LAB # 3 Drive-in fast food restaurant model

A drive- in fast food restaurant operates 18 hours per day from 6:00am to 12:00 mid-night. Service is stopped during prayers times in the following time intervals.

- From 11:45am to 12:15pm.
- From 2:45pm to 3:15pm
- From 5:00pm to 5:30pm
- From 6:45pm to 7:30pm

Cars arrive according to Poisson process with varying arrival rates as follows.

- 3 cars every 15 minutes from 6:00am to 8:00am
- 12 cars every 15 minutes from 8:00am to 11:00am
- 30 cars every 15 minutes from 11:00am to 11:30am
- 45 cars every 15 minutes from 12:15pm to 2:30pm
- 18 cars every 15 minutes from 3:30pm to 5:00pm
- 12 cars every 15 minutes from 5:30pm to 6:30pm
- 18 cars every 15 minutes from 7:30pm to 10:00pm
- 2 cars every 15 minutes from 10:00pm to 12:00 mid-night

The service time per car varies depending on the order size represented by the number of meals ordered. Historical data shows that the number meals ordered by a car follows the following discrete probability distribution.

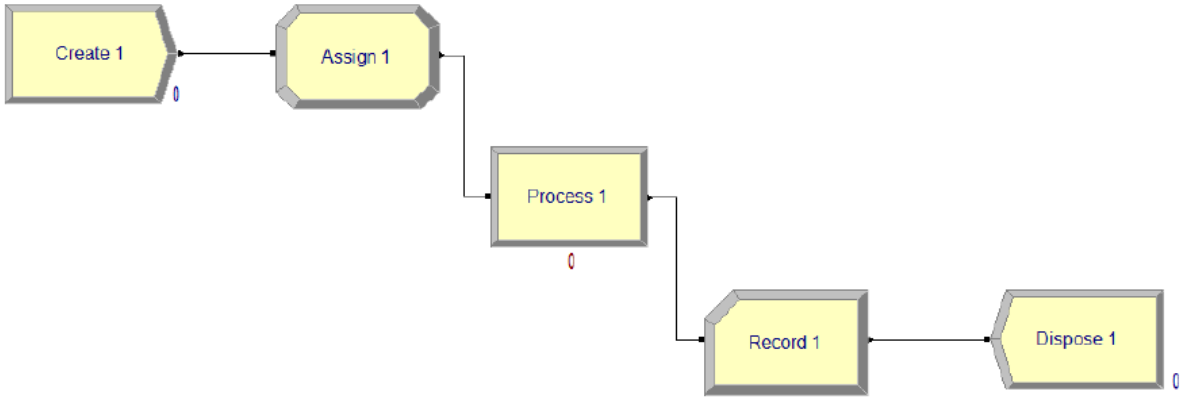
Number of meals	Probability
1	0.3
2	0.4
3	0.2
4	0.1

The time needed to serve on car by a single cook follows an exponential distribution with mean of 1.5 minutes multiplied by the number of meals ordered.

- Build a simulation model for one day using Arena for the above systems when there is only one cook working.
- Change the simulation model by considering the case in which there are two cooks working from 8:00am to 11:45am, and 4 cooks working from 12:15pm to 6:45pm and only one cook working rest of the day.

Map your process in a flowchart

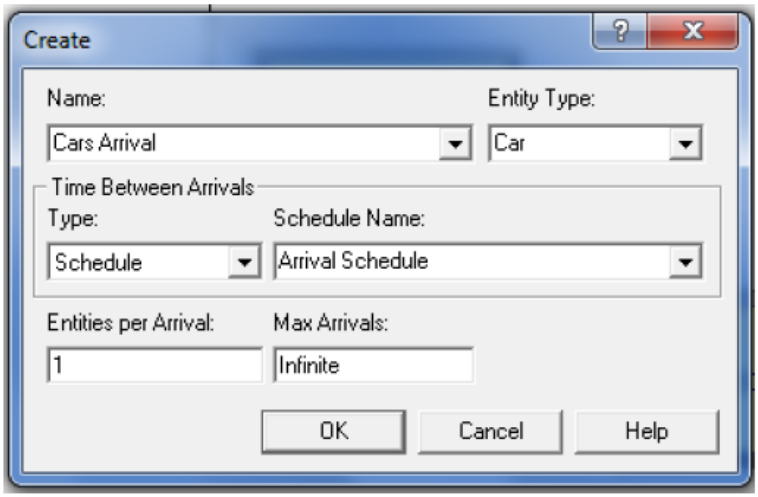
We'll be building a *chart*—also referred to as a *process map* or a *model*—that describes a *flow*. First, draw the flowchart in Arena model window representing the Drive-in fast food restaurant process. Refer to the Figure given below



Define Model Data

1-Initiate the car arrival (Create 1 module)

Double-click on the Create 1 module to open its property dialog.



→ In the Name field, type **Cars Arrival**.

→ For the Entity Type, enter **Car** to name our entities.

