluate an expression and see the result using the current variable values.



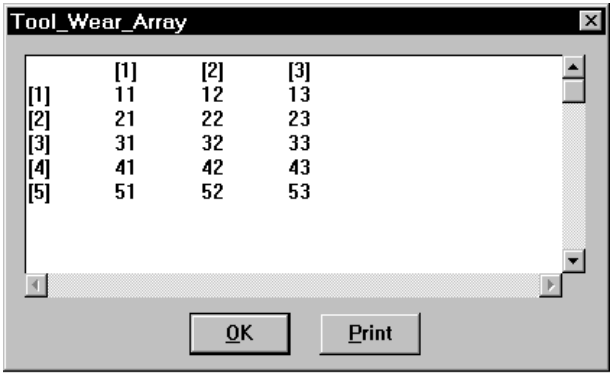
In this example, the expression (sum of two variables, WIP and THROUGHPUT) can be computed by clicking the Result button. A listing of the variables and their current values may be printed by clicking the Print button. The value of a variable may be changed at any time during the simulation by clicking the on the Change button and entering the desired variable value.

Array Display Option

The Arrays display option allows you to view the current value of the cells for an array of up to three dimensions at any point in the simulation. To view the elements of an array simply select Arrays from the Run-Time Options menu. This brings up an array selection box like the one shown on the next page. Double-click on the array you wish to view or press the View button.

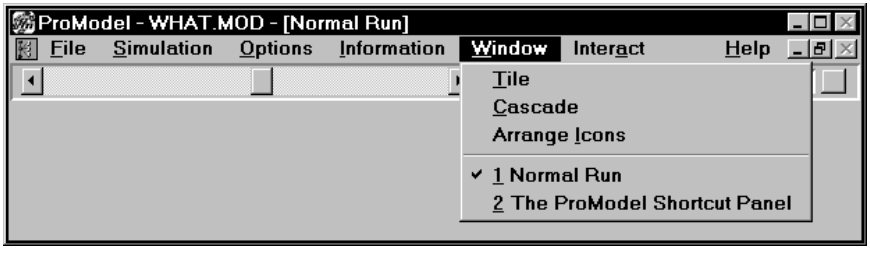


The example below is for a two-dimensional array that keeps track of the number of entities of type 1 and type 2 that have been processed at each of six locations. The six rows represent the six locations and the two columns represent the two entity types.



11.4.9 Run-Time Window Menu

The Run-Time Window menu allows you to rearrange windows and icons and select the active window. These functions are standard to all Windows applications.



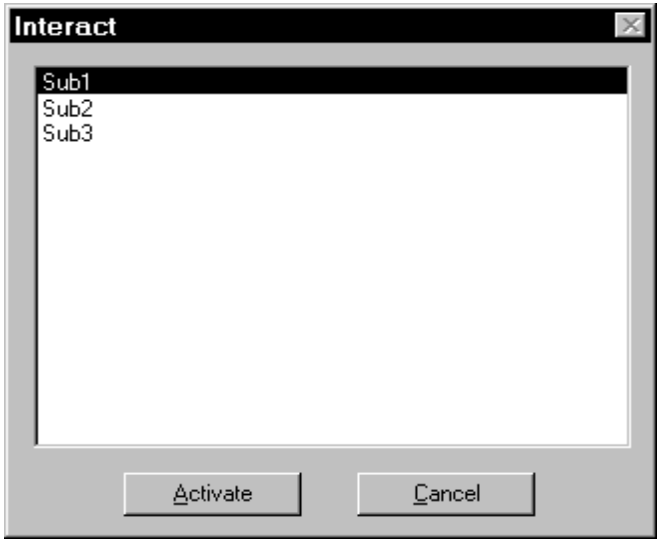
Tile Causes all open windows to fit in the available screen space. Windows hidden behind other windows become visible.

Cascade Causes all open windows to overlap such that the title bar of each window is visible.

Arrange Icons Causes all icons representing iconized applications or windows to be arranged neatly along the bottom of the screen.

11.4.10 Run-Time Interact Menu

The Run-Time Interact menu displays the Interact dialog box. It allows you to execute interactive subroutines during run-time. Interactive subroutines are defined in the Subroutines edit table (see *Subroutines Edit Table* on page 451).

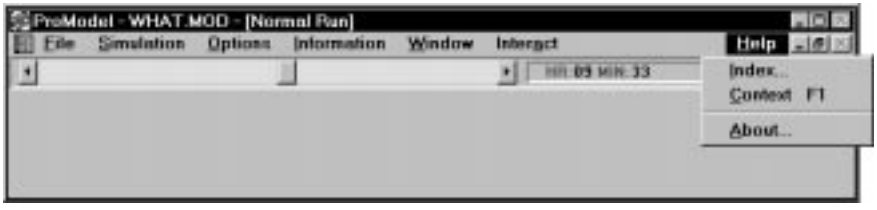


How To **Execute an interactive subroutine during run-time:**

1. Select **Interact** from the run-time menu.
2. Select the identifier for the subroutine from the list box in the Interact dialog box.
3. Choose the **Activate** button.

11.4.11 Run-Time Help Menu

The Run-Time Help menu contains selections for accessing the ProModel on-line help system. It operates the same here as in the model editing functions.



Index... Choose this option to bring up the Main Help Index.

Context Choose this option to go directly to the help screen that corresponds to the active window. If no context sensitive help exists for the active window, the Main Help Index will appear.

