Phase 4. Adding Statistics Collection

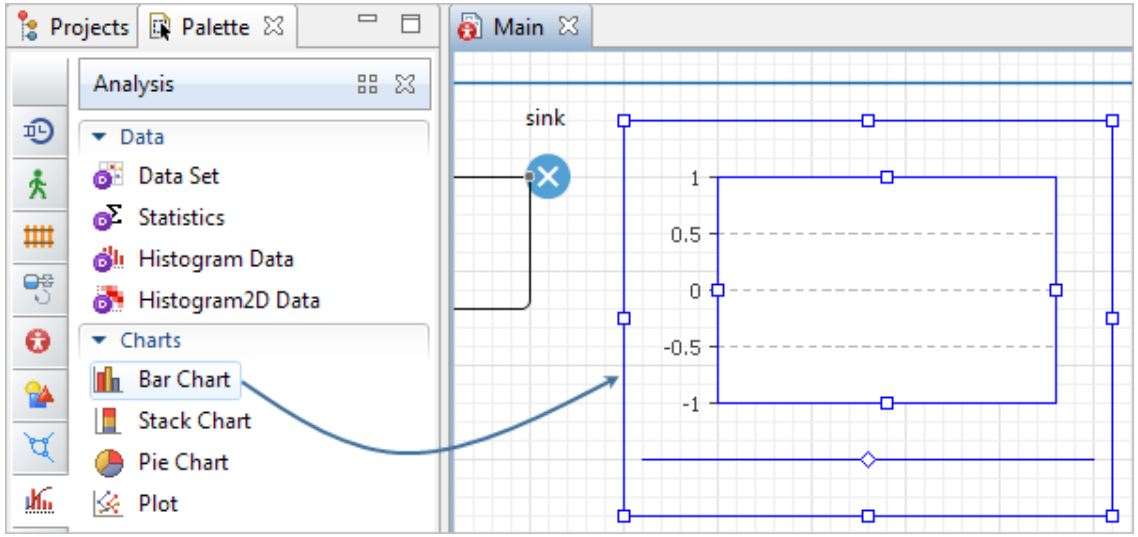
With AnyLogic, you can collect complicated statistics whenever you need them. The objects of the Process Modeling Library are already capable of collecting the basic statistics. All you need is to turn the statistics collection for the object on, as it is disabled by default to speed up the model execution. We can view the statistics collected for the flowchart objects with charts.

We want to observe how mean ATM utilization and mean queue length change with time.

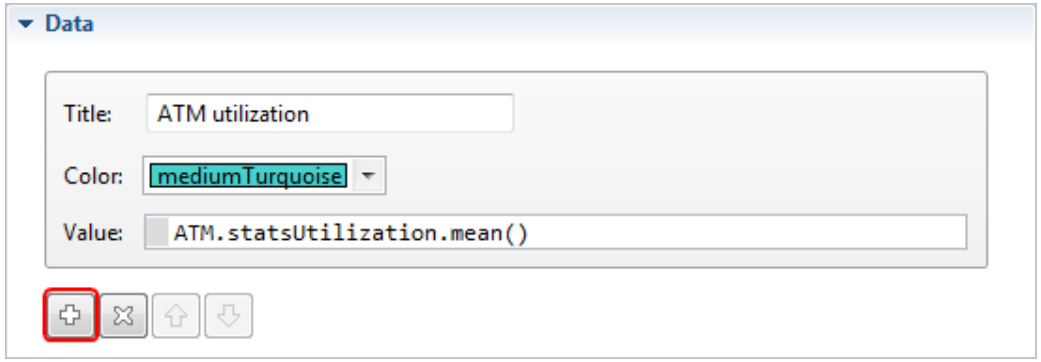
Collecting utilization statistics

Add a bar chart to indicate mean ATM utilization

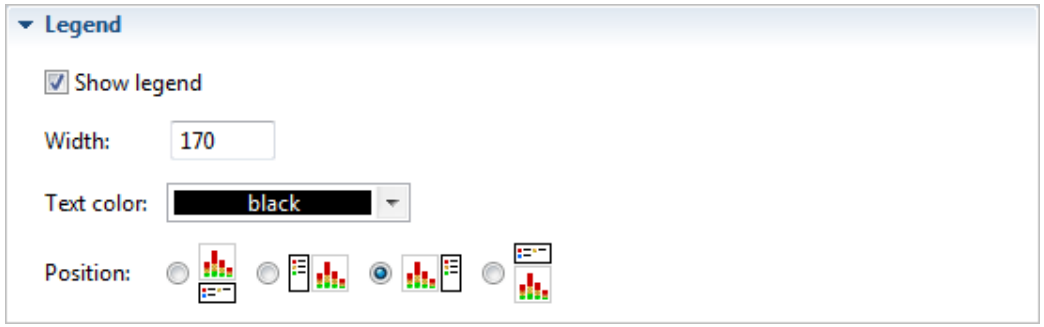
1. Open the **Analysis** palette of the **Palette** view. This palette contains charts and data objects used for collecting data and performing various statistical analysis on them. Drag the **Bar Chart** element from the stencil into the graphical editor.



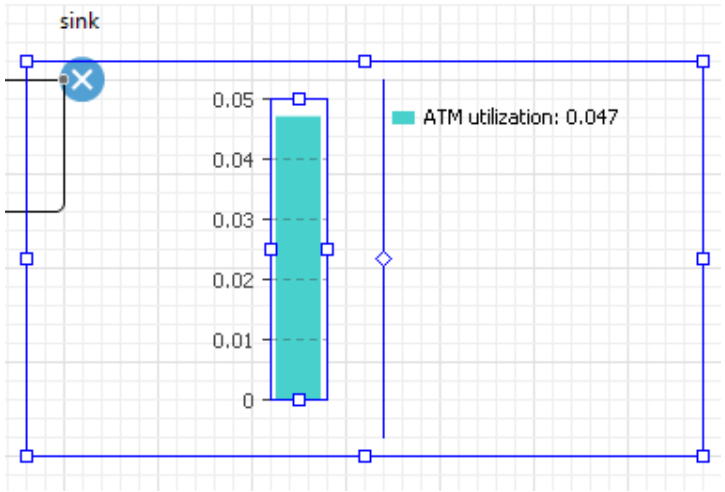
2. Go to the **Data** section in **Properties** of the chart. Click **Add data item** to add data item to be displayed by this chart.
3. Modify the data item's **Title**: *ATM utilization*.
4. Type `ATM.statsUtilization.mean()` as the **Value** of the data item. `ATM` is the name of the **Delay** object we created. Each **Delay** object has `statsUtilization` data set that collects statistics on the object utilization. The `mean()` is the function that returns the mean value measured. You can use other functions to get statistical values, such as `min()` and `max()`.