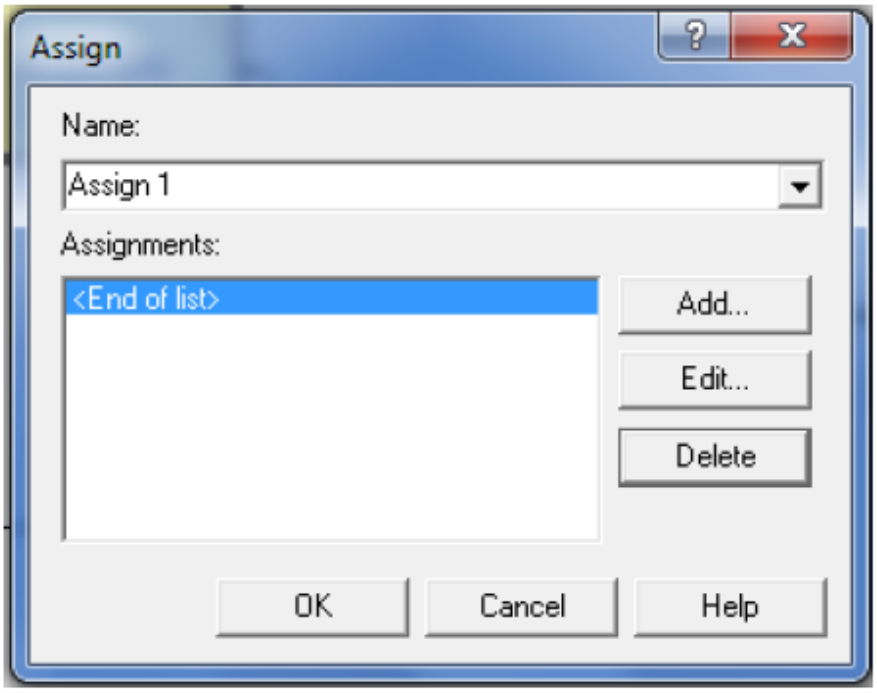
→ For the Time Between Arrivals section select Type as **Schedule** from drop down list. Then in the Schedule Name field, type **Arrival Schedule**.

→ For now leave the default value for the other Create module properties like Entities per Arrival is **1,** Max Arrival = **Infinite.**

→ Click **OK** to close the dialog box.

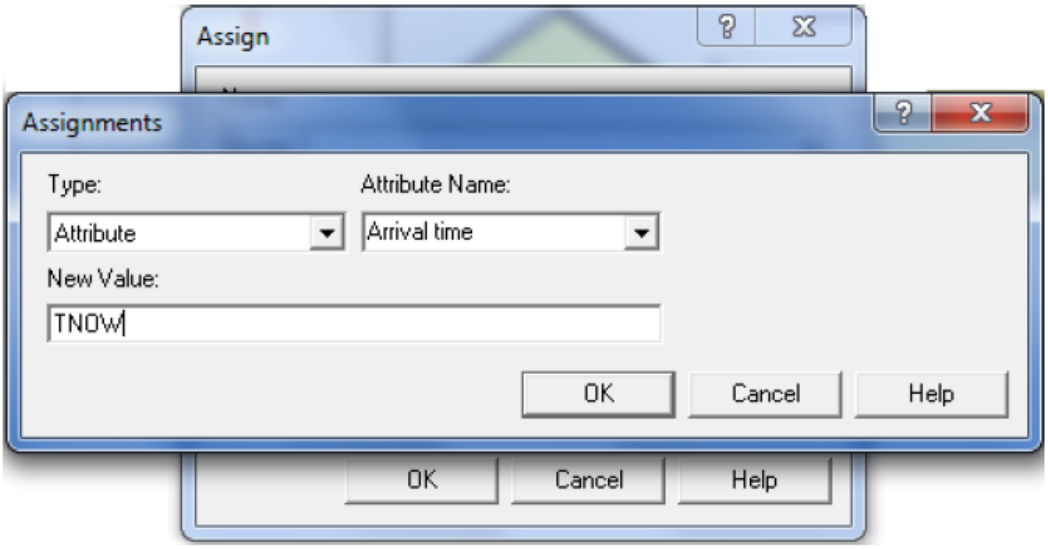
2-Store Arrival time (Assign 1 module)

Double-click on the Assign 1 module to open its property dialog.

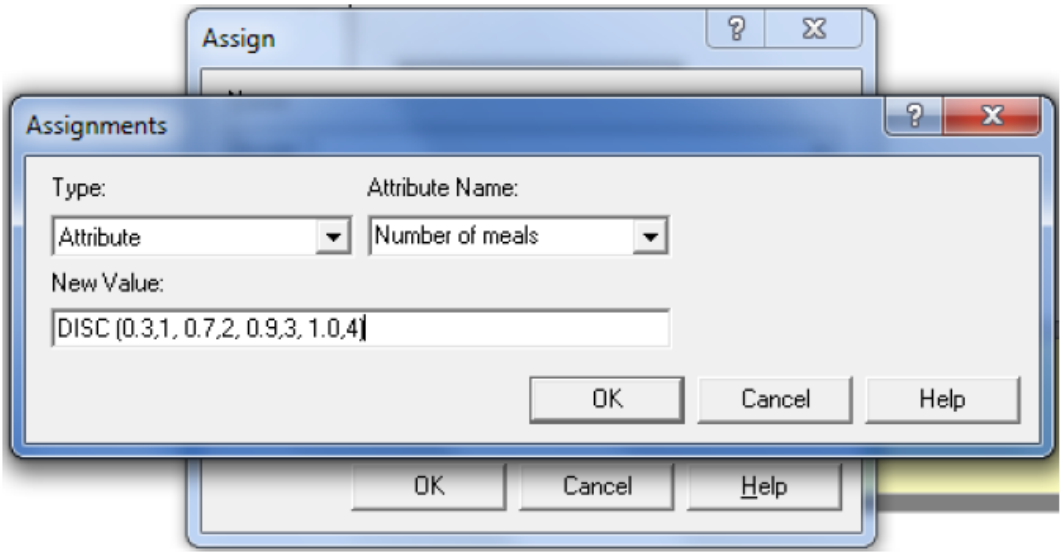


→ In the Name field, type **Assign 1**.