About... Choose the option to display a message containing software version information.

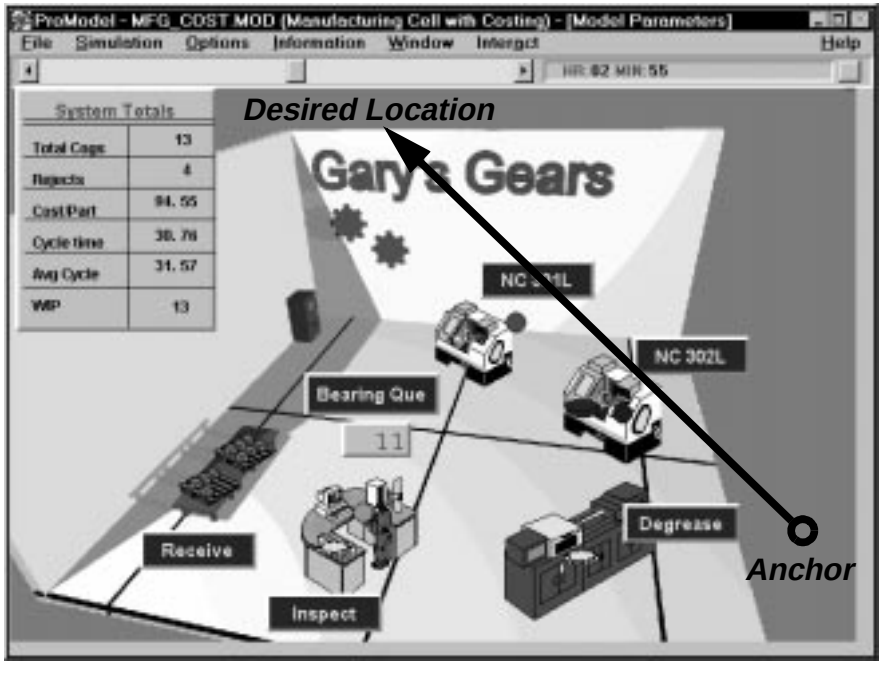
11.4.12 Run-Time Controls

In addition to the animation options discussed in the previous section, you may pan the animation screen in any direction, control the speed of the simulation, and change the format of the simulation clock display. These and other procedures are discussed in this section.

How To

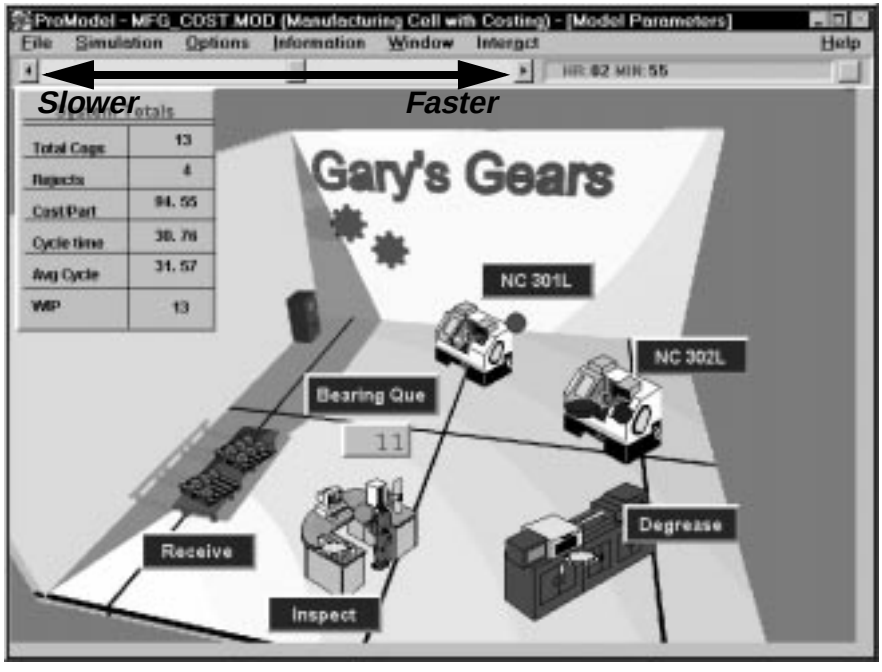
Pan through the animation:

1. Press and hold the left mouse button anywhere on the animation screen. This point then becomes the “anchor point” by which the entire animation is moved.
2. Drag and release the mouse where you desire the anchor point to be located. The following diagram illustrates this procedure.



How To **Control the simulation speed:**

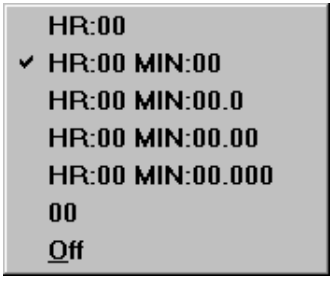
- Move the animation speed control bar to the left to decrease the simulation speed or to the right to increase the simulation speed.



Note The speed of the animation may be altered by model logic with the use of the ANIMATE statement. (See *Animate* on page 117 of the *ProModel Reference Guide.*)

How To **Change the format of the simulation clock display:**

1. Click on the simulation clock button.
2. Select a format for the clock display.



How To **Identify any location on the layout:**

- Click on a location while holding the CTRL key. (An identifier box appears, allowing you to bring up the location information window for that location.)