5. Change the position of the chart's legend in the **Legend** properties section.

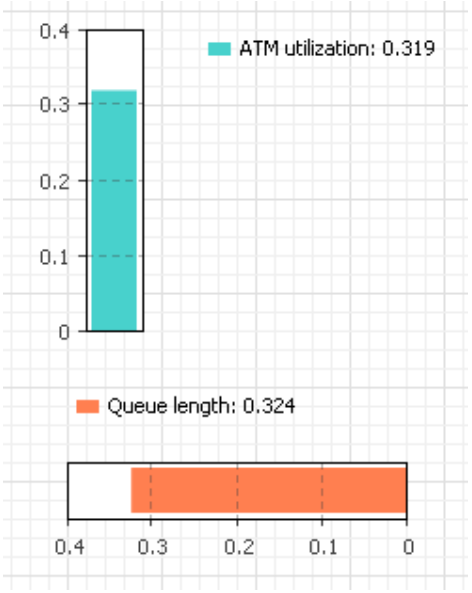


6. Then resize the chart as shown in the figure below:

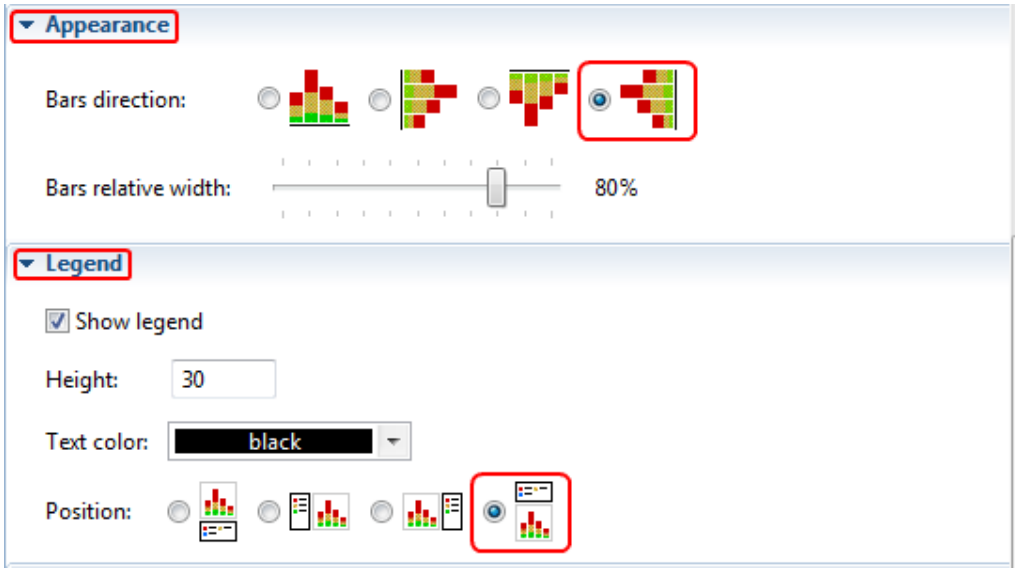


Add a bar chart to indicate mean queue length

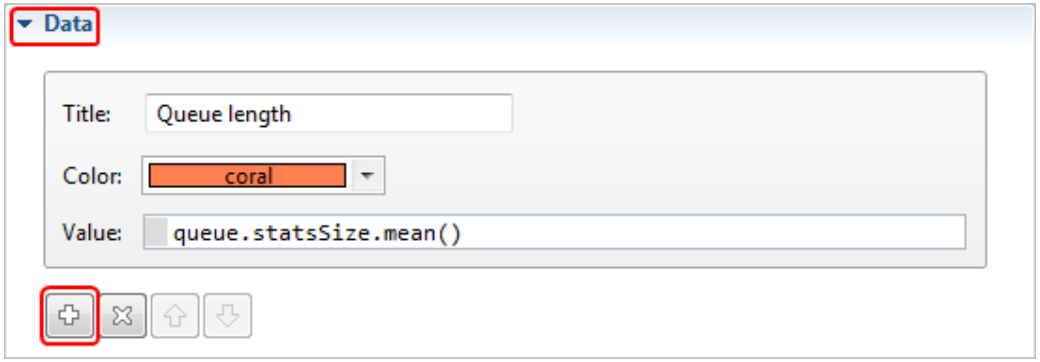
1. Add one more bar chart in the same way. Resize it to look like the one in the figure.