→ Click Add… tab, new dialog box will appear as given below in the figure for adding Assignment.



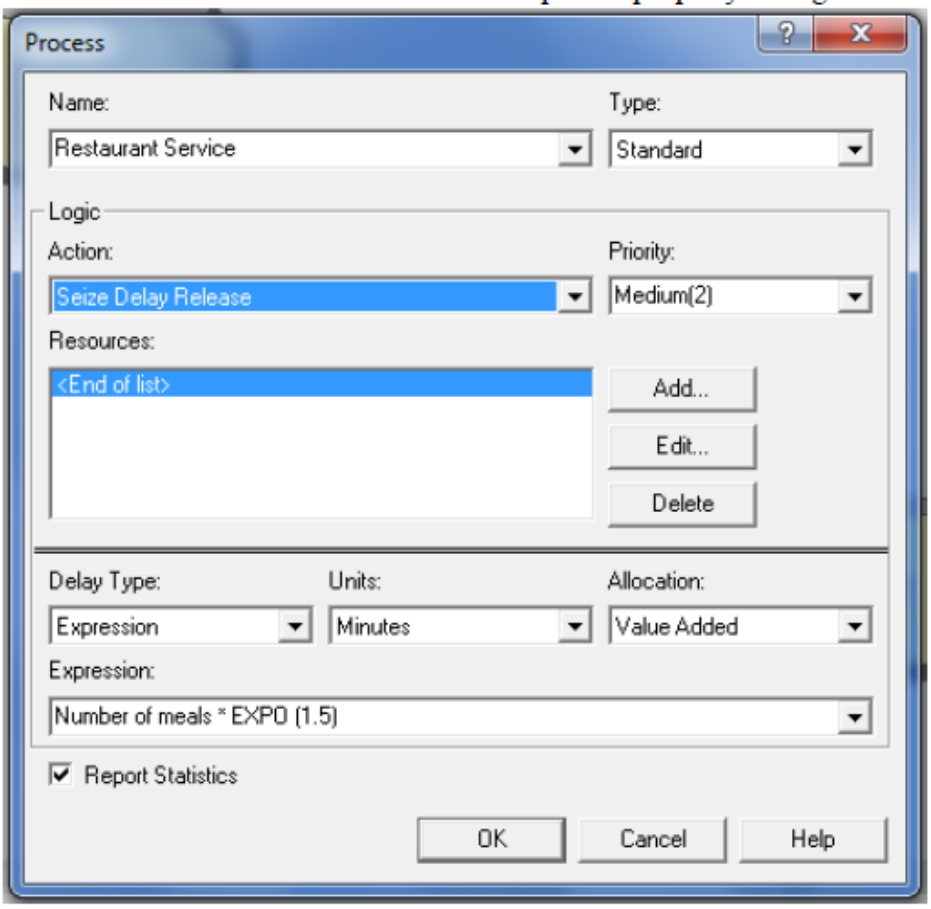
→ In the Type field, Select **Attribute**.
→ For the Attribute Name, Type **Arrival time.**
→ Arrival time value is **TNOW**.
→ Click **OK** to close the dialog box.
→ Again Click Add… tab, new dialog box will appear as given below in the figure for adding Assignment.



→ In the Type field, Select **Attribute**.
→ For the Attribute Name, Type **Number of meals.**
→ Arrival time value is **DISC (0.31,1, 0.7,2, 0.9,3, 1.0,4)**.
→ Click **OK** to close the dialog box. And again click **OK** to close the Assign dialog box.

3-Restaurant Service (Process 1 module)

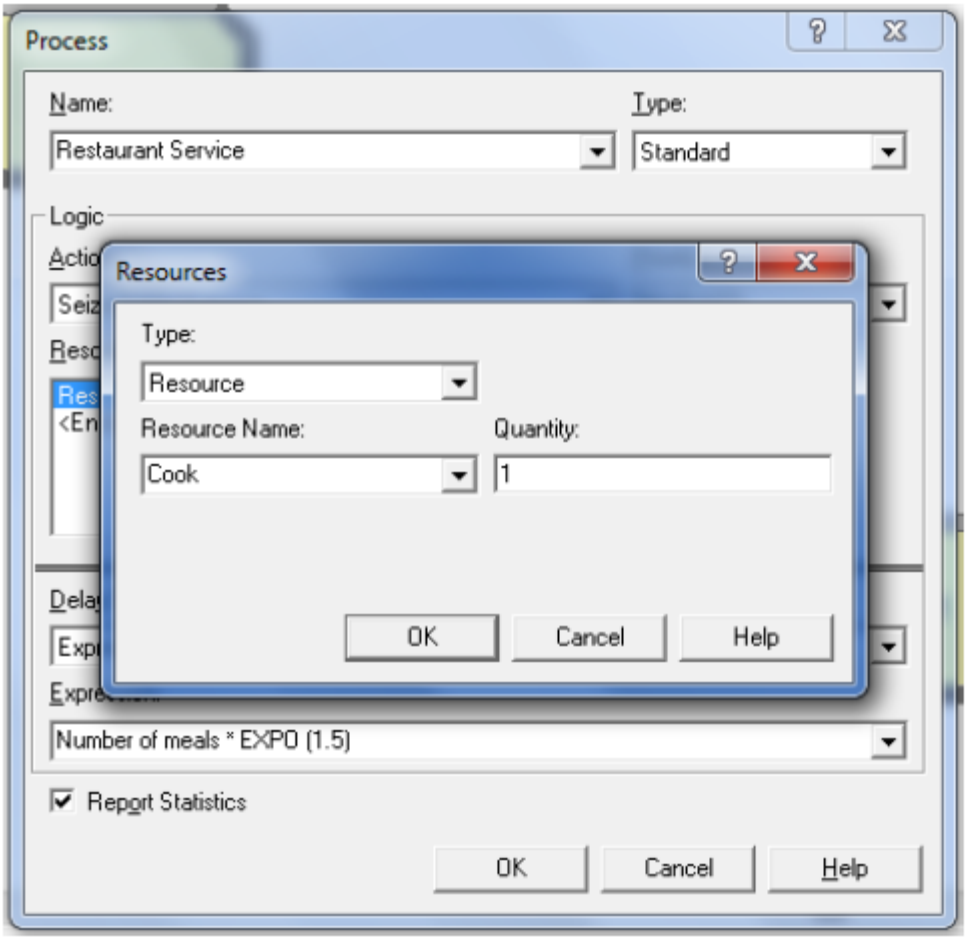
Double-click on the Process 1 module to open its property dialog.



