Integrating Decision Tables with State Machines using Enterprise Architect

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Contents

1 Introduction

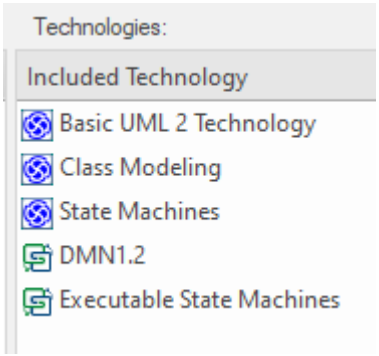
Sparx Systems Enterprise Architect (EA) supports the modelling, simulation and code generation for decision tables (DMN) and state machines (ESM).

This document provides a step-by-step guide on:

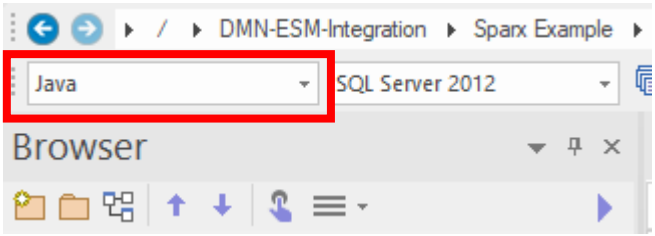
- How to model DMN, simulate, and generate Java code.
- How to model ESM, simulate, and generate Java code.
- How to integrate a DMN and ESM together using a Java Class.

1.1 Pre-Requisites

- To model, simulate and integrate DMNs and ESMs the **complete** Java Development Kit (JDK) **must** be installed on the same workstation as EA. The JDK is available free of charge from Java Downloads | Oracle.
- A perspective containing the following MDGs **must** be created and active:



- Set the Code Engineering to **Java**:



1.2 The Example

For this document the example used will be a simplified car insurance quotation, where the business rules for determining the insurance premium will be modelled using a DMN, and the process of obtaining a quote will be modelled using an ESM which will invoke the DMN to obtain the premium,

The business rules (fictitious and not representative of actual insurance premiums) for this example are as detailed in the table below:

Age	Car Type (Saloon, SUV, Sports)	NCD	Offences (Yes / No)	Premium
17 to 25	Saloon	0	No	500.00
		1 to 4		450.00
		5 to 8		400.00
	SUV	0		600.00
		1 to 4		550.00
		5 to 8		500.00
	Sports	0		700.00
		1 to 4		650.00
		5 to 8		600.00
	Saloon	0	Yes	700.00
		1 to 4		650.00
		5 to 8		600.00
	SUV	0		800.00
		1 to 4		750.00
		5 to 8		700.00
	Sports	0		900.00
		1 to 4		850.00
		5 to 8		800.00

2 Workflow

The workflow for creating an integrated DMN and ESM consists of the following steps:

1) Model the business rules as a DMN model.
2) Test the DMN model using multiple datasets.
3) Generate the DMN using the Java language.
4) Create a Java class to integrate (via an operation) with the DMN.
5) Generate the Java source code for this class.
6) Add a State Machine to this Java Class.
7) Add an Executable State Machine (ESM) artefact element to the model.
8) Add an instance (property) of the Java class to the ESM element.
9) Set the run-state of this instance.
10) Test the State Machine.
11) Add an invocation to an operation defined in step 4) to at least one state in the State Machine model.
12) Test the State Machine.
13) Either:
    a. Modify the run-state values to test a different set of business rules, and repeat for other business rules.

or

b. Add multiple instances (properties), one for each set of business rules, to the ESM artefact and add multiple invocations of the operation defined in step 4) to at least one state in the State Machine Model.

3 Worked Example

In this section a worked example is presented using the business rules as presented in section 1.2

3.1 Model the Business Rules as a DMN

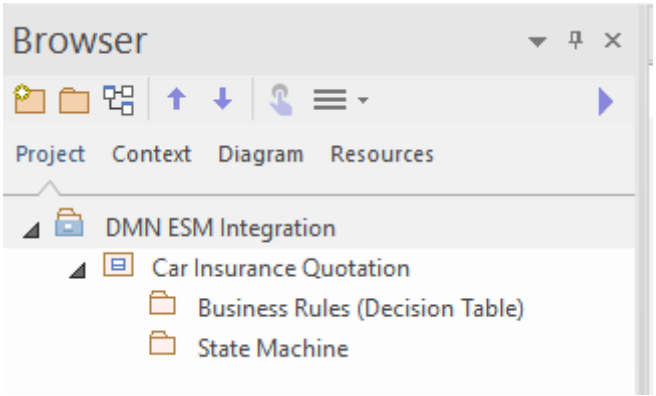
In EA the DMN 1.2 MDG provides multiple ways of modelling business rules, but every DMN model **must** have the following:

- The data (parameters) to be used as input to the decision table.
- The decision table.
- A **DMNSimConfiguration** element.

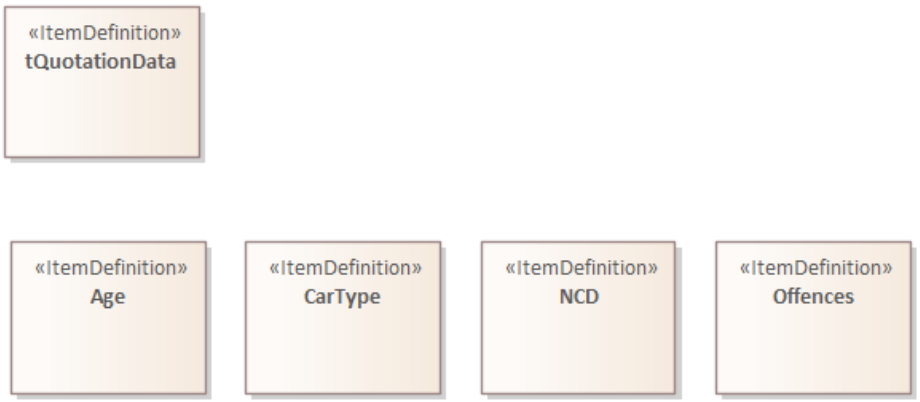
The elements above are provided in a toolbox within the DMN MDG **DMNDiagram**.

The following steps are required:

1) If necessary, create a new local EA project.
2) Create a repository structure like that shown below:



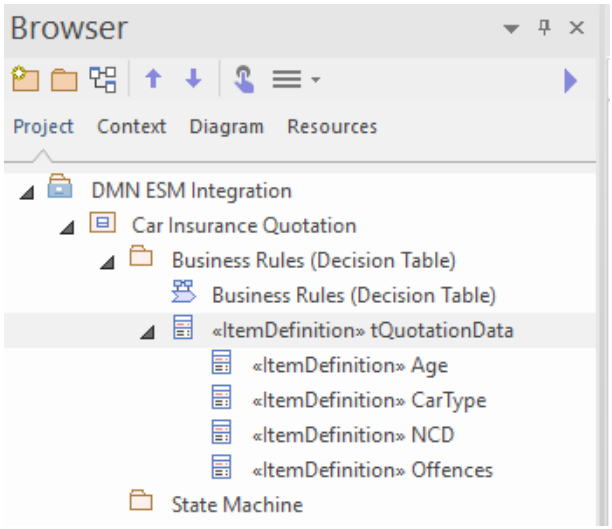
3) To the package named **Business Rules (Decision Table)** add a **DMNDiagram**
4) Using the diagram toolbox add **Item Definition** elements such that there is **one Item Definition** element for each input to the Decision Table, plus one extra **Item Definition** element will “own” the other Item Definition elements:



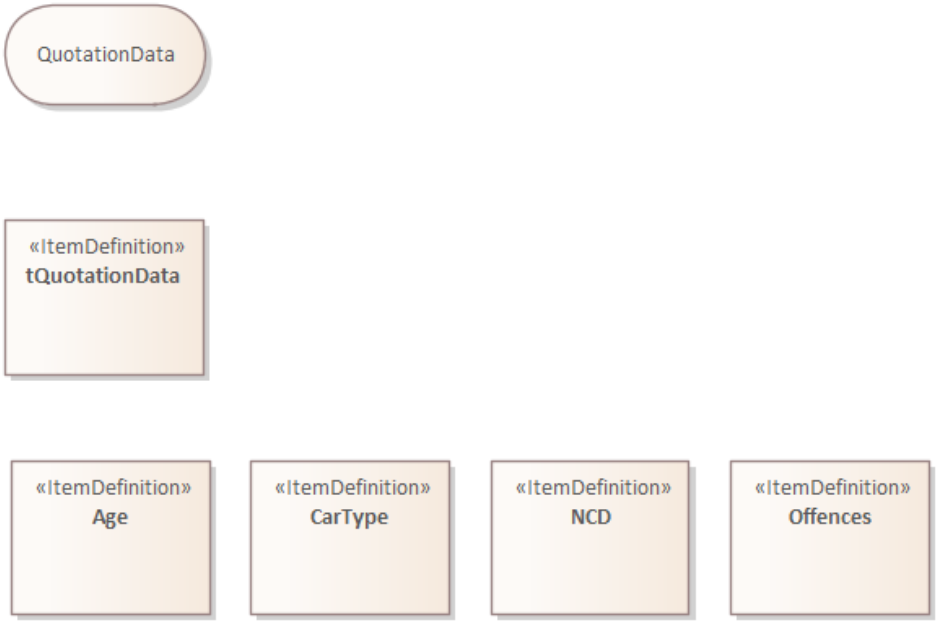
NOTE

These can be named anything you like, and the names can included spaces, but I prefer to not use spaces in the names, prefix the "owning" element with **t** and name all other elements to correspond with the inputs as per the business rules defined (in this example) in section 1.2

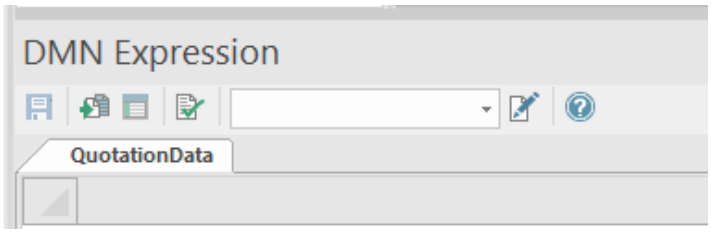
5) **IMPORTANT** structure the elements above in the Browser to reflect the "ownership" as shown below:



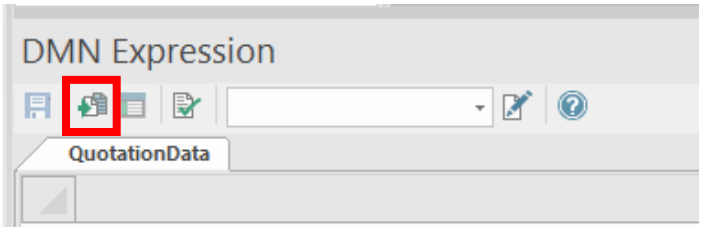
6) These elements are **not** required on the diagram and can be deleted if you wish.
7) Using the diagram toolbox add an **Input Data** element to the diagram. I usually name this element to be the same as the "owning" Item Definition element but without the **t** prefix:



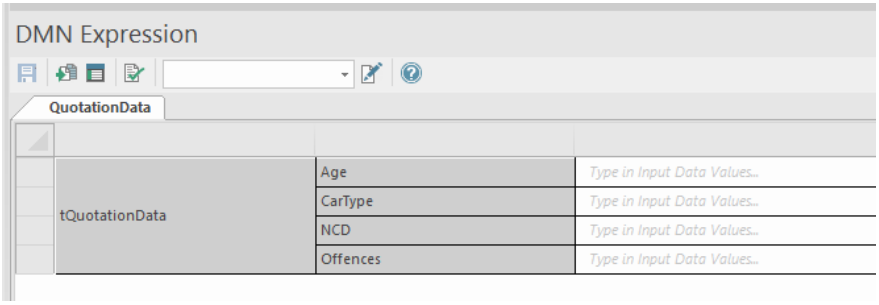
8) **IMPORTANT** Bind the **Input Data** element to the "owning" Item Definition element, by:
   a. Double-clicking the **Input Data** element to open the **DMN Expression** window:



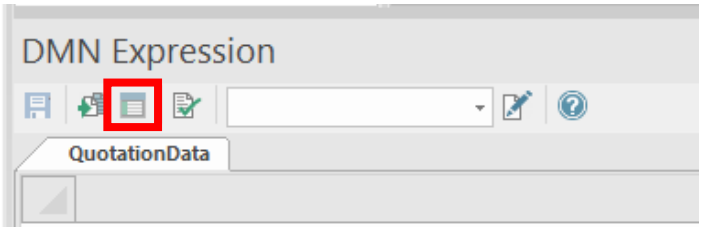
   b. Click the toolbar icon **Set Item Definition**:



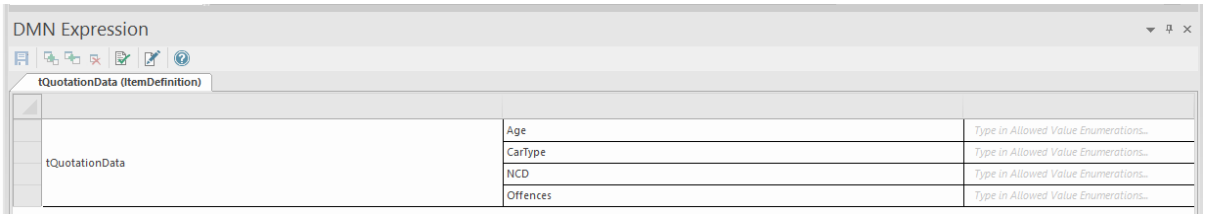
   c. Using the **Navigation Window** display, navigate to and select the "owning" Item Definition element named, in this example, **tQuotationData**:



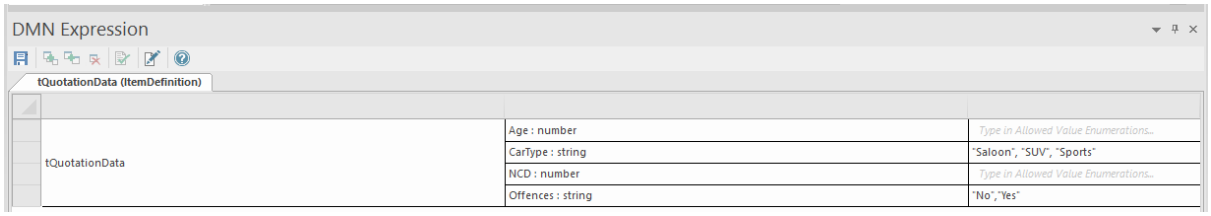
d. Click the icon **Open Item Definition**:



This will change the **DMN Expression** window to:



e. Set the **type** for each data item, by **right clicking** the data item and selecting the type from the drop down menu.
f. For a data item that can be one of a set of values (enumeration) enter the permitted values in the last column.

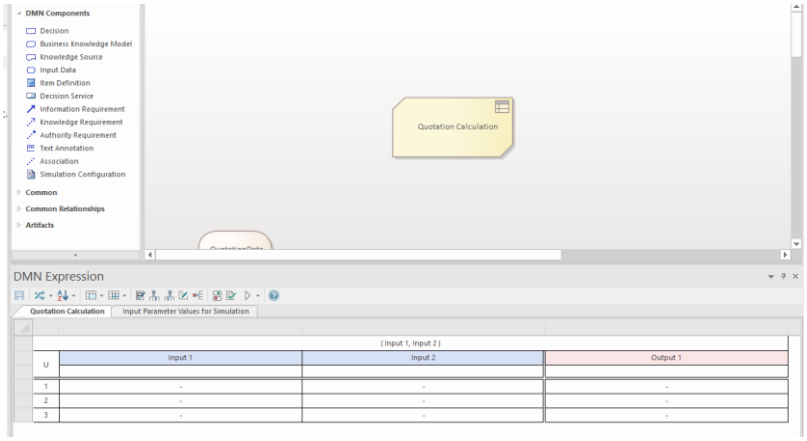


NOTE

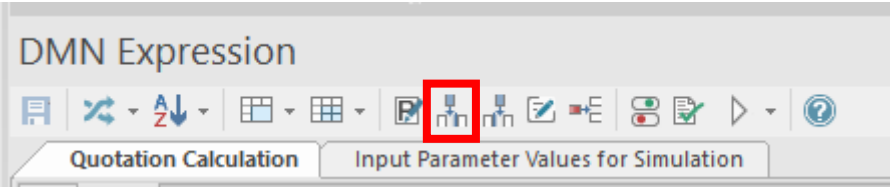
String values **must** be surrounded by double-quotes.

g. Save the changes, by clicking the **Diskette** toolbar icon.