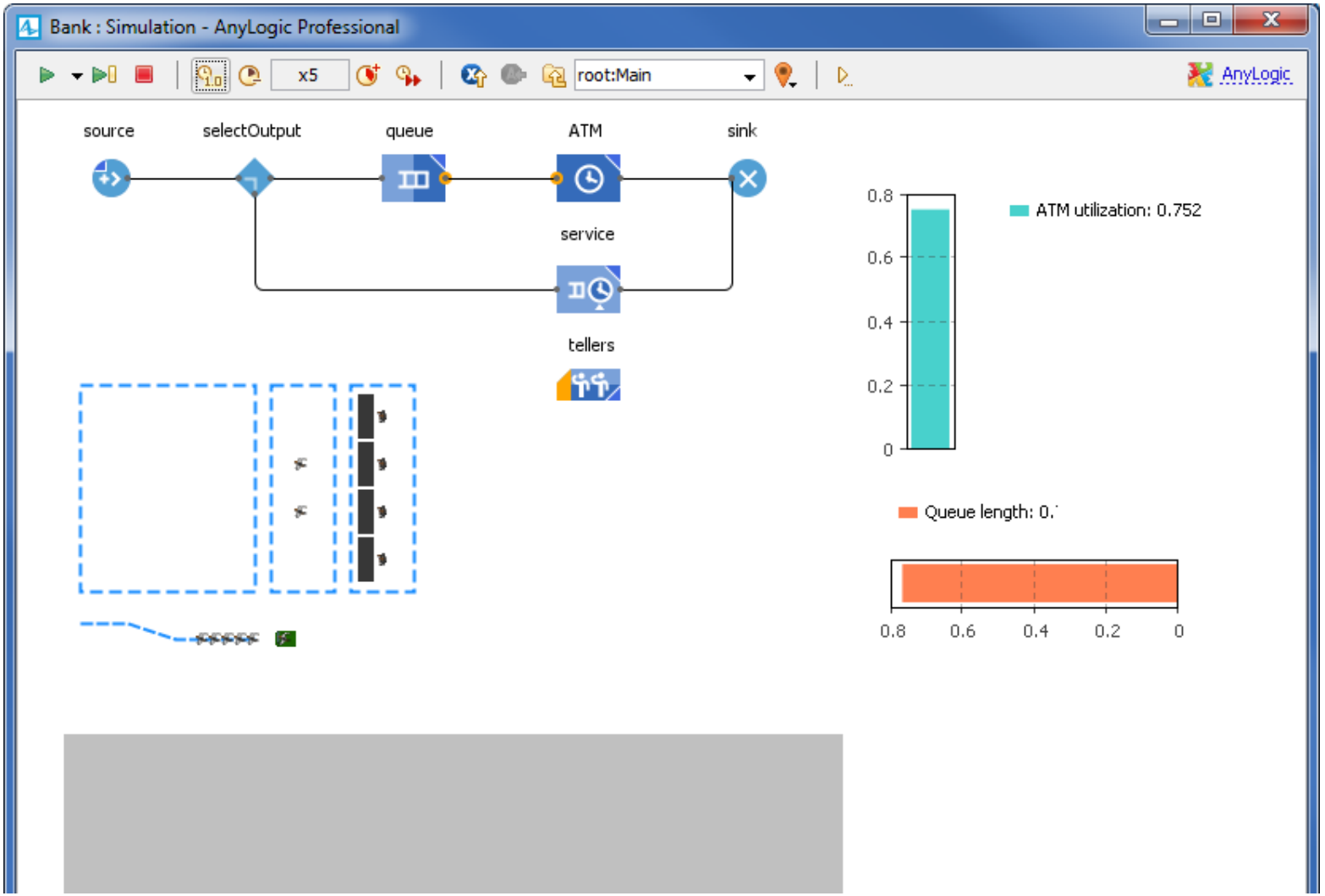
2. Open the **Appearance** section of the **Properties** view and choose the last option from the **Bars Direction** choice to make bars grow to the left and also change the position of the chart's legend in the section **Legend** (like it is shown in the figure below).

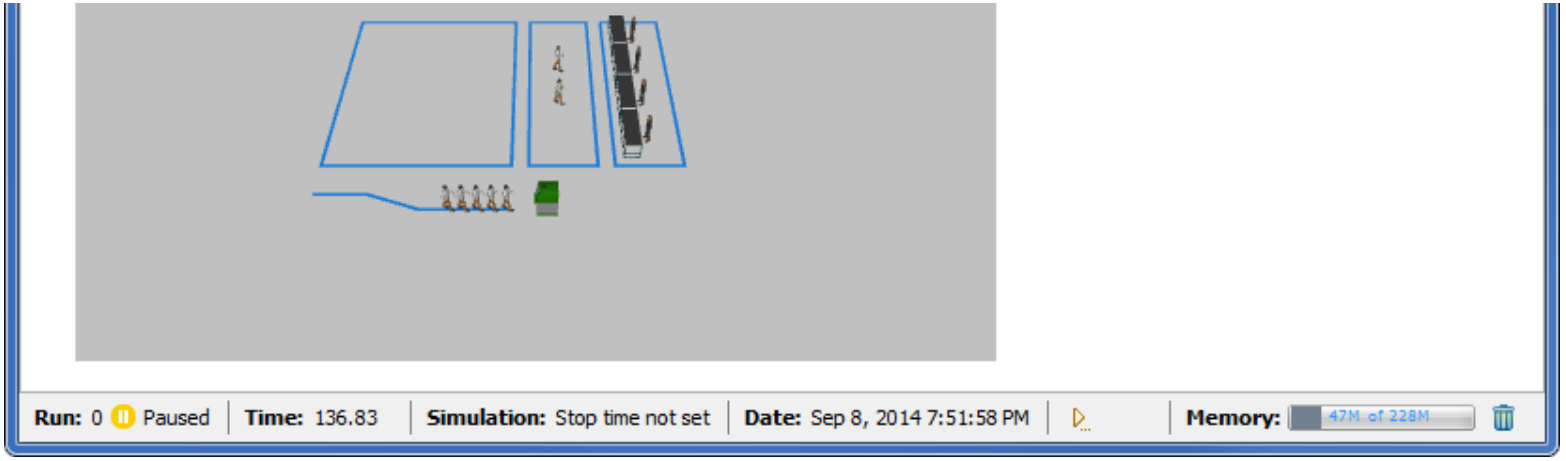


3. Add a data item to be displayed by the chart. Set **Title**: *Queue length* and **Value**: `queue.statsSize.mean()`
Here `statsSize` is the data set of type **StatisticsContinuous** that collects the statistics on the **Queue** size.



Run the model and observe the ATM utilization and mean queue length with just created charts.