→ In the Name field, type **Restaurant Service**. Keep the Type: as **Standard**.

→ In Logic Pan Select Action as **Seize Delay Release.** Priority is **Medium(2).**

→ Click **Add**… tab to add the resource for the process, then new window will pop-up.



→ For the Type Select **Resource** from drop down list.

→ Type Resource Name as **Cook** and quantity required is **1**.

→ Click **OK** to close dialog box.

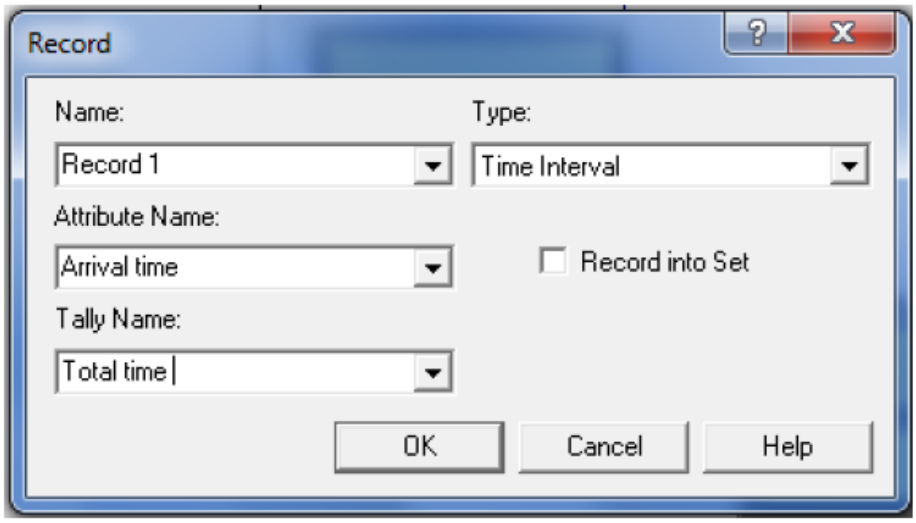
→ Select Delay Type is **Expression**, Units is **Minutes** and In the Allocation field keep it as **Value Added.**

→ In Expression field, type **Number of meals *EXPO (1.5).**

→ Click **OK** to close dialog box.

4-Record Total time (Record 1 module)

Double-click on the Record 1 module to open its property dialog.



→ In the Name field, type **Record 1**.

→ In the Type field select **Time Interval**.

→ Attribute Name field will Appear, select Attribute Name **Arrival time**.

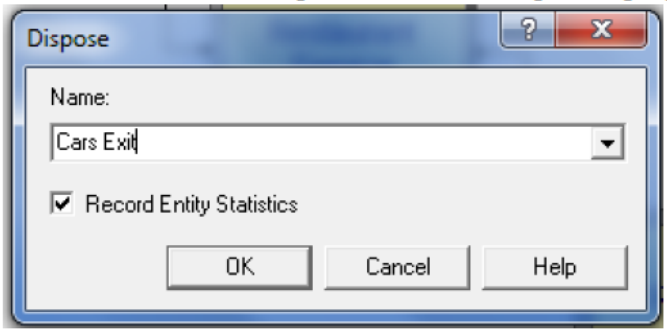
→ In the Tally Name field type **Total time**.

→ Click **OK** to close the dialog box.

5-Cars Exit (Dispose 1 module)

All the work that we're interested in is done. Now, we'll remove the cars from the model, terminating the process with a Dispose module

Double-click on the Dispose 1 module to open its property dialog.

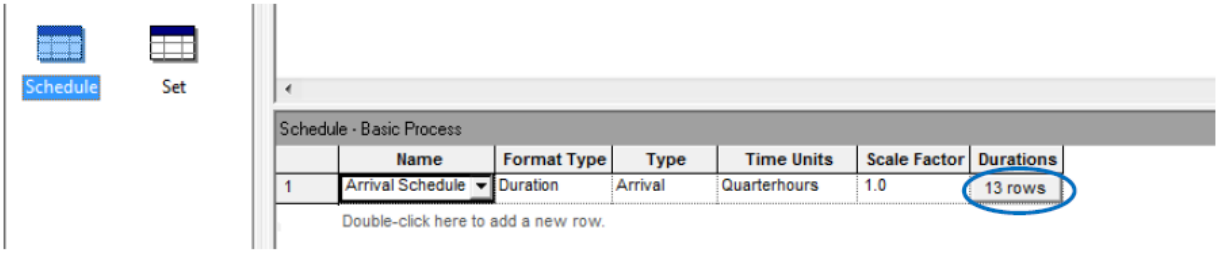


→ In the Name field, type **Cars Exit**.