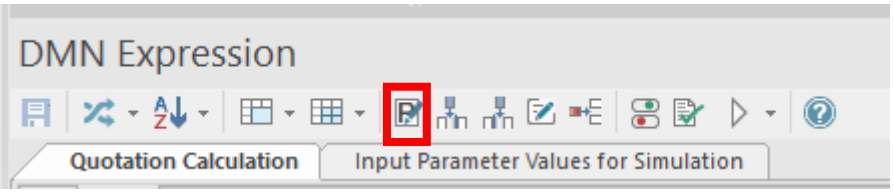
9) In this example the decision table will be modelled using a **Business Knowledge Model** element. Add a **Business Knowledge Model** element to the diagram, select **Decision Table** from the menu and give an appropriate name such as **Quotation Calculation**. Once added to the diagram the **DMN Expression** window will display an empty decision table:

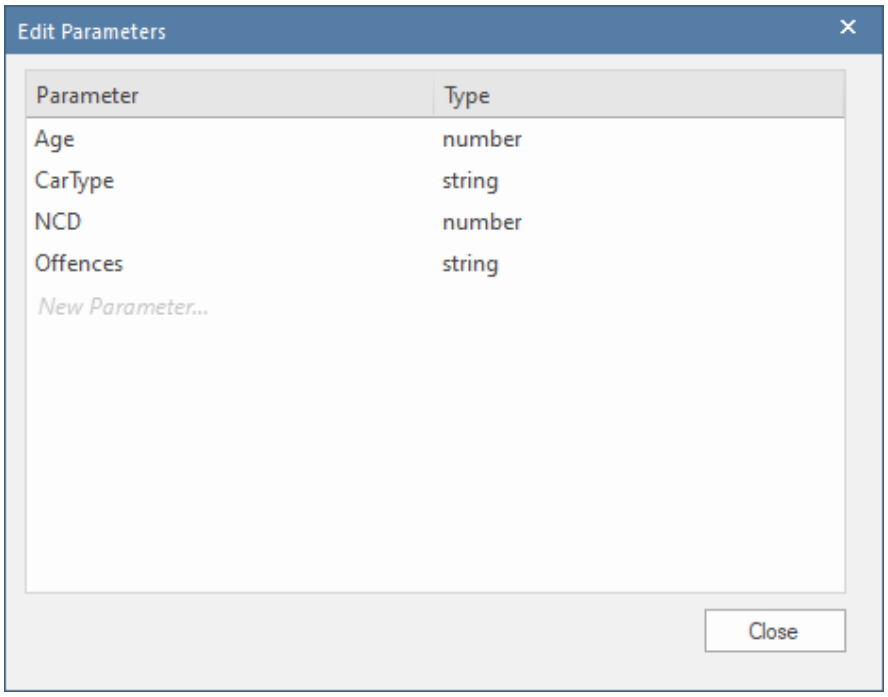


a. Using the **Add Input** toolbar icon add two more input columns:

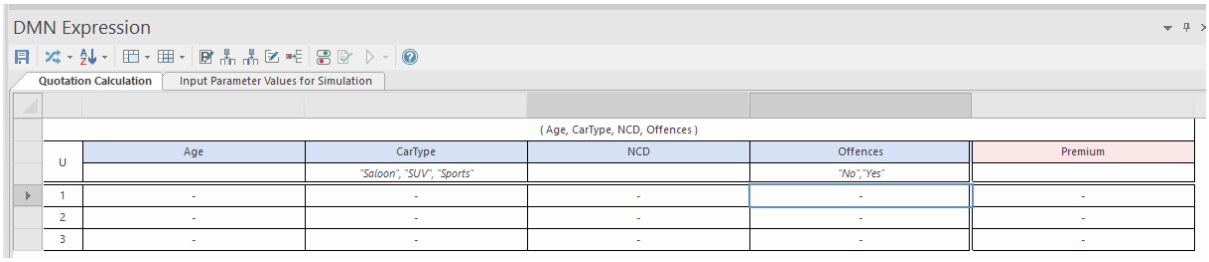


b. Using the **Edit Parameters** toolbar icon, set the parameters **these names must be the same as the "owned" Item Definition elements created earlier** as shown below:

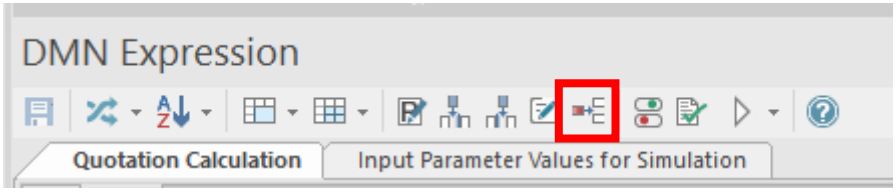


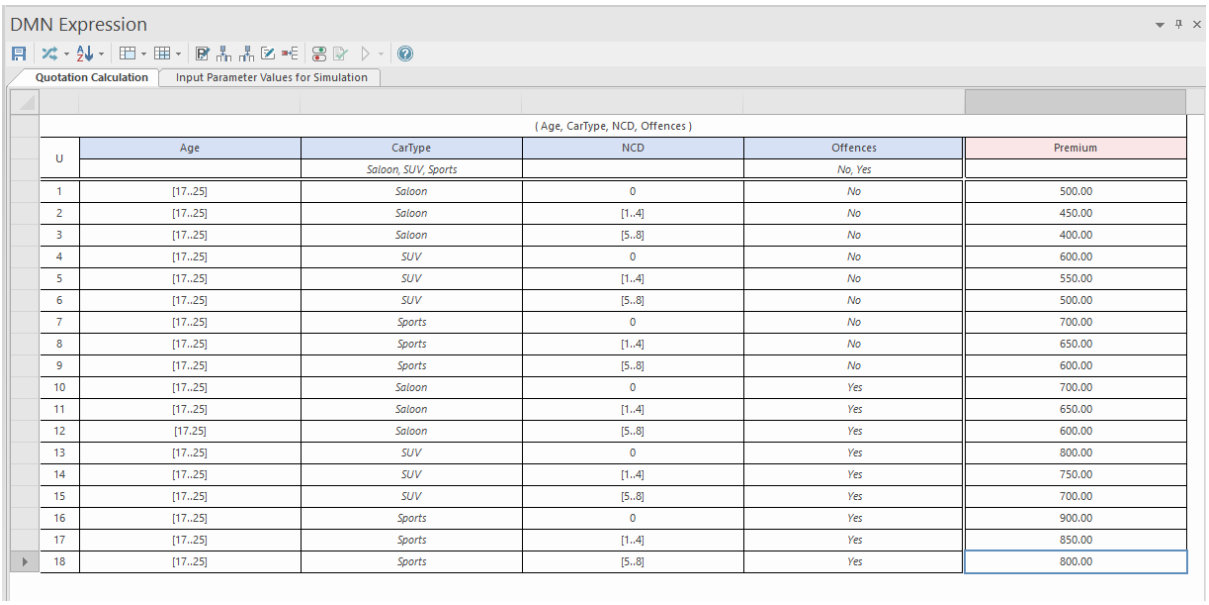


c. Change the names of the input / output columns to correspond to these input parameters (as you begin to type in an **input column**, you will see EA present a suggested name which you can then select), for an **output column** just type a name.
d. Right-click in the columns named **CarType** and **Offences** and select the type **string** from the drop-down list
e. For **string enumerations** (CarType and Offences) in our example, enter these values below (as you start to type you should see a suggestion from EA, which you should select) in section below the input column header:

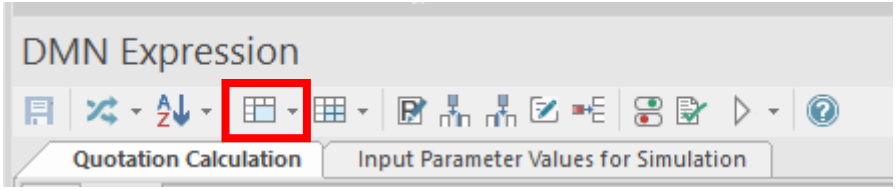


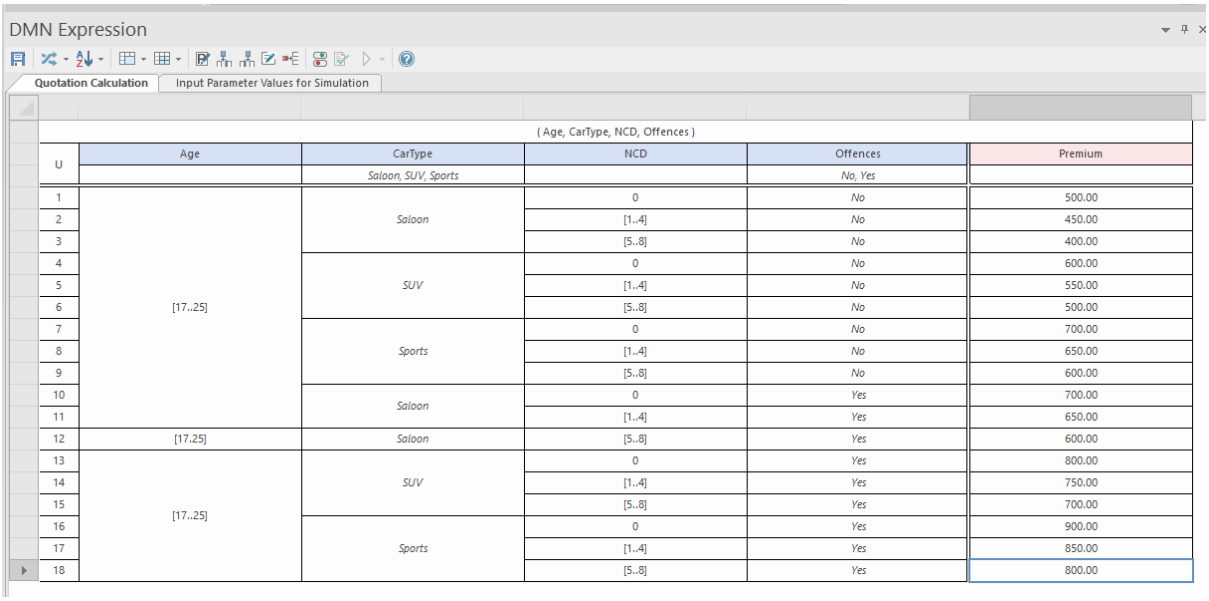
f. Now the laborious part, using the Business Rules defined in section 1.2 complete each row of the decision table. Extra rows can be added by selecting the **Add Rule** toolbar icon:





g. Save the changes by clicking the **Diskette** toolbar icon.
h. Optionally, you can merge cells by selecting **Merge All** from the menu displayed when selecting the **Merge Cells** toolbar icon. This can be reversed (unmerged) by selecting **Unmerge All** from the menu displayed by selecting the next toolbar icon (to the right) of the one shown below, so you can restore to non-merged cells if you wish.



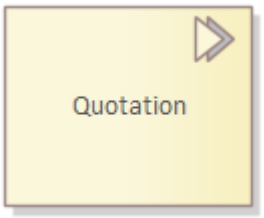

DMN Expression

Quotation Calculation | Input Parameter Values for Simulation

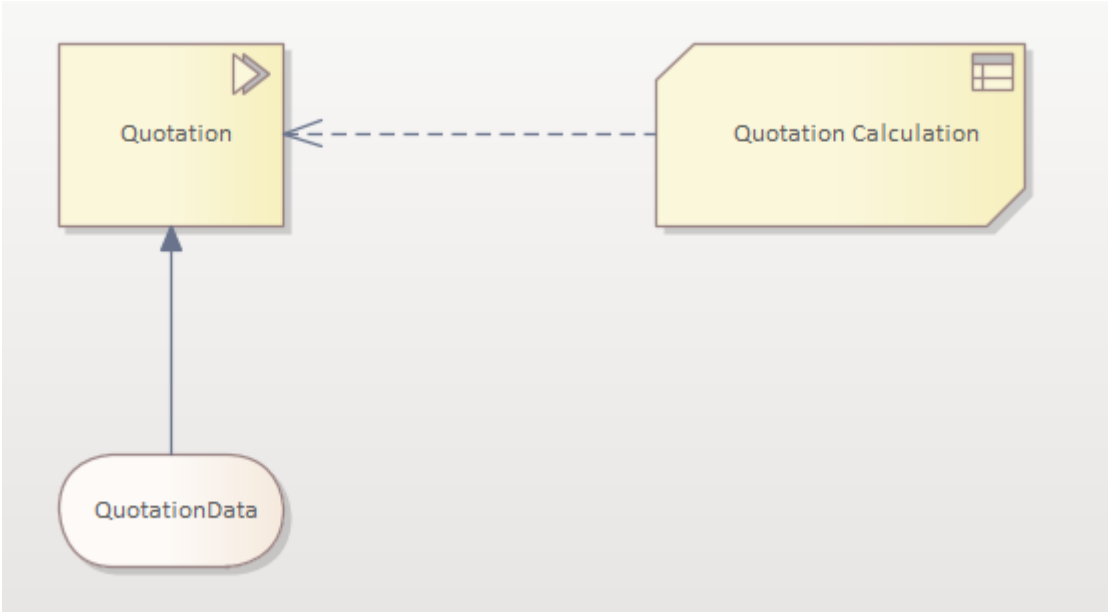
(Age, CarType, NCD, Offences)

U	Age	CarType	NCD	Offences	Premium
		Saloon, SUV, Sports		*No, Yes*	
1	[17..25]	*Saloon*	0	*No*	500.00
2			[1..4]	*No*	450.00
3			[5..8]	*No*	400.00
4		*SUV*	0	*No*	600.00
5			[1..4]	*No*	550.00
6			[5..8]	*No*	500.00
7		*Sports*	0	*No*	700.00
8			[1..4]	*No*	650.00
9			[5..8]	*No*	600.00
10		*Saloon*	0	*Yes*	700.00
11			[1..4]	*Yes*	650.00
12	[17.25]	*Saloon*	[5..8]	*Yes*	600.00
13	[17..25]	*SUV*	0	*Yes*	800.00
14			[1..4]	*Yes*	750.00
15			[5..8]	*Yes*	700.00
16		*Sports*	0	*Yes*	900.00
17			[1..4]	*Yes*	850.00
18			[5..8]	*Yes*	800.00

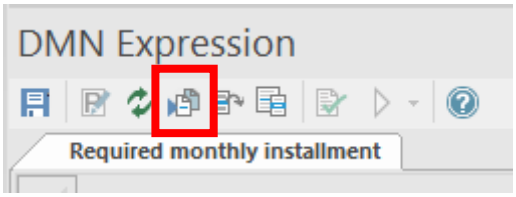
10) Add a **Decision Element** and choose **Invocation** from the menu from the toolbox to the diagram, in this example a suitable name is **Quotation**.

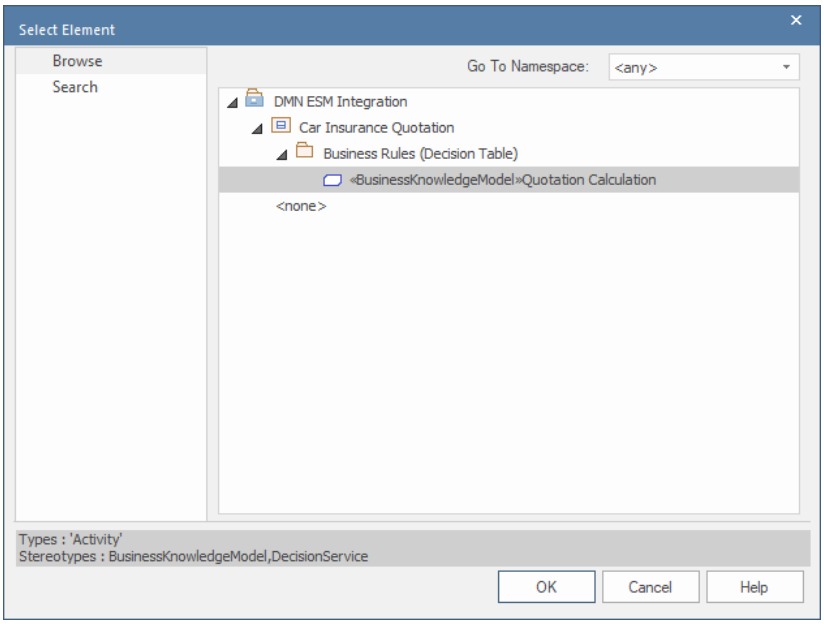


11) Using the Quicklink create an **Information Requirement** relationship from the **Input Data** element named **QuotationData** to the newly created **Decision Element**.
12) Similarly using the Quicklink create a **Knowledge Requirement** relationship from the **Business Knowledge Model** element named **Quotation Calculation** to the newly created **Decision Element**.