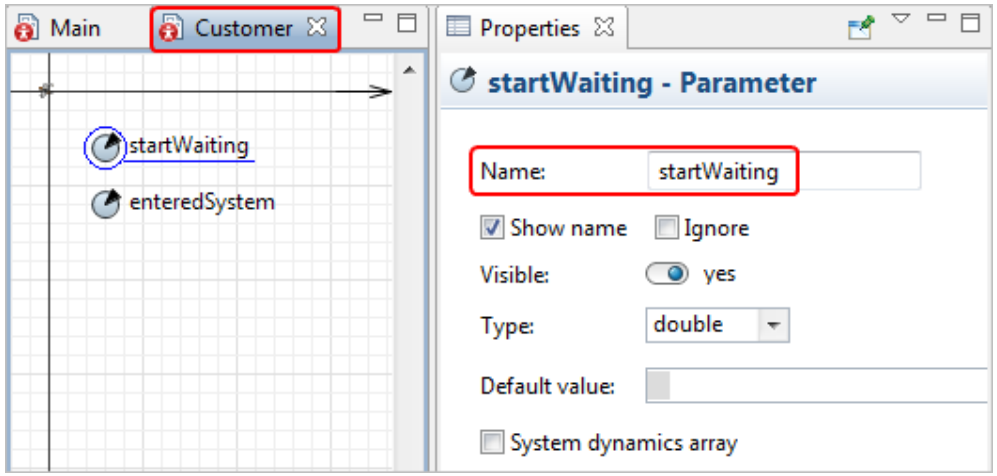
Collecting customer time statistics

We want to know how much time customer spends waiting in ATM queue and the whole time he spends in the bank. We will collect time statistics using AnyLogic analysis data objects and observe the resulting time distributions using histograms. We will use the agent type `Customer` we have created on the step 2.

First we need to add two parameters into our model.

Add parameters

1. Switch to the **Projects** view. Double-click the agent type `Customer` to open its diagram. We need to create parameteres for the agent type `Customer` if we want to collect customer statistics.
2. Open the **Agent** palette of the **Palette** view.
3. Drag the element **Parameter** into the diagram of `Customer`.
4. Leave the type `double` as it stands by default and name the parameters *startWaiting* and *enteredSystem*.

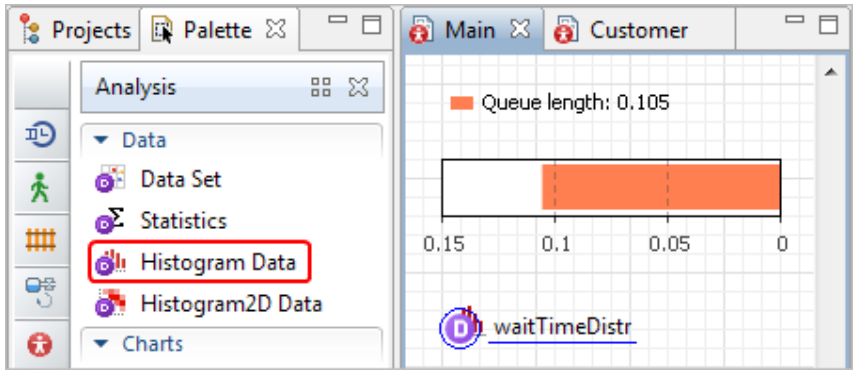


5. We will continue developing our model in the `Main` diagram.

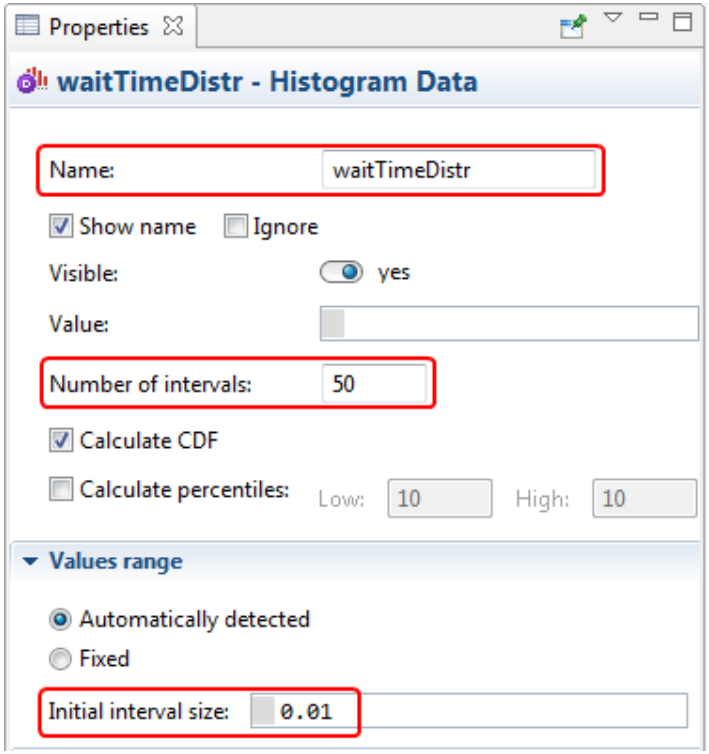
Add histogram data objects to store statistics on customer's waiting time and time in system. Histogram data objects support standard statistical analysis on the data values being added (calculate mean, minimum, maximum, deviation, variance and mean confidence interval).

Add histogram data objects to collect time statistics

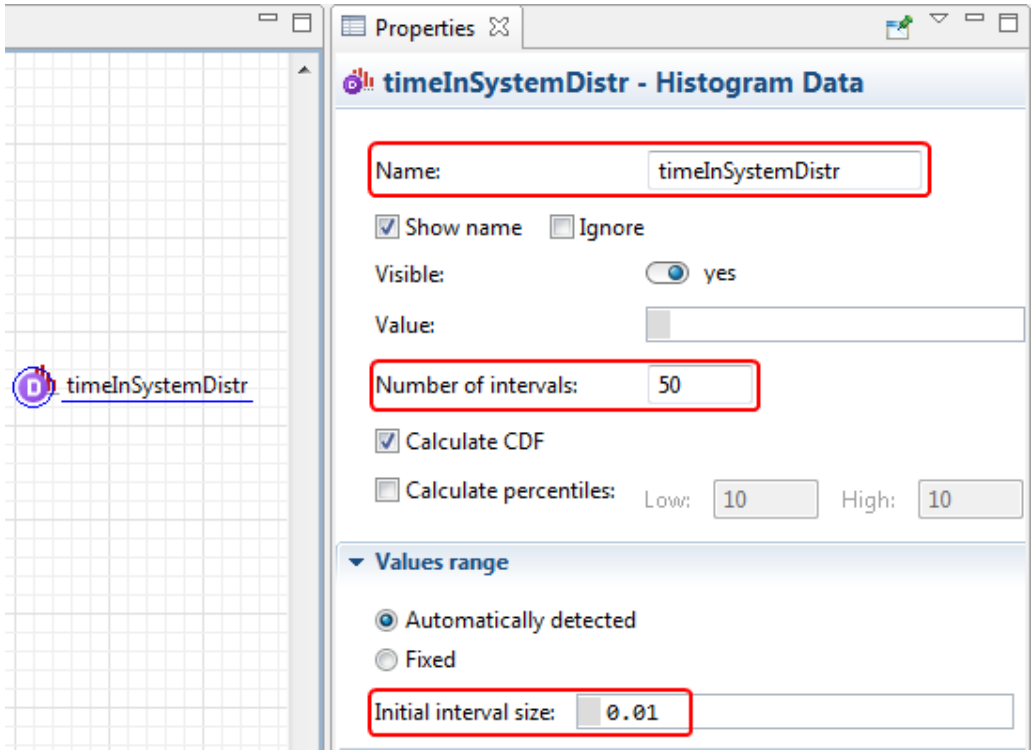
1. To add histogram data object on the diagram, drag the **Histogram Data** from the **Analysis** palette of the **Palette** onto the `Main` diagram.