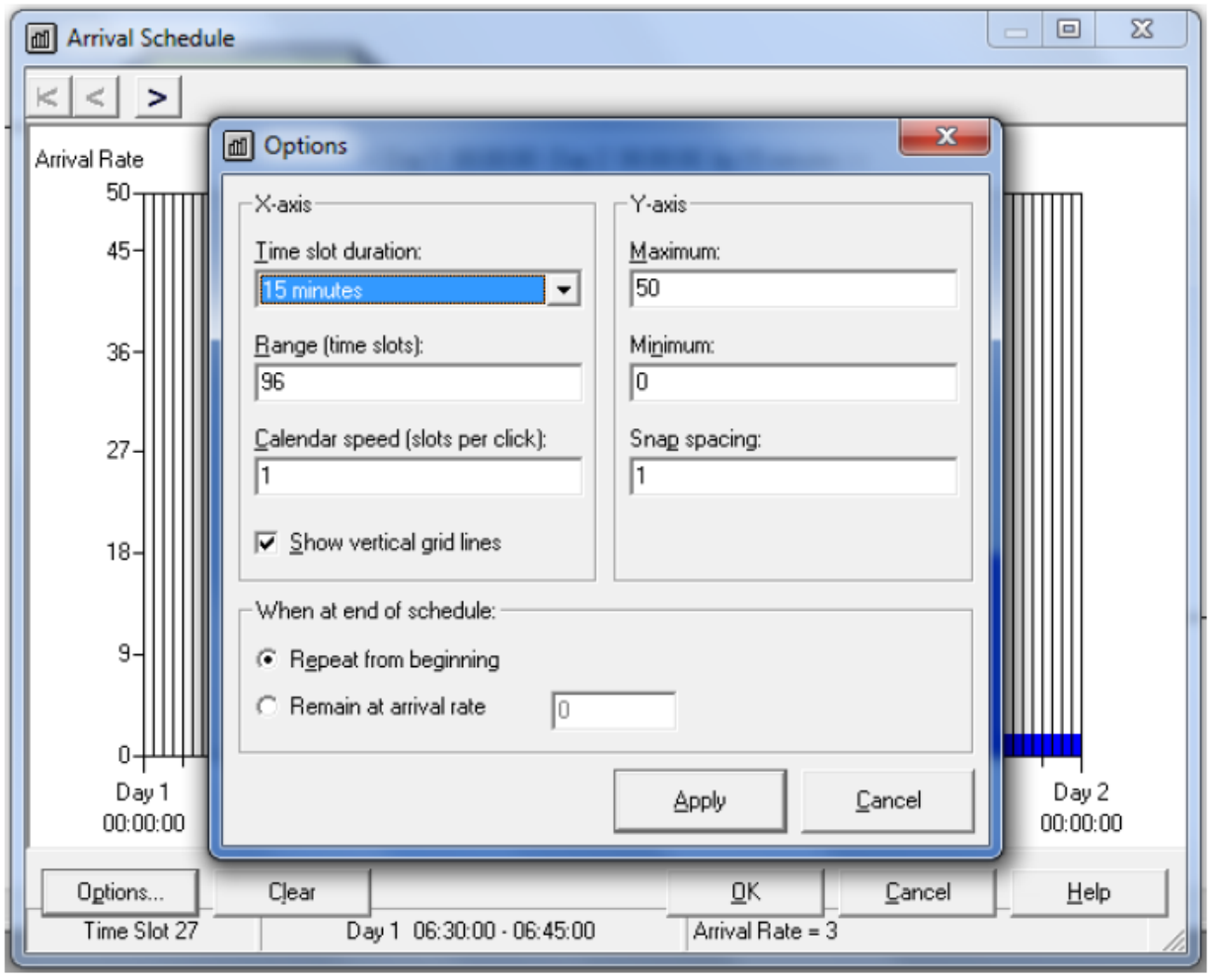
→ Click **OK** to close the dialog box.

6-Arrival Schedule (Schedule data module)

Click on the Schedule data module to open list of the schedule in the model. In the spreadsheet window you will see the list of all schedule used in the model.



Click on the **rows** column. Arrival Schedule window will appear showing the default schedule; then click on **Option** button to open the property dialog of the schedule.