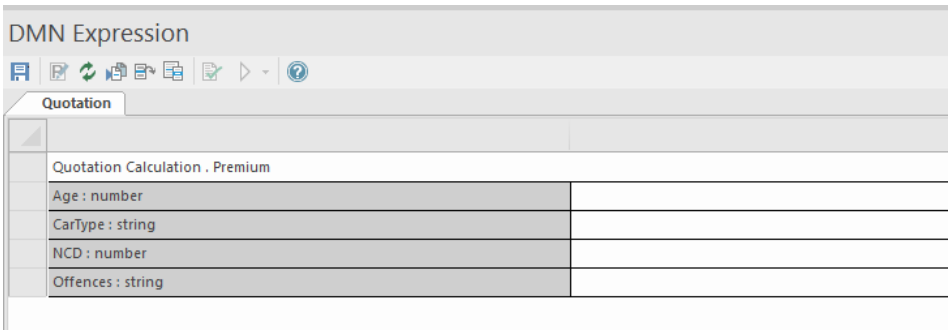


13) **IMPORTANT** Bind together the **Decision** element and the **Business Knowledge Model** element by:
    a. Double-click the **Decision** element named **Quotation** to open the **DMN Expression** window.
    b. Click the **Set Business Knowledge** icon

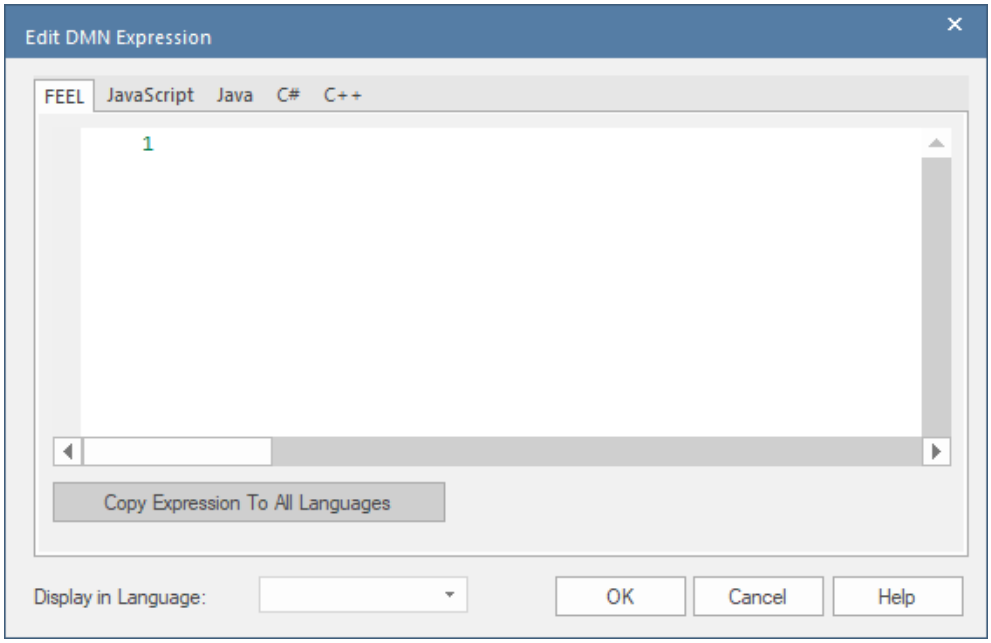




    c. If necessary, navigate to and select the **BusinessKnowlegdeModel** in this example it is named **Quotation Calculation**.
    d. Click **OK**



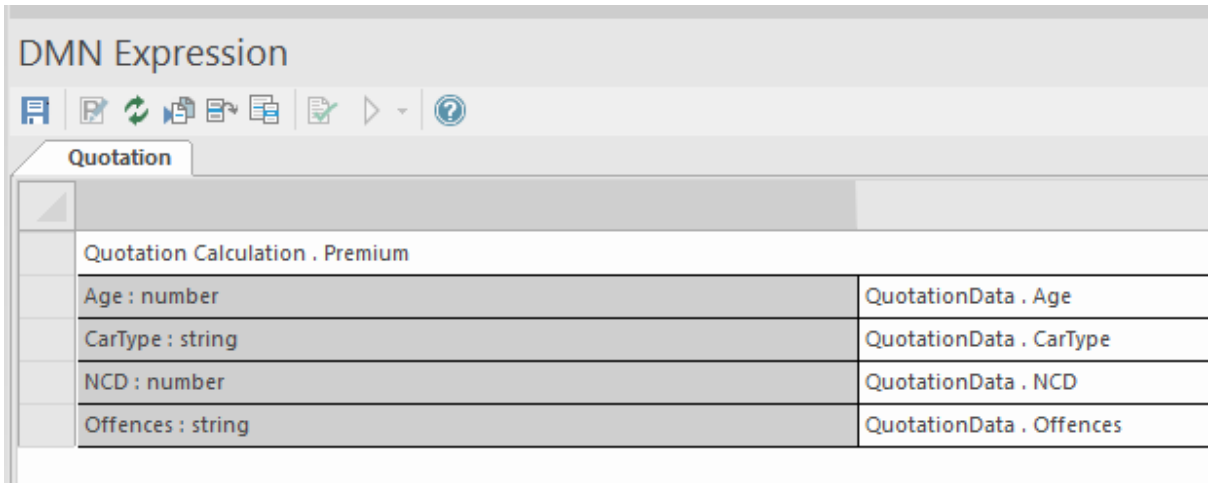
14) **IMPORTANT** Bind together the **Decision** element and the **Input Data** element by:
    a. Click in the text area adjacent to one of the input parameters listed and select **Edit Expression…**



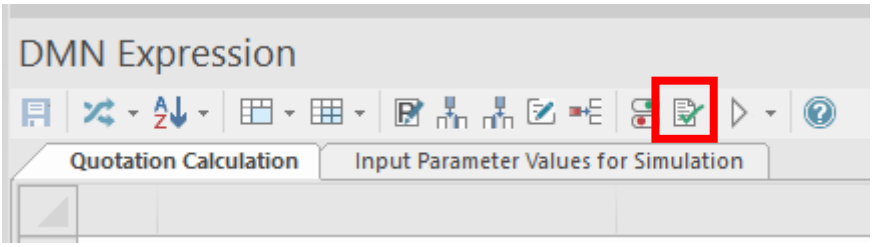
NOTE

The tab named **FEEL** is used for direct simulation and testing of the DMN model within EA. The remaining tabs are completed if the DMN is to be generated to code, for example **Java**.

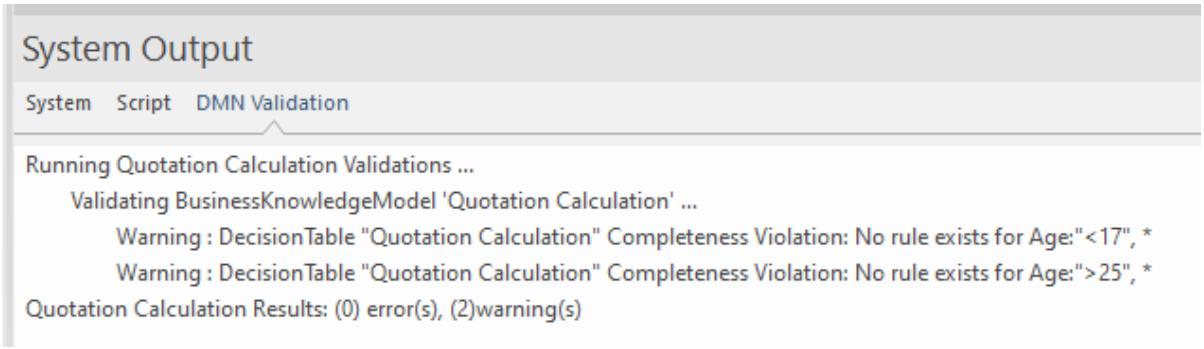
b. The syntax for the **FEEL** entry is **InputData element name . Parameter Name**
c. The syntax for **Java** is **InputData element name.Parameter name**



15) Validate the Decision Table by:
a. Selecting the **BusinessKnowledgeModel** element named **Quotation Calculation**.
b. Clicking the **Validation** icon in the toolbar:



c. The decision table will be validated, and the results shown in the **System Output** tab:



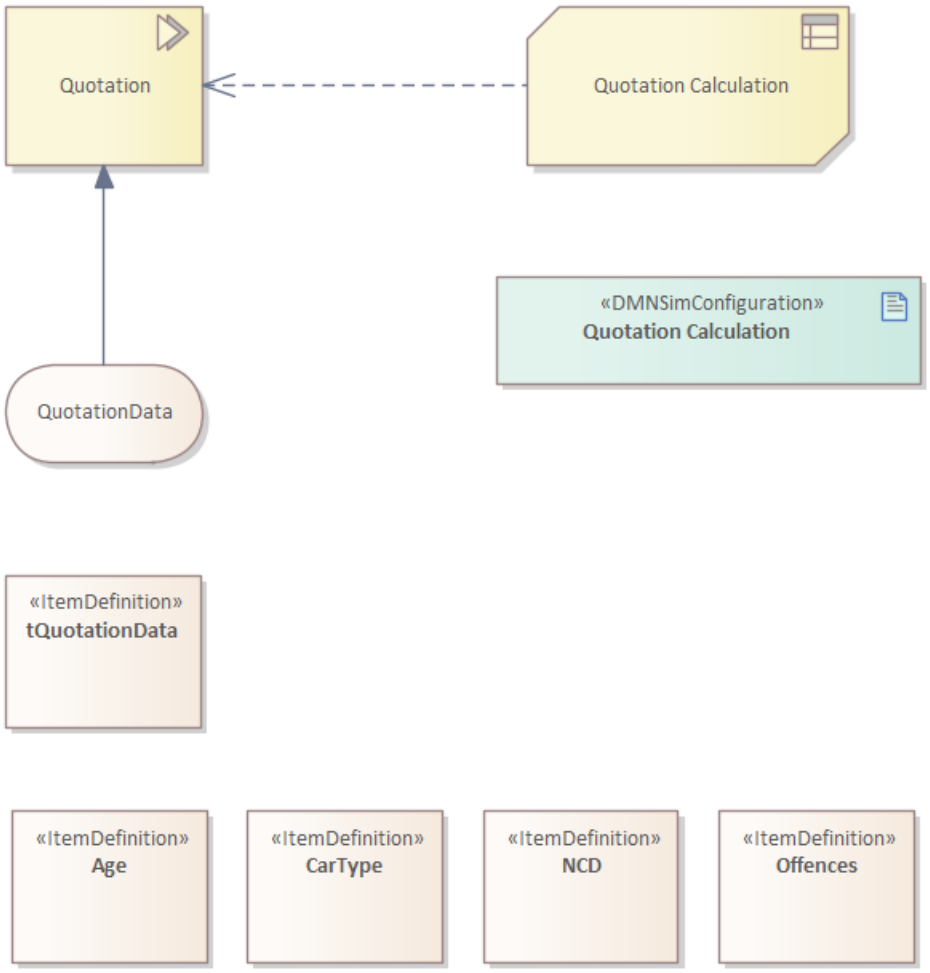
NOTE

In this example the validation provides two warnings regarding possible missing rules. In this example these missing rules are not important, but in other examples you may need to add the missing rules.

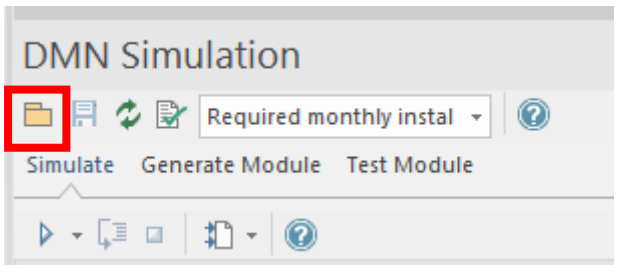
Other validation errors are syntax errors, for example entering [17.25] instead of [17..25] result in an **error**.

Warnings can be ignored. Errors **must** be corrected.

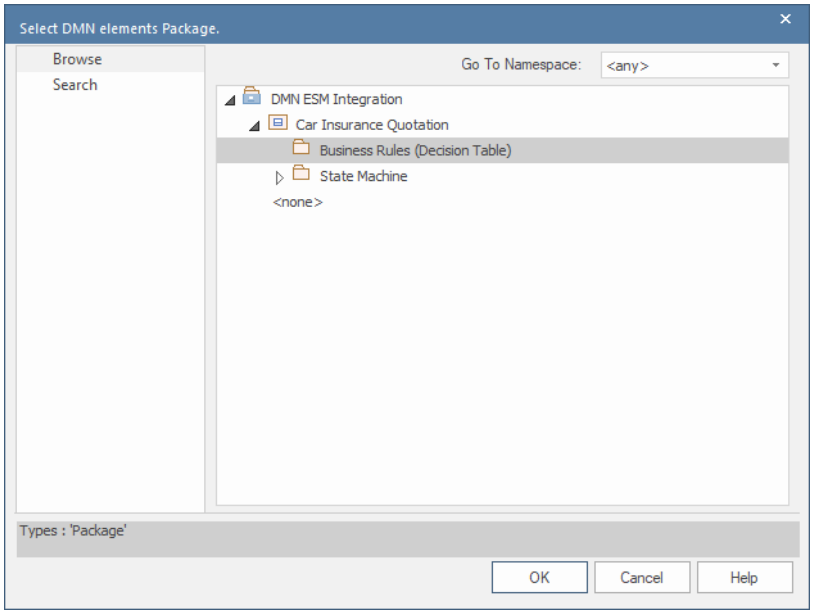
16) Using the diagram toolbox add a **Simulation Configuration** element to the diagram and give this element a suitable name, for example, **Quotation Calculation**.



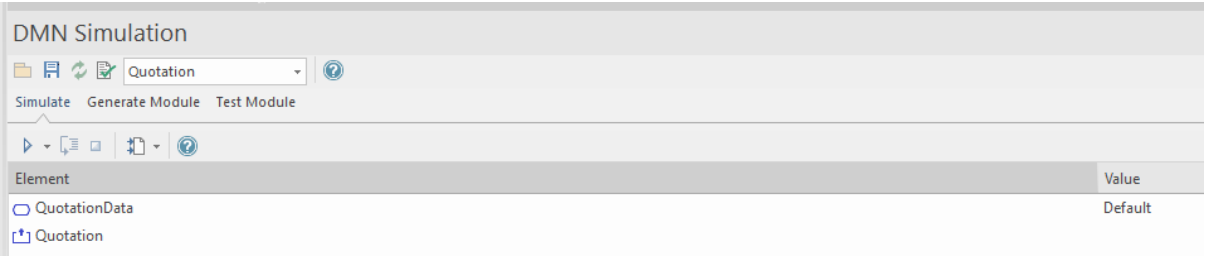
17) Bind this **Simulation Configuration** element to the **Package** containing the elements created so far:
    a. Double-click the **Simulation Configuration** element
    b. Click the **Configure Package** toolbar icon:



    c. Select the Package (in this example the Package named **Business Rules (Decision Table)** in the Select Package dialog:



d. Click **OK**.
e. Select **Quotation** (the name of the **Decision** element) from the drop-down list in the DMN Simulation window:



f. The entry for the **Input data** element named **Quotation** is shown with the value **Default**. This refers to the **Data Set** that will be used to run the simulation. Each **Input Data** element has a **Default** data set which **cannot be deleted** but can be copied to create multiple data sets for simulation. This process is described in the next section.

3.2 Creating Data Sets for the Decision Table

Before generating any code for the decision table, it should be tested to ensure all is working correctly.

A simulation requires an input data set that belongs to the **Input Data** element.

The recommended approach is:

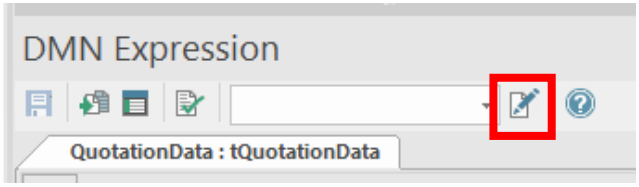
- **Copy** the Default data set
- Assign values to **all** input parameters that will test a rule.
- Repeat this process to test as many rules as required.

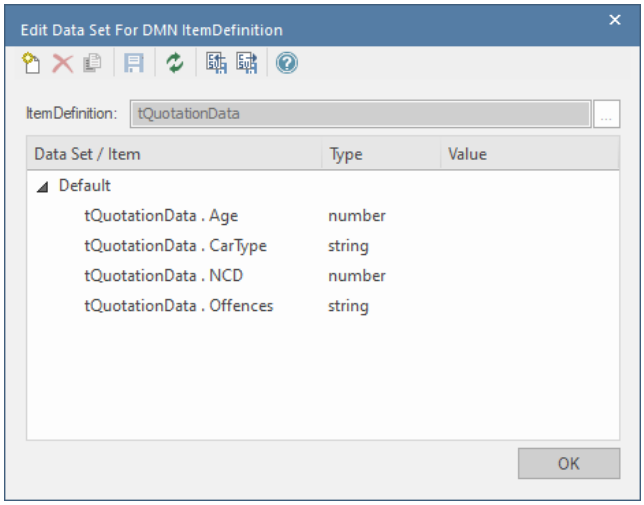
In this example we will create the data sets (the data set name corresponds to the rule number in the decision table that is to be tested) as detailed in the table below:

Data Set Name	Age	CarType	NCD	Offences	Expected Result
Rule 2	20	Saloon	2	No	450.00
Rule 6	20	SUV	6	No	500.00
Rule 7	20	Sports	0	No	700.00
Rule 11	20	Saloon	2	Yes	650.00
Rule 15	20	SUV	6	Yes	700.00
Rule 16	20	Sports	0	Yes	900.00

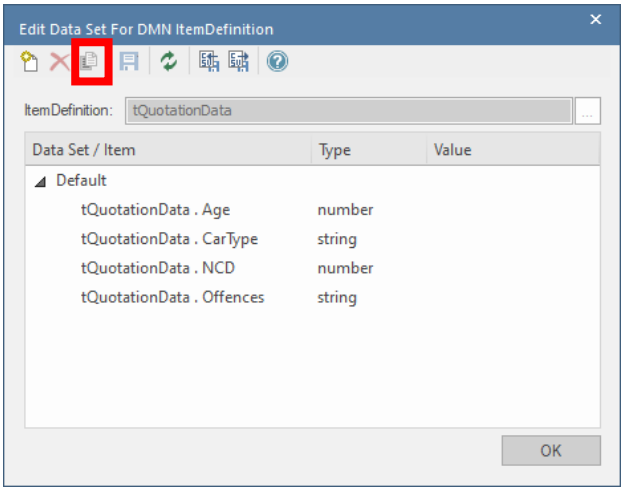
To create a Data Set for each row in the table above:

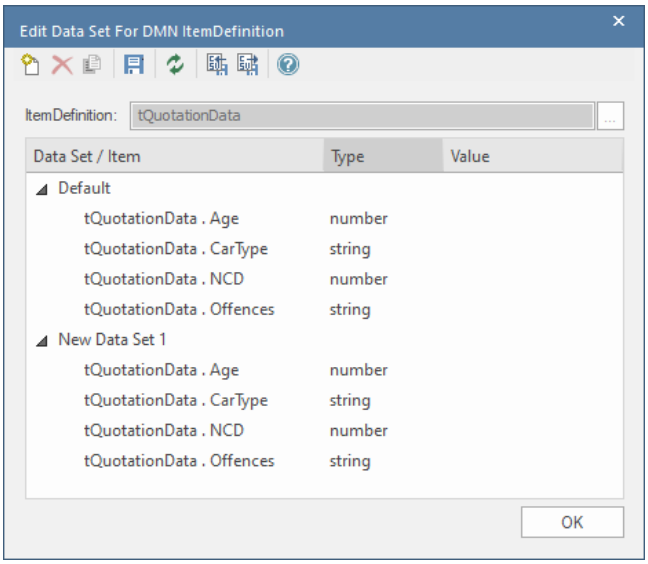
1) Double-click the **Input Data** element named **QuotationData**
2) Click the **Edit Data Set** toolbar icon:



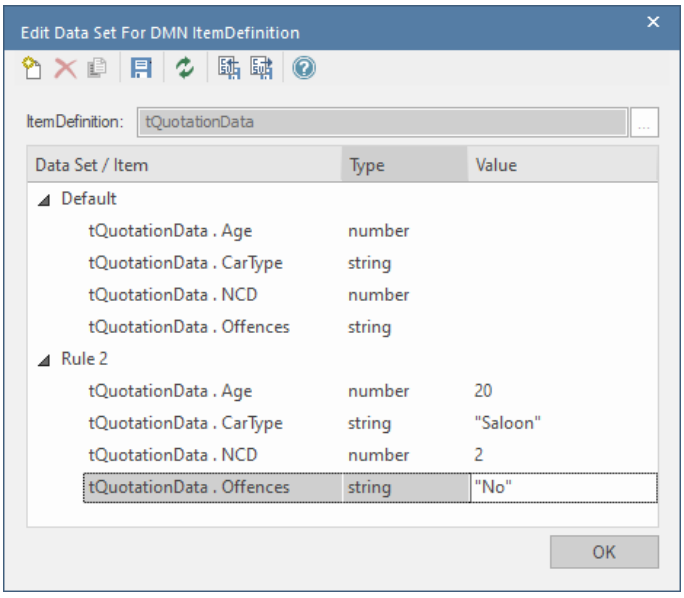


3) Copy the **Default** data set by:
    a. Selecting the Default data set.
    b. Click the **Duplicate** icon in the toolbar:





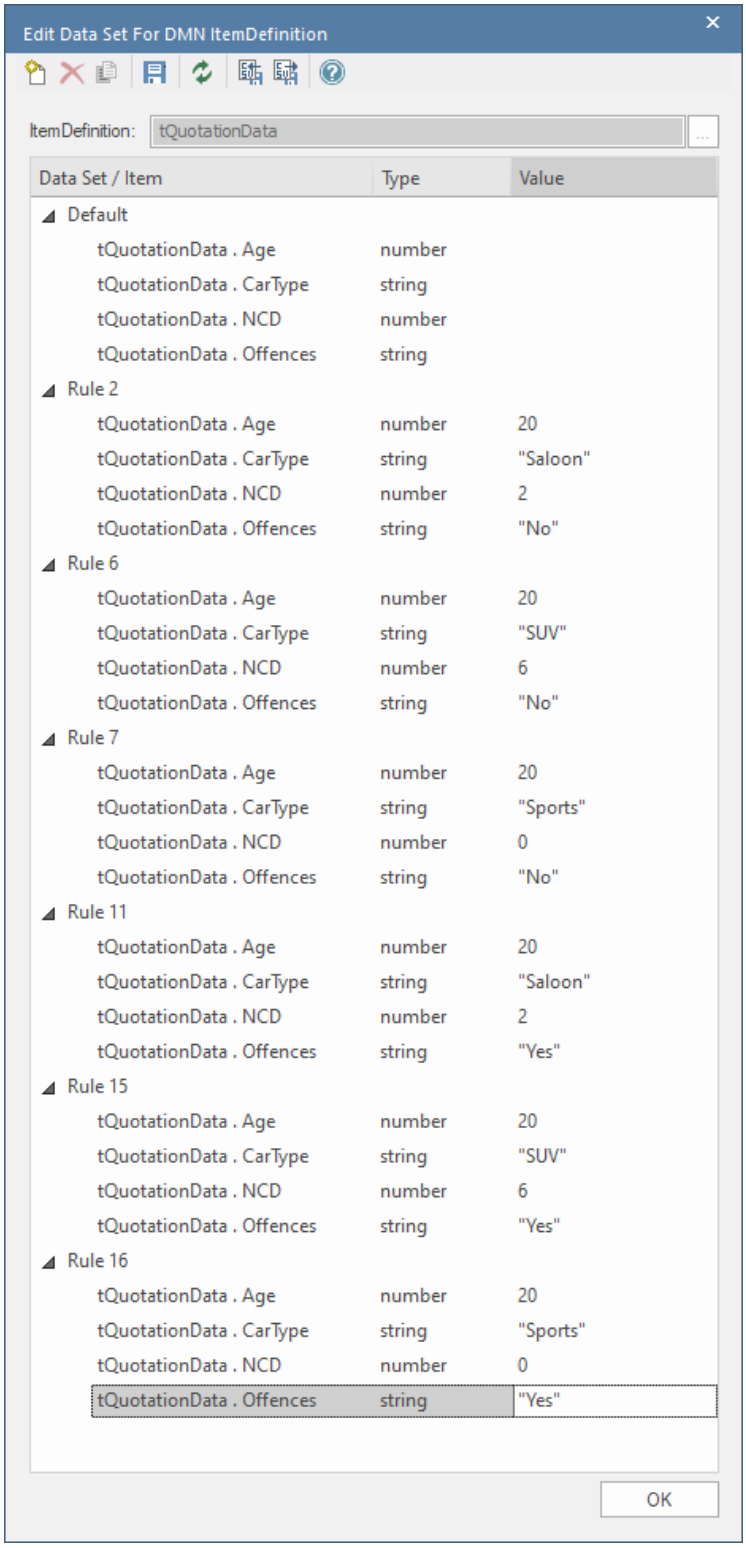
4) Name the data set and enter values for each input parameter using the table above:



NOTE

If there has been a selection defined, for example, the CarType, then a value can be selected from a drop-down list.

5) Repeat steps 4) and 5) for each row of the table above. You can either copy the Default data set **or** a data set that you have created.



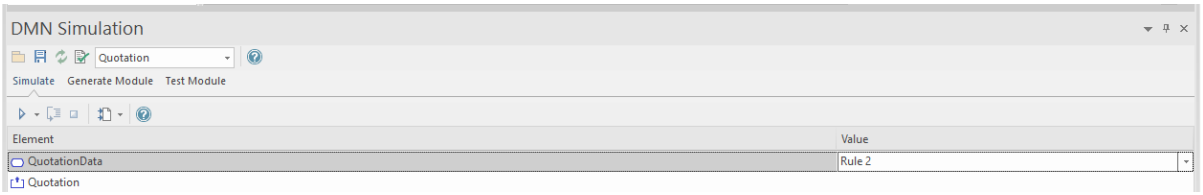
6) Click **OK**

3.3 Running a Simulation

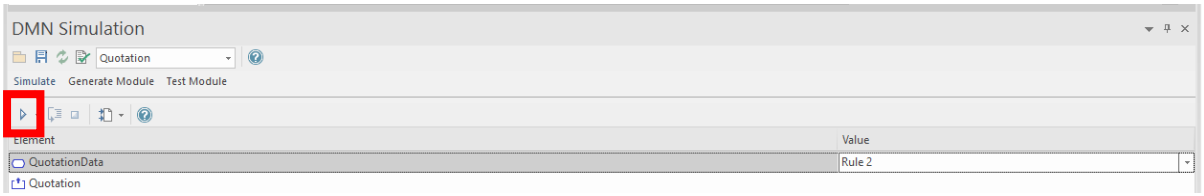
Now that we have created the Decision table, bound all the elements together and defined input data sets, we can run a simulation to test the decision table.

To run a simulation, use the following steps:

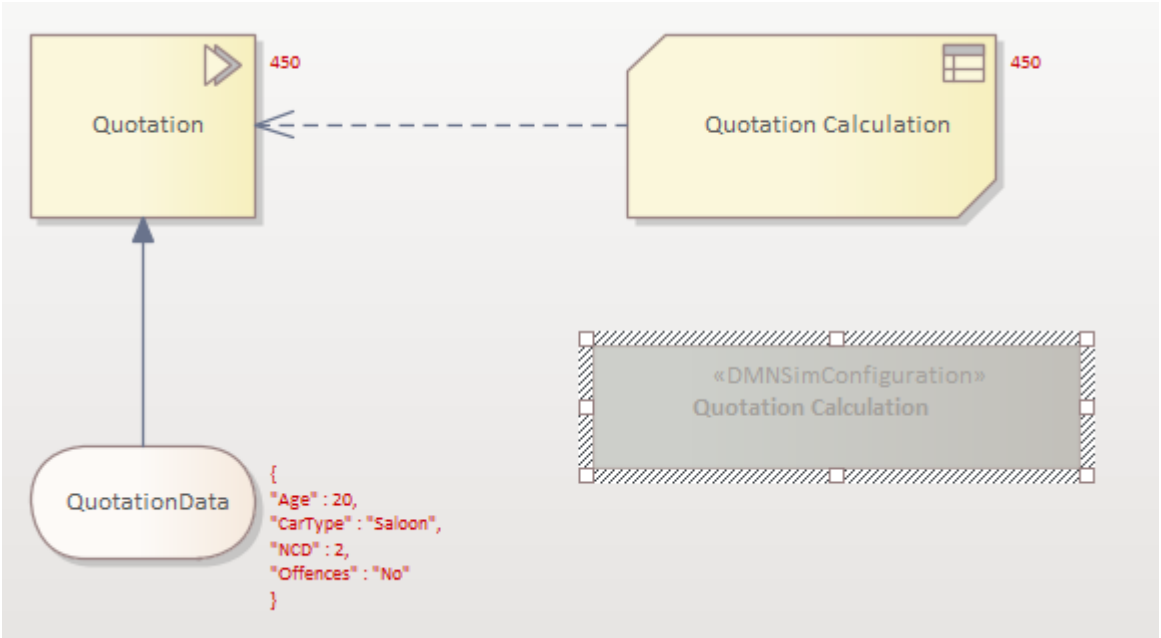
1) Decide which data set to use for the simulation, for example **Rule 2**.
2) Note the expected value, in this example **450**.
3) Double-click the **Simulation Configuration** element.
4) Select **Rule 2** from the drop-down in the **DMN Simulation** window:



5) Click the **Simulation** toolbar icon:



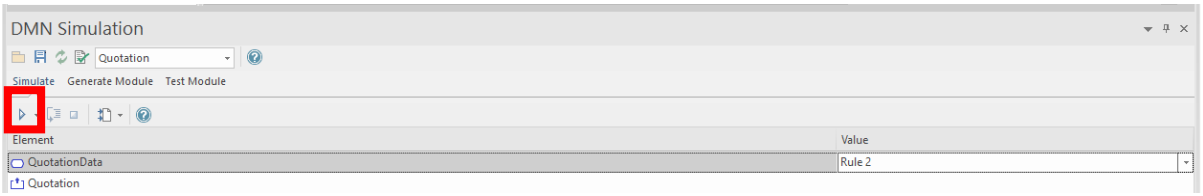
6) The simulation will run, and the results shown:



We can verify the correct result by observing the **red** text adjacent to each element. The text adjacent to the **Input Data** element is the data set used in the simulation, the other red text

is the result after evaluating the decision table rules. Comparing the result against the expected result, we can verify that the decision table is correct.

7) End the simulation by clicking the **Stop Simulation** icon in the toolbar:

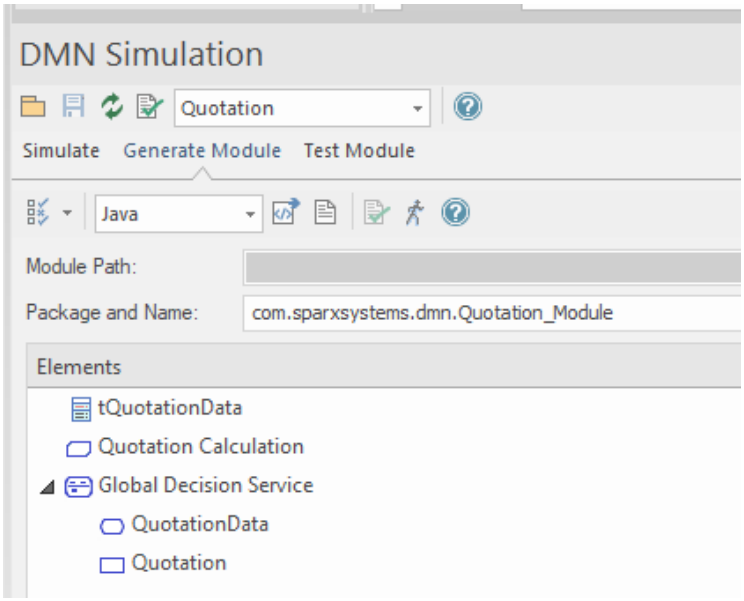


8) Repeat the steps above for each data set to verify that each data set produces the expected result.

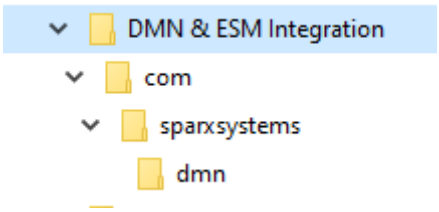
3.4 Generating the Java Classes for the Decision Table

Once the decision table has been tested using simulation and data sets, Java code can be generated using the following steps:

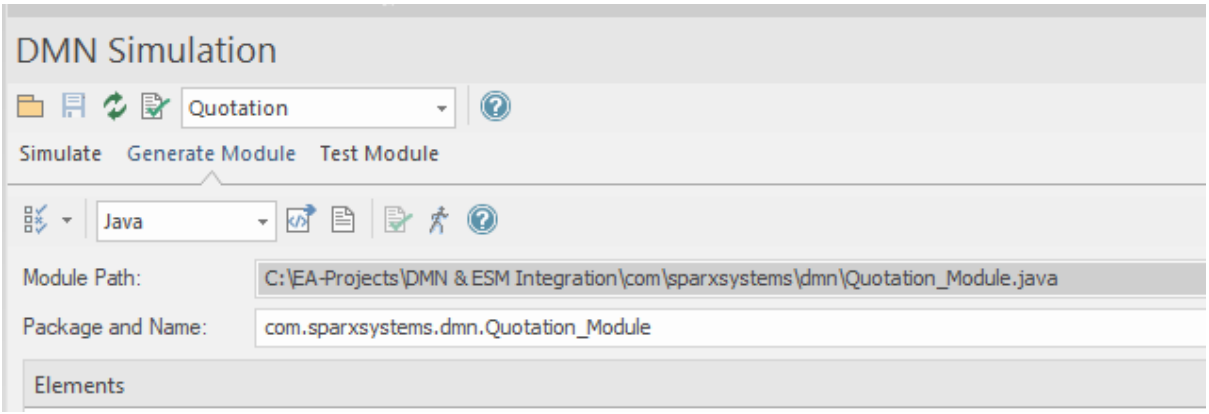
1) Double-click the **Simulation Configuration** element named **Quotation Calculation**
2) Click the section named **Generate Module**
3) Select **Java** as the language from the drop-down list:



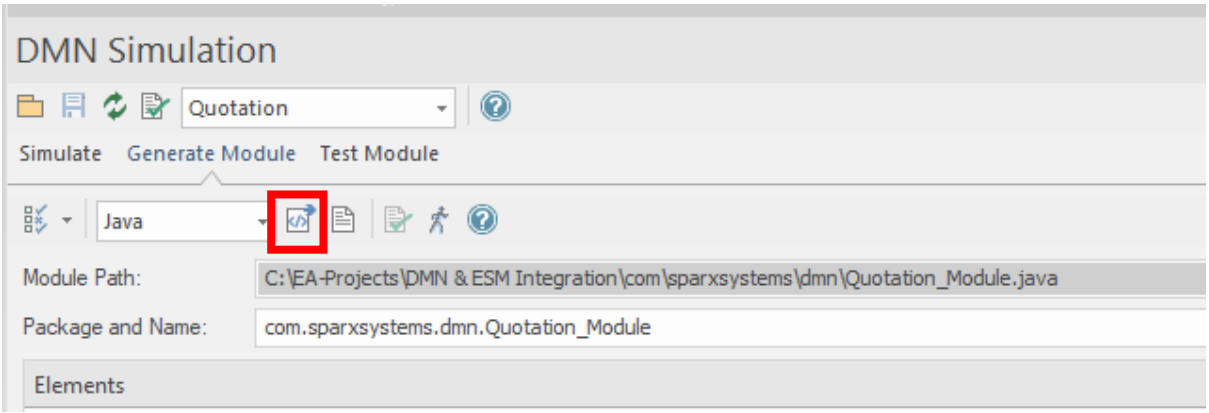
4) Note the **Package and Name**. This follows typical Java reverse domain name convention, and the **Module Path MUST** refer to a file structure that matches this reverse domain name. Therefore, use **Windows File Explorer** to create folders to reflect this structure. Although these folders could be created anywhere, I usually create them as child folders within the folder where my EA repository is located:



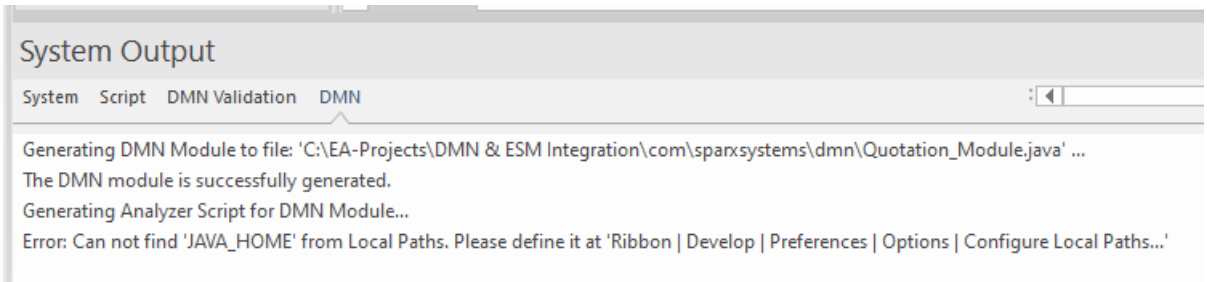
5) Using the … navigate button, set the **Module Path** to the **dmn** folder created above:



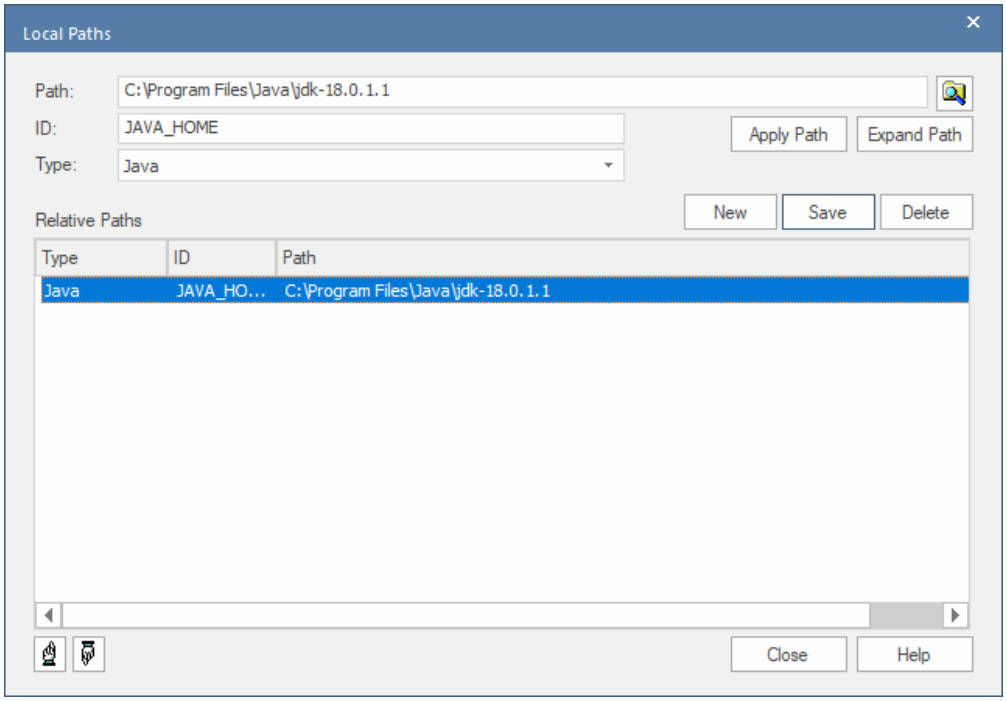
6) Generate the code using the **Generate Code** icon in the toolbar:



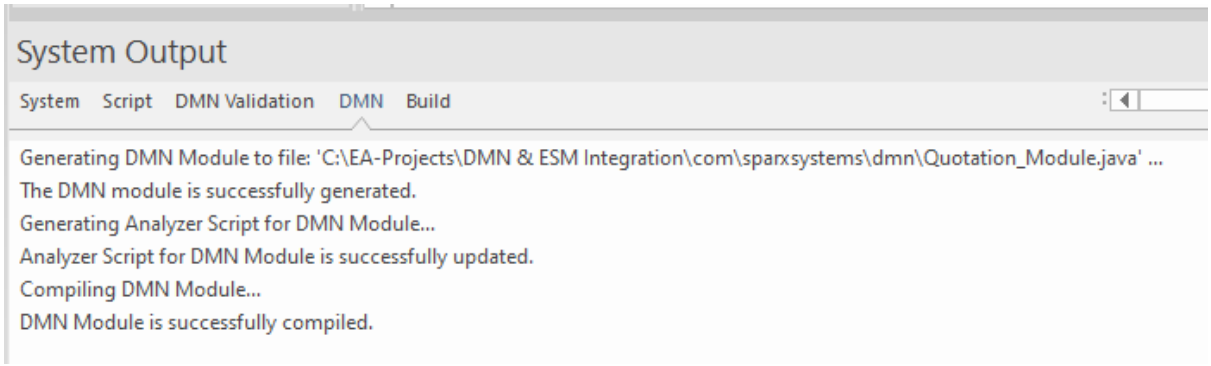
7) You may see the following error message in the **System Output** window:



8) If you do, then follow the instructions and define **JAVA_HOME** to refer to the package where you have installed the JDK. For example:



9) Repeat step 6) and check in the **System Output** window that all generated and compiled OK:



EA Gotcha and TIP

If you get any build errors, these are likely due to typos when entering the Java expression when binding the **Decision** element to the Input Data. (Section 3.1 step 14).

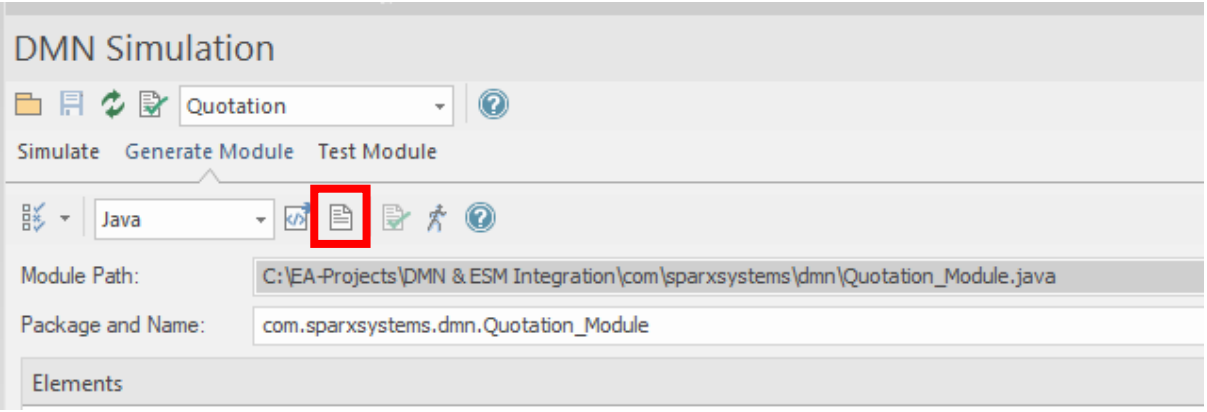
You can correct this of course, **BUT gotcha** you still get build errors! The changes have **not** been applied when the decision table code is generated.

The work around, is **save all diagrams**, close the repository and then re-open the repository.

That should solve the problem, and all should build OK.

This has caught me out several times.

If you are curious you can examine he source code generated, not shown here, by clicking the **View Code** icon in the toolbar.



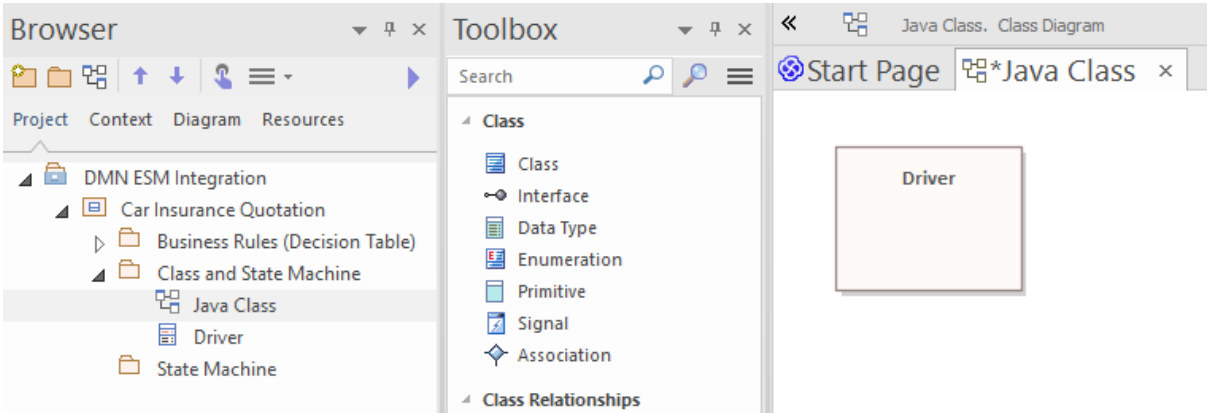
3.5 Creating a Java Based Executable State Machine

The next step is to create a simple Java based executable state machine (ESM).

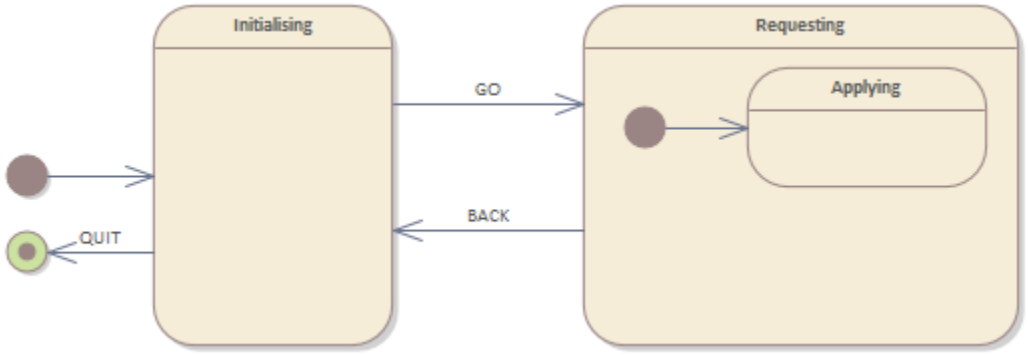
The steps involved should be familiar especially if you have model state machines in EA before.

For the example in this document, we do not require a very complex state machine and the following steps are used:

1) Create a Package named **Class and State Machine** using the Package named **Car Insurance Quotation** as the Parent.
2) Add a **UML Class** diagram to this Package and choose a suitable name for the diagram, for example, **Java Class**
3) Using the diagram toolbox and a **Java** class (a Class with its language property set to Java) to the diagram. Enter a suitable name for the class (do **not** put spaces in the class name). A suitable name in this example is **Driver**. At this point, no attributes or operations are required. These will be created in the section 3.6

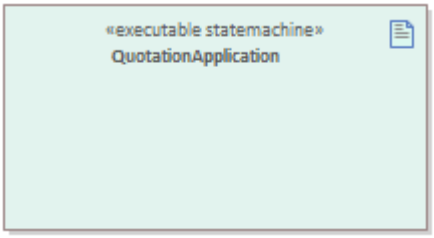


4) Right-click the class in the **Browser** and choose **Add -> State Machine** from the menu. The default name of **State Machine** is fine for this example. The child state machine will be created and the diagram for the state machine will be opened.
5) Create the following simple state machine:

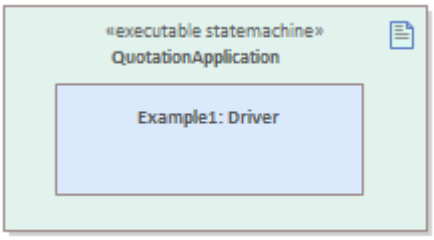


We now need to make this state machine a Java based ESM. The following steps are used:

1) In the package named **Class and State Machine** create a **UML Class Diagram** named **State Machine Simulation**.
2) Using the **Artefacts** page in the diagram toolbox add to this diagram an **Executable StateMachine Artefact**. Name this element **QuotationApplication**:

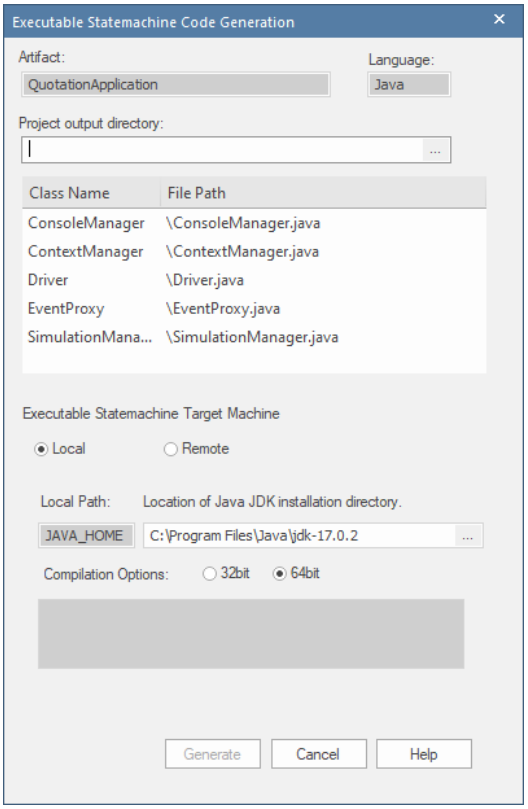


3) Drag the class named **Driver** onto this **Executable StateMachine Artefact** element and drop as a **Property**. **Do NOT drop as a link**. Name this property **Example1**:

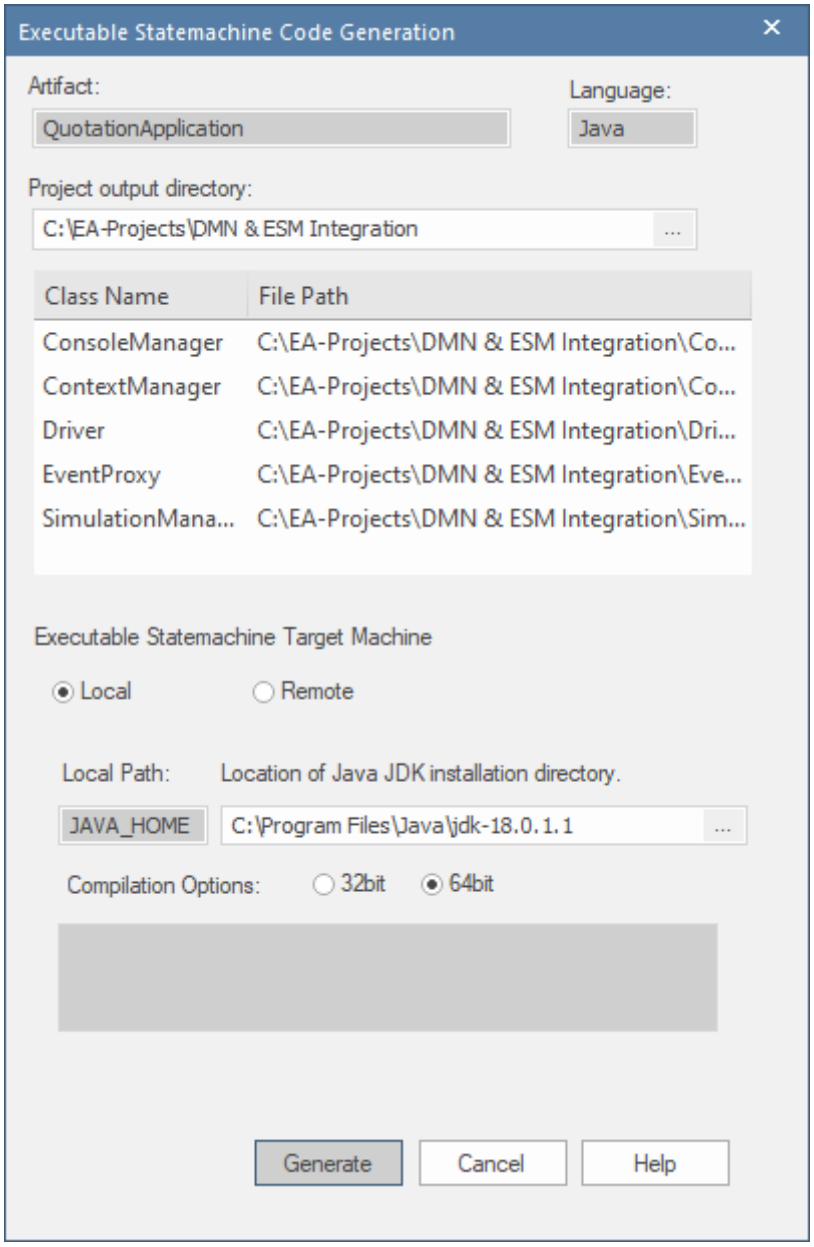


We can Build and Run the state machine to simulate it and ensure all the transitions work correctly between the various states. The following steps are used:

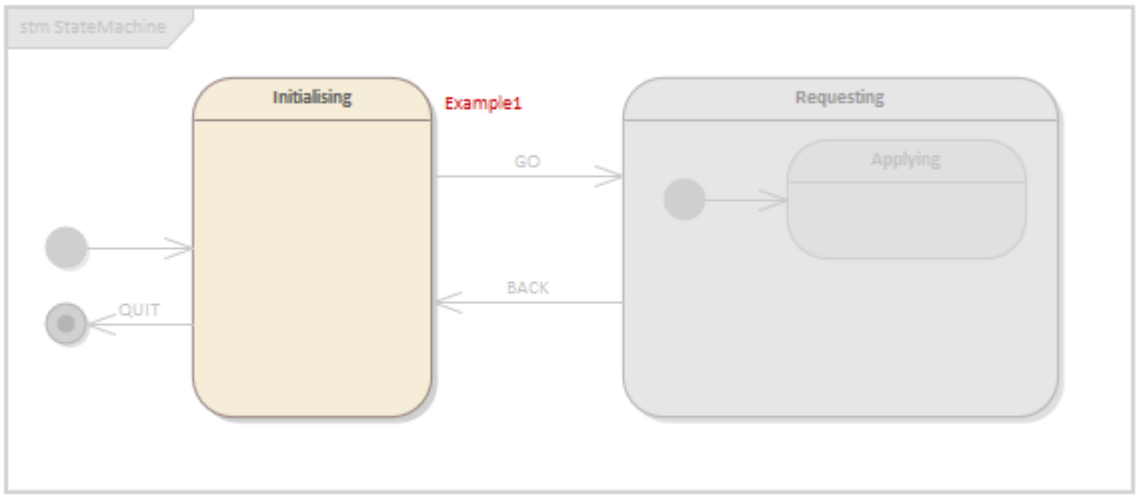
1) Select the **Executable StateMachine** artefact.
2) Select **Generate, Build and Run** from the **Statemachine** drop-down menu, in the **Executable States** section of the **Simulate** ribbon. The following dialog will be displayed:



4) Using the navigate button … navigate to and select the **same parent** folder as where the generated DMN code is located:



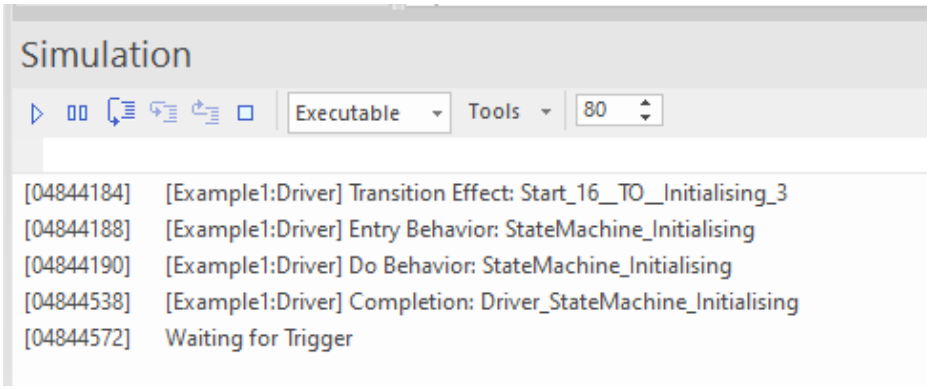
5) Click **Generate** the Java code will be generated, built and the state machine simulation started:



NOTE

The name of the Java class property instance is shown in red next to the **Initialising** state.

6) Select **Open Simulation Window** from the **Simulation** drop-down menu, in the **Dynamic Simulation** section of the **Simulate** ribbon:



NOTE

The Simulation window displays **Waiting for Trigger**, **BUT** unlike simulating a State Machine using Javascript, a list of Triggers is **NOT** displayed. This can be verified by selecting **Events** in the **Dynamic Simulation** section of the **Simulate** ribbon.

How to fire a trigger in a Java based ESM simulation puzzled me for a long time until I found the solution. Which is:

In the **Simulation Window** there is text field below the toolbar. To fire a trigger, enter

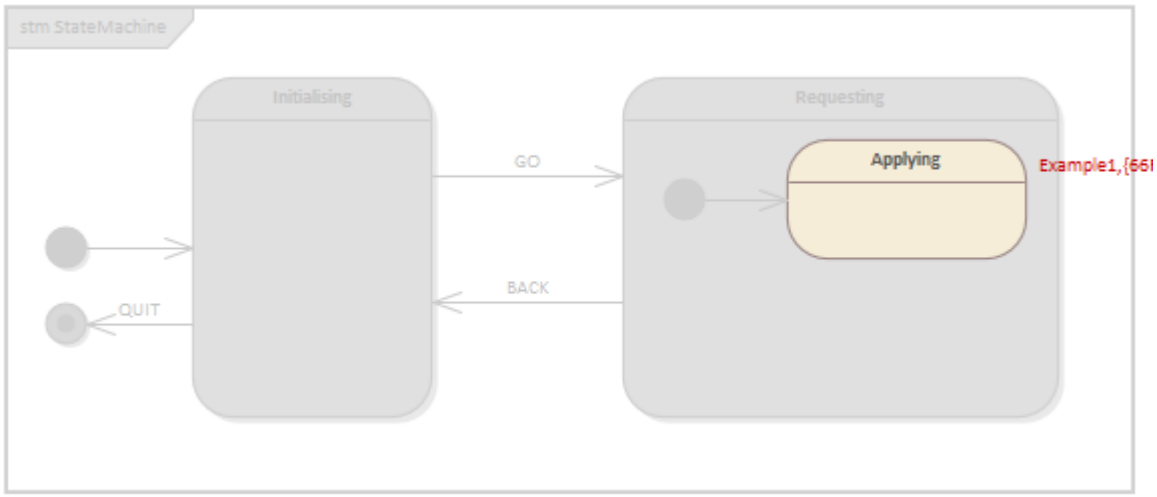
broadcast tigger name or

send trigger name to instance name

and press Enter

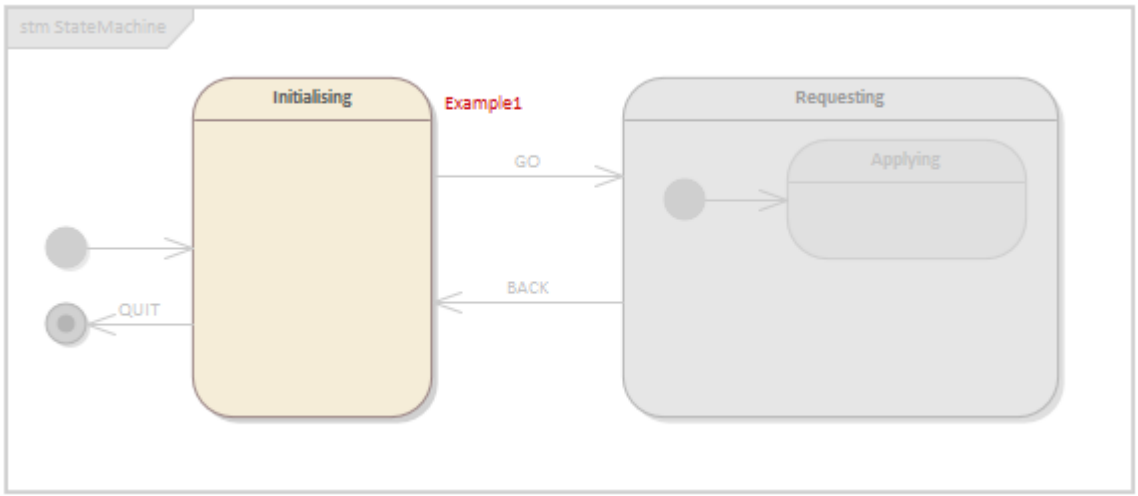
This will fire the trigger, repeat this process to test all transitions.

7) In the **Simulation Window** enter the command **broadcast GO**



The state machine has transitioned correctly to state **Applying**.

8) In the **Simulation Window** enter the command **broadcast BACK** to return to the state **Initialising**.



9) Finally, to end the simulation test, In the **Simulation Window** enter the command **broadcast QUIT** to end the simulation.

TIP

You can use the **up and down** arrow keys on the keyboard to scroll through the broadcast commands that have been entered during this simulation.

3.6 Integrating the Decision Table and the State Machine

Now that we have a working Decision Table in Java and an ESM also in Java, we can integrate them using the following workflow:

1) Add **public** attributes to the Java class that correspond with the input data within the data sets used to test the decision table, plus **public** attribute(s) that correspond to the result(s) returned from the decision table.
2) Create a **public** operation to the Java class which will call an operation that has been generated within the Decision table Java classes. This operation will return the result from the decision table.
3) Create a **public** operation that will call the operation defined in 2) above and set the result in an attribute defined in 1) above.
4) Add code to this operation to call the operation defined in 2) above and store the returned value in a suitable attribute,
5) Bind operation created in step 2) to **DMN Simulation** element(s).
6) Add Java code to this operation, that will:
    a. Set data in the Java code for the Decision Table
    b. Call the operation defined in the Java code for the decision table
    c. Return the result from the decision table
7) Add a call to the operation defined in step 4) above, within a state **do** behaviour.
8) Set the **run state** of the property instance for the class to be the values in **one** of the input data sets used to simulate the decision table.
9) Ensure the **Local Variables** window is visible.
10) Generate, Build and Run the ESM, fire triggers and observe the values in the local variables.

3.6.1 Add Public Attributes to the Java Class

First an explanation as to why the attributes are defined as **public** rather than **private**. The answer is simple, we need **public** attributes so that the run state of the Java property instance can be set. If **private** attributes are used, the Java class for the state machine simulation will fail to compile.

Attributes are added in the usual manner using the **Features** window. I have found that the following type mapping works between the Decision table and the Java types:

Decision table type **Number** – maps to Java **double** type

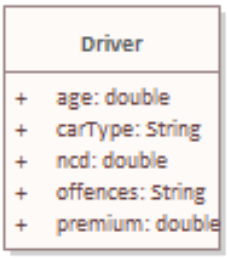
Decision table type **String** – maps to Java **String** type

NOTE

I have not tried other decision table types, for example **Boolean**, but I would guess this would map to the Java type **bool**. Similarly for the other decision table types.

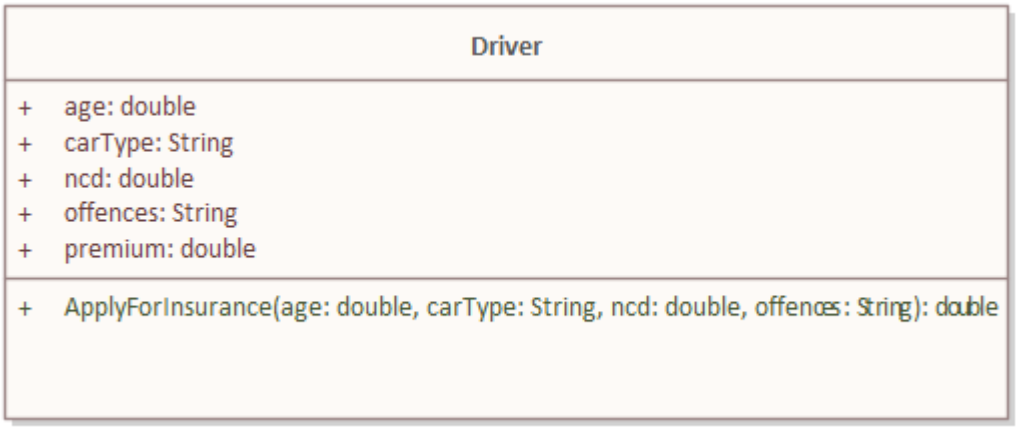
From our decision table we require Java attributes for:

- Age
- Car Type
- NCD
- Offences
- Premium



3.6.2 Add the Public Operation for Invoking the DMN

Any name can be used, but the operation **must** have parameters that correspond to the data inputs for the decision table and return a value which corresponds to the result of the decision table.



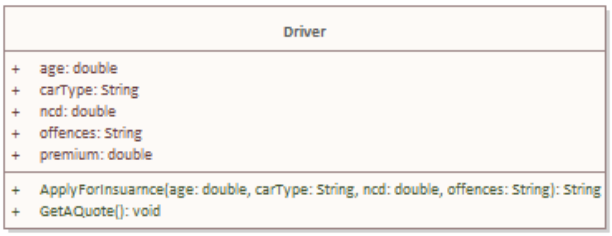
3.6.3 Add a Public Operation to Invoke the Operation

The operation can be added in the usual manner, and once created:

1) Open the **Properties** window for this operation
2) Select **Code**
3) Enter the code for the operation, for example:

```
premium = ApplyForInsurance(age, carType, ncd, offences);
```

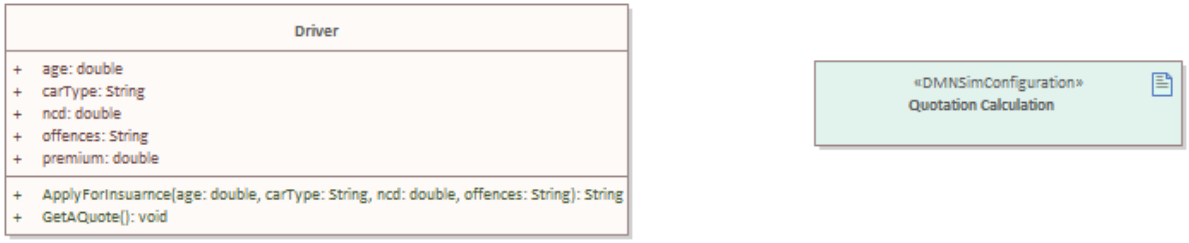
4) Click **Save**



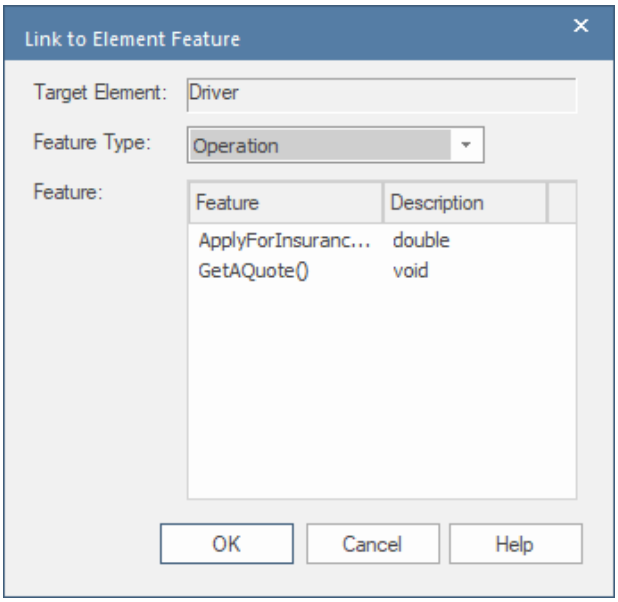
3.6.4 Bind an Operation to the DMN Simulation

This is the heart of the integration and is performed using the following steps:

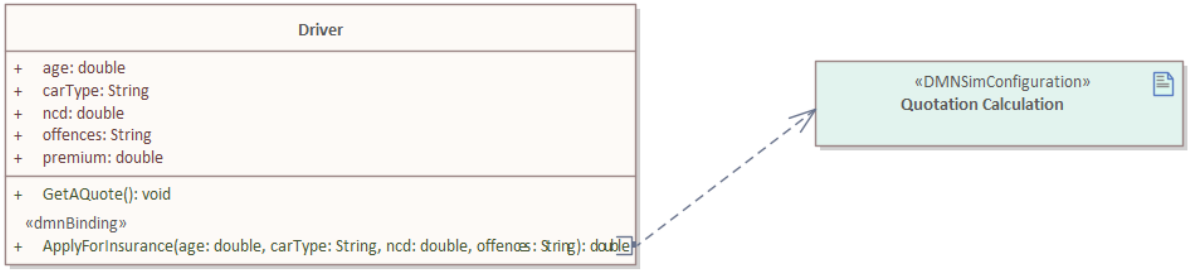
1) Re-use as a **Link** the **DMNSimConfiguration** element from the Decision Table model on the Java Class diagram:



2) Using the Quicklink create a **Dependency** relationship from the Java Class to the **DMNSimConfiguration** element. The following dialog will be displayed:



3) Select the operation that will invoke the DMN code, in this example, **ApplyForInsuranceQuote** in the list of Features.
4) Click **OK**. This will **bind** the selected operation to the DMN simulation:



3.6.5 Add Java Code to the Bound Operation

The code entered for this operation, in theory, can be any valid Java code. But **at least** the following **must** be included:

- The values in each parameter **must** be stored in variables declared within the Java classes generated for the decision table.
- The correct method within the Java classes generated for the decision table **must** be called.

The challenge is what classes, what variables and what method must be used?

According to the Sparx documentation, all of these is available using **code complete**. Whilst this may be true for Javascript based ESMs, (I haven't verified this), it is only **partially** true for Java based ESMs.

I have found the following steps work:

1) Select the operation that is bound to the **DMNSimConfiguration** element and open its Properties window.
2) Select **Code**.
3) Enter assignment statements, one per operation parameter using the following syntax:

Java Class for the DMNSimConfiguration.Java Class Name for the Data Input Element.Data Item Name.

An example should make more sense of this:

Referring to the models created so far:

In our example the name of the DMNSimConfiguration element is **Quotation Calculation**, so the Java class name is **Quotation_Calculation**. This **is** available via code complete.