2. Set up the properties of the element.
   - Change the **Name** to *waitTimeDistr*.
   - Set the **Number of intervals** equal to *50*.
   - Set the **Initial interval size**: *0.01*.



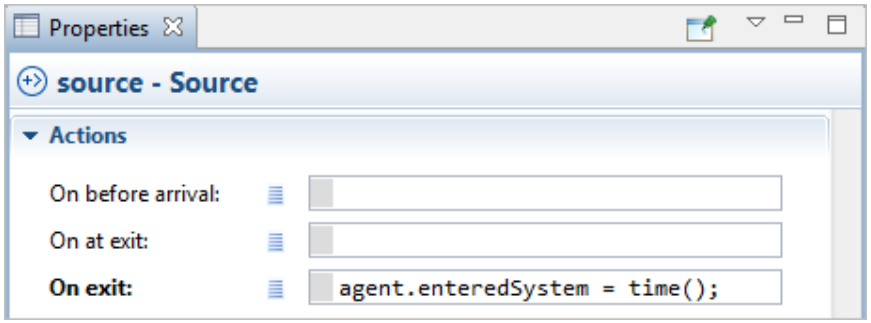
3. Create one more histogram data object. `Ctrl`+drag histogram data object to create its copy. Change the **Name** to *timeInSystemDistr*.



Now we will modify properties of our flowchart objects.

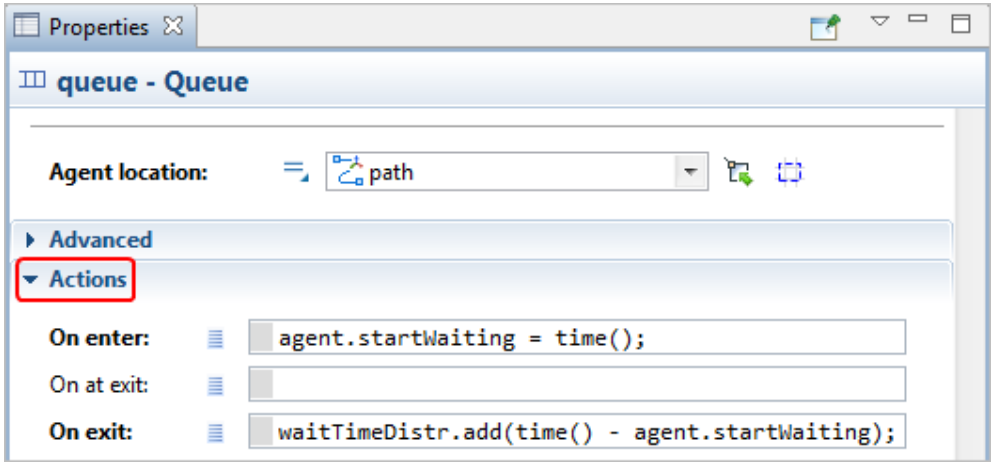
Modify the properties of the flowchart objects

1. Modify *source* properties:
   - Make sure the agent type `Customer` is specified as **New agent**. This object should continue generating agents of our `Customer` type.
   - Type `agent.enteredSystem = time();` in **On exit** action, located in **Actions** section. This code stores the time when a customer was generated in the `Customer`'s variable `enteredSystem`. The `time()` function returns the current model time value.