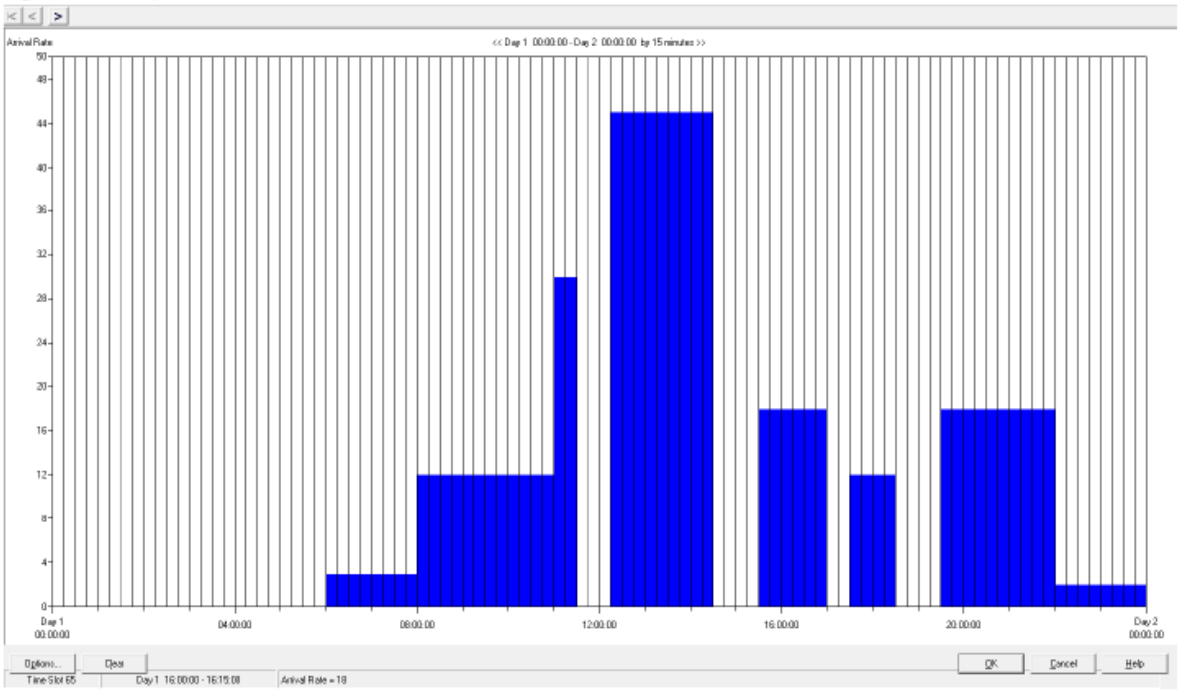


→ In the **X-axis** tab; for Time slot duration field select **15 minutes** from list, In the Range (time slots) field type **96** for 1 day, and in the calendar speed field keep it as default **1**.

→ In the **Y-axis** tab; type Maximum value **50**, Minimum is **0**, and Snap spacing = **1**.

→ Click on Apply to close & apply the setting in the schedule.

Then modify the schedule as per cars arrival rate given in the problem. (As shown in the figure below)

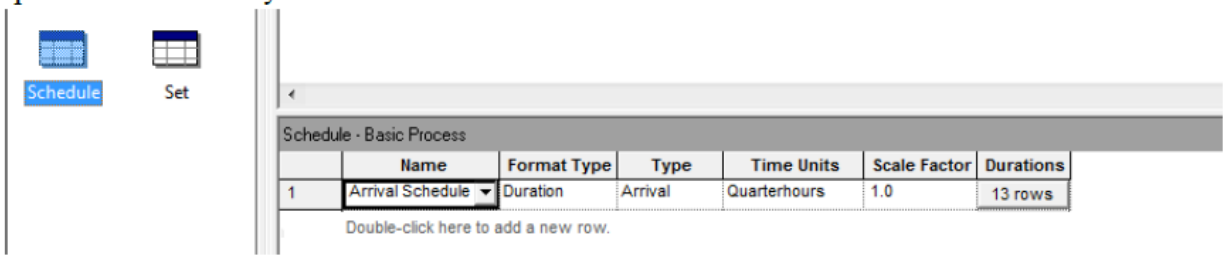


→ Select the arrival rate by clicking on the desired place in the column.

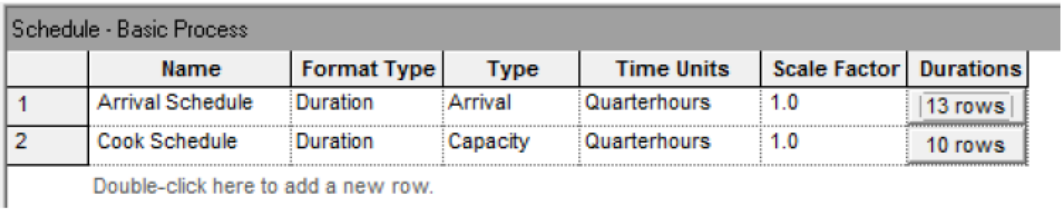
→ Click **OK** to close the dialog box.

7-Cook Schedule (Schedule data module)

Click on the Schedule data module to open list of the schedule in the model. In the spreadsheet window you will see the list of all schedule used in the model.



Double click under the row to add new schedule (row).

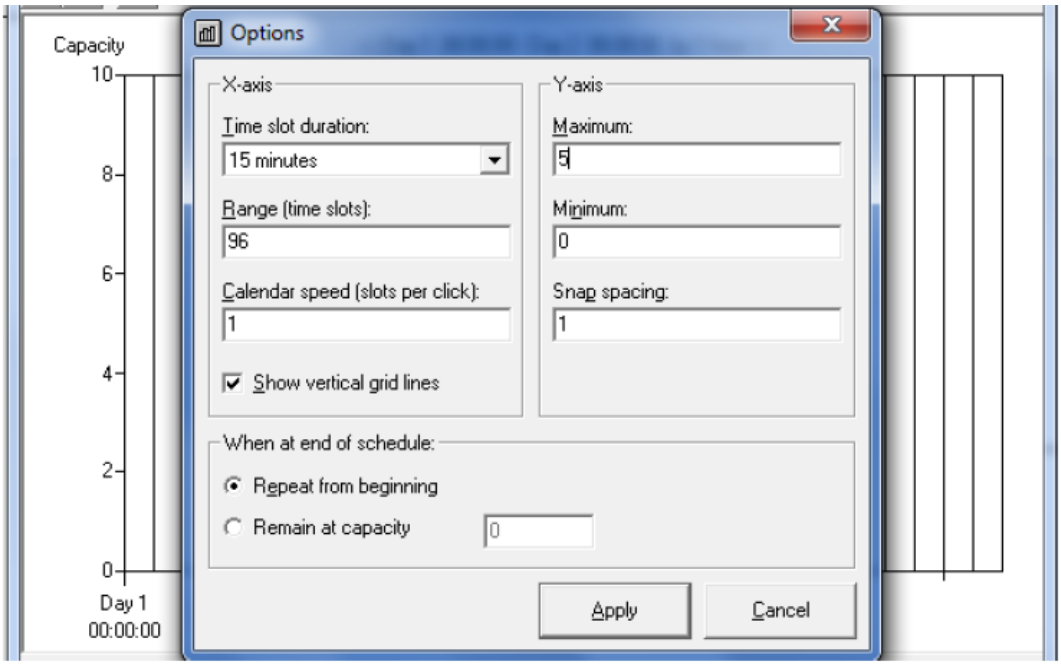


→ In the Name field, type **Cook Schedule**.