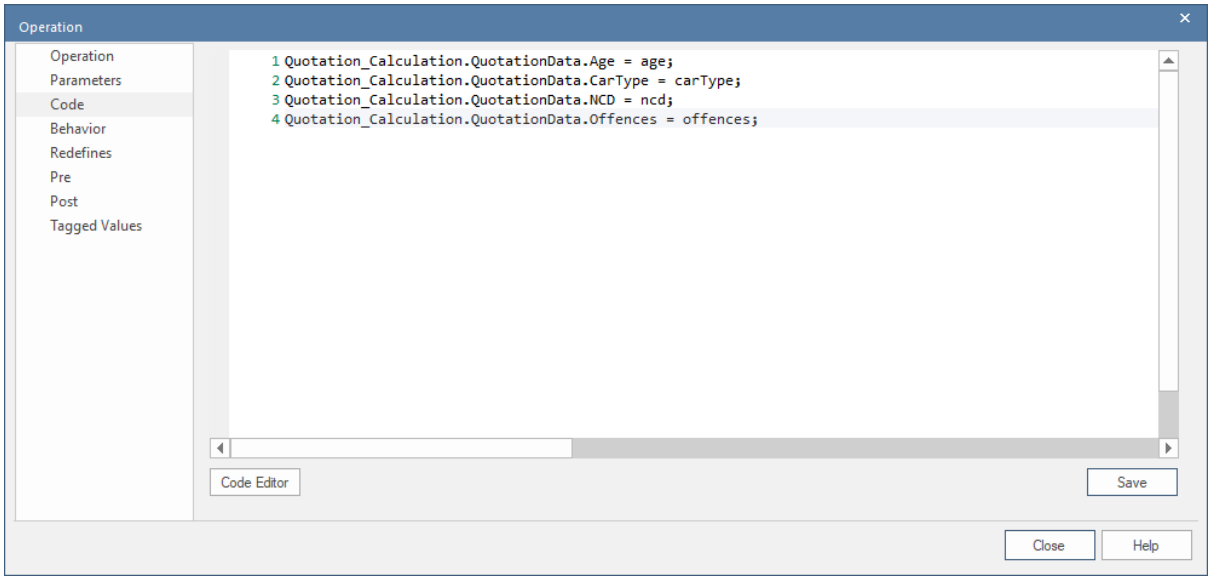
In our example the name of the Data Input element is **QuotationData**, so the Java class name is **QuotationData**. This **is not** available via code complete.

The names of the Data Items are Age CarType, NCD and Offences. These are the names used in the Java class. These are **not** available via code complete.

Hence the statements to store the parameter data from the operation to these Data Items are:

```
Quotation_Calculation.QuotationData.Age = age;
Quotation_Calculation.QuotationData.CarType = carType;
Quotation_Calculation.QuotationData.NCD = ncd;
```

```
Quotation_Calculation.QuotationData.Offences = offences;
```

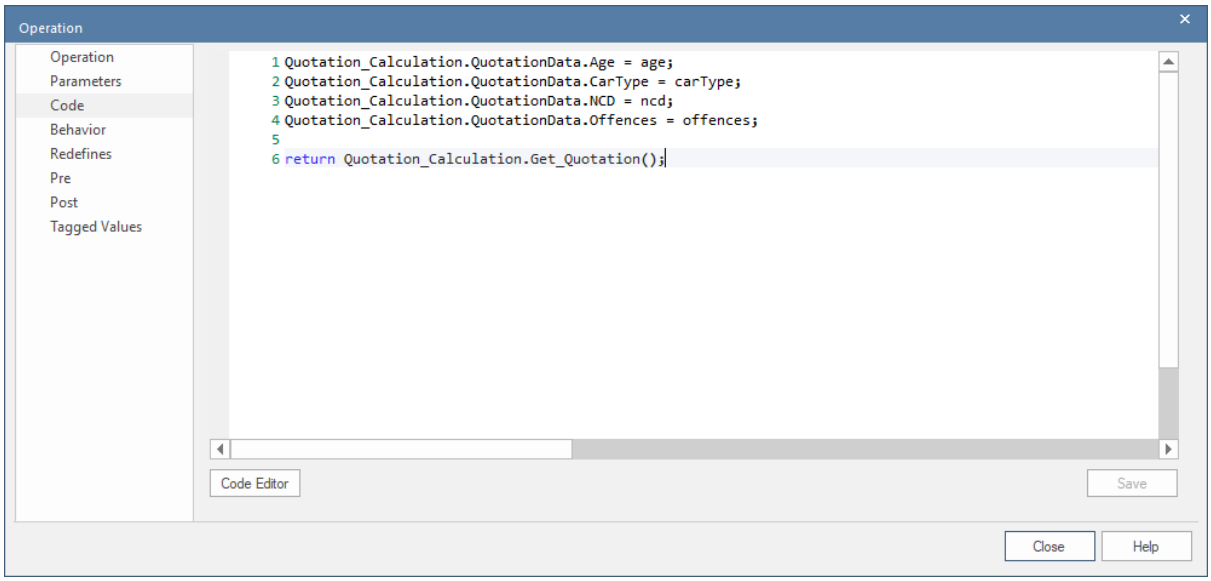


TIP

To use code complete press Ctrl + Space and you will see a list of valid entries. Once a class is selected from this list, entering . will display a valid list of operations. (Usually only one since a decision table usually returns one value. I assume for decision tables that return multiple values, there will be one operation for each result returned).

In our example we simply need to call the operation that returns the result from the Decision Table. This **is** available using code complete. The completed code for the operation is:

```
return Quotation_Calculation.Get_Quotation();
```

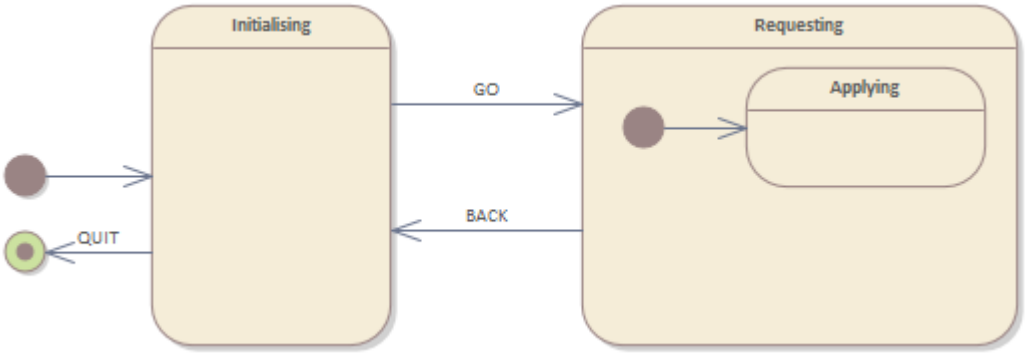


Do not forget to Save the code

3.6.6 Adding a Behaviour Operation in the State Machine

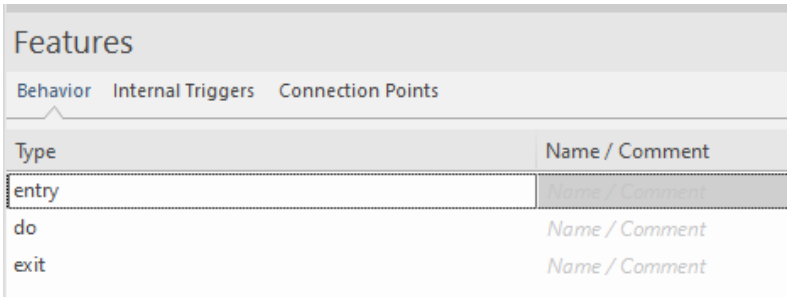
The next piece of the DMN / ESM integration is to add a behaviour operation, for example **do** to a state.

In our state machine:



We will add a **do** behaviour to the state **Applying** using the following steps

1) Select the state **Applying**
2) Right-click and select **Features -> Operations…** from the menu:



3) Enter a name for the **do** operation, for example **Apply**
4) Select this operation and open the Properties window and select **Code**
5) Enter the code that will call the method named **GetAQuote()** created earlier in our Java class that owns the state machine as shown below:

```
this.GetAQuote();
```

NOTE

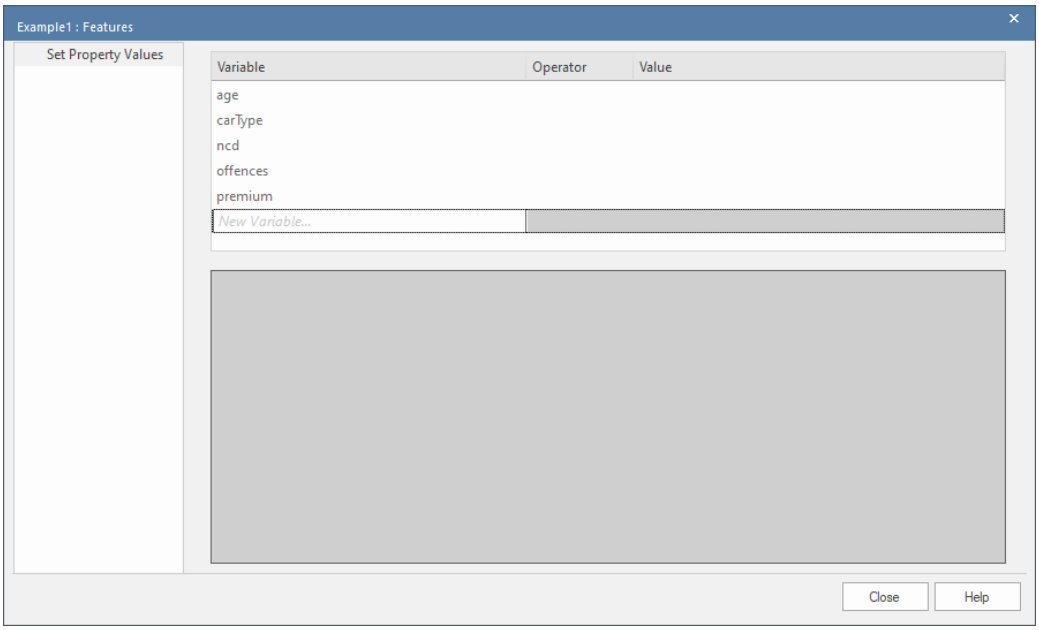
The keyword this **must** be used to invoke the method. This refers to the Property instance added to the **executable statemachine** element.

3.6.7 Set the Run State for the Property Instance

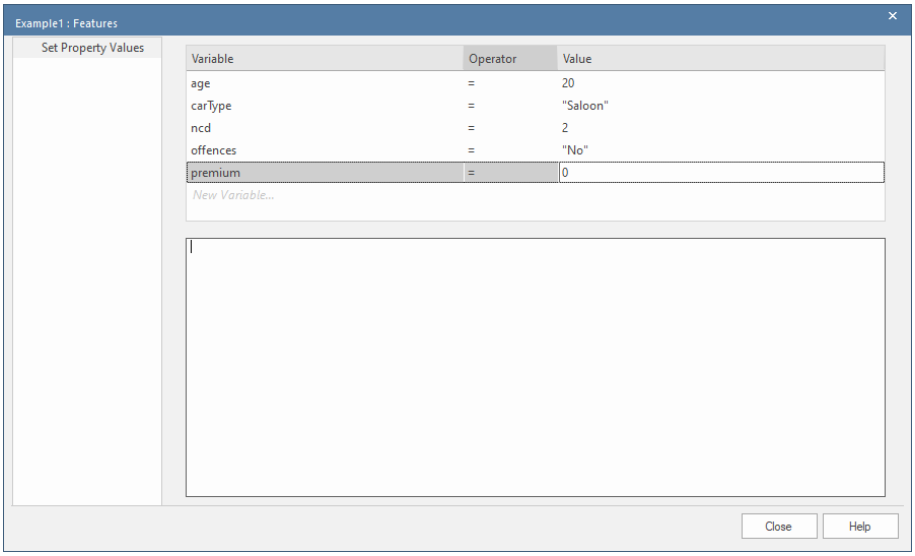
Our state machine simulation needs data, just as did our decision table simulation. This data is created by setting the **run state** of the Property instance of the Java class added to the **executable statemachine** element.

The following steps are used:

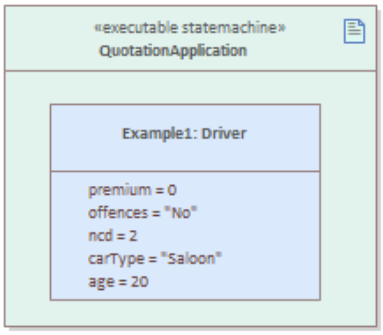
1) Right-click the **Property Instance** within the **executable statemachine** element and select **Features -> Set Property Values…** from the menu:



2) All the attributes, including the attribute for the result are listed. Using the **=** operator set values for age, carType, ncd and offences. A good set of values would be the **same** as those used in a data set used for simulating the decision table. The value of premium should be 0.



3) Click **Close**



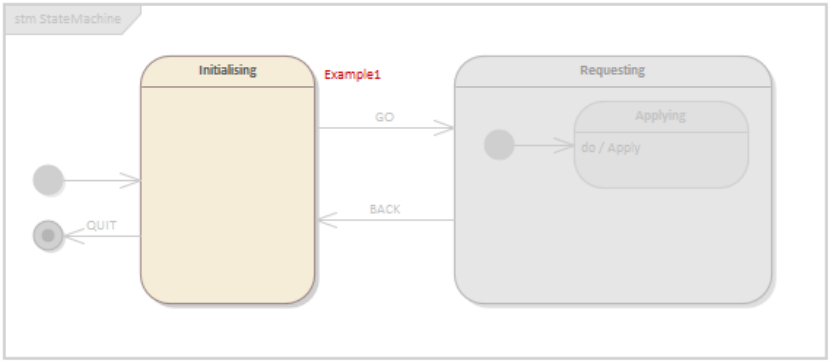
3.7 Run the Simulation

Ensure the following windows are visible (they can be accessed using the **Simulate** ribbon):

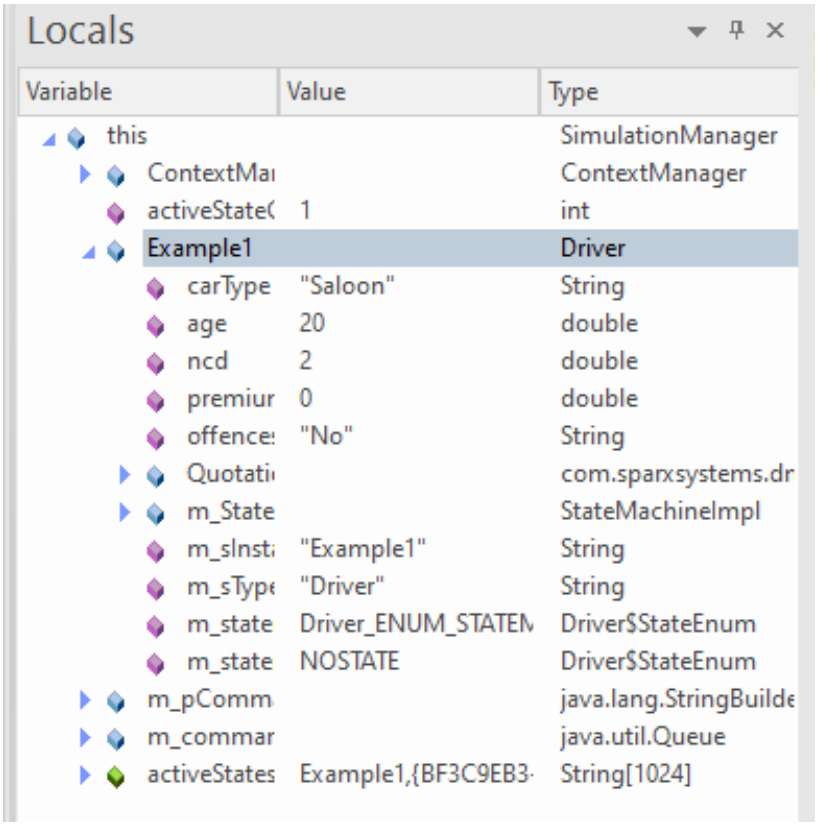
- Simulation Window
- Local Variables

Run the simulation as before by:

1) Select the **executable statemachine** element on the diagram named **State Machine Simulation**.
2) Select **Generate, Build and Run** from **Statemachine** drop-down menu. Assuming there are no build errors, (if errors are present, these are usually typos which can be corrected) then the state machine will begin to execute:

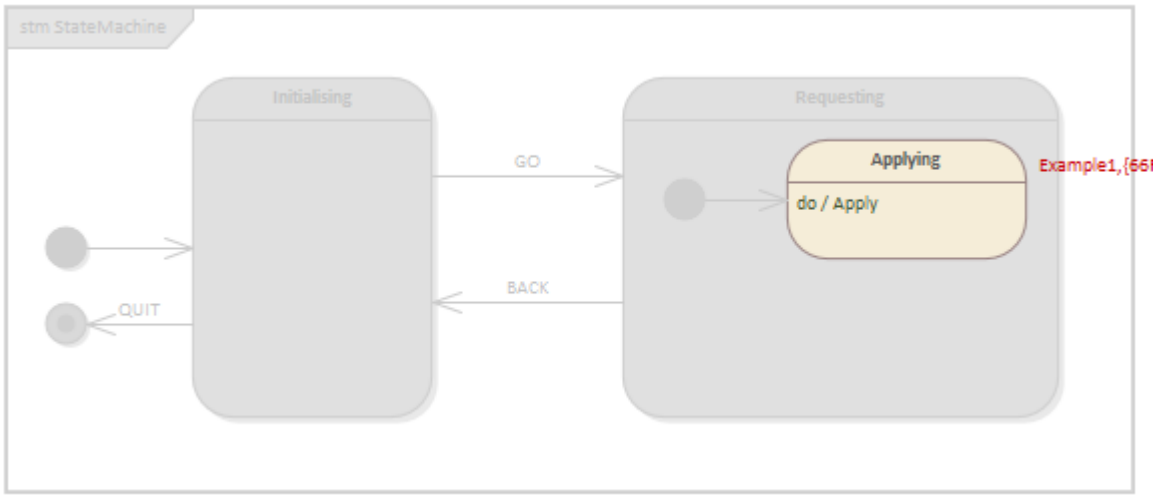


The local variables are:

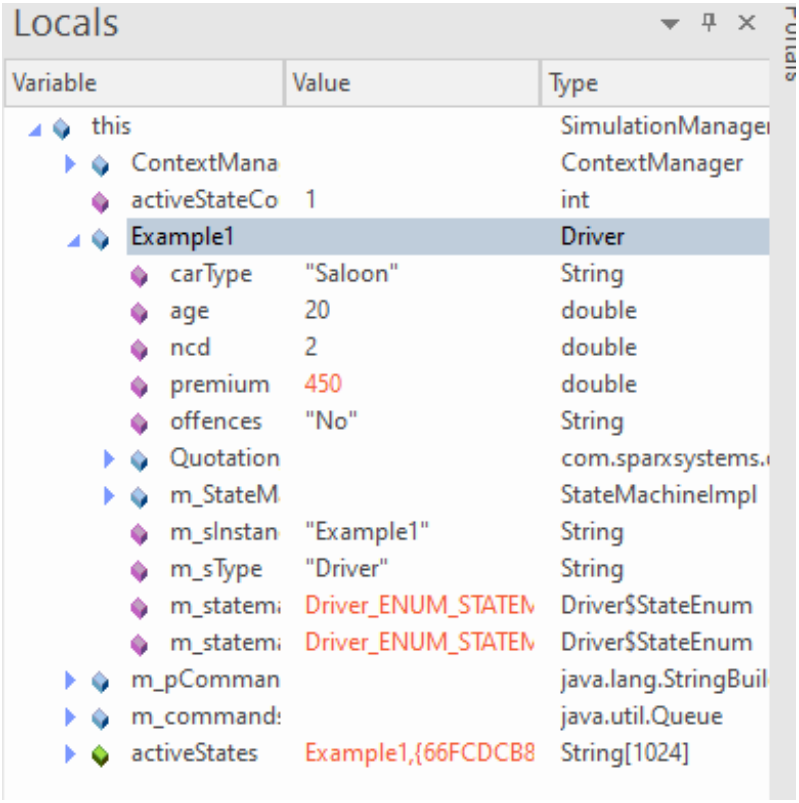


Expand the entry named **Example1** and note the values of the variables that correspond to attributes defined in the Java class have been set to the values defined in the Property instance run state.