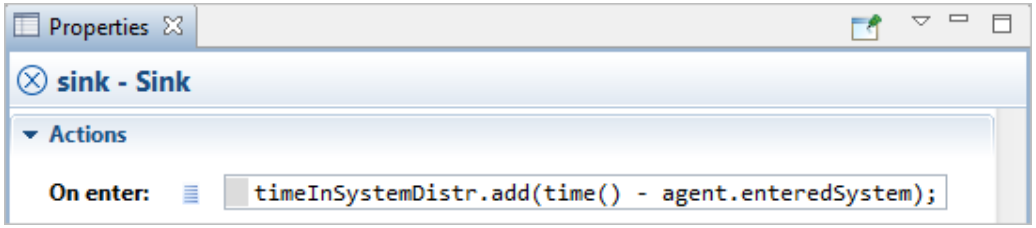


2. Modify *queue* properties:

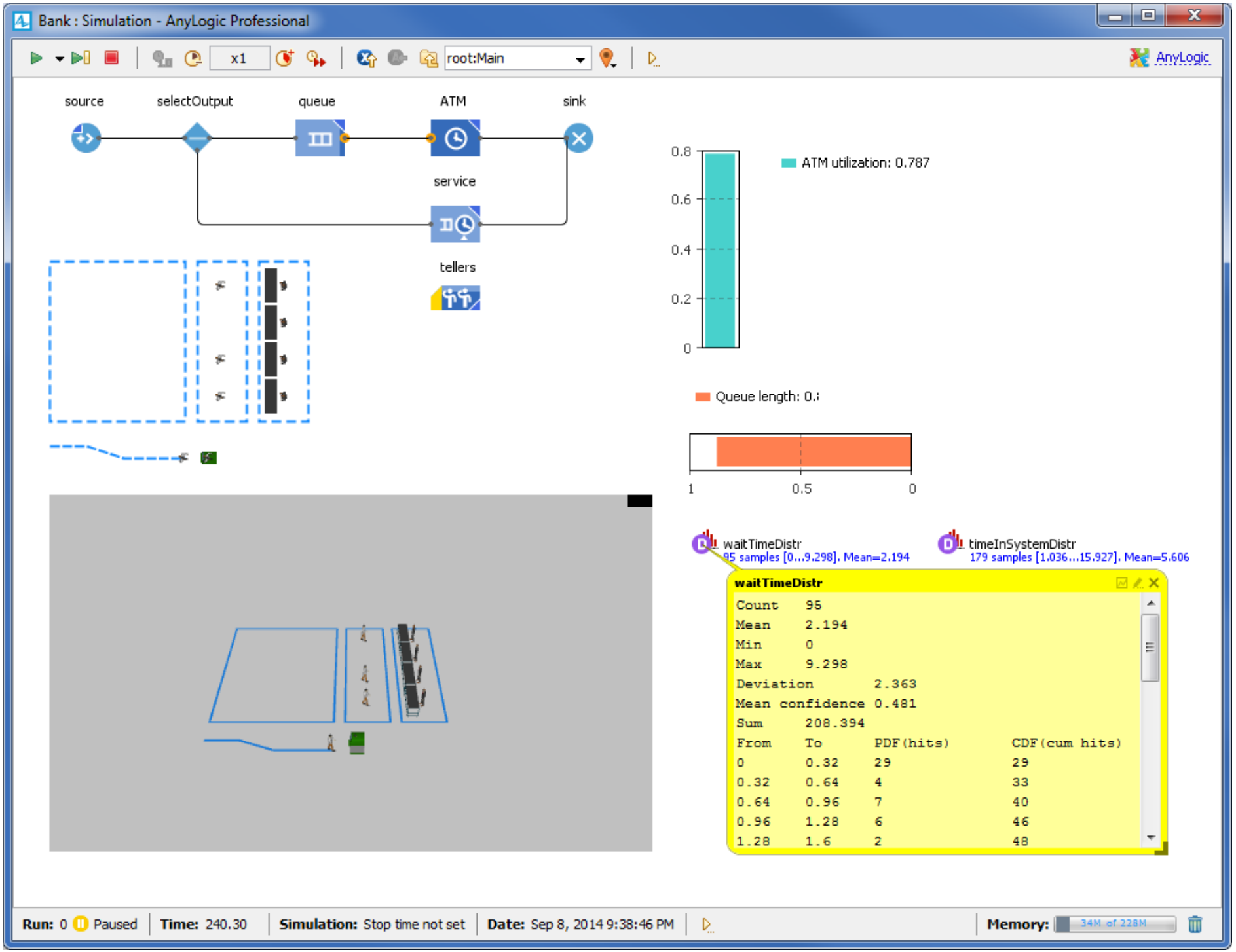
- Type `agent.startWaiting = time();` in **On enter** action, located in **Actions** section. This code stores the time when a customer started waiting in the queue in the `Customer`'s variable `startWaiting`.
- Type `waitTimeDistr.add(time() - agent.startWaiting);` in **On exit**. This code adds waiting time of the customer to the *waitTimeDistr* histogram data object.



3. Modify *sink* properties:
   - Type `timeInSystemDistr.add(time() - agent.enteredSystem);` in **On enter** action, located in **Actions** section. This code adds the whole time the customer spent in the bank to the *timeInSystemDistr* histogram data object.



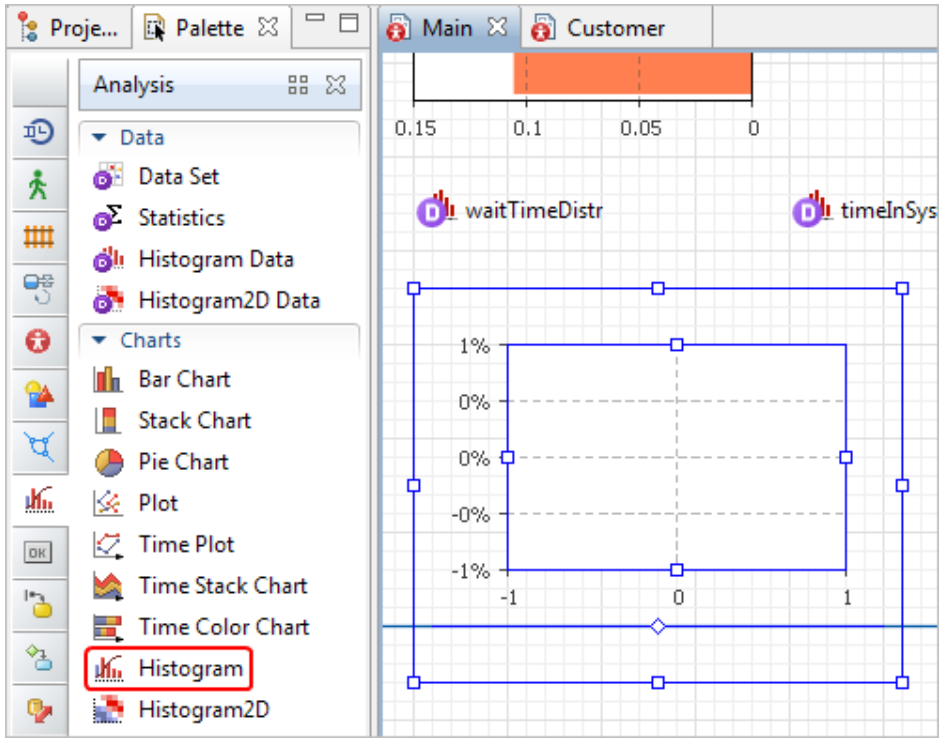
Run the model and view the statistics using inspect window of the data set. Open inspect window for data set by clicking on it. Here you can see standard statistical analysis on the data values being added to this data object.