→ Keep the default values in the remaining field.

→ Click on the **rows** column.

Cook Schedule window will appear showing the default schedule; then click on **Option** button to open the property dialog of the schedule.

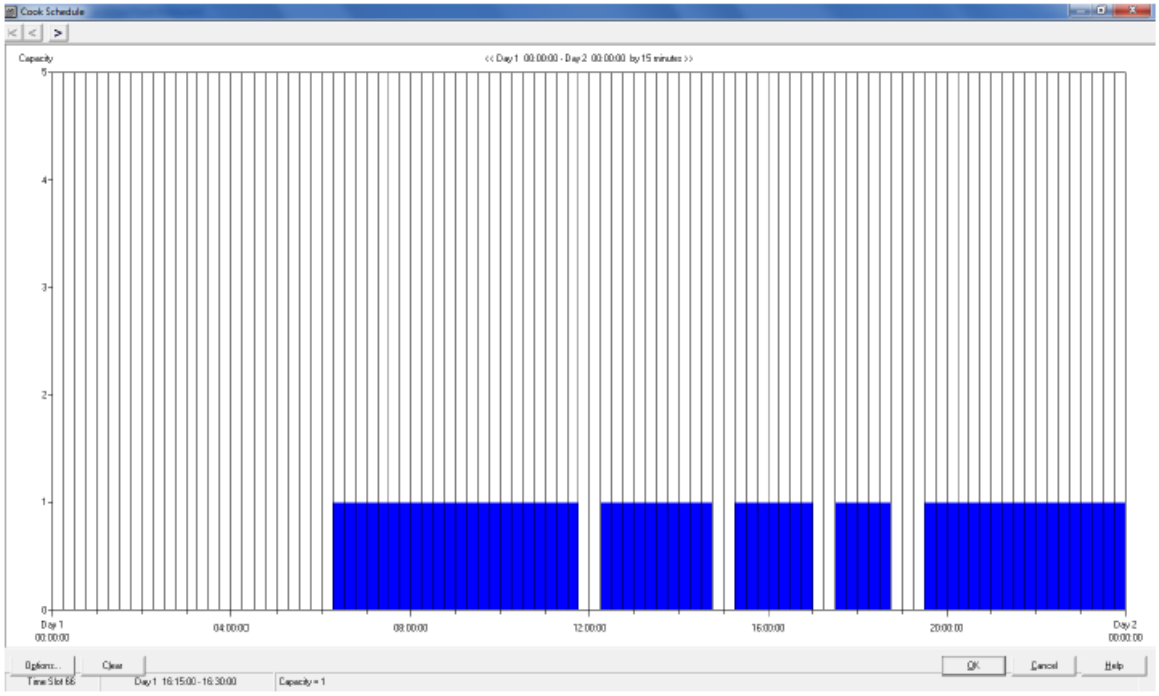


→ In the **X-axis** tab; for Time slot duration field select **15 minutes** from list, In the Range (time slots) field type **96** for 1 day, and in the calendar speed field keep it as default **1**.

→ In the **Y-axis** tab; type Maximum value **5**, Minimum is **0**, and Snap spacing = **1**.

→ Click on Apply to close & apply the setting in the schedule.

Then modify the schedule as per working time of the restaurant in the problem. (As shown in the figure below)



→ Select the No. of cook working by clicking on the desired place in the column.

→ Click **OK** to close the dialog box.

Click on the Resource data module to open list of the resource in the model. In the spreadsheet window you will see the list of all resources used in the model.

Resource - Basic Process

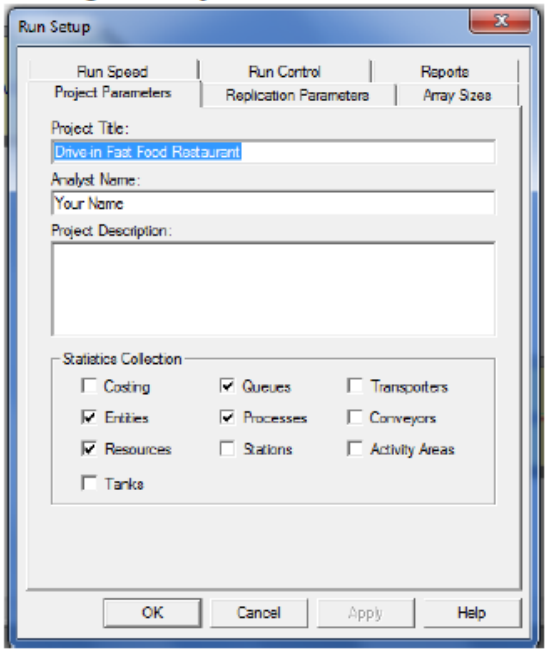
	Name	Type	Schedule Name	Schedule Rule	Busy / Hour	Idle / Hour	Per Use	StateSet Name	Failures	Report Statistics
1	Cook	Based on Schedule	Cook Schedule	Wait	0.0	0.0	0.0		0 rows	☑

Double-click here to add a new row.