3) Enter **broadcast GO** in the simulation window:



The local variables have changed to:



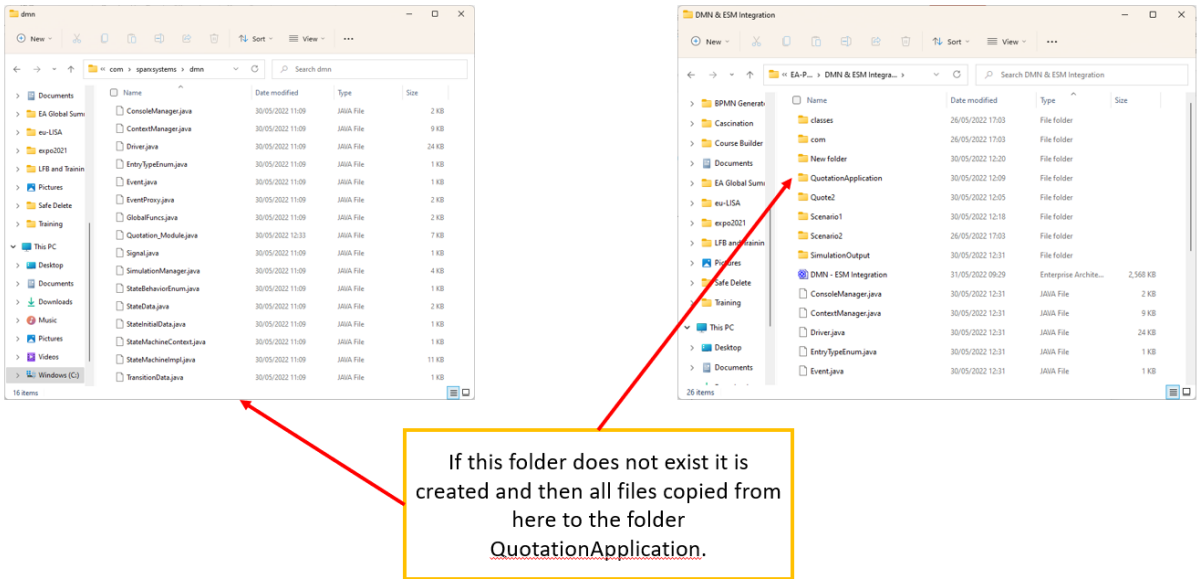
NOTE

The value of premium has been set to **450** which is the value returned after executed the decision table and is the correct result.

4) Enter **broadcast Back** in the simulation window.
5) Enter **broadcast QUIT** in the simulation window.

3.8 IMPORTANT Gotcha

When the executable state machine builds for the first time, it **copies** the code generated for the DMN from its location into a new folder with the same parent as the ESM Java class:



Therefore, for the **first** Generate, Build and Run, the folder named **QuotationApplication** will be created and the DMN files copied. **BUT** on second and subsequent simulation runs, the files are **not** copied.

What is the impact of this? Quite serious, since if the Decision Table is **modified** and code re-generated, simulating the StateMachine **does NOT** use the changed decision table code, since the files have been copied already!

The workaround is simple:

1) If the decision table has been modified, then using **File Explorer** navigation to where the folder (in our example named **QuotationApplication**) is located and **delete** this folder.
2) Select **Generate, Build and Run** as usual, and since the folder named **QuotationApplication** in our example, does not exist, it will be created and the decision table files copied, and the simulation will use the updated decision table.

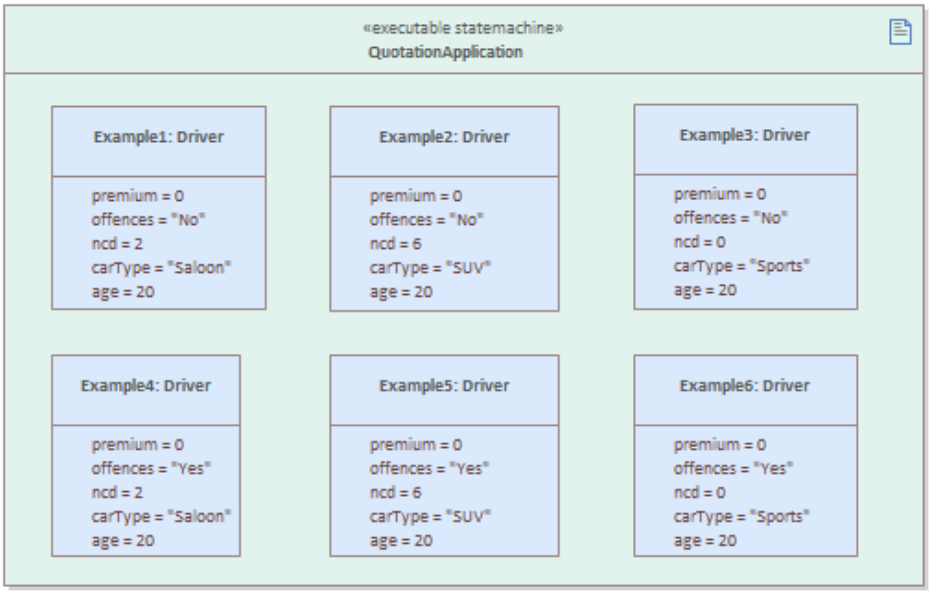
NOTE

The folder named **QuotationApplication** above is created when the simulation starts (if it does not exist already) and the name corresponds to the name of the **executable statemachine** element selected for the simulation.

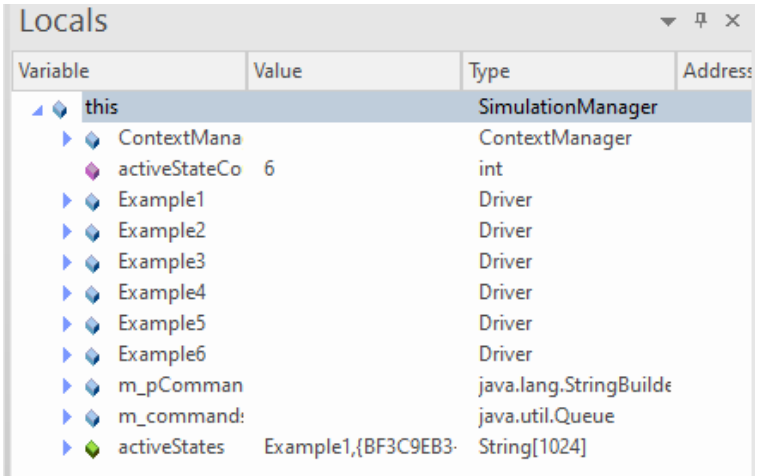
If you have chosen a different name for the **executable statemachine** element then the folder created will be named according to the name you used for the **executable statemachine** element.

4 What to do Next

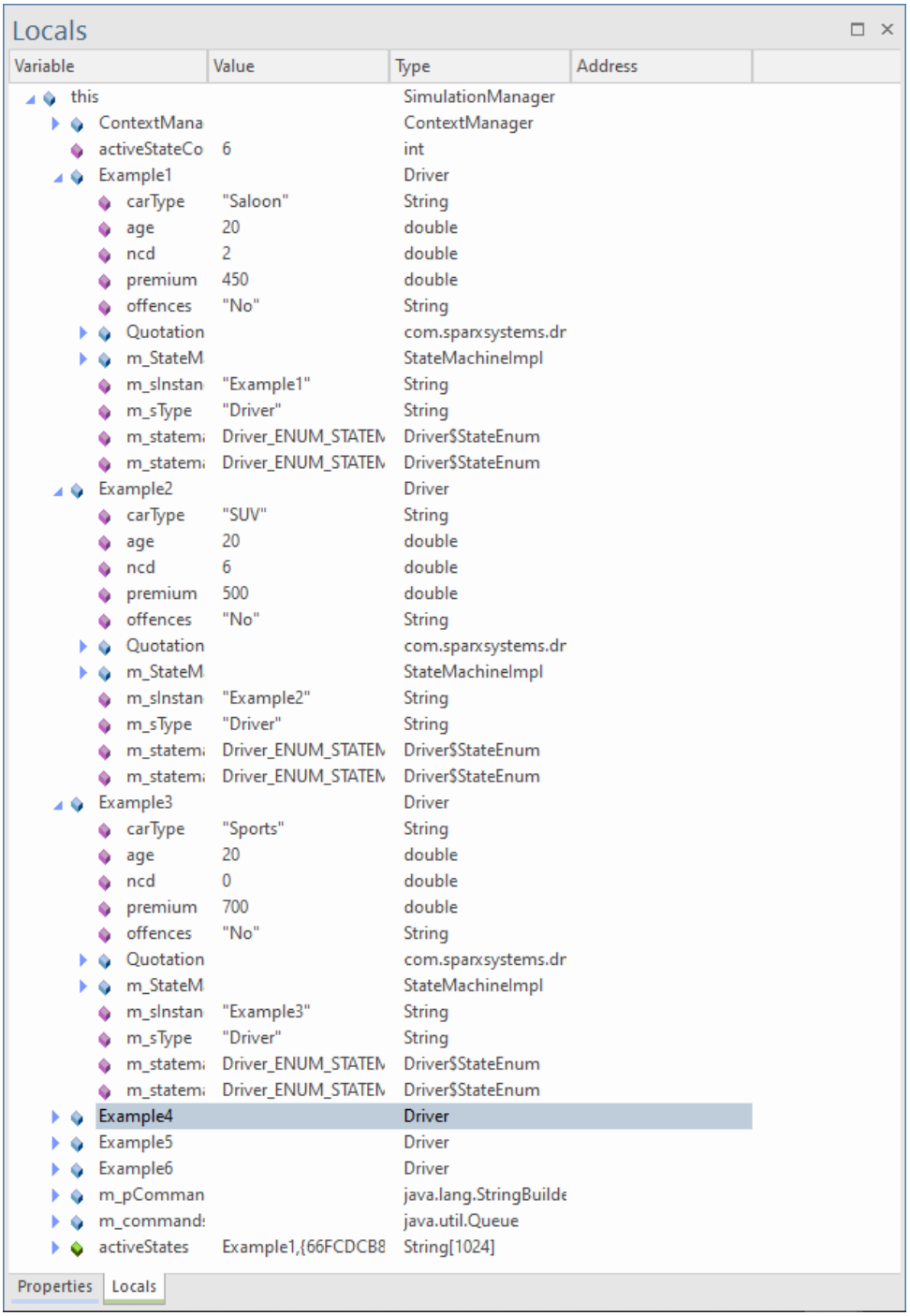
Having achieved a working integration between a Java based ESM and a Java based DMN, you could create multiple Property instances, one for each data set used to test the decision table, setting their run states accordingly. This would provide a thorough test of the integration:



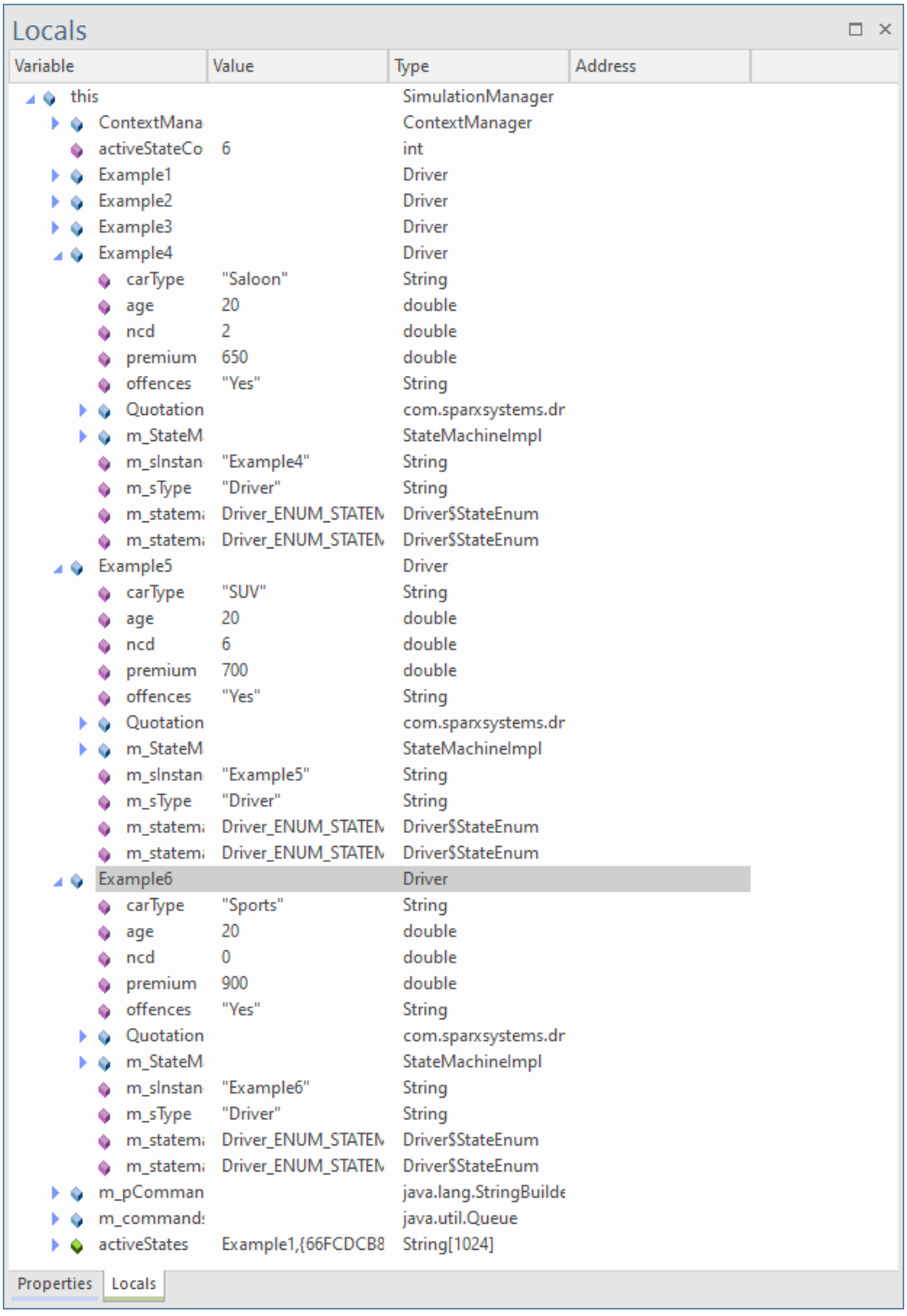
When the simulation is run, one state machine is created for each instance, and when the decision table is invoked, the results are return to **all** instances. The results can be verified by examining the local variables window:



Initial state



After transition to State Applying – Example 1, Example 2 & Example 3



After transition to State Applying – Example 4, Example 5 & Example 6

Should you wish to trigger **individual** instances so that you can control each instance separately, then fire a trigger using the following format:

send trigger name to instance name

for example

send GO to example4

You can also use **send** to send a trigger to all instances (same as **broadcast**) by using the format:

send trigger name to all

for example

send BACK to all

5 Conclusion

This document provides a step-by-step tutorial of the integration of DMN and ESM using Java. This document cannot possibly address all the possibilities of DMN / DMN integration but I really hope that it gets you started on your DMN / ESM integration.