Bank : Simulation - AnyLogic Professional
x1
root:Main
AnyLogic
source
selectOutput
queue
ATM
sink
service
tellers
0.8
0.6
0.4
0.2
0
ATM utilization: 0.787
Queue length: 0.
1
0.5
0
waitTimeDistr
95 samples [0...9.298]. Mean=2.194
timeInSystemDistr
179 samples [1.036...15.927]. Mean=5.606
waitTimeDistr
Count 95
Mean 2.194
Min 0
Max 9.298
Deviation 2.363
Mean confidence 0.481
Sum 208.394
From To PDF(hits) CDF(cum hits)
0 0.32 29 29
0.32 0.64 4 33
0.64 0.96 7 40
0.96 1.28 6 46
1.28 1.6 2 48
Run: 0 Paused
Time: 240.30
Simulation: Stop time not set
Date: Sep 8, 2014 9:38:46 PM
Memory:
34M of 228M

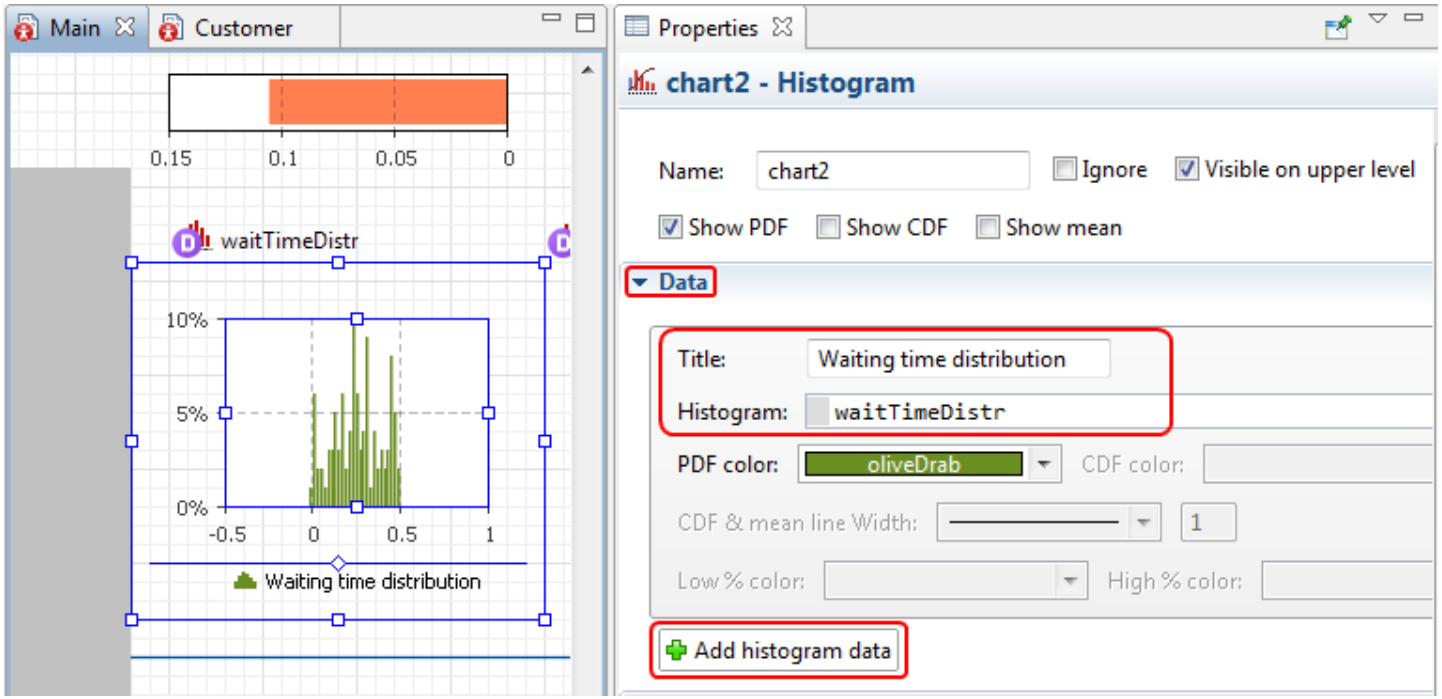
Now we want to display the collected statistics using standard histograms.

Add two histograms to display distributions of customer's waiting time and time in system

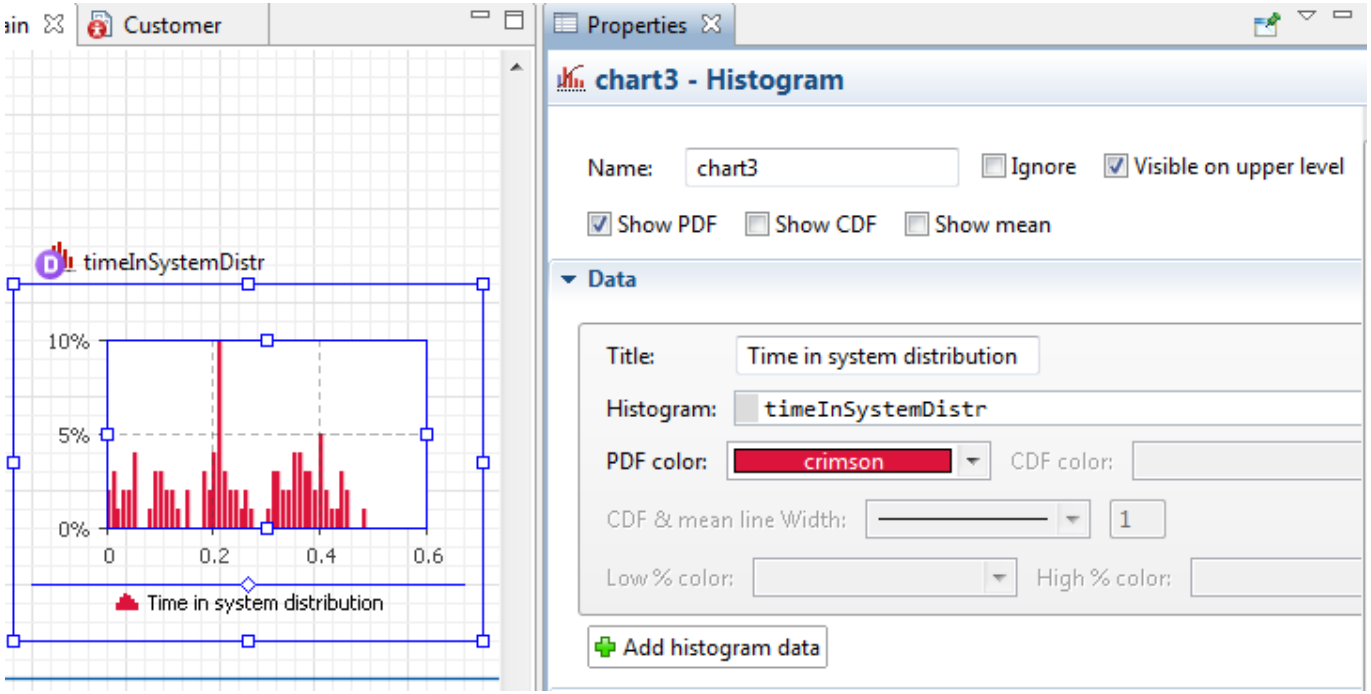
1. To add histogram on the diagram, drag the **Histogram** element from the **Analysis** palette of the **Palette** onto the diagram where you want to place the histogram. Resize it if needed.