For the resource Cook; Select Type **Based on Schedule**, Schedule Name select **Cook Schedule**, and in the all remaining field keep the default values.

8-Prepare for Simulation (Run Parameter)

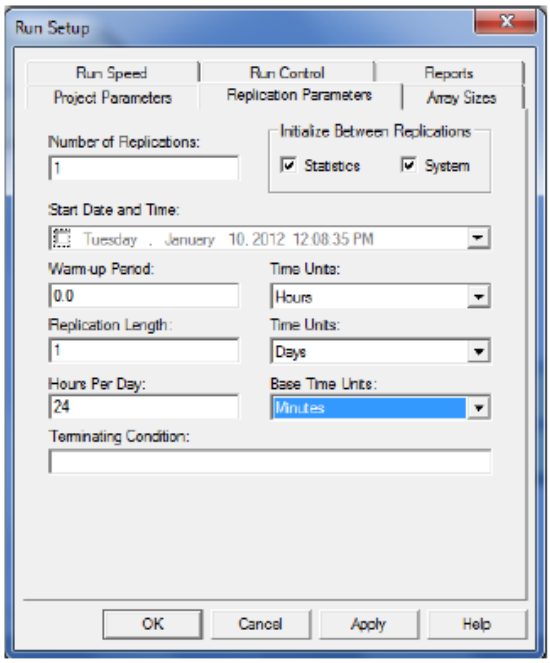
Open the Project Parameters dialog box by using the **Run** > **Setup** menu item and clicking the **Project Parameters** tab.



In the Project Title field, type **Drive-in Fast Food Restaurant**; we'll leave the Statistics Collection check boxes as the defaults, with Entities, Queues, Resources, and Processes checked.

Next, click the **Replication Parameters** tab within the same Run Setup dialog box.

In the Replication Length field, type **1**; and in the Time Units field directly to the right of Replication Length, select **Days** from the drop-down list, Choose Base Time Units as **Minutes** from drop-down list, and leave the another values defaults.
Click **OK** to close the dialog box.

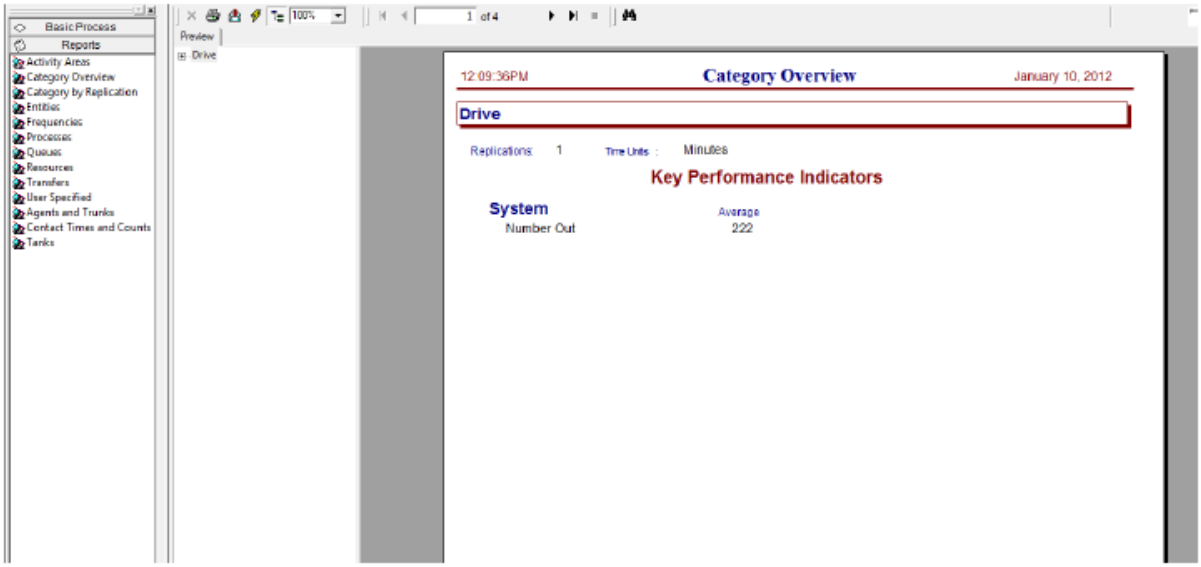


9-Run the Simulation (Run Parameter)

Start the simulation run by clicking the **Go** button or clicking the **Run** > **Go** menu item or using ▶ **Run** button in the main toolbar.

10-View Simulation Report

At the end of the run, Arena will ask whether you'd like to view reports. Click **Yes**, and the default report (the Category Overview Report) will be displayed in a report window, as shown below.



On the left side of each report window is a tree listing the types of information available in the report. The project name (in our case, Drive) is listed at the top of the tree, followed by an entry for each category of data. This report summarizes the results across all replications (although, in this model, we have only one replication). Other reports provide detail for each replication. By clicking on the entries inside the category sections, you can view various types of results from the simulation run.

After you've browsed the Category Overview Report, you can close it by clicking on the window icon to the left of the **File** menu and clicking **Close**. You can look at other reports by clicking on their icons in the Project Bar. Each report will be displayed in its own window.

To return to the model window, close all of the report windows or select the model file from the Window menu.

After you have viewed the reports and returned to the model window, end the Arena run session by clicking the ■ **End** button in main toolbar.