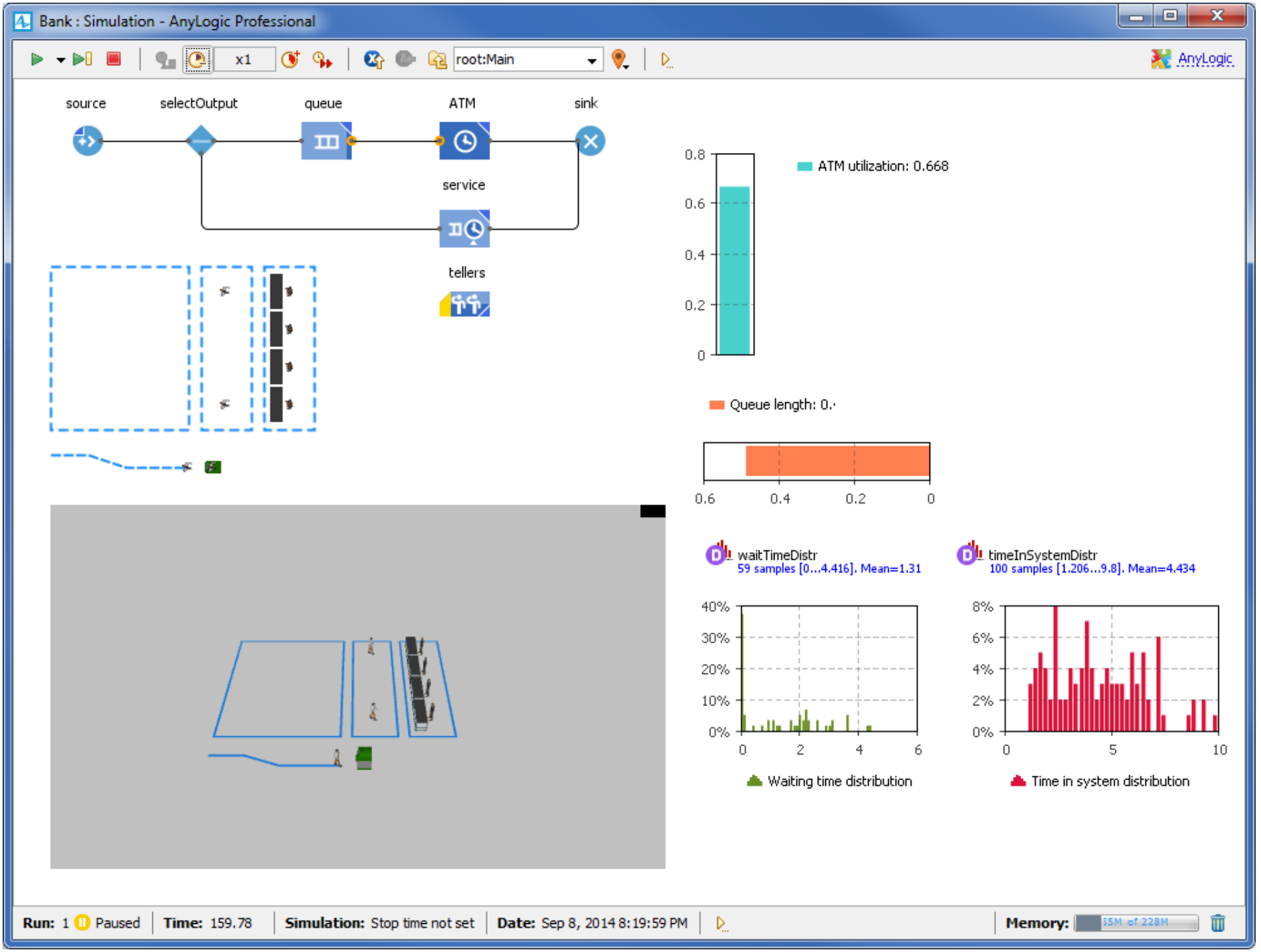
2. Define the data object to be displayed by this histogram. Click the **Add histogram data** button in **Data** section and change the **Title** to *Waiting time distribution*. Specify the **Histogram** to be displayed: `waitTimeDistr`



3. Add one more histogram below the existing one.
   Change the **Title** of the displayed data to *Time in system distribution*
   Choose the data object to be displayed: `timeInSystemDistr`



Run the model. Set virtual time mode and observe distribution of customer's time in system and waiting time.


Bank : Simulation - AnyLogic Professional
x1
root:Main
AnyLogic
source
selectOutput
queue
ATM
sink
service
tellers
0.8
0.6
0.4
0.2
0
ATM utilization: 0.668
Queue length: 0.
0.6
0.4
0.2
0
waitTimeDistr
59 samples [0...4.416], Mean=1.31
timeInSystemDistr
100 samples [1.206...9.8], Mean=4.434
40%
30%
20%
10%
0%
0
2
4
6
8%
6%
4%
2%
0%
0
5
10
Waiting time distribution
Time in system distribution
Run: 1 Paused
Time: 159.78
Simulation: Stop time not set
Date: Sep 8, 2014 8:19:59 PM
Memory:

Reference model: Bank - Phase 4

Phase 3, Adding tellers